Lost in Translations

Discourses, Boundaries and Legitimacy in the Public Understanding of Science in the UK

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I, Simon Jay Lock, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

This thesis documents the historical development of debates around the public understanding of science in the UK from 1985 until 2005. Testimonies from key actors involved in the evolution of the recent public understanding of science arena, and an examination of documentary evidence, have been used to map out how this issue was problematised by scientists in the mid-1980s, and how it has developed into a contested field of activity, political interest and academic research.

I propose that this historical period can be broadly understood in four phases each characterised by a dominant discourse of the public understanding of science. I examine how, within each phase, the various groups involved have engaged in boundary work: rhetorically constructing, and mobilising, ideas of 'science', 'the public', and the perceived 'problem' in the relationship between the two, in the pursuit of defining and legitimating themselves and these definitions of the relationship between science and public.

Phase I is characterised as a rhetorical re-framing of earlier 'problems' of the public understanding of science by scientists and scientific institutions in the context of the 1980s. Phase II is dominated by the boundary work between scientists and social scientists as they contended for legitimacy and authority over competing discourses of public understanding of science and the institutionalisation of PUS activity and research. Phase III is characterised by a variety of discursive formulations of the 'problem' of PUS following the House of Lords report (2000) and a subsequent change in the rhetoric of public understanding of science to one of public engagement. Phase IV is dominated by the language of 'upstream engagement' and identifies the political interest in managing science's relationship with the public and the social scientific responses to this.

Contents

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1 'Problems' of PUS

Or: the hows and whys

Introduction

In 1985 the Royal Society published a report on the public understanding of science (PUS).[1] The report problematised the public's levels of knowledge of science, and gave rise to a variety of science communication activities which attempted to 'correct' a perceived deficit of scientific knowledge on the part of the public. Fifteen years later, a report by the House of Lords Select Committee on Science and Technology (2000), argued that society's relationship with science was in a critical phase. Almost overnight, the promotion of public communication and outreach activities which had been practised by scientific and government agencies under the banner of public understanding of science, was replaced by an encouragement of new methods of public engagement and dialogue, under the new label 'Science and Society'.

Many commentators declared this a watershed moment in the public understanding of science movement[2], with the Minister for Science going as far as to proclaim that the 'deficit' approach to public understanding of science was dead.[3] The idea that the public were deficient in scientific knowledge, and should therefore be exposed to science communication by scientific experts, we were told, was gone, to be replaced by a dialogical model of communication, which framed the public in a very different manner - a public

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[1] Royal Society (1985), *The Public Understanding of Science*, (London: Royal Society).
[2] Miller, S. (2001), 'Public understanding of science at the crossroads', *Public Understanding of Science*, 10: 1; Wynne, B. (2006), 'Public Engagement as a Means of Restoring Public Trust in Science - Hitting the Notes, but Missing the Music?' *Community Genetics*, 9.
[3] Miller (2001), op. cit.

who should be listened to, who had something meaningful to input into scientific policy-making, and whose trust in scientists needed rebuilding.

This thesis investigates the historical development of these debates around the public understanding of science in the UK from the publication of the Royal Society report in 1985 until 2005. It documents how this became an issue of concern to scientists in the 1980s; who has been involved in these debates since that time; and how this issue developed into a contested field of activity, political interest and academic research. Many others have already provided historical accounts of these debates,[4] however, these have either covered only one aspect of the debates, be that focusing on a single profession, discipline or a smaller time frame, or have simplified the historical narrative.[5] Thus, my aim was to provide a broader and richer account of these debates in the UK, by using a wider range of research data and covering a longer time span than previous studies. The picture of PUS that emerges from this history shows it to be a more complex and contested area than some of these previous historical accounts would suggest.

While the main contribution of this thesis is a detailed historical account of these debates, I have also used this history to explore, from a science and technology studies (STS) perspective, how the idea of the relationship between science and public has been constructed, mobilised and managed over the last twenty years. This thesis initially focuses on how these ideas have developed within the scientific community; however, as other professional groups, such as social scientists, enter into this debate it considers how other actors and groups within the time period have framed these issues.

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[4] See, for example, Gregory and Miller's (1998) detailed historical account of science in the public sphere up until 1997. Irwin and Michael (2004), Wilsdon and Willis (2004) and Broks (2006), amongst others, have also provided their own accounts of aspects of the public understanding of science, focusing on social science, public engagement and popular science, respectively,

[5] For example, to a simple one of PUS in the UK being a narrative of 'deficit to dialogue', for example, The Royal Society (2004), *Science in Society Report*, (London: Royal Society); The British Association for the Advancement of Science, (2005), *Connecting Science: What we know and what we don't know about science in society*, (The British Association for the Advancement of Science: London).

It is retrospective, but also an account of an issue and debates which are ongoing and still changing. It identifies the emergence of multiple discourses about science and the public, and about how to communicate between the two; and examines how rhetorically different social and conceptual spaces have been carved out by particular professional groups in the pursuit of defining and legitimating themselves and their definitions of the relationship between science and public.

This thesis is organised as follows: Chapter 1 provides an overview of my methodology, the theoretical perspectives that have informed my analysis of the history, and a broad historical survey of ideas of science and the public to provide a context for the recent concerns on the public understanding of science, on which this thesis is focused. Chapters 2 to 9 document the historical development of debates around PUS from 1985 – 2005. Chapter 10 draws conclusions from this whole period.

The remaining parts of this chapter set the scene, historically and methodologically for the main body of my thesis. Part I provides details of my methodology: both what I studied and how I studied it. Part II outlines the theory I drew on to provide a sociological perspective on the history documented. Part III of this chapter presents a historical review of science and the public, which will provide a context for my own period of research. Finally, Part IV outlines my historical framing of the period under study.

Part I: What am I analysing?

I began my research early and speculatively, rather than formulating a strict research design. My research began with a need to gain a broad historical perspective on the UK debates around science and the public within the set period 1985 - 2005. This allowed me to grasp both the context of the debate and identify key institutions and individuals.

Data collection

The majority of my data comes from policy, academic and public literature from 1985 to 2005. I also undertook twelve semi-structured interviews with 13 key actors from this period conducted over a 6-month period to provide further historical detail and personal reflection on specific events and developments.[6]

I had to limit the collection of data to within the confines of a PhD research project, so I had to make some choices as to what would and would not be analysed. First, I limited the scope of the thesis to a history of public understanding of science in the UK, even though PUS is a much wider phenomenon. This geographical restriction should not suggest that I consider the discourse in this area to be self-contained to the UK, and the academic debates and activity, as will be shown, have crossed international borders. However, I felt justified in limiting the study in this manner for several reasons. First, the UK activity in this area, particularly institutional programmes in the public understanding of science, have become exemplars for other countries developing activities in this area.[7] Second, the activities by particular institutions in the area of science communication, for example, by the British Association for the Advancement of Science or the Royal Society, have a long history in

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[6] See Appendix for a list of all interviewees.

[7] As Pitrelli (2003) has noted, following the Bodmer report in 1985, 'Pubilc Understanding of Science' became a label employed by the Governments of all industrialised countries in the programmes for the communication of science to the general public, most of which used the recommendations from the original report as the basis for such activities.

Britain and the recent concerns over the public understanding of science follow on from these with a continued UK focus. Equally, the UK Government's involvement in this area has tended to have a nationalistic focus, with many of the justifications for funding and activity couched in terms of national pride, prosperity, or crisis. I have, therefore, included references to wider international developments only where I felt they were directly relevant to, and had a direct impact on, events in the UK. Further research would be essential to broaden the scope of this inquiry, in a similarly detailed manner, beyond the UK.

Archival research

I collated a range of primary literature concerned with the public understanding of science. This included academic journal papers, speeches, government policy documents, committee minutes, newspaper articles from media databases, as well as other material held at the Office of Science and Technology and the Royal Society Library, the National Archives, Colindale Newspaper Library, The British Association archives, The Science Museum Library and The British Library. Such publications contribute to a discursive variety which I used to construct the historical narrative and then analysed to get an idea of the competing interests and definitions in the debates surrounding the public understanding of science.

I analysed these texts as contributions to historical discourses rather than as explanations in themselves. Hilgartner uses a theoretical framework grounded in a metaphor of performance to examine struggles over credibility, authority and legitimacy in science advice, and views documents as key objects in these struggles.[8] Hilgartner's dramaturgical model allows the written document to be analysed as 'a device for self presentation that the performer uses to project his or her "voice" and create the desired impression on the audience' (p. 16). The Committee reports, policy documents and academic papers in my study, then, can be analysed in terms of their content, but also in terms of their function, and the extent to which they constitute, as well as represent, the social and political debates surrounding the public understanding of science.

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[8] Hilgartner, S. (2000), *Science on Stage: Expert Advice as Public Drama*, (Stanford, CA: Stanford University Press).

Interviewing

In total, I conducted 12 semi-structured interviews. In all cases I recorded and transcribed the interview. I conducted the interviews between June and October 2004. Themes that were covered in a typical interview included questions on the interviewee's personal history, their professional role and how it related to research or initiatives on the public understanding of science, and their reflections on specific episodes, reports, actors or institutions that they felt were important in shaping the historical development of PUS. I was particularly interested in differences and similarities between themes that emerged from institutional and academic documents, and those that emerged in interviews. I was also looking for any themes initiated by interviewees, and not obviously prompted by my questions, particularly those that recurred in a similar way in a number of different interviews.

I found all those I interviewed to be enlightening, interested in my research and generous with their time. There were, however, problems with my interviewing process. The main one was simply one of access: only half of the 25 people I approached agreed to be interviewed, of which, almost all were social science academics or policy makers. This was disappointing, and were it to have been possible to have interviewed more of the actors involved in this history, the finished product would have been a richer account of events, and may have taken my research into other areas. However, I was restricted to who was available for interview (or indeed who would agree to be interviewed), and thus I ended up relying on documentary evidence more than I had originally intended. The high number of refusals is likely to be related to the fact that those scientists and politicians who declined to be interviewed are what could be considered 'elite' figures in their field, or public life (for example Professor Colin Blakemore was head of the Medical Research Council at the time of my approach; Professor Susan Greenfield, Head of the Royal Institution; Lord Sainsbury, Minister for Science). Contacting such individuals can be immensely difficult, and finding time in their diary even more so. Conversely academics are very easy to locate and contact through university websites and publicly available email addresses.

It is also interesting to consider why no scientists (except Sir Walter Bodmer) agreed to the interview. This could suggest an indifference to reflecting on history of the public understanding of science by members of this profession, but equally could suggest an unwillingness to engage with a researcher from STS. It may have been the case that I was perceived as someone, following the 'Science Wars', who would be hostile to science and scientists.[9]

The second problem I faced with such interview subjects was one of reflexivity. As Aull Davis acknowledges, interviews are a highly artificial research situation, 'dependent upon a set of cultural understandings as to the nature of interviews, their conduct, and appropriate forms of responses to them'.[10] Interviews with any research participants then, are contrived situations that involve a relationship between interviewer and interviewee predetermined by expectations of the interview process; the interview is fundamental, not incidental, to both the form and content of the exchange.[11] Furthermore, the responses of interviewees may be shaded by a desire to please (or offend) the interviewer. I felt that these factors were further complicated in my research by the fact that nearly all those interviewed were much more accustomed than me to the interview process. Some were social scientists themselves, with careers' worth of experience in conducting qualitative interviews from 'the other side of the fence'. In a few cases, I found that the difference in status between interviewer and interviewee saw the interviewee effectively 'running away' with the interview, disregarding my questions and instructing me in what they felt I should know, rather than what I wanted to ask. Although frustrating at the time, on transcribing such interviews it became clear there was plenty of data to be taken from what these interviewees felt it was important for me to know. The interviews remained of value, and of interest, because I was able to track the themes that recurred between interviews, and those that were only mentioned by some interviewees, or not at all. A number of other interviewees demanded a considerable amount of participation from me, arguing certain points, or asking me to justify my stance on a particular question before answering it themselves.

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[9] See for Chapter 4 for a fuller account of the 'Science Wars'.
[10] Davies, C. A. (1999), *Reflexive Ethnography: Researching Self and Others*, (London: Routledge), p. 4.
[11] Briggs, C. (1986), *Learning How to Ask: a Rhetorical Approach to Social Psychology*, (Cambridge: Cambridge University Press).

To further complicate this, in some cases I already had an established academic or professional relationship with the interviewee, having worked with them, or been taught by them as part of my academic training in the field. This often meant that the interviewee spoke to me as an 'insider' to the history, readily assuming that my own position within the debates was similar to theirs (be it related to my time working at the Royal Society, or my training in science and technology studies) and inevitably this shaped their responses to my questions. These issues were a very overt reminder that 'interview data are unavoidably collaborative'.[12] I came to see interviews, therefore, not as a 'path to the truth' that, for example, lay behind the production of official and institutional reports, but as data which performed multiple functions. They were a guide to the research process, sometimes pointing me in the direction of events, reports, or people that I might otherwise have excluded from the historical account. Yet they also provided a source of historical narrative regarding actors' own involvement in debates around the public understanding of science. Finally the data also revealed an insight into the way different versions of PUS were established by different actors and an opportunity in which to see on-going boundary work being performed.

Finally, there was the tricky decision of whether to anonymise my interview data. I decided against this course of action given that the historical development of public understanding of science, as will become clear through my narrative, was largely constructed and steered by the actions and charisma of a few individual actors. To therefore refer to them as a 'scientist' or an 'academic' would remove some of the narrative purpose of recounting what was said, and for the purposes of boundary work analysis (outlined below), the personal relationships between certain actors was crucial. The interviewees were made aware that they were being recorded on tape to gather information for a PhD which would eventually be published. The lack of anonymity did probably account, in some cases, for an individual declining an interview. I felt, however, that it was important to maintain a consistent approach to all interview material rather than end up with certain individuals named and others not, which would produce an uneven historical account.

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[12] Holstein, J. and Gubrium, J. (1997), 'Active Interviewing', in Silverman, ed., *Qualitative Research: Theory, Method and Practice*, (London: Sage), p. 114.

Part II: My analytical tool-kit

> Public policy debates are exercises in rhetoric. The first battle is often a struggle over definitions, and the winning side is usually the one most able to capture rhetorical primacy by having its definitions of the situation accepted as the taken-for-granted landscape on which the rest of the game must be staged. Public debates, however, are not played out on neutral turf. Players make alliances, exercise power, make claims of legitimacy through expertise, and struggle to gain the cultural and political authority to have their perspectives written into policy directives and law.
>
> (Wolpe and McGee 2001, p. 185)

Science is viewed as commanding a large cultural authority in society, and the practice of science has been built up and promoted as a professional and specialised practice which is separate from the public, or society. Yet social studies of science argue that where the line between science and non-science is drawn is flexible, subject to social and political interests, and thus the relationship between science and the public and political spheres can be constructed differently depending on who is doing the demarcation. As the above quote suggests, the successful definition of a problem and of the social identities concerned with managing that problem is also a political and rhetorical process.

The purpose of this section is to outline the approaches from within STS and social science more widely that have both informed my historical investigation of science and its relationship with the public and provided a lens through which to interpret some of the data. It is worth mentioning that this section is not a typical literature review section on science in public, for it will not cover much research focusing on the public and science. I cover the relevant literature on, for example, recent thoughts on science in public, deficit models, or public engagement in later chapters, as it arises chronologically in the history, as a large proportion of it was conducted and published in response to institutional efforts to address the 'problem' of PUS. Thus this literature plays a role in the history and development of discourses surrounding the public understanding of science and will be considered in that context.

Science and its social context

Social studies of science have drawn our attention to the social factors that are crucial to the establishment of scientific 'facts'. Philosophers have argued for centuries that scientific knowledge is epistemologically privileged and should be seen as objective and value-free. However, as many studies have shown, scientific discovery, and the facts it produces, can often be led by the political or social interests at play.[13] Thus science has come to be viewed from a wider perspective - that of social conflict and interest rather than as a separate, insular field that follows its own special rules.

Latour, Callon and Woolgar, alongside many others, have highlighted the social interests that shape what counts as science and what does not.[14] My research continues within this constructivist view of science, viewing it as a process of social negotiation, and extending this principle not just to the knowledge content of science but to the definition of its practice, authority, and what it means to be a scientist. Central to the success of this approach has been a symmetrical treatment of 'right' and 'wrong'. This 'symmetry principle' allows for exploration of the construction of science and scientific knowledge regardless of whether it is later expertly considered to be true or false.[15]

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[13] Dean, J. (1979), 'Controversy over Classification: A Case Study from the History of Botany', in Barnes and Shapin, eds, *Natural Order: Historical Studies of Scientific Culture*, (London: Sage). For a more detailed argument of this SSK approach see Yearley, S. (1994), 'Understanding science from the perspective of the sociology of scientific knowledge: an overview', *Public Understanding of Science*, 3: 3, pp. 245-258.
[14] See Callon, M. (1986), 'Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay', in Law, ed., *Power, action and belief: a new sociology of knowledge?* (London: Routledge).; Latour, B. and Woolgar, S. (1979), *Laboratory Life: The Construction of Scientific Facts*, (Beverley Hills: Sage).; Bloor, D. (1991), *Knowledge and Social Imagery*, (Chicago: University of Chicago Press).
[15] Bloor (1991), op. cit., p. 7, also pp. 175-9.

Boundaries of science

Research within STS has provided new narratives of science which have highlighted the social embeddedness of scientific practice. Just as scientific knowledge itself can be shown to be constructed by social factors, so the boundaries that are claimed to be between science and politics, or science and culture, can also be shown to be contingent and historically specific constructions, placed there, for example, by the active promotion of science as a value-free enterprise.[16] The 'boundary problem' in science is one that has energised much debate between philosophers, historians, and sociologists. The question of where one draws the line between science and society, or science and non-science has been studied and answered in several different ways.

Largely the answers have fallen into two camps: essentialist or constructivist. Essentialists have argued for the possibility and analytic desirability of identifying unique, necessary, and invariant qualities that set science apart from other cultural practices and pursuits. Popper proposed that the superiority of scientific knowledge could be accounted for by its methodology. Through lack of falsifiability, ideology, religion, metaphysics and pseudo-science were neatly demarcated from science. Collins, however, has exposed the difficulties in deciding when an experiment has been successfully replicated arguing that the demarcation criterion that suggests some essential characteristic of the scientific method, is a matter for scientists and others to negotiate. Therefore, what counts as scientific becomes a cultural and rhetorical process.[17]

Merton proposed an equally essentialist method of demarcation, embodied in his four social norms of science.[18] The norms of communism, universalism, disinterestedness, and organised scepticism, were proposed by him as an institutionalised ethos, to which all scientists prescribed, and which were communicated and adopted as part of the socialisation

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[16] Gieryn, T. (1995), 'Boundaries of Science', in Jasanoff, et al., eds, *The Handbook of Science and Technology Studies*, (Thousand Oaks CA: Sage).

[17] Collins, H. (1985), *Changing Order*, (London: Sage).

[18] Merton, R. (1973), *The Sociology of Science: Theoretical and Empirical Investigations*, (Chicago: University of Chicago Press).

process of scientists. Certified, reliable scientific knowledge would be produced only in so far as these, and no other norms, actually guide scientists' actions. Mulkay, however, has challenged the idea that these norms are institutionalised within the scientific community. He instead views the norms as a repertoire that forms part of the dialogue or 'moral language' of scientists when communicating, evaluating and judging each other and their work. Thus again, the demarcation of science from non-science can vary, and is described in accordance with varying social interests.[19]

Constructivist social scientists have denied the possibility of a single set of demarcation principles that can work universally, and they argue that the separation of science from other knowledges or pursuits is a context-contingent and interests-driven accomplishment. It is this approach that I found more useful in analysing the historical development of debates concerned with defining science in a public context and managing the boundary between science and non-science.

Boundary work

> If there is nothing inherently, universally and necessarily distinctive about the methodology, institution, history, or even consequences of science, then why and how is science today routinely assigned a measure of "cognitive authority" rarely enjoyed by other cultural practices offering different accounts of reality?
>
> (Gieryn 1995, pp. 404-5)

Rejecting all essentialist demarcation criteria as insufficient, how does one account for the paradox, outlined in the passage above, which the failure of philosophical analyses presents? Gieryn argues that the demarcation of science from non-science is a practical and day-to-day issue for scientists in the pursuit of resources and professional advantage, and therefore studying the social actions (and here largely he refers to the discursive or rhetorical actions) of scientists themselves becomes the central component of his analysis. He shifts the focus to the ways in which actors in society assign specific characteristics to the institution of science, its methods, members, and practices, which grant it its cultural authority, and

[19] Mulkay, M. (1976), 'Norms and ideology in science', *Social Science Information*, 15: 4/5.

subsequently draw a social boundary between science and non-science. He calls this process 'boundary work'.[20]

Boundary work, according to Gieryn, 'occurs as people contend for, legitimate, or challenge the cognitive authority of science – and the credibility, prestige, power, and material resources that attend such a privileged position' (p. 405). Demarcations of science from non-science are driven by a practical 'social interest in claiming, expanding, protecting, monopolising, usurping, denying, or restricting the cognitive authority of science'.[21] Science, Gieryn argues, becomes simply a 'spatial marker' for cognitive authority, empty until its boundaries are drawn during context specific negotiations over who and what is 'scientific'. The essentialist characteristics of science, as has been suggested above, then become provisional and contextual *results* of successful boundary work, rather than being determinants of what becomes science.

Gieryn's early formulation of the concept of boundary work focused on the rhetorical style with which scientists describe science for the public and its political authorities, often hoping to enlarge the material and symbolic resources of scientists or to defend professional autonomy. The selection of different characteristics assigned to science reflects strains or ambivalence within the institution, and thus science is constructed ideologically as theoretical or empirical, pure or applied, private or public, depending on which of these characteristics best achieves the demarcation of science desired, and justifies the scientists' claims to authority. Furthermore, Jasanoff has shown boundary work to be something scientists employ not just in terms of the internal questions of what is and is not scientific, but also in a more public context, allowing them to be both political and non-political.[22]

The study of boundaries therefore provides a useful lens through which to study how different historical actors have rhetorically constructed science and scientists in public contexts, and how they simultaneously construct and maintain their own identity and

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[20] Gieryn (1995) op. cit., p. 394.
[21] Gieryn, T. (1983), 'Boundary-work and the demarcation of science from non-science: strains and interests in professional ideologies of scientists', *American Sociological Review*, 48: 6, p. 405.
[22] Jasanoff, S. (1987), 'Contested Boundaries in Policy-Relevant Science', *Social Studies of Science*, 17: 2.

cognitive authority. Indeed, Locke has argued that 'what matters with respect to the public understanding of science is not some purported division between technical and public knowledge but the activity of argumentative reasoning ... actually employed in the context of public debates about science'.[23] Equally, Irwin has argued for the importance of exploring science–public relations in an open, empirical and symmetrical fashion, rather than dismissing public talk as unsubstantiated words and empty rhetoric.[24]

Susan Leigh Star and her collaborators take a different approach to Gieryn for the sociological study of boundaries. Drawing on social worlds theory, rather than treating boundaries as markers of difference, Star conceptualises boundaries as interfaces facilitating knowledge production enabling interaction and communication across communities. Star coins the term 'boundary object' to describe these interfaces between social worlds. These objects can be material or abstract and are plastic enough to exist, and be given meaning, in different situations. Boundary objects lie at the intersection between two different social worlds, such as science and non science, and can be used by actors within each for specific purposes without losing their own identity.[25] For example, a patent on research results can be used by a scientist to establish priority or for commercial gain. It can simultaneously be used by a politician to measure the productivity of research.[26]

In his later work Gieryn employs a cartographic metaphor to describe the processes of boundary work:

> The spaces in and around the edges of science are perpetually contested terrain: cultural maps are the interpretive means through which struggles for powerful ends are fought out – the right to declare a certain rendition of nature as 'true' and 'reliable'.[27]

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[23] Locke, S. (2002), 'The Public Understanding of Science - A Rhetorical Invention', *Science, Technology and Human Values*, 27: 1, p. 102.
[24] Irwin, A. (2006), 'The Politics of Talk: Coming to Terms with the 'New' Scientific Governance', *Social Studies of Science*, 36: 2.
[25] Star, S L, and Griesemer, J. (1989), 'Institutional ecology, "translations" and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science,* 19: 3, pp. 387-420.
[26] Guston, D., (1999), 'Stabilizing the boundary between US politics and science: The role of the Office of Technology Transfer as a boundary organization', *Social Studies of Science,* 29: 1, pp. 87-112.
[27] Gieryn, T. (1999), *Cultural Boundaries of Science: credibility on the line,* (Chicago and London: The University of Chicago Press), p. 15

If science is viewed as a cultural space - one of many classifications of cultural territories that people use to make sense of the world around them - it becomes a bounded space alongside other territories such as politics, religion, or social sciences. Those involved in credibility contests between territories engage in the process of rhetorically constructing cultural maps, which are mobilised as representing 'the way things are'. Science, he argues is given particular borders and territories, landmarks and labels, in order to enhance the credibility of one contestant's claims over those of other authorities. The cultural maps become a version of the truth, which, if accepted as such, allow others to act on that map, and the claims-makers to gain, or retain, their authority to make truth. Those contesting the borders of science, Gieryn argues, often draw on older maps or past episodes of boundary work to legitimate the validity of their own. Thus scientific practices and antecedent representations of it provide a repertoire of characteristics available for selective attribution at another point. Gieryn argues, it is therefore misleading to speak of the 'epistemic authority of science' as if it were an always and already present feature of social life. Epistemic authority is enacted as people debate where to locate the legitimate jurisdiction over matters of fact, and is a locally and temporally contingent enterprise.

Gieryn uses a interesting geographical metaphor, yet Eden *et al* argue that it is important not to reify the boundaries themselves, as cartographic representations tend to do, but recognise that they are always shifting and unstable, dependent upon continual renegotiation.[28] Rather than reducing complex entities such as 'science' or 'social science', into black and white immutable and homogenous objects, the boundary (and the identities of those occupying the terrain that lie either side of it) should be more properly thought of as a fuzzy zone of negotiation and rhetoric - a grey area which may, moreover, be very different for different issues. Given these dangers of reification they suggest it is better to focus upon the `work' than the 'boundary'.

Taking this into consideration I decided to draw on Gieryn's earlier formulation of boundary-work as a study of the rhetorical style of professional actors, as a way of bringing

[28] Eden, S, Donaldson, A and Walker, G, (2006), 'Green groups and grey areas : scientific boundary work, NGOs and environmental knowledge', *Environment and Planning A*, 38: 6, pp. 1061-1076.

to the fore the social interests which can be inherent, yet often invisible, in the specific demarcations of science from non-science, or scientist, from non-scientist. Given the long historical time period I was documenting, I also felt that social worlds theory and the analysis of boundary objects, which ask for a much closer analysis of all social worlds in a given setting would be difficult to sustain at the level of detail required over such a diverse, complex and long time period. Where Star and Griesemer focus on specific boundary objects and how they facilitate co-operation across many different social worlds, Gieryn's original formulation of boundary work lends itself to the study of big epistemological domains such as scientific, social scientific and public knowledge. Furthermore, it is a rhetorical form well suited to the seizure, monopolization, and protection of those 'goodies' like power, authority, expertise, prestige, and funding, actions which I felt came out more strongly from the historical data.[29] When considering a historical episode which intersects with the so-called 'Science Wars', the study of the conflict between professional groups and individuals also seemed more appropriate. This is not to suggest, however, that there were no fruitful interactions and co-operation between particular social groups within this time period, merely that these were not the focus of my study.

Gieryn has identified several different types of boundary work which are employed depending on the type of contest that is occurring. While the typology outlined below is not exhaustive, nor describes distinct and mutually exclusive categories, it is helpful in identifying some of the interests that are at stake in specific boundary conflicts, particularly those concerned with PUS. With reference to the history of public understanding of science, we are, at times, dealing with multiple types of boundary work along multiple boundaries. Thus, we can identify, for example, a group of qualitative social scientists can be attempting to expel certain quantitative social scientists from their epistemological domain, while simultaneously attempting to expand this domain into an area previously considered to be the epistemological preserve of natural scientists:[30]

[29] Gieryn (1995), p. 440
[30] See Gieryn (1999), pp. 15-18.

Expulsion

This genre defines a contest between rival authorities each of whom claim to be scientific. All sides seek to legitimate their claims about the natural world as made and vetted inside the authoritative cultural space, while rhetorically constructing discrepant claims and claimants outside. Neither side wishes to challenge the epistemic authority of science itself, but rather to deny the privileges of the space to others.

Expansion

This genre describes a contest where two or more rival epistemic authorities compete for jurisdictional control over a contested ontological domain. As Gieryn describes, 'those speaking for science may seek to extend its frontiers, or alternatively, spokespersons for religion, politics, ethics, common sense, or folk knowledge may challenge the exclusive right of science to judge this' (p. 16).

Protection of autonomy

This refers to a type of boundary work which involves the erection of walls to protect the resources and privileges of those inside. Boundary work is employed in the struggle for control of science among scientists and outside powers. For example, scientists could fight to retain autonomy in setting research agendas or deciding among methodological strategies, and they risk loss of prestige, credibility, or even funding if blamed for unwanted technological developments. Or, for example, when the mass media reproduce scientific knowledge in a popularised format not to scientists' liking, scientists will mobilise a model of science communication which places them as the only legitimate communicators of science (for further discussion of this specific point, see discussion of science communication below).

The history of the public understanding of science in the UK is a good case study to apply Gieryn's boundary work analysis, for within it we find many different professional groups competing for public funds, and social, political and epistemic authority over definitions of what is science and who is scientific, or perhaps more importantly in this case, what is considered not to be science and who is unscientific. Although researchers have commonly seen boundary-work as a fairly strategic and deliberate practice, Kinchy and Kleinman have argued that it may be far less so, becoming normalised or unreflexively routinised within daily scientific and professional practice.[31] Over time, with familiarity and accumulation, the constructions of scientific authority may be 'naturalised', so that science's authority is no longer seen publicly as constructed, but as immanent and therefore less challengeable (if at all). Hence, the construction work is obscured or forgotten: 'the repeated drawing of boundaries along similar lines across time reflects the historically resonant, and consequently, taken-for-granted character of the discourses on which actors draw'.[32] What makes boundary work an interesting and useful layer of analysis when documenting the history of the public understanding of science then, is that we see some of these taken for granted 'characteristics', or constructions of 'science' and scientific authority being challenged and re-negotiated.

Boundary work analysis need also not be confined to the study of scientists themselves, but to all those who mobilise their own claims, or counter-claims, in the negotiation process over where the boundary lies between science and non-science, scientist and non-scientist, I have, therefore, considered, not just the scientists but those other professional groups involved in PUS debates and their attempts to construct and mobilise their own authority and legitimacy in society, in the process of defining and constructing their own social world and the place of science in society within it.

Discourse

This thesis studies the historical development of debates over the public understanding of science, and how these have been tied up within a larger discourse concerned with the nature of science, what it means to be a scientist or a member of the public, and how this discourse has conferred legitimacy on particular professional groups to define and manage this relationship. As already highlighted, social studies of science such as those by Latour and Woolgar, or Gilbert and Mulkay, have examined the way in which scientific 'facts' and

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[31] Kinchy A., Kleinman D. (2003), 'Organizing credibility: discursive and organizational orthodoxy on the borders of ecology and politics', *Social Studies of Science* 33: pp. 869 – 896.
[32] ibid., p. 871.

conversations are established through a process of argument and dispute which relies heavily on the presentation of plausible accounts and the rejection of alternative explanations.[33] These studies attempted to deconstruct the process of scientific discovery by probing the social context in which this takes place – a social context, furthermore, that is mediated by language.

Michel Foucault's approach to historical discourse was to see it as a realm in which institutions, norms, forms of subjectivity and social practices are constituted and made to appear natural.[34] He investigated, amongst other things, how our understanding and experience of sexuality was shaped by a set of moral, medical and psychological discourses, and, furthermore, how these discursive constructions linked to the social shaping of institutions and practices of social regulation and control. Habermas has also articulated a discursive account of the manner in which 'displays of representation' of power on the part of ruling elites have co-constructed the public and those elites, forming the entities themselves and setting the terms of their relationship and the boundaries of power and authority.[35]

Equally, representations of science through communication offer objective 'ways of seeing' both science and culture, and as Macdonald argues, 'representation - particularly rendering things up to be viewed – becomes a key means of apprehending and 'colonizing reality',[36] thus having broader political implications than simply a public understanding of science. Foucault has argued that politics in this broader sense is concerned with power. In his interpretation, 'knowledge' and 'power' are mutually implicated with power being involved in the construction of truths and knowledge having implications for power.[37] Traditionally, knowledge production, particularly scientific knowledge production, has been rhetorically

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[33] Latour and Woolgar (1979), op. cit.; Gilbert, N. and Mulkay, M. (1984), *Opening Pandora's Box: a sociological analysis of scientists' discourse*, (Cambridge: Cambridge University Press).
[34] Foucault, M. (1984), 'The Order of Discourse', in Shapiro, ed., *Language and Politics*, (Oxford: Blackwell).
[35] Habermas, J. (1989), *The Structural Transformation of the Public Sphere*, (Oxford: Polity Press).
[36] Macdonald, S. (1998), 'Exhibitions of Power and Powers of Exhibition: An Introduction to the Politics of Display', in Macdonald, ed., *The Politics of Display*, (London: Routledge), p. 10.
[37] Foucault, M. (1979), *Discipline and Punish: The Birth of the Prison, translated by Alan Sheridan*, (London: Allen Lane), p. 380.

separated from any connection with politics and hence power. Yet in Foucault's interpretation the display, or communication, of a particular discourse of knowledge is a form of governance, in the sense that representing certain facts or particular 'truths' can influence how people understand the world, which in turn can influence how people act, or perceive they are allowed to act. This is particularly the case if these 'facts' are used to legitimate particular political ideals. Thus communication of science, which is always tied up with representations of truths and knowledge, is also involved with questions of power and politics.

Drawing on this, my history of the debates over the relationship between science and the public considers how our understandings of science, scientists, and science in public have been shaped by scientific, social scientific, and political discourses, and how these in turn have shaped those social institutions themselves.

Science communication

Gieryn argues that the rhetoric of scientists is important in constructing the authority of scientists and, more broadly, the professionalisation of science as a distinct community.[38] Indeed, Luhmann has argued that communication is the defining characteristic of all communities.[39] The issue of science communication and popularisation is a central part of debates over the public understanding of science, however, it is a separate academic field of study and so has provided theoretical insight into the way in which scientists communicate or view science communication. For example, Hilgartner has identified a culturally-dominant view of science popularisation:

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[38] Gieryn, T., *et al.* (1985), 'Professionalization of American Scientists: Public Science in the Creation/Evolution Trials', *American Sociological Review*, 50: 3.
[39] Luhmann, N. (1995), *Social Systems: translated by John Bednarz*, (Stanford, CA: Stanford University Press).

> A two-stage model is assumed: first, scientists develop genuine scientific knowledge; subsequently, popularizers disseminate simplified accounts to the public.[40]

This dominant view, he argues, holds that any differences between genuine and popularised science must be caused by 'distortion', often being attributed to outsiders such as journalists or by a public that misunderstands what it reads. This normative conceptualisation of the communication process from scientists to non-scientists has, he argues, become dominant within the scientific community because this model, though oversimplified and idealistic, serves scientists as a political resource in public discourse. This dominant view provides a flexible vocabulary used in rhetorical boundary work to demarcate 'genuine' from 'popularised' knowledge. By defining what is popularisation, scientists also establish genuine scientific knowledge as the exclusive preserve of scientists. Scientists can popularise science to the public claiming they have done so at an appropriate level, yet when attacking the claims of others, the notion of 'distortion via popularisation' can be levelled at any other actor or institution in an attempt to disallow the authoritative stamp of 'genuine' scientific authority. As Hilgartner claims:

> The dominant view of science popularisation shores up the epistemic hierarchy which ranks sciences above such actors as policy-makers, journalists, technical practitioners, historians and sociologists of science and the public. (p. 533-34)

Dornan also identifies a similar 'dominant concern' within studies of science and the media, that 'lay acquaintance with science is insufficient and press coverage of science is inadequate' and needs to be improved.[41] In this model of science and the media, he argues:

> Science is seen as an avenue of access to assured findings, and scientists – in the dissemination of these findings – as the initial sources. The members of the laity are understood purely as recipients of this information. Journalists and public relations personnel are viewed as intermediaries through which scientific findings filter. (p. 51)

This dominant representation of how science communication should work, Dornan argues, has served 'to advance [a view of science as] an essentially heroic, apolitical, and inherently

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[40] Hilgartner, S. (1990), 'The Dominant View of Popularization: Conceptual Problems, Political Uses', *Social Studies of Science*, 20: 3, p. 519.
[41] Dornan, C. (1990), 'Some Problems in Conceptualizing the Issue of "Science and the Media"', *Critical Studies in Mass Communication*, 7: 1, p. 65.

rational endeavour' (p. 50). The scientific community is privileged as the ultimate arbiter of the adequacy of science coverage, and thus, he argues, these prevailing normative assumptions have served to legitimate a prevailing social order that places science at the top. Lewenstein, in response to this characterisation, has proposed a different model of science communication which attempts to redress the epistemic hierarchy assumed within these dominant models. His web model eschews the top-down hierarchy which, in the dominant model, implies a distinction between expert and non-expert communications.[42]

Within debates over the public understanding of science, we can consider science communication as an act of boundary work, selecting particular attributes for science and mobilising them as part of a wider discourse, and indeed these dominant models of communication become themselves constructs which are mobilised as part of the boundary work between different professional groups' ideas of how society should function.

Issues of subjectivity and reflexivity

In adopting an STS approach to the analysis of the history it was important to draw on Bloor's notion of reflexivity to consider my own position as researcher and analyst and how this shaped the research project.[43] The personal identity of the researcher, and their perspective and approach to the research, are themselves constituted through various discourses. It is not possible for the researcher to stand 'outside' discourse, observing from a distance and producing some type of 'objective' analysis. If, as Berger and Luckmann suggest,[44] human beings create and sustain all social phenomena through social practices, then the social phenomena under scrutiny, here discourses surrounding the public understanding of science, are both created and sustained by that process of scrutiny.

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[42] Lewenstein, B. (1995), 'From Fax to Facts: Communication in the Cold Fusion Saga', *Social Studies of Science*, 25: 3.
[43] Bloor (1991), op. cit.
[44] Berger, P. and Luckmann, T. (1966), *The Social Construction of Reality: A Treatise on the Sociology of Knowledge*, (New York: Doubleday).

One of the phenomena I aimed to investigate in this study was the construction of public understanding of science as a 'problem' by scientists and how this has been challenged. However, it could be argued that I am constructing problems around the problems of PUS.[45] Equally, in a research project considering how multiple constructions of the public are mobilised within debates concerned with science and public, my use of the terms 'the public' and 'public' becomes slightly problematic. 'The public' and 'public' are terms that can have, and have had, many different meanings and uses,[46] all of which are available, not only to myself but to all the actors I am studying. It is difficult to step outside of these discursive resources when conducting research on science and public, but so far as it is possible, I have endeavoured to stick to describing the rhetorical constructions mobilised by the actors in this time period, while, steering clear of mobilising my own. Further to this, given the focus on boundary work at disciplinary divides, my own allocation of disciplinary affiliations is potentially problematic, and I stood in danger of constructing my own dichotomies where they may not have existed. Where possible I have endeavoured to allocate an actor's affiliations on the basis of their own stated professional interests/qualifications in their contemporary, rather than subsequent, context. Equally to avoid adopting and propagating the rhetorical dichotomies of concepts such as social science versus natural science, or quantitative versus qualitative which are mobilised by certain protagonists, I have tried to document their characterisation of, for example, another's professional affiliation, or a generic grouping, such as 'scientists', or 'social scientists' as described by themselves at that point. That is not to suggest that these divisions are not present, but again, to accept that these are rhetorical constructions being mobilised by individuals, and my adoption of these dominant discourses would run the risk of not depicting the diversity in the literature and discourse of the period.

Furthermore, if, as I claimed earlier in this chapter, reports, or documents in general, are seen as both constitutive and representative of phenomena, then my study, a report in its

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[45] For more on this see Woolgar, S. and Pawluch, D. (1984), 'Ontological Gerrymandering: The Anatomy of Social Problems Explanations', *Social Problems*, 32: 3.

[46] See for example the variety of discourses mobilised in the writings of Dewey, J. (1954), *The Public and its Problems*, (Athens, Ohio: Swallow Press/University of Ohio Press).; Lippmann, W. (2003), *The Phantom Public*, (New Brunswick, NJ/London: Transaction Publishers [1927]).; Habermas (1989), op. cit.; Hannay, A. (2005), On The Public, (Oxford: Routledge).

own right, is also constituting the phenomena on which it reports. For example, my interview questions partially pre-determined the responses I got, and my questions were informed by themes I thought I had noticed in the literature and debates over PUS, as well as my own pre-existing understanding of, and sometimes professional relationships with, the interviewees, the debate and the social world at large. I therefore risked producing an interpretation of interview data that was a projection of my own preconceptions and imaginings.

Throughout the research, I attempted to document an accurate and faithful account of the historical events and debates concerned with the public understanding of science in the UK. However, I found that there were a number of obstacles to doing this in any 'objective' or straightforward manner and I felt it necessary to be reflexive about my own role in constructing this thesis.

Unlike many historians, I appear as an actor within the period under study, and my direct observations of events therefore play a part in shaping my history account. Further to this, I have also contributed to the intellectual content of a few of the reports, or initiatives that I have analysed. This has both advantages and disadvantages. Certainly from the point at which I became professionally involved in these debates, which was both in the period before starting this project, and during it, my access to data was not limited to archival or interview research. I, in a sense, became a participant observer, which provided me with an insider account of events within the Royal Society in 2001, and the Office of Science and Technology in 2005, as well as access to documents and data I may not have otherwise have had. The latter parts of the history are therefore informed by additional types of data than the former, and it was therefore important to triangulate my own observational accounts with other sources to ensure a fair and balanced account. However, I also felt that the addition of this 'insider' historical detail would add to the history rather than detract from its validity.

Also problematic was the issue I faced of researching and documenting ideas and actors within my own academic discipline. My professional training, and previous work in the field has meant that I myself have formed strong opinions on the way in which the relationship between science and the public is constructed and should be managed. While Eaglestone is keen to point out that 'suggesting that [a] person's identity is the same as their method is a mistake', I feel that the only honest way to proceed is to locate my own perspective on the subject, rather than attempting to conceal it behind a 'neutral' analytical stance.[47]

My academic training is from within both the biological and social sciences. I have studied Science and Technology Studies at undergraduate and post-graduate level, with a particular focus on the historical, social and public dimensions of science. I have also worked as a project officer and social scientific researcher within various non-academic institutions. In 2001, I worked at the Royal Society, where I helped develop and implement the first year of their Science in Society public dialogue programme. From 2002 to 2005 (a period during most of which I was also working on this thesis) I worked at the Royal Society of Arts on a project which aimed to encourage science based industry to adopt public engagement as part of their innovation programmes. Finally, in 2005 I worked for four months within the UK Office of Science and Technology, assisting them with their interpretation and communication of a national public survey on public attitudes to science, technology and public engagement.

Throughout all these experiences I have been largely sympathetic to what might be called a 'contextual view' on the public understanding of science, that is that I believe that science and scientists can not claim a hegemony on public definitions and understandings of science, instead these are defined through a process of negotiation between different social actors within the context of specific settings. Further to this I have worked on projects which have explicitly criticised a 'deficit model' of public understanding of science, and I have worked towards fostering a two-way approach to communication between scientists and members of the public and the development of new public engagement techniques and initiatives.

Finally, as Held points out, all historical 'representations' involve interpretation, which embodies a particular framework of concepts, beliefs and standards.[48] Eaglestone puts it

[47] Eaglestone, R. (2001), *Postmodernism and Holocaust Denial*, (Cambridge: Icon), p. 27.
[48] Held, D. (1996), *Models of Democracy*, (Cambridge: Polity).

differently when he argues that 'history .. is never *just* stories. implicitly or explicitly, and particular history embodies a methodology or a philosophy of history.'[49] Accordingly, particular interpretations of data cannot be regarded as *the* correct or final history of a phenomenon, or indeed a perfect reconstruction of a historical event.. As Geertz says about qualitative social researchers, 'what we call our data are really our own constructions of other people's constructions of what they and their compatriots [or colleagues] are up to'.[50] Interpretations are always open to reinterpretation from new perspectives. This thesis therefore represents my historical reconstruction of debates over the public understanding of science, the reality of which, as 'debates', is itself constructed. As with any academic study, it is also bounded essentially by my desire for a controlled research project and can only be based on the data I myself collected and analysed.

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[49] Eaglestone, R. (2001), op. cit. p. 30.
[50] Geertz, C. (1973), *The Interpretation of Culture*, (New York: Basic Books), p. 9.

Part III: Science and Public in a historical context

This section provides an overview of the context for the rise of concerns about the public understanding of science in the 1980s. The focus of the historical review is informed by the theories I have outlined in the previous section, and therefore draws attention to the ways in which the relationship or boundary between science and the public has been historically constructed and negotiated. There is a particular focus on the emergence of a discourse of science within which we can identify concerns with the popularisation or communcation of science, or the public's understanding of science, and how these ideas have been central in constructing and defining the role of science, scientists and the public. My focus is on the UK, and specifically focuses on the role of institutions that have been involved in these debates. I start this history in the early nineteenth century as in this period new British science institutions were born, some of which were concerned with the issue of science communication. It also marks the beginning of a process of professionalisation of science in Britain, both in terms of its members and institutions.

Science in the nineteenth century

Science, in the early nineteenth century became a popular topic of discussion, particularly among a growing middle class who wished to appear educated or enlightened, and it was common for a gentleman or a lady to own a microscope or a telescope alongside a cabinet of stuffed birds, or other natural objects, or to host a science discussion as an after-dinner activity. Popular science books, written in a less technical manner, were appearing, and newly written encyclopaedias played a major role in the dissemination of scientific knowledge to the growing middle classes. Production of scientific facts was, however, limited to those deemed legitimate by other natural philosophers, all of whom occupied a largely private sphere.[51] Having established these boundaries it became easier for natural philosophers to

[51] Shapin and Schaffer (1985) argue that the practice of experimental natural philosophy had constructed a boundary around science and its constituent actors, practices, and institutions. Thus can also be viewed as an attempt to exclude the 'other': that which is not considered to be science,

discredit anyone promoting 'alternative' or 'unorthodox' knowledge or beliefs, by denying them access to membership of this domain, and thus to the authority this also conferred.[52]

The Royal Institution of Great Britain, which had been founded in 1799, increased its lecture activity in the early nineteenth century popularising science to the upper and middle classes. It staged elaborate demonstrations of scientific experiments, moving discussions of science out of the cosy private salons and drawing rooms, and into a more public domain. Scientists were now regularly displaying their knowledge to large crowds, as Gregory and Miller argue, physically separated off from the audience by a lab-bench, bearing lots of complicated specialised experimental apparatus.[53] By the end of the nineteenth century, few towns of any significance had not been visited by itinerant lecturers who offered courses of a dozen or twenty lectures over a few weeks, supplementing their income by selling their books, apparatus and medical cures, by performing land surveys or giving private tuition.[54]

The Birth of the British Association for the Advancement of Science

A growth in the number of scientists popularising science in the early-nineteenth century had coincided with a general rise in the flow of knowledge and information into what had now become a large middle class. This new intermediate social class, or bourgeoisie, between the nobility and the peasantry, arose around mercantile functions in the cities of Europe.[55] While the nobility owned the countryside, and the peasantry worked the countryside, this new stratum of society in the cities often contained the wealthiest individuals. With this wealth

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and those who do not have the authority of one with access to 'matters of fact'. The first interesting aspect of this discourse is the contradictory notion of science as being semiotically public: that is something that should be conducted and validated by a collective 'public' witnessing, while at the same time being in practice a very closed social enterprise.

[52] Gieryn provides several different accounts of instances where 'outsiders' to this bounded sphere of science were denied authority, or their claims discredited by virtue of their outsider status. See for example chapters 3 and 4 in Gieryn (1999), op. cit.

[53] Gregory, J. and Miller, S. (1998), *Science in Public: Communication, Culture and Credibility*, (New York: Plenum), p. 21.

[54] Porter, R. (2000), *Enlightenment: Britain and the Creation of the Modern World*, (London: Penguin), p. 144.

[55] Habermas (1989), op. cit.

came a greater exchange of goods and knowledge, and this also provided a niche for new cheap periodicals and lectures, and a new arena in which to discuss and debate the issues of the day. The rise in merchant trade also brought with it new artefacts from all over the world, which were displayed in newly opened public museums. Previously private Royal collections were opened to the public and expanded. The display of these objects, often objects of science, can be seen as a medium through which the public were encouraged to witness the spectacle of science.[56] Thus this display also tacitly reinforced the authority and expertise of scientists, who had discovered, created and understood these artefacts.

In 1830, the Cambridge mathematics professor Charles Babbage published his book *Reflections on the Decline of Science in England*, which accused the universities of not teaching, and the State of not supporting, pure science. He blamed a lack of public interest for the declining prominence of pure science in Britain, and his main attack fell squarely on the Royal Society for being too generalist and for not having enough influence within government. David Brewster, editor of the *Edinburgh Journal of Science*, agreed with Babbage, and discussed openly his dissatisfaction with the organisation and the position of science at this time. He bemoaned that nobody was aware of the state of the arts and sciences, or of their recent decline, and of the 'horrid construction of all those institutions which are intended to promote them ...'.[57] He contrasted the British situation with the state-funded French science, and suggested a national decline would occur if the sciences were ignored. Writing to Babbage after he had published *Reflections*, Brewster was convinced that it would be necessary to obtain the co-operation of political and influential persons in order to produce a practical result, exclaiming:

> It is a disgrace to men of science, and to the Royal Society, the natural guardian of English Science, that they have not combined in a vigorous attempt to raise public feeling on the subject.[58]

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[56] For a more detailed discussion of science museums and the display of science as a form of boundary work see Lock, S. (2002), *Constructing the Nation: Science and Display at the Festival of Britain, 1951*, (MSc Thesis: Birkbeck College, London).
[57] Morrell, J. and Thackray, A. (1981), *Gentleman of Science: Early Years of the British Association for the Advancement of Science*, (Oxford: Oxford University Press), p. 41.
[58] Brewster to Babbage, 12 Feb. 1830, British Library London fols 49-51 in Morrell, J. and Thackray, A. (1981), ibid., p. 47.

Babbage and Brewster expressed envy of the professional resources that men of science had overseas and, in a bid for more public money, resources and greater job security in Britain, blamed the lack of government support on a lack of public interest in science. The Royal Society was still operating along the idea of science needing the patronage of the aristocracy, and it had, as some of the reformist Fellows argued, too many Fellows who may have been distinguished but had a passing interest in science. Reformers in the Royal Society wanted the Society to become a more professional body of scientists that belonged to them. Brewster had suggested to Babbage in personal correspondence that 'an Association should be organised for reviving science in England',[59] and a year later, the reformers in the Royal Society decided to form such an organisation. These men believed the solution to greater professional identity and more importantly greater resources for science, was to popularise science even more to the public. Implicitly there appeared to be a link between public feeling and support for science and government support. Thus the management of the relationship, or boundary, between the public and science was considered very important.

Thus in 1831 the British Association for the Advancement of Science (BAAS) was born. The Association was, according to Caroe, designed to be a mouthpiece for science; 'it was to catch the attention of the nation, stimulate research and provide a meeting ground for discussion'.[60] The British Association for the Advancement of Science was immediately popular, gaining a large membership, and providing a place for scientists to exchange papers and views. Its Annual Meeting, held in a different location in Britain or in a British Dominion each year, attracted both scientists and amateurs and was widely reported in the press.[61] When the Association was launched in Yorkshire it immediately proposed a link with regional amateur societies, suggesting that its members could usefully collect data. Being launched in York itself was a very deliberate move: the organisation tried to move away from the very traditional (London, Cambridge, Oxford) base and symbolise the social integration of England, Scotland and Ireland. It was also at one of the early meetings of the British Association, in 1833, that William Whewell coined the term "scientist" to refer to what had

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[59] Brewster to Babbage, 16 June 1830 British Library London fols 229 – 30 in Morrell, J. and Thackray, A. (1981), ibid., p. 50.
[60] Caroe (1985), op. cit., p. 61.
[61] Morrell and Thackray (1981), op. cit., p. 224.

become a burgeoning professional group.[62] The use of a distinct label which rhetorically consolidated a distinction between professional and amateur is a further development of a discourse of professional science and a new resource to mobilise in continuing boundary work. The word 'science' too, began to take on a more specialised and distinct meaning. 'Science', Morell and Thackray argue, like natural philosophy before it, was promoted by the British Association for the Advancement of Science as the 'intellectual progenitor of technology, the guarantor of God's order and rule, the proper way of gaining knowledge, and the key to national prosperity and international harmony'.[63] The old discourse of natural philosophy was recast in these new, more professional terms, of the mid-nineteenth century, yet we can see that many of the ideological beliefs, for example, that science should play a key role in shaping society, and that the scientists had access to special knowledge continued to be part of this.

As it continued to be popularised, science grew as an amateur pursuit, with natural history and astronomy becoming common pastimes for men and women. The onset of the Industrial Revolution brought technology closer to the public with many aspects of daily life influenced in some way. The manual labour-based economy of Britain was replaced by one dominated by industry and the manufacture of machinery. Textile industries were mechanised, iron-making techniques were developed and the use of refined coal increased. Where once travelling lecturers had brought new knowledge about agriculture and new technologies to the provinces, Mechanics Institutes were now established which provided places for often distinguished scientists to teach working men, making them qualified to do more technical jobs in factories and mines. Science was promoted as an entertainment for the middle and upper classes but as a means of improvement for the working classes.

The British Association for the Advancement of Science harnessed the power of display to establish itself as an influential body in the public domain. Science as spectacle, according to Morrell and Thackray, became a deliberately cultivated feature of the Association's meetings, which became grand affairs not only for those distinguished guests attending the lavish

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[62] Gregory and Miller (1998), op. cit., p. 23.
[63] Morrell and Thackray (1981), op. cit., p. 96.

dinners with speakers, but also for the working classes who by witnessing the spectacle were expected to passively absorb the implicit message about the power, majesty and progressive nature of science. Technological displays, they argue, became a regular feature of the meeting, often accompanied by 'a band, cannons, flags and the shouts of thousands' (p. 96). In 1841 at Plymouth a battleship was lifted by wedges and launched in front of thousands. The annual address at the British Association for the Advancement of Science meetings became a regular 'pulpit' in which leading figures of the organisation could deliver messages of morality and law, through the mouthpiece of natural knowledge. All these public displays were intended to bolster the growing cultural authority of science in a public context, while maintaining a boundary between scientists and lay-public. Display of science became more common in the nineteenth century as public museums were opened for the first time, and previously private collections made public. Public museums and exhibitions, such as the Great Exhibition in 1851, which displayed a large number of technological artefacts, can in this context be considered as displays of science, or acts of boundary work, which served to reinforce the authoritative role of scientists in shaping society, as well as enforcing a political message about the technological prowess of the British Empire. The public were thus constructed as passive receivers of this scientific knowledge and these other implicit messages.[64]

Professionalising science

Institutions such as the Royal Institution and the British Association for the Advancement of Science continued in the Victorian era to promote a more professional image of science, in an attempt to demarcate the amateur from the professional. John Tyndall, who took over from Michael Faraday as Superintendent at the Royal Institution, continued to provide public lectures which displayed the progress of science. Tyndall used his prominent position to promote a variety of ideological arguments to justify scientists' requests for greater public support. Career opportunities and research facilities available to scientists in the late-nineteenth century were minimal and public support was again perceived by scientists to be

[64] Lock (2002), op. cit.

crucial to garnering political leverage and resources. Tyndall and other scientists such as Thomas Henry Huxley, concerned at what they saw as the large amount of intellectual authority religion commanded, engaged in public debates concerning natural selection and religious accounts of creation and the natural order, particularly following the publication of Darwin's *The Origin of Species* in 1859. Gieryn, furthermore, has argued that Tyndall's Presidential address to the British Association in 1874, to deny the authority of religious beliefs over natural, scientifically derived ones, was boundary work, fighting for cultural authority and resources for science.[65] Indeed, Turner has also suggested that the decades following the publication of Darwin's work should be viewed as a 'professional conflict for authority and prestige' between science and religion rather than simply an academic debate between different accounts of natural history.[66] The British Association was concerned with ensuring that science formed a part of the curriculum, particularly at public schools, where pupils would go on to hold positions of influence as decision makers. If they were exposed to science at school the British Assocation hoped pupils would then adopt a more favourable attitude towards it.[67]

By the 1880s, the presidential addresses of the British Association's Annual Meetings were routinely concerned with what they perceived as the publics' woeful lack of interest in, and support for, science. Sir Lyon Playfair, speaking in 1885, and seemingly concerned with the lack of scientists coming out of the education system, asked:

> "How is it that in our great commercial centres, foreigners push aside our English youth and take the places of profit which belong to them by national inheritance? How is it that in our colonies German enterprise is pushing aside English incapacity? How is it that we find whole branches of manufactures, when they depend on scientific knowledge, passing away from this country in order to engraft themselves abroad, although their decaying roots remain at home?"[68]

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[65] Gieryn (1983), op. cit.

[66] Turner, F. (1978), 'The Victorian conflict between science and religion: a professional dimension', *Isis*, 69., quoted in Gieryn (1983), op. cit.

[67] Layton, D. (1981), 'The Schooling of Science in England, 1854-1939', in Macleod and Collins, eds, *The Parliament of Science*, (London: Science Reviews Ltd), p. 190.

[68] Playfair, L. (1886), *Presidential Address, Report for 1885*, (Aberdeen: BAAS).

He answered his own question by quoting Michael Faraday's observation that 'our schoolboys are ignorant of their ignorance at the end of all that education'.[69] Similarly John Burdon-Sanderson, at the Annual Meeting in Nottingham in 1893, suggested:

> "It is not the fault of governments, but of the nation, that the claims of science are not recognised. We have against us an overwhelming majority of the community, not merely of the ignorant, but of those who regard themselves as educated, who value science only in so far as it can be turned into money ... "[70]

Over fifty years since similar concerns had prompted the foundation of the British Association for the Advancement of Science, the question of whether science was valued and supported financially by government, or exploited by industry, seemed now to be intricately tied up with notions of public education and support for science.

The end of the Victorian era saw science firmly established as a powerful and professional institution that had more influence over the educational system and commanded a large proportion of public money. These new professional scientists were different from those amateur gentlemen who had come before them, and from the public. The scientific societies had become closed to those not considered professional scientists, and popularisation became a distinct type of communication from the more technical internal scientific communication within the community. Goodell has argued that popularisation was even looked down upon by many scientists who believed it sullied the purity of the scientific endeavour.[71] However, an authoritative discourse of science was certainly a well established and convenient rhetorical resource available to scientists engaging in boundary work to construct, maintain, or enlarge the boundaries around their profession.

Science enters the twentieth century

The effects of the First World War on the status of science were both positive and negative. The war had precipitated a large increase in government support for science in the UK, and

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[69] ibid.
[70] Burdon-Sanderson, J. S. (1893), 'Inaugural Address', *Nature*, 48.
[71] Goodell, R. (1977), *The Visible Scientists*, (Boston: Little Brown).

the establishment of a government Department of Scientific and Industrial Research is testament to this, accelerating the continued professionalisation of a distinct scientific community. However, the war had also highlighted the destructive capabilities of science to the public, with its application to military technologies. The use of poison gas, to rather graphic effect, had resulted in many dubbing the conflict 'the chemists' war', which was a blow to the public image of chemistry. This perceived public unease prompted organisations such as the British Association for the Advancement of Science, which up until now had been a vocal cheerleader for science, to reformulate its approach to the popularisation of science. With dwindling support from the active science community, the British Association also needed to define and maintain what it saw as its central position in the scientific life of the nation. Many of the Presidential addresses at Annual Meetings in the 1920s reflect scientists' attempts to manage the public image of science. Peter Collins argues that the Association was confident that, if there was any cause for disquiet about the social effects of science, 'the fault lay with 'society' and not with 'science'.[72]

The economic crisis of the 1930s in Britain, however, posed a challenge to scientists, as many people blamed science for many of the social problems that resulted from the economy. Problems such as the displacement of large numbers of people from work due to increasing mechanisation, and the shortening of working hours resulting in too much leisure time for the working classes, were seen as results of an increasing industrial and technological society. Members of the British Association for the Advancement of Science responded defensively to this perception of negative public opinion, and many scientists at the time reconsidered the assumption that their scientific endeavours were necessarily making the world a better place. As J.G. Crowther, science correspondent of the *Manchester Guardian*, recalled, the feeling that the organisation had to redefine its role, in light of the financial crisis in 1931, was palpable:

[72] Collins, P. (1981), 'The British Association as Public Apologist for Science', in Macleod and Collins, eds, *The Parliament of Science*, (London: Science Reviews Ltd), p. 216.

> Against this background, the Victorian form of the British Association seemed rather irrelevant. In the situation the institution had little to offer. In fact, Brewster's British Association of 1831 appeared more modern. The government of the Association, and many individual scientists, felt uncomfortable, and began to discuss what action the Association and scientists should take to make themselves more effective in this direction.[73]

While scientists had attempted to portray science as being devoted solely to the pursuit of objective scientific truth, above politics, and unaffected by social or ideological influence, there was now a rise in the number of scientists who argued that scientists should be more involved in considering the moral and social effects of their work. High profile scientist popularisers J. D. Bernal and Hyman Levy spoke about the connections between science and socialist goals, believing that the scientific method should be applied to social and political affairs. The British Association for the Advancement of Science initially distanced itself from these radical scientists, being less concerned with social progress than about, as Collins suggests, 'the dangers public apathy posed to the continued advancement of science: in order to secure essential public support, it was necessary to demonstrate that the social consequences of science were generally to be welcomed'.[74] Thus far from being a change in the discourse of science I have outlined so far, several features became more prominent at this time, particularly the idea that a bad image of science was in some sense the fault of the public. Indeed, as Collins argues, the perception of a hostile public was so strong that the British Association, in their self-appointed role as mediator between science and the public, set itself up as a public apologist for science. In 1933 its Council introduced a specific policy to ensure that the Association try to allay public anxieties about the relations between the advances of science and the life of the community. Josiah Stamp, President of the Association in 1936, Collins argues, was so concerned to point out that science should not have a political agenda, and to distance the organisation from more radical scientists, that he stated it was far from clear that scientists had any special authority outside of their own discipline at all. Others at the same meeting were prepared to go further and admit that the public might even be partially justified in its misgivings about the social consequences of science, and that the socially responsible scientist should educate himself and the public on the social implications of science.

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[73] Crowther, J. G. (1970), *Fifty Years With Science*, (London: Barrie and Jenkins), p. 83.
[74] Collins (1981), op. cit., p. 213.

The meetings of the British Association were not, however, the only public domain in which conversations about the social function of science, or impacts of science on society, were being held. Popular writing by scientists was a practice limited to a few of what Gregory and Miller call the 'dabblers, idealists and stars of the 1920s and 1930s', in contrast to the rather more common practice it had been in the Victorian period.[75] A symptom of the increased professionalisation of science was that scientists were encouraged to write about their work first and foremost for their professional peers and only then was it deemed acceptable to write a more 'public friendly' popular account. A few well-known scientists and intellectuals, such as J. B. S. Haldane, Julian Huxley and Bertrand Russell, continued to write about science in newspapers, magazines and books, often providing speculative accounts of a society in the future, created for better or worse by science, through which they could expound their thoughts on the impact of science on society. This was a much more open and creative forum in which to extrapolate on the implications of science than was permitted from within the scientific community. In the inter-war period this informal science writing became a place where the previous pre-war assumptions, that science could only be beneficial for society, were challenged. As Jon Turney has noted, the most conspicuous products of this reappraisal were the literary dystopias, but there was also a growing literature in which the pace of progress, the quality of human life, and technology and social change were discussed in more detail.[76] Haynes has also noted this ambivalence in the representations of scientists in films.[77] Alongside these bleaker images of scientific futures came a continuation of the debate over what science is. Russell in his essay *Icarus, or the Future of Science*, feared that science would only be used 'to promote the power of dominant groups' rather than for the more utilitarian goal to 'make men happy'.[78] Julian Huxley, the grandson of Thomas Henry and brother of novelist Aldous, wrote about biology for the educated classes in up-market magazines, and, in his only fictional work, questioned the assumption that the promotion of science to the public was automatically a good thing.[79]

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[75] Gregory and Miller (1998), op. cit., p. 38.
[76] Turney, J. (1998), *Frankenstein's Footsteps: Science, Genetics and Popular Culture*, (New Haven and London: Yale University Press), p. 97.
[77] Haynes, R. (2003), 'From Alchemy to Artificial Intelligence: Stereotypes of the Scientist in Western Literature', *Public Understanding of Science*, 12: 3.
[78] Russell, B. (1924), *Icarus, or the Future of Science*, (London: Kegan Paul).
[79] Turney (1998), op. cit., p. 106.

Away from the more intellectual discussion of scientific futures, a different market for science fiction was growing and pulp science fiction became a popular locus for the discussion of science and society. A detailed discussion on science fiction is beyond the scope of this thesis, but it is important to note the rise and impact of the genre. Books such as *Brave New World*, as Turney has argued, have entered the public consciousness in a similar manner to the *Frankenstein* myth, and have most likely played some role in subsequent public debates about the impact of biology on society.[80]

The public's understanding of science

Boon has provided a detailed account of the way in which scientists continued, in the twentieth century, to be concerned with the public's understanding of science.[81] In 1938, the British Association for the Advancement of Science set up a division for the Social and International Relations of Science 'to further the objective study of the effects of advances in science on communities, and reciprocally the effects of social conditions on the progress of science; and the encouragement of the application of science to promote the well-being of society'.[82] It was the only Section of the Association that remained active during the war, organising several conferences. Boon has noted that the 1943 conference, called 'Science and the Citizen: The Public Understanding of Science', was organised by many of those same scientists on the left of the political spectrum that the organisation had distanced itself from in the early-1930s.

The conference followed on the heels of several books devoted to the issues of science in society and, because of their authors' left-wing leanings, how Britain might steer science towards more socially beneficial goals. J. D. Bernal's *The Social Function of Science* (1939), and J. G. Crowther's *Social Relations of Science* (1941) both argued that an effective citizenship required some knowledge of the potential of science. As *Daily Herald* science correspondent

[80] Wilson, D. (2005), *The development of human tissue storage*, (PhD Thesis: University of Manchester).
[81] Boon, T. (2004), *Science and the Citizen: Documentary Film and Science Communication in World War Two*, (Oxford: Oxford University).
[82] Science (1938), 'Committee of the British Association for the Social Relations of Science', *Science*, 88: 2295.

Richie Calder had explained at the conference, citizenship and science were intertwined concerns:

> The scientist is a functional citizen ... this is a war for better government, and that better government will depend on the individual citizen being properly instructed. He must be made alive to the vast potential of the twentieth century and to the vast complexities which science and technology have introduced into the life of society. The scientist has his contribution to make, not only in the shape of his new discoveries, but in impressing upon the public the implications of these new discoveries.[83]

Crowther echoed Calder's emphasis on the public's need to understand science. He argued that "a hundred years ago, it was desirable that the people should know about science: to-day it is necessary for survival".[84] He called for a "more professional and systematic" approach to the "explanation and appreciation of science", arguing that scientists could no longer leave this task to "occasional and amateur activity" if we were to "look forward to a scientific civilisation supported by democratic approval, understanding and participation".[85] Boon's account of the conference shows how a dominant metaphor, present in many of the discussions concerning ways in which to address the public understanding of science, was a transmission and reception model of science communication. The scientists differed on what sort of science should be popularised; however, they all appeared to agree that the goal of getting a message about science to the public was important. Haldane had expressed a similar concern with the importance of an understanding of science for democratic purposes in *Science and Everyday Life* (1939):

> 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.[86]

Following the conference, the Council of the Association appointed a standing committee to 'consider and give effect to means of extending the public understanding of the benefits of

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[83] Advancement of Science (1943), *Advancement of Science*, 2, p. 335. in Boon (2004), op. cit,
[84] Advancement of Science (1943), op. cit.
[85] ibid., p. 335, cited in Boon (2004), op. cit.
[86] Haldane, J. B. S. (1939), *Science and Everyday Life*, (Harmondsworth: Pelican), p. 8.

science'.[87] The conference itself represents the earliest known mention of the phrase 'the public understanding of science', and we can see that it was tied up with ideas of how to manage the public, while ensuring that science was serving a greater democratic purpose. Thus again we also see a feature of the discourse of science from scientists, was that science could help shape a better democracy. Here again these scientists were advocating greater science communication: explicit boundary work to manage the public and its relationship with science and scientific knowledge.

Post-war science

Much of the history of science in the public domain in the post-war period has yet to be fully researched. However, it is well established that science had a high profile in media coverage after the Second World War.[88] Its contribution to the war effort had been central, and indeed Churchill even claimed that without it the war might not have been won.[89] Newspaper coverage of scientific issues increased with, as Gregory and Miller claim, 'the morale-boosting, optimistic rhetoric that had carried readers through the war', and 'new technologies in medicine, energy, transport and communications produced during the war were celebrated and praised'. [90] As Irwin has shown, increasing 'public understanding' was viewed by many as an important task for scientists, as decisions over the social control of science was the responsibility of every citizen. In 1947, the Association of Scientific Workers, encouraged by the post-war Labour Government, argued that the relationship between scientist and citizen could be summed up as saying that the scientist should play his part more fully as a citizen, while the citizen should acquire more scientific awareness.[91]

Alongside this citizenship argument, the Association also made workforce and cultural rationales for a public understanding of science. The former rationale was based on the need

[87] Nature Editorial (1943), *Nature*, 151, p. 595.
[88] Shortland, M. and Gregory, J. (1991), *Communicating Science: A Handbook*, (London: Longman), p. 15.
[89] Gregory and Miller (1998), op. cit., p. 38.
[90] ibid., p. 37.
[91] Irwin, A. (1995), *Citizen Science*, (London and New York: Routledge).

to address the 'inadequate standards of available labour' for science and particularly industry, while the latter was based upon the assertion that 'no man can be considered to be cultured who makes no serious attempt to understand and appreciate the broad principles of science'.[92] They argued for the same sorts of approaches to disseminating science to the public as the 1943 conference delegates had: further education, and greater representation in media through museum exhibits, film, the press and the radio.[93]

A good example of both the celebration of science, and the push for a greater public understanding of it, can be seen by its prominence at the Festival of Britain in 1951. The Festival was an exhibition which followed in the tradition of the Great Exhibition and United States' Worlds Fairs, in that it devoted a large area to displaying material objects of science, with the public positioned as passive consumers to be both impressed and educated by the displays.[94] The scientists, from many of the scientific institutions such as the British Association for the Advancement of Science and the Royal Society, were heavily involved in developing the science within the exhibitions, and great emphasis was placed on getting the scientific information correct.

A gulf between science and public?

The mediation of science in public after the Second World War, aside from a few of the 'big names' in science such as Haldane and Lancelot Hogben, became the role of a new breed of professional science journalists and science writers, who took to the task with their own very clear agenda and strategies. This resulted in placing a greater distance between the scientists and the public. Initially, as Lewenstein has argued in relation to science writers in the United States in the post-war period, journalists were committed to the promotion of science, thus

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[92] Members of the Association of Scientific Workers (1947), *Science and the Nation*, (Harmondsworth: Penguin), p. 205. cited in Irwin (1995), op. cit., p. 11.

[93] Lewenstein has also shown how, in the United States, there was a similar perception that the relationship between scientists and the public needed to be actively managed. For a detailed history of this development see Lewenstein, B. V. (1992), 'The meaning of 'public understanding of science' in the United States after World War II', *Public Understanding of Science*, 1: 1.

[94] For further discussion of the Festival and methods of display of science see Lock (2002), op. cit.

continuing in the same vein as the scientist popularisers before them.[95] However, this changed significantly over the following years. Science writers and journalists adopted a much more critical voice and became a public watchdog for science, rather than simply its cheerleader.[96] Reasons for this change in tone have not yet been widely researched; however, it has been attributed to a general public movement away from traditional authorities and more specifically a feeling of disappointment that had followed the pro-science rhetoric immediately following the war. It is also likely that more general shifts in news reporting and journalistic values and agendas changed. More significantly, it has been seen as a response to the perceived failures of technology, particularly with regards to environmental degradation. C.P. Snow's 'Two Cultures' treatise in 1956 discussed a perceived gulf between science and public culture,[97] arguing that 'the intellectual life of the whole of Western society is increasingly being split into two polar groups' (p. 3). Referring to the relationship between scientists and non-scientists - here largely meaning those who had studied humanities - he characterised it as:

> ... a gulf of mutual incomprehension – sometimes (particularly among the young) hostility and dislike, but most of all, lack of understanding ... . The separation between the scientists and the non-scientists is much less bridgeable among the young than it was even 30 years ago. Thirty years ago the cultures had long ceased to speak to each other: but at least they manage a kind of frozen smile across the gulf. Now the politeness is gone, and they just make faces. (p. 4)

Many were critical of Snow's thesis, not least the arts community itself. A leading literary critic from Oxford, F.R. Leavis, roundly criticised Snow in his 1962 Richmond lecture and in the *Spectator* magazine, questioning his authority to speak upon such matters in the first place, as if a scientist had no place discussing culture.[98] Edgerton has pointed out that many critics of Snow's thesis were also scientists who believed him to be exaggerating the idea that science and the role of scientists was somehow in decline. Indeed, Edgerton argues that Snow's own position as a prominent scientist working within the Government refutes his

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95 Lewenstein (1992), op. cit.

96 Bauer, M. and Gregory, J. (2007), 'From journalism to corporate communication in post-war Britain', in Bauer and Bucchi, eds, *Journalism, Science and Society*, (London: Routledge).

97 A version of his argument was published in the *New Statesman and Nation* in 1956 and then re-iterated in a more popular format as a Rede lecture in 1959 see Snow, C. P. (1993), *The Two Cultures: with an introduction by Stefan Collini*, (Cambridge: Cambridge University Press, Canto edition).

98 Leavis, F., 'The significance of CP Snow', *The Spectator*, 9 March 1962.

suggestion that there were no scientists in positions of power.[99] Whether Snow's assertions were founded or not, the idea of a 'two cultures' divide between those in the scientific community and those from the arts and humanities was a focus for discussions concerning the relationship between the two. In many ways Snow's argument can be seen in a context of the ongoing boundary work over which self-appointed professional elite commanded, or should command, ultimate authority in society, and therefore as a re-articulation of the same discourse of science we have already seen, for example, from Boyle or The British Association.

A new grouping of commentators, from both sides of the Atlantic, many of whom were not scientists, also came forward at this time, to articulate a wider concern with, and perspectives on, the public and science. American literary critic Lionel Trilling argued that the debate between Snow and Leavis in the mid-twentieth century should be seen as a 're-run' of the debate at end of nineteenth century between T. H. Huxley and Matthew Arnold, and a similar argument put forward by anthropologist Margaret Mead shows that it was not simply a British preoccupation.[100] Writing towards the end of the 1950s, Mead was concerned with what she perceived as a growing alienation of lay people from the worlds of science and technology. She suggested that a 'schismogenic process' was taking place in Western culture, which could only be stopped by the discovery of 'new educational and communication devices' that would be able to bridge the gulf between 'the specialized practitioners of a scientific or humane discipline and those who are laymen in each particular field'.[101] As the title of her paper 'Closing the Gap between Sciences and Others' suggests, she felt scientists were now so specialised professionally that they were perceived even by other scientists in separate fields as bounded off from each other.

The term 'scientific literacy' was also coined at this time in the United States. Interest in the concept was fuelled by concerns among the American science community over public

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[99] Edgerton, D. (2002), 'Science and the Nation: towards new histories of twentieth century Britain', *Inaugural Lecture, Imperial College, October 2002*, published in Historical Research February 2005.
[100] Trilling, L. (1967), *Beyond Culture: Essays on Literature and Learning*, (Harmondsworth: Penguin).; Mead, M. (1959), 'Closing the Gap Between Scientists and the Others', *Daedalus*, 88.
[101] Mead (1959), op. cit.

support for science following the launch of the Soviet satellite Sputnik.[102] Increasing scientific literacy was seen by scientists as a way of ensuring that American children were equipped to cope with a society of increasing scientific and technological sophistication. As Waterman noted in 1960, in a review of the National Science Foundation, 'progress in science depends to a considerable extent on public understanding and support of a sustained programme of science education and research'.[103] Harold Wilson also drew on this established discourse of science in his first speech as Labour party leader in 1964, stating:

> "In all our plans for the future we are redefining, and we are restating, our socialism, in terms of the scientific revolution, but that revolution cannot become a reality unless we are prepared to make far reaching changes in economic and social attitudes which permeate our whole system of society."[104]

Thus we can see that throughout this period both scientists and politicians drew on the idea that science should be understood and appreciated by the public in order for society to function successfully.

Criticisms of science

This general celebration of science and technology and its benefits to society came in for further criticism as concerns about the environment began to be voiced. The publication of *Silent Spring* (1962), a book in which Rachel Carson documented the degradation of the environment by human exploits, and particularly the dangers to wildlife from chemicals, brought these issues into the public domain. Over the following decades *Silent Spring* came to be seen as the start of an environmental movement which, by the end of the 1960s, became a vocal critic of science and its goals. This critical turn also meant that scientists were engaging in less popularisation of science, with the public communication of science being performed solely by journalists and science writers.[105] As Goodell has argued, tacit rules within the scientific community had developed over the past few decades, which dictated when a scientist could popularise and when they could not, which exercised a 'powerful

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[102] Luagksch, R. C. (2000), 'Scientific Literacy: A conceptual overview', *Science Education*, 84: 1.
[103] Waterman, A. T. (1960), 'National Science Foundation: A ten year resume', *Science*, 131.
[104] Transcribed from archive video footage at www.bbc.co.uk, accessed on May 20th 2008.
[105] Gregory and Miller (1998), op. cit.

system of social control'.[106] In 1969, Franz Ingelfinger, the editor of the *New England Journal of Medicine*, decreed that no scientist could publish their results in the journal if they had already announced their results somewhere else, such as in a newspaper or popular magazine. Professional science was now something that was supposed to happen in a very separate arena from the public.

In the late-1960s, a small group of scientists and other academics established a new organisation, called 'The British Society for Social Responsibility in Science'. Their manifesto, as one of the founding members, biologist Steven Rose, recalls 'criticized the prevailing notion of the 'neutrality' of science'.[107] The group, in a similar fashion to the left-wing radical scientists in the 1930s and the post-war years, wished to discuss and communicate the use of science for political ends. They were heavily influenced by the radical demands of the student movements of 1968, and critical of the uses of science and technology in the Vietnam war, arguing strongly that 'science and technology were intimately part of the industrial–military complex of advanced capitalist societies, and that it simply was not possible to separate a 'pure' science from the context in which it was commissioned, funded, researched, published and exploited' (p. 308). A course on Science and Society was created on the Open University's Foundation Science Course, which specifically raised the idea that scientists should be responsible for communicating the implications of their work to the rest of society. The relationship between science and society was 'an essential aspect of the whole process of scientific advance'.[108]

While members of the British Society for Social Responsibility in Science were concerned about the social aspects of science, more general concerns over how scientists should be communicating with the public at all were being raised by social scientists throughout the 1970s. Indeed the *Program on Public Conceptions of Science,* largely run by scholars from the new field of the social studies of science, acknowledged that the public understanding of science was now a matter of priority within various scientific associations and organisations and

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[106] Goodell (1977), op. cit.
[107] Rose, S. (2003), 'How to (or not) communicate science', *Biochemical Society Transactions*, 31: 2, p. 307.
[108] Open University (1971), *Science and Society*, (Milton Keynes: Open University Press).

argued for a co-ordinated network of programmes to address this issue.[109] For example, a seminar run in 1974 asked the questions: 'What is the responsibility of scientists to communicate to the public the aims, the methods, the results and consequences of their research? What are the impediments to such communication? How can the impediments be removed?'[110]

Not all academics were in agreement that this focus on the public understanding of science, which was in effect a move to closely manage the relationship between science and public through an increased communication, was a good thing. Trachtman questioned what he saw as a now unchallenged assumption that scientific organisations should be promoting and interpreting scientific knowledge to and for the public. A greater knowledge of science by the public was now perceived as 'a good thing' he argued, continually justified by journalists and scientific institutions with the argument that the enlightenment of citizens was necessary for a better democracy and personal decision-making, but also that it should form the basis of any cultured man's knowledge.[111] Trachtman, however, felt that these justifications were over-stated and that it may well be damaging, by raising public expectations of what science was capable of and simplifying scientific controversy in the goal of straightforward communication.

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[109] McCarty, T. (1974), *Newsletter of the Program on Public Conceptions of Science*, 6, p. 13.
[110] Perlman, D. (1974), *Newsletter of the Program on Public Conceptions of Science*, 6, p. 12.
[111] Trachtman, L. E. (1981), 'The Public Understanding of Science: A Critique', *Science, Technology and Human Values*, 6: 36.

Conclusions

We can see that historically science communication and the idea that the public needs to know about science has been used not only as a means of managing the boundaries between science and society but as a means of constructing an identity for science and scientists, in opposition to the identity of an 'other' social or professional group. This history has shown that to construct, *expand*, and maintain their cultural legitimacy, science communication has at particular points become a large part of the professional activity of the scientist. This served, as Foucault would argue,[112] as a civilizing function: scientists, by constructing and rhetorically mobilising a specific discourse concerned with their position in society and relationship with the public, show the public 'how things are'.

The role of the scientist in public has been constructed through the mobilisation of a discourse of scientists as people of authority and expertise, with access to special knowledge which could improve society and educate the public. This implicitly therefore maintained the notion that the public had no part to play in the practice of science itself: the discovery of 'facts' occurred behind closed doors in the private realms of scientific institutions. We can also see from this history that an established discourse of science has developed, which represents science as free from political influence, yet able to shape society and politics for the better. A relationship between public understanding, public support and government support is also articulated as this professional discourse of science developed. All aspects of this discourse provide rhetorical resources for scientists to utilise when engaging in boundary work to construct and maintain a boundary around themselves. An ignorant public must be assumed before scientists can promote themselves as experts with authority and access to specialised knowledge. In what seems a contradiction, however, scientists have at points argued for the very boundary they are trying to rhetorically shore up to be made permeable, arguing also for science to be understood by the public. This is a good example of what Gieryn calls *protection* boundary work. Scientists construct science as separate to the public yet are careful to not construct themselves as too distant else they risk a perceived critically

[112] Foucault (1979), op. cit.

important route for their legitimation: social utility or funds. Thus scientists set themselves up as in control of the 'gate keeping' or permeability of their 'fence', to allow some one-way movement of knowledge, from science to the public but to restrict any in the other direction, for what makes science useful is its perceived objectivity and rationality. We can see that this co-construction of science and society has been a continuous activity and many representations and science popularisation or communication can be viewed as rhetorical acts of boundary work which have constructed both science, its institutions and the public in a manner which advances the social interests of the individual or group deploying the rhetoric.

Many of the studies from which this section's history was drawn assume that the elite scientific discourse being communicated within any period was both successful and effective, that is to say that the manner in which scientists discursively constructed their relationship with the public is exactly how it then manifested. It would be naïve to assume that this is the case; however, this merely serves to remind us that, as Gieryn suspects, many scientists assume that their representations of science 'tell it like it is', and thus are always solely in control of their own identity and cultural authority.[113]

[113] Gieryn (1999), op. cit.

Part IV: My Historical Framework

In this history I document the activities and discussion related to the main individuals and institutions involved in the public understanding of science. I identify the different conceptualisations of 'the public', of 'science' and of 'scientists', and beliefs about the manner in which their relationship should be managed. The dominant discourses of public understanding of science over the whole period are identified and the boundary work being performed by different professional groups is analysed.

Having identified the major trends in activity and discourse, I decided that this historical period could be broadly understood in four phases. The phases are the results of my research. However, I have structured content of the thesis around them, to allow each phase to be characterised and discussed as it concludes chronologically, rather than leaving all my analysis to the final chapter. Each phase is dominated by a different discourse concerned with the 'problem' of PUS, and characterised by different boundary work as different professional groups involved in the PUS debates attempt to construct and mobilise their own expertise. Thus while the phases do not have a discrete beginning and conclusion in the real world, they show how the dominant discourses, the actors involved and the boundary work, have changed over time. Certain types of boundary work and discourse persist through the successive phases, and are therefore – to varying extents – present at any given moment.

Phase I (Chapter 2) can be largely characterised as centring around the re-framing of a 'problem' of the public understanding of science by scientists and scientific institutions from roughly 1985 to 1990.

Phase II (Chapters 3-5) runs from roughly 1990 to 1998, in which counter-claims about the problem of public understanding of science are mobilised from a different professional group - social scientists - and focuses on the boundary work between these two groups as they contended for the legitimacy and authority to define and control the discourse of public understanding of science and the institutionalisation of PUS activity in both the academic and non-academic sectors.

Phase III (Chapters 6-8) covers the period from roughly 1998 to 2003 in which a very sharp change in the dominant rhetoric of the public understanding of science occurred, and it centres around the House of Lords Report published in 2000 and the reformulation of the 'problems' of PUS into a 'crisis' of Science and Society. The transition from science communication to public engagement is examined, as well as the ensuing boundary work as the many different professional groups involved in constructing and managing the science and public relationship compete for renewed legitimacy under new formulations of the problem.

Phase IV (Chapter 9) finally considers the recent phenomenon of the promotion of 'upstream engagement'. The language of upstream engagement begins to dominate both social scientific and political arenas during 2004-5. It considers the political interest in managing science's relationship with the public and the social scientific response to this.

At the end of each phase a conclusion will draw together my main points of analysis on that period. The whole history will be considered analytically in the final concluding chapter.

2 Re-inventing the Wheel?

Phase I

Concern over the relationship between the public and science rose to prominence again in the UK scientific community in the 1980s. The Conservative Government at this time had decided it had little need of scientific advisors and without the 'special status' that had been accorded to prominent scientists in policy-making, particularly those in the Royal Society, their influence declined.[114] The Conservative administration had turned away from academic science as a guiding influence on public spending, and believed instead that industry should know what they needed in the way of research and development, and should pay for it themselves. Members of the scientific community were faced with a lack of support from government, as well as declining public funds, falling numbers of students studying science, and a drain of talented scientists to the United States. The Royal Society sent regular delegations to meet with the Secretary for Science and Education, who were told that the Government could not afford to spend more on science.[115] The scientific community also perceived itself to be faced with a lack of support from the public who, scientists felt, at best showed indifference to science, and at worst were likely to question its uses and practitioners.[116] As John Ziman, a leading physicist, and Fellow of the Royal Society, later reflected there had been a concern within the science community that the efforts of those scientists over the past hundred years, who in his words 'had made it their business to explain in simple terms what the scientists were doing', had not had much

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[114] Yearly, S. (2000), 'What Does Science mean in the "Public Understanding of Science"', in Dierkes and Grote, eds, *Between Trust and Understanding: The Public, Science and Technology*, (London: Routledge).
[115] Bodmer, W. (2004), *Interview, 5 October 2004*, transcribed by Simon Lock.
[116] Survey results published around this time had also suggested a general public discontent with science. See, for example, Garfield, E. (1982), 'Is public confidence in science declining?' *Current contents*, 45.; Herman, R. and Kenward, M. (1985), 'What do people think of science?' *New Scientist*, 105.

effect.[117] This perceived lack of public understanding of science by some in the scientific community was baffling to them, as he recalled:

> It seemed a paradox that so many people should have so little understanding of the science that dominates their culture. They might find themselves quite unable to make sense of important practical questions affecting their lives – small questions, such as the goodness of eggs; large questions, such as the safety of nuclear power. In fearful ignorance, they might even take against science altogether, heedlessly throwing out the baby with the bath water. (p. 99)

In 1983 these concerns came to a head, and following a recommendation by a Royal Society report concerned with science education for 11-18 year olds in England and Wales,[118] the Royal Society set up an *ad hoc* working group to 'investigate ways in which the public understanding of science might be enhanced'.[119] Dr Walter Bodmer, Director of Research for the Imperial Cancer Research Fund and Fellow of the Royal Society, was appointed as chair. Bodmer already had experience in discussions concerned with the social aspects of science, having previously been asked to chair a committee on issues in biology, by John Maddox editor of *Nature*, called Biological Advances and Social Concerns.[120] He had also been Chairman of the BBC's Science Consultative Committee. Thus the choice of Bodmer set the focus of the Royal Society study firmly on issues of public communication from the outset. The working group's remit was to:

- Review the nature and extent of public understanding of science and technology in the UK and its adequacy for an advanced industrial democracy;
- Review the mechanisms for effecting the public understanding of science and technology and its role in society;
- Consider the constraints upon the processes of communication and how they might best be overcome.[121]

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[117] Ziman, J., *et al.* (1991), 'Public Understanding of Science', *Science, Technology and Human Values*, 16: 1, p. 99.
[118] The Royal Society (1982), *Science Education 11-18 in England and Wales The Report of a Study Group*, (London: The Royal Society).
[119] The Royal Society (1985), op. cit., p. 7.
[120] Bodmer, *Interview, 5 October 2004.*
[121] The Royal Society (1985), op. cit.

The working group, comprised mostly of other Fellows of the Royal Society (including, for instance, well-known science broadcaster Sir David Attenborough),[122] took both written and oral evidence from a variety of individuals and organisations professionally involved in science.[123] The working group also made visits to media organisations such as *The Guardian*, *New Scientist*, ITN Channel 4 News and the Science Museum, and drew on a range of reports and academic papers. Though the working group spent a couple of years examining the state of public understanding of science, Bodmer later admitted that much of the final report was his own work:

> "I think its very important that if you are chairman of a group like that and you want to have any impact. In the end you've got to write most of the report yourself ... in the end I just sat down over a weekend or two, and decided I've got to make it a bit more forthright, more punchy, and get the main points in the executive summary".[124]

The Bodmer report

The report unanimously concluded that 'public understanding of science was inadequate'.[125] As the working group admitted in the final report, entitled *The Public Understanding of Science*, from the outset, their terms of reference had raised three problems of definition, that of the 'the public', 'understanding' and 'science' (p. 15). 'Science' they defined broadly to include mathematics, technology, engineering and medicine, and anything which comprised the 'systematic investigation of the natural world and the practical application of knowledge derived from such investigation' (p. 7). Their definition of 'understanding' included a 'comprehension of the nature of scientific activity and enquiry', which they specified was not

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[122] The members of the group were Mr R. Artus, Sir David Attenborough, F.R.S., Professor R.J. Blin-Stoyle, F.R.S., Sir Kenneth Durham, Sir John Mason, Tres.R.S., Mr M.J. Savory, Lord Swan, F.R.S., Professor Dorothy Wedderburn, Dame Margaret Weston and Professor J.M. Ziman, F.R.S.
[123] The evidence taken was from a variety of sources including learned and professional bodies for science (e.g. The Royal Society of Chemistry, Institute of Physics, Institution of Chemical Engineers); Government bodies and individuals (e.g. Department of Education, Department of Trade and Industry, Parliamentary and Scientific Committee, Department for Agriculture Fisheries and Food, Chief Scientific Adviser, Cabinet Office); bodies concerned with the popularisation of science (e.g. BAAS, Royal Institution); media organisations (e.g. BBC, Association of British Science Writers, ITN Channel 4 News).
[124] Bodmer, *Interview, 5 October 2004*.
[125] The Royal Society (1985), op. cit., p. 15.

simply just knowledge of some of the facts. The level of understanding required by each individual, according to the report, would depend on the purpose it was needed for. 'The public' they took to mean 'mainly the predominantly non-scientific public'. They classified five different public groups according to their requirement for a greater public understanding of science. These five groups were (i) private individuals for their personal satisfaction and wellbeing; (ii) individual citizens for participation in civic responsibilities as members of a democratic society; (iii) people employed in skilled and semi-skilled occupations, the large majority of which had some scientific component; (iv) people employed in the middle ranks of management and in professional and trades union associations; and (v) people responsible for major decision-making in our society, particularly those in industry and government (p. 7).

The working group identified PUS as, 'an issue that is important not only, or even mainly, for the scientific community but also for the nation as a whole and for each individual in it' (p. 5), and cited many different reasons why the public understanding of science should matter. The main thrust of their argument was that greater public understanding of science would increase national prosperity; successful exploitation of innovation required a good understanding of science and technology. They also felt that there were now few public policy issues that did not contain a scientific or technological component, and cited examples such as the disposal of radioactive waste, the fluoridation of the water supply and the introduction of vaccines. Furthermore, they argued, that a better understanding by government and the higher levels of the Civil Service would lead to better policies for science. 'Science and technology should be major considerations in public policy' (p. 5), they stated, though how far this could happen would depend, according to the report, on how far the decision-makers and their advisers, and the public to whom they are ultimately responsible, understood the scientific and technological aspects of each issue, and more generally, the scope and limitations of the scientific method. A greater understanding of science was also identified as being important for the individual when making personal decisions about, for example, diet, smoking, or screening programmes. Furthermore, the working group felt that scientific knowledge would help the individual to resist pseudo-scientific information:

> An uninformed public is very vulnerable to misleading ideas on, for example, diet or alternative medicine. An enhanced ability to sift the plausible from the implausible should be one of the benefits from better public understanding of science. (p. 10)

To assist with this, the working group argued that understanding the nature of risks and uncertainty was essential. The group berated those sections of society that seemed to demand that an industrial procedure or a nuclear power plant be free from risk. A public lack of understanding and knowledge of scientific information was the central problem as far as the working group were concerned.

To achieve all of these goals depended 'on the willingness and the ability of the scientific community to explain these aspects publicly' (p. 10). Thus the main recommendations in the report were aimed at the scientific community, and its most direct and urgent message to scientists. This recommendation broke with the community's prevailing attitude to science popularisation (that it was not part of the professional duties of a scientist), asking scientists to 'learn to communicate with the public, be willing to do so, indeed consider it your duty to do so' (p. 6).

The Bodmer report (as the report was commonly referred to) raised the profile of the public understanding of science from something that had been a relatively private concern of a minority of individual scientists and academics, to something which all scientists should be concerned with. Science communication was something all scientists needed to learn how to do. That this command had come from the Royal Society was also significant, as Walter Bodmer later reflected:

> "... it was sort of the right time and people were thinking about these things, you know, nothing all that new in it. But I think that the fact that it was asked for by the Royal Society, was very important, and it reflected a willingness of the Society to get involved in interaction with the public, which frankly it had been not very good at doing before, and it might have been rather aloof in some ways."[126]

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[126] Bodmer, *Interview, 5 October 2004.*

The report's recommendations were not aimed solely at the scientific community, and many were more broadly targeted at other sectors of society. To assist in their communication with the public, scientists and politicians were also asked to learn how the media worked, and the constraints of using this avenue as a communications system. They were also told to learn how to explain science simply, without jargon and without being condescending.

Science education at school was hailed as being the 'ultimate basis for an adequate understanding of science', and the report therefore asked for a broadly based scientific education at school for all to the age of sixteen, and the resources to make this possible.[127] The working group's perception was that there was a lack of science within the media, as well as a tendency to discuss science in a superficial and sensational way, and the working group made several recommendations to the mass media. They felt that there was a strong case for the inclusion of more science in the media generally, both on television and in the press. The authors urged editors and senior journalists to take a much more positive attitude to the role of science in their newspapers, and that science, which often did not qualify as news, should be seen in feature articles more often. They also felt that mechanisms needed to be found to increase contact and collaboration between scientists and journalists. As science journalist, Jon Turney, reflected, this was an explicit attempt at managing members of another profession:

> I mean Bodmer being Bodmer ... he basically wanted to tell us journalists how to do their job, because that's his general attitude to other people doing less intellectually demanding things than him.[128]

British industry was also targeted in the report as an area which could help to promote the public understanding of science. Businesses were asked to inform the public, particularly in their own local communities, about the scientific and technological basis of their activities, as well as the benefits and problems that might arise as a result.

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[127] The Royal Society (1985), op. cit., p. 6.
[128] Turney, J. (2004), *Interview, 11 August 2004*, transcribed by Simon Lock.

In preparing the report the Bodmer working group had also examined recent survey work into public attitudes to science and technology. A Commission of the European Community public opinion survey had concluded in 1977 that 'in principle, there was no crisis of confidence in Europe with regard to science'.[129] A later Gallup poll for *New Scientist* in 1984, which examined public esteem for science and priorities for research, came to broadly similar conclusions.[130] Overall, the working group, having considered survey results from both the United States and Europe, concluded that the research demonstrated that the general public was interested in science and would like to know more about it. They also concluded that the public tended to over-estimate the ability of science to solve what were essentially social problems, though generally the public was guardedly supportive of science, while being wary of some of its applications. The report's authors, feeling that the public attitudes to science revealed by surveys might be a valuable guide to the improvement of understanding, and surveys would identify areas of concern and interest, as well as deficiencies in knowledge and understanding, recommended that the Economic and Social Research Council (ESRC) devise methods of 'assessing the effects of an improved understanding', and 'methods of monitoring attitudes to science' (p. 31).

Finally, the report asserted that the Parliamentary and Scientific Committee become more effective at raising scientific issues within parliament more frequently. The report also claimed that the Royal Society itself would make improving public understanding of science one of its major activities, and this, certainly at that time, was the most implementable of its recommendations.

The impact of the Bodmer report I – practical efforts

There were two main outcomes from the Bodmer report recommendations. The first was the formation of a committee. During the work of the Bodmer working group the British Association for the Advancement of Science had written to Bodmer to ask for his views on

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[129] Commission of the European Communities (1977), *Science and European public opinion*, (Brussels: CEC).
[130] Herman and Kenward (1985), op. cit.

their proposal to set up their own committee on the public understanding of science. Bodmer's response was to suggest that the British Association do nothing until his working group had reported.[131] Subsequently, one of the Bodmer report's recommendations was that such a committee should be formed, but under the Royal Society. As Peter Briggs, Chief Executive of the British Association for the Advancement of Science from 1990 to 2002, recalled, in many ways COPUS, the committee that was later formed, presented a threat to the organisation and had it not been in a relatively weak position in the mid-1980s, the outcome of the Bodmer report may, he felt, have been different:

> ... it [the BAAS] could hardly refuse to be part of COPUS; neither could it sit back and see COPUS take over its role or allow COPUS to become simply a committee of the Royal Society. So the BA's strategy – in reality the way it undertook its role within COPUS rather than a thought-through approach – was to play as active a part as possible and to be the body that took the lead on those COPUS activities that most closely overlapped with what it saw its own role to be. It was an approach that worked well for ten or more years.[132]

The resulting committee was established in 1986 as a joint committee of the Royal Society, the Royal Institution and the British Association for the Advancement of Science, with the title COPUS, which stood for the Committee on the Public Understanding of Science. The reasoning behind the plural membership of the Committee was that the PUS agenda overlapped with the agenda of all three institutions. However, as Peter Briggs reflected, the real reason was slightly more personal:

> It just so happened that the incoming President of the Royal Society at the end of 1985 was George Porter, who was also Director of the Royal Institution and that year's President of the BAAS. Because of this unique coincidence, George Porter became the founding Chair of COPUS rather than Walter Bodmer, who may have been the obvious choice. (p. 24)

George Porter, a Nobel Prize winning chemist, was an enthusiastic proponent of the public understanding of science agenda, and things therefore happened quickly within the Royal

[131] Briggs, P. (2003), *The BA at the end of the 20th Century: A personal account of 22 years from 1980 to 2002*, (The British Association for the Advancement of Science), p. 23.
[132] ibid., p. 24.

Society with him at the helm. Porter had, according to neurobiologist Colin Blakemore, stated that 1986 had 'been a year when the morale of the scientific community has fallen to its lowest point this century'.[133] So the work of COPUS could be viewed as a means of boosting the morale of scientists. This low morale was also reflected in this year by the establishment of a lobby group for science, called Save British Science. The group was created following the publication of an advert in *The Times*, by a concerned group of over 1500 scientists and engineers, who had raised the money to pay for the advert among themselves. The advert, under the headline 'Save British Science' had cautioned, 'whole areas of research are in jeopardy ... There is no excuse: rescue requires a rise in expenditure...We can and must afford basic research'.[134] Subsequently, Save British Science set itself up as a lobby group and campaigned for greater funding for science in the UK. The morale of the scientific community thus appeared to be formulated in terms of both public and financial support, and a scientifically educated society was key to allowing science to continue to operate.

COPUS was, however, less concerned with scientific funding. It had been established with the general aim of raising the profile and number of public understanding of science activities in the UK, particularly among scientists, and to take forward many of the direct recommendations from the Bodmer report. The Committee was to be representative of the scientific community so, in addition to the two members nominated by each of the parent bodies, other members were drawn from the media, science museums, and the Research Councils. Early members included historian of biology John Durant; Michael Kenward, editor of *New Scientist*; and Sir David Attenborough, the popular science broadcaster. The extra administrative work that COPUS created resulted in the British Association for the Advancement of Science and the Royal Society hiring new staff, though the Committee itself was administered at the Royal Society. So for the first time jobs specifically concerned with the public understanding of science were created.

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[133] Blakemore, C. (1989), 'Who Cares about Science?' *Presidential Address (General Section) British Association for the Advancement of Science*, Sheffield, 12 September 1989.
[134] Save British Science, 'Save British Science', *The Times*, 13 January 1986.

The first activity of COPUS was to set up a grants scheme to fund those scientists who wished to stage science communication activities. Due to the lack of any independent legal status on the part of the Committee, it was necessary to establish the scheme as a Royal Society scheme, with an advisory committee appointed by COPUS. The other main venture established by COPUS in its first year was a Media Fellowship scheme, to be run by the British Association for the Advancement of Science. The Fellowship was to provide scientists with the opportunity to work alongside a science journalist in radio, television, newspapers or magazines for up to two months. The idea was to try to bridge the perceived gap between science and the media - 'helping scientists better to understand how the media worked, the pressures journalists experienced and what constituted news'.[135] It was hoped by the Committee that the learning experience would be mutual and that journalists would also improve their understanding of science. Some members of COPUS hoped that by building this alliance with the media they would be able to change the way in which it reported science and suggested that Fellowships should also be provided for journalists to experience science, by spending time in a university or other research institution. This ambition however, was never realised, due largely to the unfeasibility of journalists being able to take the time off. The COPUS committee hoped that it would be able not only to improve the way the media reported science, but also to increase the amount of science in the media.[136] Here we can see that COPUS had set themselves up in opposition to the media, and furthermore wished to colonise this aspect of the public sphere and improve it to their advantage. The 'common sense'[137] belief that the media exerted a powerful, and often, in their perception, dangerous, influence on the public made it a prime target of COPUS, and many of the discussions at early committee meetings were preoccupied with ways of exerting influence over newspaper editors or broadcasting outlets.[138] The public were also again conceptualised as being a passive 'mass' audience for the media, easily swayed by whatever messages were transmitted.

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[135] Briggs (2003), op. cit., p. 25.
[136] British Association for the Advancement of Science (1987), *Report for COPUS, Media Fellowships 1987*, (London: The Royal Society).
[137] Sonia Livingstone has suggested that this conception of media effect is commonplace, though not very easy to back up with evidence. See Livingstone, S. (1996), 'On the continuing problem of media effects', in Curran and Gurevitch, eds, *Mass Media and Society*, (London: Arnold).
[138] COPUS minutes (1986), *PUS/9(86)*, (London: The Royal Society).

The final COPUS initiative, aimed at encouraging scientists to get involved with the public understanding of science, was the establishment of the Faraday Award. This was a medal awarded to a scientist or engineer deemed by COPUS to have contributed significantly to the public understanding of science. The first recipient of the award was Charles Taylor, Professor of Physics at the University of Cardiff, who had given popular lectures on physical sciences to the general public for years. Taylor was awarded one thousand pounds, and was expected, upon receiving the award, to give a lecture at the Royal Society.

The impact of the Bodmer report II – research

The second recommendation of the Bodmer report was the establishment, by the Economic and Social Research Council, of a research programme on Public Understanding of Science. In 1986 the Science Policy Support Group (SPSG) was set up by the ESRC as a non-profit company, and registered as a charity, to run a grant selection process and to maintain a network of academics working on the PUS programme.[139] The Chair of the SPSG was Ziman who, as well as having been a member of the Bodmer Committee, was also well-known for his writings on the social aspects of science, and his affinity with the social studies of science. Ziman's book *Teaching and Learning about Science and Society* (1980) had covered many of the basic concepts from the academic discipline of science and technology studies. Though he had criticised the discipline for what he described as a 'negative anti-scientific prejudice', he nonetheless now found himself in charge of commissioning work from many academics within this field.[140]

According to Durant, there had been a tension between Ziman and Bodmer on the working group:

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[139] SPSG later took on the wider role of promoting the application of science, technology and innovation studies to policy, practice and management in Europe.

[140] Ziman, J. (1980), *Teaching and Learning about Science and Society*, (Cambridge: Cambridge University Press), p. 55.

> "... there was a huge, I'm afraid, rather petty rivalry between Walter Bodmer and John Ziman. I think John would have preferred to be the chair of the Committee and certainly believed that he knew better than Walter Bodmer what the real issues were. It's one of the features you'll probably have discovered in public understanding: everybody thinks they know what the real issues are."[141]

Now, however, Ziman, for the first time since the publication of the Bodmer report, had a platform from which to not only discuss PUS in the manner which he felt appropriate, but also to commission further research into it. There were few academics researching the public dimensions of science and technology at this point in the UK, and the relatively new field of STS had, since the 1970s, largely been focused on scientific knowledge, the inner workings of science, and what happened within the laboratory.[142] The Bodmer report had not taken any social scientific work into account when drawing up the report other than the survey data, which, though surprising given Ziman's presence on the working group, may have reflected a prejudice from within the Royal Society more generally against the social sciences.[143] It may also have simply reflected that some scientists within scientific institutions were certain that PUS was a problem for scientists to solve themselves, and thus it was constructed as a problem of how to communicate science to the public in greater amounts and more efficiently. This did not mean, however, that there had been no interaction between the scientific and social scientific communities. During the early-1980s John Durant, who had been teaching biology in the Continuing Education Department at Oxford University and physicist Geoffrey Thomas, who was Head of the Department for External Studies had run two one-week Science Studies seminars per year. Both Bodmer and Ziman had attended these seminars at different times, to report on the work of the Royal Society working group. Durant, reflecting later on these Oxford meetings, recalls seeing the interest the Royal Society was taking as an opportunity:

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[141] Durant, J. (2004), *Interview, 28 June 2004*, transcribed by Simon Lock.
[142] See for example Latour and Woolgar (1979), op. cit.; Collins (1985), op. cit.
[143] Social scientists were not eligible to become Fellows of the Royal Society. Many years later when I was working at the Society in 2001 there was still a debate between Fellows as to whether statisticians could be accepted as members. All other social scientists were not eligible.

> "... from my point of view it was just great that in the early '80s, as it were, the little group of us who were passionate about science communication, about public understanding of science, suddenly began to find that there were receptive ears for this in high places in the science community. I saw what they were doing as just a great opportunity to get more attention paid, more funding for this thing."[144]

Also implicit in this quote, and the one below, however, is the idea that now the Royal Society had taken an interest in this area, it validated it as a 'real thing', granting some legitimacy on the social scientists. Perhaps highlighting social scientists perception of a lack of their own cognitive authority in society at the time:

> "... what we saw was great, the Royal Society's coming on board, the Royal Society's beginning to realise that this thing that we have known is important and interesting for some time, for years as it were, that it really is interesting and important. And there was a sense I think on our part, yes, genuinely, that the science community particularly at senior level, was *beginning to join the party.*"[145] [my emphasis]

The ESRC research programme on public understanding of science was tasked to commission research which would inform the scientific institutions' agenda of increasing the public understanding of science.[146] The issue was broken down into three basic questions: What do people say about science in general? How do people use science? How is scientific knowledge supplied and received?[147] SPSG was told to run the research programme as initiative funding, which meant that they had to solicit and encourage proposals to fit into the predetermined topic of public understanding of science. Research funding was highly competitive in the social sciences, and this funding opportunity attracted researchers from anthropology, education, history, philosophy, politics, psychology and sociology, as well as multidisciplinary subjects such as media studies and science and technology studies. Durant characterises the move by all these disciplines to 'cash in' on PUS as a rather cynical reformulating of existing work to fit in with the current priorities within the Research Councils:

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[144] Durant, *Interview, 28 June 2004.*
[145] ibid.
[146] Healey, P. (1986), *Public Understanding of Science Award,* (ESRC/SPSG).
[147] Ziman, J. (1990), 'Public Understanding of Science', paper presented at the conference *Policies and Publics for Science and Technology,* Science Museum, London, 7-11 April 1990.

> "... they could see that this was kind of the coming thing and there was money to be had, and what people ... what irritated me was not all of that so much as the fact that people would try therefore to re-present their own existing research agenda as somehow being relevant to this new thing."[148]

His construction of social scientists' motivations are an indication of the boundary work amongst social scientists. Each saw this thing called the public understanding of science differently, but each as a domain relevant to their own expertise. To sociologist Alan Irwin, of Brunel University, it did appear that the call for proposals was an opportunity to get more money for research they were already doing:

> ...so we, opportunistically – I mean, I really don't mind saying - but we'd been developing this research and it fitted with this [PUS] ... we weren't thinking public understanding of science I suspect.[149]

Thus with many different motives leading them, some empirical, others contingent on the current climate for funding, five projects were funded in the first phase of research, which SPSG said reflected a 'new approach to research and its efforts to devise effective 'bottom-up' measure of the public understanding of science'.[150] A large proportion of the money went to Durant and Thomas, who were to conduct a national scientific literacy survey assessing what knowledge about science the public had. As Durant later explained, their survey was proposed because they had found people in the United States had been doing similar work surveying science literacy, through the National Science Foundation since the early-1970s.[151] The scientific literacy concept, which was already prevalent in the United States, had many similarities to the concept of PUS.[152] Knowledge of science had been

[148] Durant, *Interview, 28 June 2004.*
[149] Irwin, A. (2004), *Interview, 29 June 2004*, transcribed by Simon Lock.
[150] Healey (1986), op.cit.
[151] Durant, *Interview, 28 June 2004.*
[152] Jon Miller had defined his concept of scientific literacy in 1983, which included four elements: (a) knowledge of the basic facts of science. (b) an understanding of scientific methods such as probability reasoning and experimental design, (c) an appreciation of the positive outcomes of science and technology, and (d) the rejection of superstitious beliefs in astrology or numerology. Miller had constructed indicators for scientific literacy which had become the basis of bi-annual

measured by quiz-like items as well as questions interrogating public attitudes to science, and these same aspects of the North American surveys were used as the basis of the UK survey research. Other bids that were awarded money focused on researching science in specific social contexts, rather than at a national level, and had come from social researchers such as Brian Wynne from Lancaster University, Steven Yearley from York and Hilary Rose from the Open University. All were social scientists from a variety of disciplines, and they shared a common interest in environmental and medical hazards and risks and had been involved in discussions over the public and political dimensions of science in the 1970s.

It became apparent to the researchers who had won research grants that there was a split between the different approaches to analysing the subject within the research programme. According to Durant the first programme "spent a lot of time struggling with that difference".[153] Put crudely, the difference was between qualitative and quantitative methodologies; however, this split was more than simply an argument about which methodological tools to employ. Each side reflected different tacit models or ideologies concerning the nature of the public, its understanding of scientific knowledge, and the role of science in society. Researchers from the programme recall the often difficult meetings held between all of the researchers on the PUS programme. As Durant, on the team employing quantitative methods, again recalls:

> "... here I was looking at people who seemed to have almost nothing in common. There were one or two others but not many in that research programme who ... would've similarly acknowledged the validity of what we were doing. But there were others who would regard it all with the gravest suspicions, and actually it was something I had to work through with Brian Wynne. Brian was definitely on one side of this, very dubious about whether there was any value in surveys at all, whereas I was arguing that there could be some ..."[154]

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science indicator surveys for the United States National Science Foundation. Some boundary work is obvious, highlighting that an wider examination of these debates, for example, in the United States, would be fruitful.

[153] Durant, *Interview, 28 June 2004.*

[154] ibid.

Another of the quantitative researchers, Martin Bauer at the Science Museum, also recalls:

> "There was certainly an element of dogmatism around which created a conflict ... I remember observing that many of the members of this research programme were on non-speaking terms. So I realised that there are these kind of two teams, what I came to realise was that this conflict was about something very strange which was whether you used numbers or not ... qualitative or whether you use a survey."[155]

What is striking about the recollections of this period is that, at the time, each side of the methodological divide represents the other as being given too much priority, and thus resources and legitimacy, within the programme. Bauer accuses the qualitative researchers as being 'dogmatic', a trait which was not considered to be good scientific practice. Durant meanwhile now attempts to distance himself from the conflict. The qualitative researchers, as Alan Irwin reflects, felt that the quantitative survey group had secured most of the money and most of the subsequent publicity:

> "... we went along to the first meeting, which probably was in Oxford ... and then I started to tune into what had happened. And, of course, we could see that it seemed like the bulk of the money was tied up in this large-scale quantitative study which of course has had so much publicity since ... that would have been the view of the group at the time, it was the big number crunchers who dominated the money. I don't know if that was even true, but that was how it seemed. And we're now doing the thing which isn't the big number cruncher."[156]

Irwin's use of the phrase 'number crunchers' minimises their understanding of society and the public. In the quote below he again recalls the feeling by the qualitative researchers that the programme was conducting the wrong sort of research. Branding the quantitative research as a 'pub quiz' again can be seen as an attempt to downgrade the status of the other social research:

[155] Bauer, M. (2004), *Interview, 26 May 2004*, transcribed by Simon Lock.
[156] Irwin *Interview, 29 June 2004.*

> "I remember at the time there was a lot of moaning and groaning from the social scientists, I really remember that. 'Well, that's just typical. The Royal Society model on how to do research on public understanding of science. It's a big, quantitative study'."[157]

> "So that issue of how to relate large-scale quantitative surveys, which I quickly christened the pub quiz approach of public understanding of science. The pub quiz approach being really rude about it. So we'd sit there in the pub and go, 'this is terrible and the qualitative stuff is being missed out and it's missing out the cultural angle'."

Dissecting PUS

Despite the split in approaches and the difficult joint meetings, the researchers spent the next few years conducting their research, while the scientific institutions continued with their practical efforts to influence the public understanding of science. Calls for a greater understanding of science tended, in these initial years, to come only from leading figures within the scientific community, such as Walter Bodmer and Colin Blakemore. Thus PUS had apparently not permeated beyond those directly involved in COPUS or related institutions. This also meant that their PUS agenda went largely unexamined. To Bodmer this lack of questioning simply seemed to confirm the approach was valid, as he made clear in his J.D. Bernal Lecture in the year following his report:

> I have sometimes asked the question in public 'Does anyone have an argument against the public understanding of science?' and never received a reply. It is really very hard to see how one can argue against improving the public understanding of science. Can it do any damage? Should one keep the public ignorant?[158]

To him it was therefore self-apparent that 'the more that people knew about science, the more they realise its importance' (p. 8)

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[157] ibid.
[158] Bodmer, W. (1986). 'The Public Understanding of Science'. *The Seventeenth J.D. Bernal Lecture delivered at Birkbeck College, London.* p. 6.

In 1987, two years on from the publication of the Bodmer report, that many scientific organisations were encouraging a greater public understanding of science prompted a greater academic interest in the PUS phenomenon. A paper by Thomas and Durant asking "Why should we Promote the Public Understanding of Science?" was published in the first issue of *Scientific Literacy Papers* with Michael Shortland as editor.[159] It was produced by the Scientific Literacy group, a research initiative funded by the Department of Education and Science and based in the University of Oxford. The journal was a vehicle by which the group could introduce the scientific literacy term to an already label-laden debate surrounding 'science and the public', 'the public understanding of science' or 'the popularisation of science'. As the editorial made clear, they were also starting to question the claims of scientists as to what the problem of PUS was; arguing that their formulation of scientific literacy was superior to others' efforts to increase scientific understanding, as the quote below exemplifies:

> Scientific literacy does not rely on a model of understanding which prescribes what members of the public *should* know; on the contrary, it reflects an attempt to grasp what kind(s) of understanding(s) of scientific issues members of the public may want or need. We do not begin with the assumption that the public necessarily requires more science in its diet, that scientists are the ones to provide it, or that the major problem is one of communication or popularisation.[160]

The Thomas and Durant paper was based on a review of the small amount of literature that had been produced on the public understanding of science, to assess why exactly it was regarded as a 'good thing'. From their review they identified nine different, though overlapping, arguments for the promotion of PUS ordered according to the benefits which were ascribed to each one. Their paper, therefore, identified a mix of motivations behind the activity called the public understanding of science. As Thomas and Durant acknowledged, different authors meant different things by the terms 'public', 'understanding' and 'science'.[161] The various justifications identified by the authors are summarised below:

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[159] Thomas, G. and Durant, J. (1987), 'Why Should We Promote the Public Understanding of Science?' *Scientific Literacy Papers*, Summer 1987.
[160] Shortland, M. (1987), 'Preface', *Scientific Literacy Papers*, Summer 1987.
[161] Thomas and Durant (1987), op. cit. p. 2.

Benefits to Science

Aside from the need to recruit new scientists into the community, the argument that support for science depended upon some level of public understanding, or at least awareness of the processes and facts of science, was identified as a common refrain from scientists and scientific institutions. The science writer Isaac Asimov, they identified, had even gone as far as to claim that 'Without an informed public, scientists will not only be no longer supported financially, they will be actively persecuted'.[162] The paper also pointed to the work of Harry Collins, a sociologist of science who had put forward a slightly different sort of argument. He had argued that the public needed to understand that scientists, in their role as experts, could only offer 'the best advice that there is to be had', and to expect more than this would risk 'widespread disillusion with science'.[163]

Benefits to National Economies

As Thomas and Durant pointed out, this was one of the main arguments which had been put forward by the Royal Society in 1985. It derived from the idea that a public with a greater understanding of science would supply scientifically trained personnel into national research and development programmes, which in turn would generate new goods and services, which would then create a healthy economy both nationally and internationally.

Benefits to National Power and Influence

Greater public understanding of science, the authors identified, was claimed to bring wider political benefits, and such benefits had been widely pronounced in debates about scientific education in the United States in the post-Sputnik years. Scientific education had been perceived to be a national necessity if the United States was to maintain its position of intellectual and ideological leadership in the world. The country needed a greater number of

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[162] Asimov, I (1984), cited in, Thomas and Durant (1987), op. cit., p. 3.
[163] Collins (1985), op. cit.

scientists and engineers, not only to sustain its expanding civil and military industries, but also 'to help spread American influence to the rest of the world'.[164]

Benefits to Individuals

This argument again, they pointed out, had been used by the Royal Society in 1985. It had claimed that an improved understanding of science and technology was essential to everybody living in a scientifically and technologically sophisticated society. More knowledgeable citizens would be able to make better decisions about diet, health-care and personal safety, as well as make better consumer choices. Individuals with a greater understanding of science would also be more employable, and better able to take full advantage of technical developments in their place of work.

Benefits to Democratic Government

This argument claimed that in a democratic society citizens possessed the right to influence decisions taken on any matters in which they had an interest. So much of science was publicly funded, and the results had an impact on the whole of society. If science was to be influenced by the people, the people had to know something about science. Thus a greater public understanding of science could promote, not only more democratic decision-making, but also better decision-making. The authors again highlighted that the Royal Society had made this argument in 1985.

Benefits to Society as a Whole

Alongside benefits to the individual this argument, the authors detailed, suggested that, for the health of a nation, science should not become alienated from the rest of society, and should rather be fully integrated into society.

[164] Thomas and Durant (1987), op. cit., p. 4.

Intellectual Benefits

Thomas and Durant noted that this argument, about intellectual benefits, echoed C. P. Snow's in the 1950s, or Matthew Arnold's in the 1890s, who had asserted that an educated and cultured mind should be one which understood and appreciated science and technology. Thus the promotion of PUS became part and parcel of the promotion of a more general intellectual culture.

Aesthetic Benefits

This argument articulated that PUS should be promoted using the same sorts of arguments for the preservation of rare books, the conservation of beautiful buildings and the promotion of the arts. Science helped us to reveal the beauty and order of the natural world and thus should be central to a truly cultivated mind.

Moral Benefits

This argument in recent years, had, according to Thomas and Durant, become unfashionable, however, they noted that earlier arguments, such as those of Herbert Spencer, had rested upon the idea that science provided a superior ethical system by which society could be ordered.

As Thomas and Durant pointed out, not all of these arguments would necessarily be used by all proponents of PUS. Social, political, or professional interests were likely to dictate which of them an individual, or an institution, would favour. The paper did problematise the idea that public understanding of science was one coherent goal or entity, and instead argued that beneath the tacit consensus that PUS was a good thing lay 'profound differences of orientation, of outlook, and of aim' (p. 9). So the label of PUS was deceptively simple. Of particular note here was their examination of the argument for PUS put forward by many scientists, which they argued rested on the assumption that a greater public understanding of science was something readily identifiable:

> By understanding do we mean a grasp of the aims of science, the norms of science, the processes of science, the products of science, or a combination of some or all of these? And by regard, do we mean approval of the practice of science, the principles of science, the expert judgements of science, the research priorities of science, or again a combination of some or all of these? (pp. 9-10)

This argument raised a greater problem to Thomas and Durant, however, as it appeared to rest on the notion that an increase in understanding automatically meant an increase in approval. The idea of understanding as the 'manipulation of consent' was unacceptable to both authors, who felt that it was unreasonable to assume that science would, or could, never be disapproved of by those individuals with an informed understanding of it. If this was not the case then, as their paper pointed out, the 'relationship between understanding and approval is not necessary, but rather contingent upon, the nature of the particular understandings and the particular contexts in which they occur' (p. 10). Having problematised this particular argument of public understanding of science, the authors went on to argue that the promotion of scientific literacy, their own preferred term, would instead be a better goal. Promoting their brand of public understanding of science, they advocated an attempt to 'enhance people's abilities to live with, and benefit from [science]'. This would, according to the authors, also avoid the public being 'mystified or oppressed by, the scientific and technical expertise that are such fundamental aspects of our society' (p. 12).

Another early academic exploration of public understanding of science is provided by Harry Collins, then Reader in Science Studies and Director of the Science Studies Centre at the University of Bath, and published in the journal *Social Studies of Science* in 1987.[165] Collins's main work was in the sociology of scientific knowledge (SSK), and his paper outlined his analysis of the way that the representation of science as certain knowledge on television impacted on the public understanding of science. He started his paper by also problematising the phrase 'public understanding of science' arguing that it contained important ambiguities, which he went on to define:

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[165] Collins, H. (1987), 'Certainty and the Public Understanding of Science: Science on Television', *Social Studies of Science*, 17: 4.

> ... the phrase itself does not make clear whether the understanding is to be of the *content* of scientific knowledge or the *nature* of science as a cultural enterprise. These two types of understanding are quite different. (p. 690)

Collins argued that understanding how scientific knowledge was generated was very different from understanding the facts of science, and even a scientist may have little understanding of the former. He agreed in principle to the argument put forward by the Bodmer working group, that providing more knowledge of the agreed facts to the public was a good thing, however, he disagreed with some of the rationale that the Bodmer group had outlined:

> Now it is true that citizens who understood more about science would be in a better position to make decisions where an issue included matters of science, but it is a mistake to think that the crucial issue is more practical understanding. More knowledge of the factual background to disputes, or more familiarity with the findings of science, would not help. (p. 690)

Collins argued that the type of scientific issues about which the public were asked to make decisions, such as diet, whether to smoke or not, and alternative medicines, were often controversial, and often the experts themselves could not agree. What the citizen needed in this situation, he argued, was what he called, a 'reflective' understanding of science. This was an understanding of science as a cultural enterprise and not an understanding of scientific facts. However, in cases of ordinary science, he argued, citizens only needed 'knowledge of the scientific facts, for no decisions concerning competing claims are called for' (p. 690). It was in cases of more controversial science, Collins asserted, that scientists were more likely to base their decisions on everyday criteria such as who seemed trustworthy, whom they knew personally, who worked at a prestigious institution. He suggested that here scientists might benefit from being a little bit more 'streetwise' and drawing on public knowledges, rather than calling for an increased understanding of science by the public. Calling once more for a more reflective understanding of the way science generates certainty, Collins attacked the assertion in the Bodmer report that a greater understanding of science would assist the public in sifting between scientific and unscientific claims. What is scientific, he argued, was a philosophical question that remained to be settled amongst philosophers, and providing the public with a large amount of factual knowledge would not assist them in solving the demarcation problem.

Quantifying PUS

In July 1989 the results of the ESRC funded Oxford survey into public attitudes towards, and understanding of, science were published in the leading scientific journal *Nature*.[166] Durant and Thomas (with the addition of a social scientist who specialised in survey research, Geoffrey Evans) rehearsed the arguments they had laid out previously, as to why anyone should care about the public understanding of science:

> First, science is arguably the greatest achievement of our culture, and people deserve to know it; second, science affects everyone's lives, and people need to know about it; third, many public policy decisions involve science, and these can be only genuinely democratic if they arise out of informed public debate; and fourth, science is publicly supported, and such support is (or at least ought to be) based on at least a minimal level of public knowledge. (p. 11)

The authors went on to claim that, 'common sense suggests that the scientific community would be unwise to presume upon the continued backing of a public that knows little of what they do' (p. 11). Their appeal to common sense appeared to contradict the 1987 paper where Thomas and Durant had felt it was unacceptable of those proponents of PUS to assume that understanding was necessarily linked to public support. Their own stance in this paper, however, bore more of a resemblance to the Royal Society's than their previous paper had, suggesting that they had perhaps presented their own research slightly differently now that they were being published in the world's leading scientific journal, to align themselves with their audience. The survey had, however, appeared to show that a higher level of education was linked to a more positive attitude towards science. The *Nature* paper compared the data from the Oxford survey with data from a similar survey carried out in the United States by Jon Miller and colleagues. This was the first time this type of survey had

[166] Durant, J., *et al.* (1989), 'The public understanding of science', *Nature*, 340.

been compared internationally and consisted of over two thousand randomly sampled participants in each country interviewed in the previous summer. The main findings of the surveys, according to the paper, were that levels of British and American interest in science, technology and medicine were relatively high, but levels of knowledge in each area were far lower. The authors were surprised at the high levels of interest expressed towards science, particularly as it was rated as more interesting than sport or politics, but the levels of understanding found were less welcomed and, as the authors stated, 'if modern science is our greatest cultural achievement, then it is one of which most members of our culture are very largely ignorant' (p. 13).

This so called 'ignorance culture' of the British public received extensive press coverage, which expressed a mixture of surprise and horror at the low levels of public understanding of science.[167] The section of the survey that received the most publicity, however, was the knowledge-based quiz, which had been a new section of the survey designed to determine the level of scientific literacy of the respondents, rather than simply their attitudes to science. The quiz asked respondents to decide whether a statement of a scientific fact was true or false, and they scored a point for each correct answer; 'correct' being determined by what the researchers considered to be the currently accepted scientific answer. Examples of questions used, or statements the participants must agree or disagree with included: 'Does the Earth go around the sun or does the sun go around the earth?'; 'The centre of the earth is very hot'; 'Electrons are smaller than atoms'; and 'Antibiotics kill viruses as well as bacteria'. The results were represented as worrying to both the researchers and the commentators, with 34% of Britons and 64% of Americans answering that the Earth went around the Sun, or, as every press article reported, 'two-thirds of Britons did not know that the Earth went around the Sun'.[168] The second dimension of scientific understanding measured was concerned with the process of science, which was assessed in the form of the open-ended question, 'What does it mean to study something scientifically?'. The results would, the authors argued, make 'gloomy reading' for anyone who took the conventional, quasi-Popperian model of scientific

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[167] Quote taken from Conner, S. 'Ignorance Culture: Science and the British', *The Independent*, 28 January 1989.
[168] Durant, *et al.* (1989), op. cit.

method seriously, as less than 14% of respondents made any mention of either theory construction, hypothesis testing, or the experimental method.

The other, more traditional aspect of the survey required respondents to express a positive or negative attitude (expressed on a Likert Scale) towards statements such as: 'Science and technology are making our lives healthier, easier and more comfortable'; 'The benefits of science are greater than any harmful effects'; and 'We depend too much on science and not enough on faith'. These results, as already stated, were more positive, and used to claim that interest in science and technology was high, though this appeared to suggest to them that many people perceived a gap between themselves and the world of science, about which they wanted to know more. Thus the paper concluded that the results did provide a case for optimism about the scope for improving the public understanding of science.

Following the publication of the survey work, John Durant was given a visiting chair in the history of science and public understanding of science at the Science Museum and Imperial College London. This appointment was a further sign that public understanding of science was both moving up the agenda within certain institutions, and becoming more professionalised, with resources and 'experts'. Similarly, though its publication was perhaps not directly responsible, the Bodmer report's recommendation - that science be taught alongside more liberal arts subjects until later in the curriculum - was realised with the introduction of the Education Reform Act in 1989, which introduced a national curriculum in England and Wales, with science as a core subject that all pupils had to study from 5-16. The inclusion of science into the curriculum was justified by the National Curriculum Council, by arguing that:

> Appreciating the contribution science makes to society will encourage pupils to develop a sense of their responsibilities as members of society and of the contributions they can make to it.[169]

[169] National Curriculum Council (1989), *Science: Non-Statutory Guidance*, (London: NCC), p. A5.

Within the National Curriculum an 'understanding of science' was given the narrow definition of 'the ability to use theories and models based on scientific ideas' when it related to concepts, and as 'the ability to bring together skills and concepts into a strategy to produce valid and reliable data for solving a problem or answering a question', when it related to procedures (p. 78). In this document we can identify the Government using the term 'public understanding of science' as a rhetorical resource to legitimate its own activities, thus simultaneously forging and instantiating alliances between itself and those scientific institutions promoting the same arguments.

Throughout the second half of the 1980s, COPUS, and the British Association for the Advancement of Science, continued to provide the main arenas in which scientists carried out PUS related activities. Following a review of its activities in 1986, the British Association reformulated its mission statement to place public understanding of science at the centre of the institution's activities.[170] In the process, they also decided to change their name to simply the 'British Association', or 'BA' for short, with the strap-line of 'Promoting Science and Technology'. Their Annual Meetings continued also to be a space at which scientists would discuss the role of science in society, and the discussion of the public understanding of science became a regular topic. Colin Blakemore, gave a Presidential address at a Section meeting in Sheffield in 1989 entitled 'Who Cares about Science?', in which he spent a lot of time discussing the problems of science in the media, and why the public was "painfully ill-informed" about science and technology.[171] The media, though a source of concern to COPUS, had given some publicity to the public understanding activities in recent months, discussing the low score on the scientific literacy section of the national survey. Blakemore saw this, however, as a confirmation of the PUS mission:

> "Professor John Durant will amuse but shock you with an account of the now well-publicised results of recent surveys of the public understanding of science ... the one that disturbed me most was the finding that nearly half of Britons believe that nuclear power stations cause acid rain. How can people be so staggeringly ignorant on such a topic of vital social and political importance? That result alone should warn us that something is seriously wrong in the mechanisms of communication between science and the public." (p. 10)

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[170] Briggs (2003), op. cit., p. 30.
[171] Blakemore (1989), op. cit. p. 12.

Science or scientists were not to blame, according to Blakemore, the problem of public understanding of science was poor communication. The quantitative research proved a useful rhetorical resource with which to rally the scientific community to communicate more. Blakemore used this data alongside that from earlier surveys, which had shown that 90 per cent of the population said that they thought that everybody ought to study some science up to the age of at least 16, and that only 19 per cent of people in the UK had 'a great deal of confidence' in the scientific community. This, to Blakemore, seemed to make the rationale for increasing the public understanding of science self-evident. His speech also provided an insight into just why the PUS mission was so important to the scientific community:

> "These apparently contradictory results are just one example of an ambivalence of attitude towards science that is deeply rooted in public opinion and which may be the basis of present government policy. The non-scientific public thinks that science is important, but they have little respect for it. And they seem to understand precious little about how it works." (p. 4)

Just like his counterparts at the British Association in the early-nineteenth century, Blakemore's concern was that public misunderstanding or apathy towards science would also mean bad science policy, and a lack of funding. Thus he was arguing that the way to influence government science policy was to enrol the support of the public. This time, however, it was not just a passive appreciation of science that was required: the modern world demanded that both the public and government needed "more than just the scientific facts: they need to know how to assess risk and how to judge probabilities" (p. 4). Blakemore blamed public apathy towards science as a product of "public ignorance" and of "public distrust of these things that they do not understand" (p. 9). However, the scientific community was also to blame for not taking up the public understanding of science mission quickly enough:

> "Maybe the main problem for science ... is that the public just doesn't understand because scientists either don't bother to explain themselves or aren't very good at it ... scientists have grown to think that their only responsibility is to convince their peers that their work is worth supporting. We have distanced ourselves from the public and the government: re-establishing mutual confidence will not be easy and will require scientists to understand that they have a responsibility to justify themselves and their work to ordinary people." (p. 9)

In the process of arguing for science to be treated as a distinct community, thus attempting to consolidate the boundary-lines between science, the public and government, Blakemore was also arguing that these boundaries be permeable, yet only in the direction of science to the others. Also of interest here is Blakemore's formulation of public ignorance as leading to mistrust, again showing that the boundary work scientists were engaging in through their discourse of PUS was not just about educating the public but to change their attitudes and create a more favourable image of science.

The quantitative survey research appeared to have impressed upon the scientific community the urgency of the PUS mission as a review of COPUS in 1990 stated:

> ... a recent study shows that the public is largely uninformed about science, in spite of being interested in it. Many individuals and organisations outside the scientific community believe that the attitudes and behaviours of scientists in the past have alienated a large sector of society. COPUS recognises this and realizes that it must change scientists' perception of the need for a greater public understanding of science. It must also increase significantly their involvement in improving public understanding.[172]

[172] COPUS (1990), *COPUS Looks Forward: The Next Five Years*, (London: The Royal Society).

Phase I: Conclusions

In Phase I we can see that, as in previous episodes of financial strain or perceived public hostility, the scientific community turned to the management of their relationship with the public, and specifically the public's understanding of science, as a key issue. Largely speaking, scientists' actions were a re-invention of previous boundary work in the context of 1985. This boundary work was a means of legitimacy building and authority manufacturing. An increase in science communication, and bringing science to the public, was advocated as a means of gaining public understanding, support and acceptance. Science, and scientific knowledge, were promoted in a public context as essential to modern life. Yet this process of science communication and popularisation tacitly affirms the old idea that the public served, in its capacity as passive witnesses to scientific knowledge and practice, to legitimise scientific authority. This also affirms a boundary which maintained science as a private, specialised practice which was only open to scientific experts, an example of Gieryn's *protection of autonomy* boundary work.

Constructing a 'problem' of public understanding of science - problematising the public as ignorant, the media as flawed and scientists as not conducting enough science communication – allowed scientists to then set out to solve this problem by appointing themselves as experts who needed to communicate science to the public. This in turn, they believed, would lead to greater funding for science and an increase in public trust in science. In many ways this was a similar strategy to the one that scientific institutions had deployed in the past. Science communication was viewed as the means of correction to the perceived social problem identified. They were able to draw on what was a now established discourse of science that rhetorically constructed them as experts and the public as needing a greater understanding. Within their construction of PUS scientists problematised the public and their cognitive processes, which by implication implicitly suggested that scientific knowledge, practice and institutions were unproblematic. Science was only problematic in the sense of scientists no longer doing enough popularisation.

It is interesting to note that there is a sense in which 'the public' only mattered in a certain respect as something in opposition to the scientist. The construction of 'the public' served as a means to construct a specific identity and image of 'science' and 'the scientist'. The views of certain public institutions, such as government, appear to have mattered more than actual views of the public, yet public opinion or understanding is used as a proxy for government opinion. So a greater positive feeling on behalf of the public is perceived to lead to a more scientifically focused government, which in turn would lead to greater resources for science. This also suggests that C. P. Snow's identification of two cultures (the non-scientific one being that which largely ran the country) could well have still been in operation in the minds of, or at least was being drawn on rhetorically by, some scientists, either to construct science as separate from government, or because they felt that government needed to know more science, or at least change their attitude to it.

The tensions within scientists' discourse of science identified in the previous chapter also continue within this phase. Scientists were representing science, on the one hand, as something to be understood by the public, which implies that it is not an expert discourse, and it is accessible to lay-people; while on the other hand they represented science as something to be perceived as a form of authoritative knowledge only accessible to experts. The problem of PUS, seems to be a phenomenon of this tension, a 'problem' which only scientists felt they could fix, thus it retains, or reinstates their role as elites who could shape society. Equally, we can see this as a good example of Gieryn's *protection* boundary work. Scientists rhetorically drew boundaries with the public and the media in a way that made them useful and important to achieving particular professional goals, while protecting 'science' from any loss of objectivity, or rationality by association with these other cultural domains.

This historical episode is, however, also different from previous attempts by scientists to construct and maintain scientific authority in a public context. Scientists and scientific organisations were placing themselves, as they had previously, in a position of cognitive and social authority; the problem of PUS was defined by them as a matter of scientific concern and thus a matter for scientists to manage. However, scientists were now not the only professional group addressing and problematising the public understanding of science. Social scientists, many of whom had conducted research and discussions in this area since the 1970s, now had the opportunity to get research funding under the banner of public understanding of science. So social scientists also became engaged in research and debate concerned with a 'problem' of public understanding of science, and, by virtue of mobilising different expertise, some problematised the issue in a different manner from the scientists. Thus we see the emergence of a different discourse of science and its relation to the public: public understanding of science, to social scientists, was not a scientific issue, but was one which was subject to social scientific investigation. They felt that the scientists were joining an existing social conversation about the public dimensions of science that was already happening elsewhere, yet scientists on the other hand had invited social scientists to assist them in their 'problem' of PUS. So we see here again that this thing called PUS meant different things to different people, and was viewed as part of the existing intellectual domain of many different professions. Social scientific expertise had been explicitly requested by the Bodmer report. Social scientists, the Bodmer report argued, should be able to identify gaps in the public's understandings of science, and assist scientists in achieving maximum fidelity with their scientific communication. This was therefore not in a manner which would confer 'ownership' of the issue to social scientists. Thus the implication here is that construction and management of the boundary between science and the public, and the boundary between science and social science was, to the scientists, legitimately theirs to control and maintain.

I have also shown how, within the ESRC social scientific research community concerned with PUS, there were different professional approaches to constructing and defining the 'problem' of PUS. Quantitative and qualitative social scientists both felt that their expertise was better suited to the investigation of the 'problem', and competed for cognitive authority, public legitimacy and resources. Thus not only can we identify boundary work between social scientists and scientists both competing for legitimate authority to define and mobilise their own definition of the 'problem', but I have identified this type of boundary work also being performed within the ESRC research programme as each group in Gieryn's *expansion* mode, attempted to increase its resources and authority. Furthermore, we can see that from the outset there was boundary work within the scientific community with shifting lines of allegiance between institutions and competition as to who should be in charge of managing the relationship between science and the public.

3 Criticisms and Colonisations

Phase II

In April 1990 a five-day international conference entitled 'Policies and Publics for Science and Technology', was organised by John Durant's section at the Science Museum, the European Association for the Study of Science and Technology, and SPSG, half of which was devoted to public understanding of science research. The other half of the conference, dealt with science policy. The overall aim of the conference was to relate the two fields to each other, assess the existing work in the fields and how it might develop in the future.[173] The variety of papers given at the conference highlights how diverse research into public understanding of science was at this point. Papers on science fiction, and the Victorian media sat beside papers on survey data and Thatcher's science policy-making. The conference participants were drawn from many different disciplinary traditions within the social sciences and, while the main objective of the conference was to provide an exchange between academics, a full day of presentations aimed at an audience of senior scientists, science policy-makers and politicians was also organised, with the aim of 'communicating the results of research to those who are best placed to make good use of them'.[174] Thus the intention of the organisers was that this emerging academic research into PUS influenced science policy.

The conference also provided the first opportunity for the public dissemination of all the results from the ESRC funded research into public understanding of science. This social research, with perhaps the exception of the survey which had been a direct request from the Bodmer working group, had approached PUS from a qualitative research perspective, and the results, heard for the first time here, challenged many of the assumptions implicit in the approach which COPUS had been actively pursuing since 1985. It is also notable that the

[173] Science Museum (1990), *Policies and Publics for Science and Technology Booking Leaflet*, (London: Science Museum).
[174] ibid.

person who articulated this challenge was John Ziman, now acting as a conduit between the social science and scientific communities. He here, however, diverged from the views of the Bodmer working group, and was critical of the stance taken by the scientific institutions following the report. As Irwin reflects, however, Ziman's motivations had been to conduct some serious research into PUS and were not, as many saw it, politically motivated, but simply a reaction to the results of the research which had shown a very different picture from the one many expected:

> "I think John's a genuine intellectual actually, in the sense that he really was interested in the idea, he wasn't playing this politically ... my recollection is of John moving his position as the programme developed, initially, I think, for good, practical reasons, looking back at it – he wanted to deliver some large-scale quantitative data that his friends at the Royal Society would understand. Which I think we'd be right to say was basically uncritical. But, in fairness to John, he said, "well actually, what we've got here is a new paradigm". And I remember him using that expression which I kind of squirmed at a bit. But that's what he was saying, it's a new paradigm for approaching this, because you're talking about science being problematic rather than the public being problematic."[175]

As the 1987 paper by Thomas and Durant had pointed out, the promotion of PUS by the Royal Society and other institutions had rested on the idea that a lack of public understanding could be equated with a lack of support for science. Ziman described this ideology and the actions that had been taken by COPUS, and its constituent institutions, to address this issue, as a "simple 'deficit' model", the first time that this phrase had been used. Ziman argued that this 'deficit model' was inadequate as an analytical framework for research into PUS, exactly because it tried to "interpret the situation solely in terms of public ignorance or scientific literacy".[176] In contrast to this Ziman described how the ESRC research had shown a far more complex picture emphasising the importance of the context within which the scientific knowledge was being received by the public. This approach was backed up by other presentations from Brian Wynne and Roger Silverstone, other researchers funded by the programme.

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[175] Irwin *Interview, 29 June 2004.*
[176] Ziman (1990), op. cit.

Wynne's conceptualisation of 'the problem' in the public understanding of science was different from the one identified by the scientific institutions. He argued that, "the current institutional structures within which science is organised and projected may be part of the problem in public understanding of science".[177] He called for a wider conceptual framework in which to study the public dimensions of science, which considered these institutions, as well as the public, as objects of research. As he argued:

> "... it is only from such a conceptual basis that constructive development and redesign of institutional structures concerning science and policy can take place in a measured and self aware way, rather than as ad hoc piecemeal and 'blind' reaction to political events." (p. 2)

Wynne went on to note, as "an object of curiosity", the science-centric basis of the research programme on public understanding of science requested by the scientific community. This science-centric focus, and the belief that scientific knowledge should be understood by the public, led only to a particular, and in Wynne's assertion, the wrong, type of research:

> "It ... appears only natural to build research and policy programmes on the assumption that science is unitary and coherent, and that it should be central to everyday beliefs and practices. This allows us not only to measure how far people fall short of some level of scientific understanding – i.e. their 'ignorance' – but also to assume that such 'ignorance' indicated a deficit of democratic capability." (p. 3)

The starting point for his, and the other's, qualitative research on the programme was a different insight: that there was no clear consensus, even among scientists themselves, as to what science, or scientific knowledge, was in any given context. Science meant different things, to different people, in different situations. This, Wynne explained, was why, when the public was asked in surveys about science in general and abstract terms, they expressed a large positive response, but science then suffered from lack of public esteem in many specific contexts. Research methods were key to the types of results received, and crucially therefore, how the public was framed within the research. As Wynne underlined:

[177] Wynne, B. (1990), 'Knowledges in Context', paper presented at the conference *Policies and Publics for Science and Technology*, Science Museum, London, p. 27-11 April 1990.

> "Our research methodology has used small-scale and interpretive approaches rather than large-scale samples and standardised questions. The main methods of obtaining data have been participant observation, longitudinal panel interviews, structured in-depth interviews and some local use of questionnaires on specific issues." (p. 5)

These qualitative projects had examined issues of public understanding of science within specific practical social contexts. Examples included a study of those who had inherited the familial hypercholestorolaemia, an investigation into two communities living close to hazardous industry, and an analysis of the role played by scientists in environmental organisations. Understanding how science was contextualised within these people's lives, Wynne argued, was "crucial to understanding the social authority (or lack of authority) of science" (p. 5). One of the main findings from Wynne's project was that people did not use, assimilate, or experience science as separate from other elements of knowledge, judgement or advice; supplementary knowledge was always required to make any scientific understanding valid and useful in that context. This supplementary knowledge, he argued, despite often not being recognised as such due to the institutional structures of science, could often be highly specialist, such as the locally specific knowledge of sheep farmers, when faced with scientific responses to the radiation exposure of their flocks:

> "A sheep farmer may therefore understand that radiocaesium is flushed from lambs more quickly on improved valley grass than on the high fells. But he may also know what the scientist doesn't – the valley grass is a precious and fragile resource whose loss by intensive grazing can have damaging consequences for future cycles. The scientific account is valuable, but the situation requires more than scientific understanding." (p. 7)

A practical implication for current public understanding initiatives by scientific institutions, Wynne argued, was that the institutions themselves needed to reorganise themselves so as to better understand and relate to public agendas and knowledges. Science and technical information were less and less visible in the everyday discussions of technical issues. People considered not simply the scientific knowledge, but the way in which that knowledge was clothed in the social and political forms of the institution: what Wynne called its "social body language". These other considerations, particularly whether that institution was perceived to be trustworthy or competent, Wynne argued, were more significant than a narrow focus on scientific knowledge communication. Apprentices working at the Sellafield nuclear processing plant knew little about basic radioactive processes, but more importantly, Wynne argued, they did not feel the need to know. The lack of understanding of what, by some scientists, would be considered as absolutely crucial knowledge for people working in their institution was, to Wynne, a perfectly functional response. The workers simply learnt the organisational procedures, and were sure that the scientific expertise in radiation had been considered in the design of the plant and its organisation; they had confidence in the institution and thus felt they did not need the scientific information. What could be perceived as a lack of cognitive ability or a rejection of the science by some was simply a judgement that the science was not necessarily useful in that context. The judgement of whether or not to show an interest in science was therefore a social one tied to judgements of one's own power (or powerlessness) to act in one's social environment.

'Ignorance' of science, was therefore, Wynne argued, far more than a vacuum, but could actually be actively constructed and maintained. If, however, people wanted relevant scientific information, they had a large capacity to assimilate and understand it, given sufficient access to it, as in the case of families suffering from hypercholestorolaemia.[178] Wynne finished his paper by again questioning the current institutional approach to public understanding of science, arguing that lay understandings or misunderstandings of science as a cognitive issue were not the central point:

> "Whilst many commentators portray a lack of public understanding of science as an obstacle to democratic vitality, it may be that the reverse is also true; that impoverished democracy and intensifying hegemony around science is a major obstacle to the public understanding of science."[179]

Wynne, with this attack on the scientific institutions' approach to the public understanding of science, was engaging in boundary work. He argued that a social scientific, and more specifically, a qualitative social scientific, rather than a scientific, definition of PUS was a better description. In other words the public were better suited to social scientific study than scientific. Wynne was problematising science as being democratically deficient. In opposition

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[178] Lambert, H. and Rose, H. (1996), 'Disembodied Knowledge? Making sense of medical science', in Irwin and Wynne, eds, *Misunderstanding Science? The public reconstruction of science and technology*, (Cambridge: Cambridge University Press).
[179] Wynne (1990), op. cit., p. 17.

to this, social science was therefore constructed as the legitimate and authoritative site of expertise in this area. Wynne, in similar boundary work to the scientists', was constructing a problematic 'science', which could then be fixed, this time with social scientists constructed as the 'experts' to do this, and who were aligned with the interests of society and the public.

Roger Silverstone from the Centre for Research into Innovation, Culture and Technology at Brunel University followed Wynne's paper by presenting his research into the communication of science in more formal settings: the mass media, museums and schools. Drawing on previous research into communication, Silverstone outlined four assumptions on which his research rested, which challenged the idea, as expressed by the authors of the Bodmer report, that the problems of public understanding of science could be resolved by a policy of "more equals better in the communication of science to its various publics".[180] His first assumption was that there was no such thing as 'the communication of science'; science and the media were both heterogeneous communities. This meant that science was not communicated as a unified phenomenon. Scientists could, and did, disagree with each other in public. Science could also be embedded within many different kinds of communication, all with very different agendas. This would create very different understandings which would not necessarily be the same as the intended message. The second assumption similarly claimed that there was no such thing as 'the public'. The Bodmer report had identified different audiences within the public to which science communication should be directed; however, Silverstone's meaning here was different from simply identifying different target audiences. Whereas the Bodmer report had assumed that once the audience had been targeted they would receive the message in identical ways, to Silverstone, the differentiation within the public meant that their understandings of the science would also differ - "they will understand or misunderstand, remember or forget in different ways" (p. 2) His third assumption was that, in the modern communication environment, science could not claim any privileged status; it had to compete for attention of both the producers of media and the receivers. Despite bemoaning the lack of science in the media, the scientific community was

[180] Silverstone, R. (1990), 'Communicating Science to the Public', paper presented at the conference *Policies and Publics for Science and Technology*, Science Museum, 7-11 April 1990, p. 9.

one interest group amongst many and their knowledge claims would not necessarily come to the fore of professional media communications.

Finally, Silverstone challenged the preoccupation with the media by organisations such as COPUS, arguing that the "omnipresence of the media does not equal omnipotence"(p. 10). He acknowledged that the media played an important role in framing public understandings of science, however, these took place alongside the communication of science in schools and museums and incorporated local knowledges, practical understandings and common sense. Thus, like Wynne, Silverstone's message was that the communication of science was a lot more complex than many scientists had suggested. Context, he similarly argued, was key to understandings:

> "The receivers of such communications are themselves context bound. They have their own knowledges. They bring to their understanding of science their own agendas, their own interests, their own cultures ... Local knowledges provide their own context for, and, practical understandings provide their own inflection of, science communications. Understanding public understanding of science requires understanding public understanding." (p. 8)

Thus like Wynne, Silverstone was representing scientists as having a deficit of social scientific understanding, particularly when it came to understanding the public, and thus social scientists were constructed as the more legitimate and authoritative profession.

The ESRC funded survey research by Durant, Evans and Thomas was also presented to the conference. Much of the presentation was concerned with countering the criticisms of their quantitative methods, and they started their paper with a substantial justification:

> "It may be thought that this attempt is flawed in principle by its reliance upon a so-called 'deficit' model, according to which science is seen as an unproblematic body of knowledge and the public is judged according to how much of this knowledge it has acquired. This model, it may be argued seriously misrepresents both scientific knowledge, which is itself problematic, and the public, which possess informal or unofficial knowledge that is different from, rather than merely inferior to conventional science.

> We hold no brief with a deficit model. Nevertheless, we are unconvinced by this criticism. Science is an enormous and enormously complex body of knowledge. In our view it is unhelpful – indeed, it is ultimately patronising to those we study – to suppose that it is illegitimate or improper to inquire about the extent to which they are familiar with this knowledge. We wish to discover how much science people know, and how far beliefs may differ systematically from formal or official science. In neither case do we see how this can be done without forming some estimate of people's understanding against the bench-mark of science itself."[181]

Again, here we can see Durant and colleagues engaging in boundary work. They were firstly attempting to draw a line between themselves and the 'deficit model' label. This was something that was not part of their construction of public understanding of science research. More importantly, they identify themselves as the social scientists who are 'on the side' of the public. Anyone who criticised their work was being 'patronising' - the implication is that their critics did not have a proper understanding of the public. The analysis of their results had suggested to them two important findings. The first was that those respondents who scored higher on levels of understanding of science, also tended to draw sharper distinctions between science and non-science. Thus knowledge of science also meant familiarity with the concept of the scientific enterprise and, as Ziman had asserted in his introduction earlier, "the better informed possess a generally more supportive view of science".[182] The second point drew on Moscovici's idea that complex issues can often take on distinct social representations in the public sphere, which could bear little relation to the original artefact.[183] Medicine, they argued, which came out top in terms of self-reported interest in science in the survey, occupied a special place in public perceptions of science. They believed that a generally non-cynical and largely supportive attitude towards medicine in the public sphere explained why the survey had shown a very positive and supportive attitude to science and technology as a whole on the part of the public, "in spite of the large number of social and environmental problems with which science is often associated" (p. 10). The researchers stressed what they perceived as an irony in these results having been produced by their survey. Their findings had shown that there were differences between

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[181] Durant, J., *et al.* (1990), 'Characterising Public Understanding of Science in Britain', paper presented at the conference *Policies and Publics for Science and Technology*, Science Museum, London, 7-11 April, p. 3.
[182] Ziman (1990), op. cit., p. 5.
[183] Moscovici, S. (1984), 'The phenomenon of social representations', in Farr and Moscovici, eds, *Social Representations*, (Cambridge: Cambridge University Press).

public and scientific perceptions of science, with the former relying on medicine as a paradigm for all representations of science. Critics of the deficit model had insisted, however, that one of its weaknesses was to force public perceptions of science into the mould of professional, scientific understandings. The authors concluded by hoping that they had "done enough to show, both that understanding can be measured, and that this measurement is worth making" (p. 11).

Summarising all of the ESRC findings, Ziman occupied a careful middle ground between the two different methodological approaches to research into public understanding of science. What was clear from all of the studies, Ziman argued, was that the public did not draw on the stable, formal 'textbook' accounts of scientific knowledge. In contrast, its meaning was "actively constructed by the processes and circumstances under which it is communicated and received".[184] Secondly, the engagement with, or selection of, any particular scientific knowledge depended on the context in which it was needed, and that this would occur according to the public's own interests, personal and social histories, and involvement. Ziman stressed that the public did not passively accept scientific knowledge presented to them by experts. The credibility of any source of knowledge, and what the communicators' perceived interests were, would play a major part in the acceptance of it. Finally, the research had suggested that public conflicts between scientific experts would serve to downgrade the privileged position of scientific knowledge, but that this would allow other understandings, such as ethical or personal views, to enter into the debate. This should not, however, necessarily be seen as a bad thing. Thus Ziman was mobilising a view of science which was rather different from how many scientists represented it, where science stood apart from such views.

All of these points conflicted with the Bodmer report's characterisation of the 'PUS problem' as being a lack of scientific knowledge on the part of the public. This view did not take into consideration the life context of any individual during an encounter with science. Science, according to the social researchers, was actively constructed and received by the public in a multitude of ways, and thus simply trying to educate or 'correct' the public's

[184] Ziman (1990), op. cit., p. 3.

cognitive deficit was not the answer to the problem. Ziman, vouched for the fact that the Bodmer report had been the product of thorough research, and that its shortcomings were simply based upon the meagre amount of existing research conducted into PUS in the early-1980s. The 'contextual model' of PUS research which had emerged from the ESRC programme, he viewed as a continuation of this research, which now suggested a more complex picture than had been originally perceived. Wynne, in contrast, was much more critical of this earlier approach to PUS stressing the need to balance the scales by devoting equal research time to the various ways in which scientists understand and interpret science. If they failed to do this, as Wynne stated, "the false view is tacitly consolidated that the problems are all to do with the public's understandings rather than also with scientists and scientific institutions" (p. 3).

Ziman himself did not stray too far from many of the claims of the Bodmer report, concluding also that the degree of public ignorance was very distressing and "would seem to call for a very determined effort of education and re-education, through formal schooling and the media" (p. 5). However, he argued that this sort of policy response attached a great deal of weight to the weaknesses in people's formal scientific knowledge, and did not make allowances for the difference between a person's tacit understanding of the state of affairs and their ability to state verbally what they know. This point was confirmed, he felt, by the contrast in the survey between the poor showing of most people on direct questions about the nature of scientific discovery and their good grasp of the practical logic of drug testing and of the inheritance of genetic defects. Thus he stated that social scientists must be able to locate their qualitative interpretations of public understanding of science on a properly scaled map. Appearing to try to reconcile the division between the methodological approaches, he argued it was essential to have some "hard" quantitative data about the social phenomenon they were studying.

Colonising PUS

The Science Museum conference had also publicised the forthcoming launch of a new journal entitled *Public Understanding of Science,* which was to be set up by John Durant and Jane

Gregory at the Science Museum, with Durant as editor. A further development at Imperial College and the Science Museum was the establishment of a MSc course in science communication. The degree, open to applications from those with an honours degree in a scientific or science-based subject, was based upon academic work on the public understanding of science, to provide a thorough professional training in the principles and practices of science communication.[185] The rationale for the course, as explained in the recruitment brochure, was based upon recent studies, which had revealed 'widespread public ignorance about the nature and content of science, and considerable public unease about some scientific and technological developments'. The brochure continued:

> Concern about the gap between science and the public has been growing steadily in recent years. Part of the problem has always been a shortage of people who have both an understanding of science and an ability to explain and interpret it in ways that make sense to non-scientists.[186]

Thus this course which granted the first academic qualification in science communication very much interpreted the 'problem' of PUS in the same terms as COPUS and the Bodmer committee. Those who were to graduate from this degree were seen as agents of 'correction', who would help communicate science to an ignorant public. Contrasting this approach the academic journal *Science, Technology and Human Values* published summaries of the presentations by Ziman, Wynne and Silverstone at the Science Museum conference, all of which had questioned this characterisation of the problem.[187] Academic interest in PUS was growing, and showed a diversity of approaches.

In early 1992 the first issue of the journal *Public Understanding of Science* was published. Durant's editorial, and indeed the rest of the journal, provides an interesting snapshot of the state of thinking around public understanding of science at this time. Reflecting on whether there was a need for the journal Durant noted that no other journals at that time were

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[185] Imperial College London (1991). 'MSc in Science Communication Brochure'. (London: Imperial College).
[186] ibid.
[187] Ziman, J., B. Wynne and R. Silverstone (1991), 'Public Understanding of Science', *Science, Technology and Human Values*, 16: 1.

devoted solely to that area.[188] When he and colleagues had been considering where to publish the results of the Oxford survey in 1989, they had felt that there was no outlet that would bring their work before all of their intended audience, and had therefore published two different synopses in different places: *Nature*, and an International report on British Social Attitudes.[189] This compromise, Durant had felt at the time, had served to reinforce 'the conventional barrier between the natural and the social sciences, that continually works against productive dialogue about the place of science and technology in contemporary culture' (p.1). *Public Understanding of Science*, Durant claimed, would remedy this situation and reflect the 'diversity of complementary, contrasting and occasionally conflicting research practices' (p. 1). It would present new work on the public dimensions of science and technology to all those who may be interested in it, from whatever discipline. Public understanding of science was an emerging interdisciplinary research field, and therefore there was, Durant claimed, 'no single generally acknowledged exemplar, no universally accepted model, no body of securely established theory'. The field was so new, that Sage, a large social science publishing house, had not been interested in publishing the journal. It was instead published by the Institute of Physics, a publisher that could afford to take a financial risk, due to its large, and successful, output of physics journals and who thought PUS was a good thing for the scientific community.[190] Thus we can see here one of the institutional mechanisms through which boundary work is performed. Durant was attempting to gain scientific and social scientific authority by the establishment of a journal, one of the hallmarks of legitimate scientific work being the publishing and peer review of that work in an established journal. Sage had, however, rejected the new discipline on the grounds of it not being established enough to warrant the financial risk.[191]

The journal, from the outset, had an international scope, with abstracts published in English, French and Spanish, and associate editors from India, Germany, France, the United States, and Australia. The journal's Advisory Board drew its members from a wide range of

[188] Durant, J. (1992a), 'Editorial', *Public Understanding of Science*, 1: 1, p. 1.
[189] Durant, *et al.* (1989), op. cit.; Evans, G. and Durant, J. (1989), 'Understanding of science in Britain and the USA', in Jowell R et al, ed., *British Social Attitudes: Special International Report*, (Aldershot: Gower Publishing).
[190] Personal communication from Jane Gregory.
[191] Sage acquired the journal in 2003.

academics, again reflecting the variety of interests and approaches to the field. Some members were from institutions with an interest in PUS, such as Walter Bodmer from the Imperial Cancer Research Fund, Neil Cossons from the Science Museum, and John Ziman from SPSG. Others were drawn from academia, largely from science and technology studies, such as Bruno Latour, Harry Collins, and David Edge. It is notable also that there were members such as Arie Rip and Gerald Holton, both of whom (along with Steven Shapin who contributed a paper to the first issue) had been involved in the *Newsletter of the Public Conceptions on Science and Technology* and had therefore been concerned with issues in this area for several years before the publication of the Bodmer report. The name of the PUS journal had been debated amongst its editorial team before the launch, some feeling that *Public Understanding of Science* was too ambiguous, and had no meaning outside of the UK context, or indeed, the English language.[192] However, as Durant argued, its relation to the UK activities, following the Bodmer report, had been a strength, and, as well as being a direct and relatively simple name, it was hoped that the title would convey the nature of the field the journal intended to cover. The addition of a subtitle, as Durant later reflected, was intended to clear up any ambiguities:

> "... we called it that knowing that this was a term which had all kinds of ambiguities and all kinds of connotations, but we used the subtitle, "a journal of research in the public dimensions of science and technology", which I've never been unhappy with because it always seemed to me to be explicitly open to many different kinds of questions that might be asked about science in public."[193]

Of note in the editorial is the implicit criticism by Durant of both the Bodmer report and the scientific community. He stated that while the inspiration for the ESRC research programme into public understanding of science 'lay in the concerns of the scientific community, in several respects the research itself appears to have gone beyond them' (p.3). Durant underlined the diverse agendas for research in the PUS field, and how he hoped the journal would therefore foster 'frank but (we trust) friendly debate between researchers who come to our field with widely different concerns' (p. 3). His request for friendly debate signalled that relations between actors within, both the scientific and social scientific communities,

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[192] Durant, *Interview, 28 June 2004.*
[193] ibid.

and indeed within the social scientific community were increasingly fractious. In the previous phase this conflict had been confined to discussions behind closed doors, but were now increasingly spilling out into more public arenas. All were staking their epistemological claims to PUS and promoting different approaches to action and research. Yet these claims were not simply epistemological, as each was also promoting a different ideology about society, for example the 'correct' relationship between scientists and the public, or the public and policy makers. All also aligned themselves with the public, in the sense that they claimed to be acting in their interests, and others were not.

The first issue of the journal commissioned eight different 'launch perspectives' from leading figures in this new field to stimulate debate. The papers were also commissioned to display the variety of different perspectives on public understanding of science in 1992.[194] They also show quite clearly how the different professional interests and perspectives shaped the various conceptualisations of PUS. Bodmer, now Chair of COPUS, and Janice Wilkins, Head of Public Relations at the Imperial Cancer Research Fund, wrote the first. It was couched as a plea to the social scientific community to provide useful research to help those 'involved actively in trying to improve the public understanding of science'.[195] However, only certain social scientific research was seen as relevant. Ignoring all but the survey research from the ESRC research programme, they cited the research conducted in Britain up until that point as having 'plumbed the depths of public ignorance about science' and characterised its main finding as having 'discovered that the British public has an unsatisfied appetite for more information' (p. 7). Bodmer and Wilkins also made it clear what they thought the role of social scientists should be, suggesting that the social research should be conducted to serve the needs of existing public understanding of science programmes, or more specifically the needs of COPUS:

[194] As well as the launch perspectives discussed below, two others were written by science communications scholar Sharon Dunwoody and museum director, and physicist, Jorge Wagensberg.
[195] Bodmer, W. and Wilkins, J. (1992), 'Research to improve public understanding programmes', *Public Understanding of Science*, 1: 1, p. 7.

> ... it would be helpful if we knew more about the ways in which various target audiences may be reached most effectively with information about science and technology ... This would be the standard approach for anyone marketing goods and services and a similarly professional approach should be taken for the public understanding of science. (p. 7)

Here we can see that they conceptualised the role of the social researcher as limited to providing the evidence on which better communication techniques could be based. The public, on the other hand, in opposition to many of the conclusions that had come out of the ESRC programme, were again painted by Bodmer as passive receivers of scientific information. The idea that the work of COPUS was to some extent a public relations exercise comes out here even more explicitly than it had seven years earlier. The fact that his co-author was a Public Relations officer (as well as being a member of the Public Affairs Committee of the BAAS), points to this idea, as does the use, in the quote above, of marketing language which talked about selling a product, in this case science, to the public. The media, a constant concern of the COPUS committee members, could, however, be used in 'helping to revise the public's view of scientists', and Bodmer and Wilkins had 'no doubt that a fascinating soap opera could be built around a team of scientists who, after all, spend their days doing what might be described as a kind of detective work and who have private lives as varied and interesting as any other section of the community' (p. 8).[196] This paper highlights how little the stance taken by Bodmer had changed since the 1985 report, as well as how little impact much of the social research had had on him, and on others in the scientific community in so far as he can be taken as the spokesperson for COPUS.

A similar characterisation of public understanding of science was put forward by Jon Miller in his paper which outlined the previous thirty years of survey work, much of which was his own, in the United States.[197] He also characterised public understanding of science as a 'contemporary problem', though one of which our understanding had become more scientific. Though he identified the problem of PUS as one for science to solve, he offered no other indication of how this might happen other than arguing for better survey data to

[196] Bodmer and Wilkins would perhaps be heartened by the success of the CSI television drama series which started in 2000.

[197] Miller, J. (1992), 'Towards a scientific understanding of the public understanding of science and technology', *Public Understanding of Science*, 1: 1, pp. 23-26.

measure scientific literacy. No mention was made of qualitative approaches to the subject: both Miller's, and the Bodmer and Wilkins papers were, as Durant argued in his editorial, 'chiefly preoccupied with the extent to which the general public has an adequate understanding and appreciation of elementary scientific principles' (p. 3), at least as they had defined them.

Some of the other papers in this launch issue, however, questioned this approach and characterisation of the public understanding of science. Pierre Fayard, a French science journalist and academic asserted that the political motivations behind every popularisation venture were to 'celebrate and emphasise the difference between those who are in the know and those who aren't'.[198] A more appropriate question to ask, he suggested, would be how these ventures see their public: 'as empty vessels to be filled, as warped minds in need of straightening out, as citizens with whom to enter into dialogue, or as tax payers to be convinced of the necessity of funding research?' (p.15).

Physicist Jean-Marc Lévy-Leblond made a similar plea for a reconsideration of how the public were conceptualised by those deploring their poor understanding of science. He argued in his paper for some symmetry in public understanding of science research, calling for research into the understanding of the public by scientists. A scientist could be just as much a lay-person in relation to a different branch of science from their own as could a member of the public. Lévy-Leblond highlighted that while lay-people may not have formal and recognised expertise, they did have sophisticated and highly technical skills in other domains and were not bad at mastering the technological environment, showing 'a rather uncanny ability to learn what they need *and not more*'.[199] Challenging the assertions of COPUS, and asking for a more sophisticated and critical approach to the popularisation of science, Lévy-Leblond argued that scientists should admit and admire the achievements of lay-people: 'driving without knowledge of mechanics; cooking without knowledge of chemistry; word processing without knowledge of computer science' (p. 19). He criticised

[198] Fayard, P. (1992), 'Let's stop persecuting people who don't think like Galileo!' *Public Understanding of Science*, 1: 1, p. 15.
[199] Levy-Leblond, J. (1992), 'About misunderstandings about misunderstandings', *Public Understanding of Science*, 1: 1, p. 19.

the quantitative research techniques such as surveys, which asked the public to answer 'arbitrary and irrelevant questions' (p. 19). Lévy-Leblond also denied that the public understanding of science should be characterised as a special problem, believing that the public could be shown as not very knowledgeable about a lot of aspects of society and culture when asked through such polls.

Wynne used his paper to be very critical of what he called the 'dominant public understanding of science agenda', an unstated dimension of which, was the perceived crisis by scientists in public support of science.[200] He argued that the recent resurgence of interest in the area should be seen as part of the 'scientific establishment's anxious response to a legitimation vacuum which threatened the well-being and social standing of science'.[201] Wynne therefore agreed with the scientists' perception that there was a 'problematic' relationship between science and the public. This legitimation vacuum, he argued, could be seen as a direct result of the way science had in the past distanced itself from the public, which is notably similar to Bodmer's conceptualisation of the problem. Science however, Wynne argued, now found itself 'hoist with its very own petard, namely the cultural alienation whose establishment it actively, if innocently promoted' (p. 38). He also questioned what he called the 'presumed authority' of scientists' characterisation of the problem of public understanding of science, and whether social scientists should follow that as a model on which to base research, as Bodmer had suggested earlier in the journal. Wynne again argued that the scientific institutions themselves were part of the problem of public understanding of science and argued that the findings of his research refuted the scientists' view of the public:

> The technical ignorance lamented as an intellectual vacuum (and social defect) is revealed instead as a complex 'active' social construction which reflects a broader array of particular social relationships of dependency, trust, alienation, division of labour, etc. with which people constitute their moral identities. (p. 39)

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[200] Wynne, B. (1992a), 'Public understanding of science research: new horizons or hall of mirrors?' *Public Understanding of Science*, 1: 1, p. 37.
[201] ibid.

As well as constructing science as problematic, and criticising the scientific misunderstanding of the issue of public understanding, Wynne also used this opportunity to criticise quantitative methods of social research. The assumption that survey research could assess the levels of assimilation of technical concepts or attitudes to science was, he argued, misleading, as these attitudes and concepts were defined by the analysts with no regard for the context in which the science would normally be embedded in people's lives.

The first issue also contained a paper by Bruce Lewenstein, Assistant Professor in the Departments of Communication and Science and Technology Studies, at Cornell University. His paper was a historical examination of those institutions popularising science in the post-war period in the United States, and argued that these advocates of popular science who used the rhetoric of improving the public's understanding of science, were in practice trying to gain the public's appreciation of science. As Lewenstein stated:

> ... they were seeking to improve the attitude of members of the public toward science as a body of knowledge, science as a way of knowing about the world, scientists as individuals, and the particular requests for support and funding that came from scientific institutions ... some people believed that increasing public knowledge about scientific discoveries would necessarily yield better public appreciation, while others thought that popular science should be aimed at improving public attitudes toward science.[202]

Though Lewenstein referred to contemporary questions only at the start of his historical case study he did suggest that it may apply to the more modern usage of the phrase 'public understanding of science'. Referencing the UK's Bodmer report, he argued that these more modern practitioners of science popularisation still refrained from presenting their motives in 'Machiavellian terms', and instead presented their interest in public understanding of science as part of the general enlightenment appropriate in the modern world. His problematisation of the meaning of the word 'understanding' within 'public understanding of science', thus called in to question the motivations of those advocates in UK using the same phrase, just as Thomas and Durant had done.[203] Lewenstein noted that Dorothy Nelkin had similarly argued that 'public communication [of science] is shaped by the co-operation

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[202] Lewenstein (1992), op. cit. p. 46.
[203] Thomas and Durant (1987), op. cit.

and collaboration of several communities, each operating in terms of its own needs, motivations and constraints'.[204]

A further paper in this first edition of the journal, by Gerald Holton, Professor of Physics and History of Science at Harvard University, showed another motivation for many proponents of public understanding: a concern about a perceived rise of an anti-scientific public. Holton attributed a rise of a 'dangerous segment of what some call the anti-science movement' to the 'rampant scientific illiteracy in the USA', and went on to suggest that this high level of poorly informed citizens in a democratic society would in turn lead to 'erroneous policy and eventual social instability' and 'enormous catastrophes'.[205] The need to educate the public and stem the tide of the resulting disaffection with science was, to Holton, paramount. We can see here Holton mobilising a discourse which promoted science and its knowledge as being good for society, as had the Royal Society in the seventeenth century. Holton argued that by themselves, these 'para-scientists' - astrologers, anti-evolutionists, spiritualists and peddlers of new-age thinking - would 'otherwise be merely a source of condescension or amusement' (pp. 108-9). But Holton argued that delegitmating forces, unique to the late-twentieth century, such as philosophers of science who argued that science could now claim no more than the status of a 'useful myth', and a general dismay with modern science and technology, played into the hands of this anti-science movement. Holton believed that science was under attack, and that the '"pro-science" imbued world picture of the late-twentieth century is a rather vulnerable and fragile minority position' (p. 107). An embrace of para-science was, to Holton, a distinctly anti-modern characteristic, and an attack on the whole of the Enlightenment project; and social scientists were the problem. Thus in a reverse of Wynne's boundary work, Holton was blaming certain social scientists for science's lack of authority in society. Holton's view of the public as vulnerable to 'para-science', and misrepresentations of science, was a common reason why scientists believed that addressing the public understanding of science was necessary. Indeed, Bodmer and Wilkins, in their paper, had alluded to this idea when they bemoaned a report in a magazine, which suggested 'that scientific curiosity and lack of caution could lead to someone's child

[204] Nelkin, D. (1987), *How the Press Covers Science and Technology*, (New York: W. H. Freeman), p. 11.
[205] Holton, G. (1992), 'How to think about the 'anti-science' phenomenon', *Public Understanding of Science*, 1: 1, p. 104.

being born with yellow eyes and three noses'.[206] No scientists would be susceptible to this, however, as they continued that:

> To any scientist, the notion is breathtaking and unbelievable but, sadly, there is no doubt that some readers will now just believe in the possibility and await an announcement of the birth of such a child. It is tempting to get on with the science that is one's job, convincing oneself that the scenario outlined above is so grotesque that no member of the public could ever take it seriously. (p. 8)

Overall, however, the majority of the papers in the launch issue contained a substantial amount of criticism of the way in which scientific institutions such as the Royal Society or COPUS had formulated the public understanding of science as a problem, and of the sort of action they felt was needed to correct it. Wynne certainly was not willing to provide the sort of assistance that these institutions wanted, concluding that 'it would be a pitiful waste if social science research could manage no more than to consolidate and justify that [science's] neurosis'.[207] Taken as a whole, the range of perspectives on the public, science, public understanding, and the relationship between public and science, in the first volume of *Public Understanding of Science*, did show, as intended, how varied scientists and other scholars were in their conceptualisation of PUS. Most authors argued that their profession, or their methodological approach, was aligned with the public, or public interest. In other words, only they had the legitimacy to construct, define or change the public for the better.

PUS, risk and trust

The same boundary dispute that Wynne was engaged in, over qualitative and quantitative constructions of scientific facts and public attitudes towards science and risk, was not just confined to this emerging academic field of public understanding of science. Similar fault lines had also appeared at a conference, and report launch, on risk at the Royal Society that same year. As sociologist Les Levidow's review of the subsequent report, in *New Scientist*, argued:

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[206] Bodmer and Wilkins (1992), op. cit. p. 8.
[207] Wynne (1992a), op. cit. p. 42.

> The latest Royal Society report on risk reveals deeper methodological divisions among risk researchers themselves. Although natural and social scientists have gained some mutual understanding ... the bridge with social sciences has not been put in place.[208]

The disciplinary divisions had been explicit at the conference, according to anthropologist Mary Douglas, who was quoted in *The Times Higher Educational Supplement* (THES) as saying:

> Complete decorum reigned until near the end when a psychologist got up from the floor. When he asked that the term 'social construction of risk' be eliminated from the discussion, shouting, clapping and hissing broke out and the meeting was adjourned.[209]

The tensions were between those who would attempt to put numbers on risk and those who would deconstruct its latent assumptions. While the former approach privileged the quantitative assessment of risk, presenting it as scientifically rational, the social scientists at the meeting challenged two of its underlying dichotomies - between real and perceived, or objective and subjective risk; and between risk analysis and its management. Risks, to these social scientists, in a similar conception to Wynne's socially situated science, were culturally constructed, created by people according to their experience and perception of the world.[210]

Further academic criticism of the 'dominant approach' to PUS, and the scientific framings of risk analysis, continued to emerge in social scientific journals. Wynne was the most vocal critic and in another paper in *Public Understanding of Science,* he outlined further his problems with the scientific institutions' approach:

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[208] Levidow, L. (1992), 'Review: Risk: Analysis, Perception and Management', *New Scientist,* 1851.
[209] Hinde, J. 'Why talk of risks is full of hazards', *The Times Higher Education Supplement,* 14 March 1997.
[210] This bitter boundary dispute over whose conception of risks was valid spilled over into the construction of the report, *Risk: Analysis, Perception and Management.* The preface explicitly distanced the Royal Society from the latter part of its own report, written by qualitative social scientists. As John Adams, Reader in Geography at University College London, was quoted as saying: he had "never been to a launch party before where the authors of part of the report were being rude about the authors of the other parts." (Hinde 1997, ibid.)

> ... much of the impetus for the current interest in this subject stems from a broad anxiety among scientists and policy-makers about what they see as the public's inability or unwillingness to understand 'correct' messages about risks as given to them by the experts. I have noted the irony that this formulation of the problem only encourages more public alienation, hence justifying and consolidating the neurosis.[211]

Wynne argued that it was now accepted that issues of public understanding of science, and of public risk perceptions, were not so much about public capabilities in understanding technical information, but about the trust and credibility they were prepared to invest in scientific spokespersons or institutions (p. 282). Drawing on his research into understanding of radioactive fallout in Cumbria from the Chernobyl nuclear power plant, Wynne proposed a different framing of the public understanding of science 'problem', and of the closely associated risk perception issue:

> Public experiences of risks, risk communications or any other scientific information is never, and can never be, a purely intellectual process, about reception of knowledge *per se.* People experience these in the form of material social relationships, interactions and interests, and thus they logically define and judge the risk, the risk information, or the scientific knowledge as part and parcel of that 'social package'. A corollary of this is that people do not simply not understand science when they are seen to disregard it; they do not recognize it, or identify with it, morally speaking. (p. 281-2)

Criticising both scientists' and quantitative social scientists' approaches to studying the public's understanding of science, Wynne asserted that the trustworthiness and credibility of the social institutions concerned was basic to people's definition of risks, or uptake of knowledge. Further to this, it should be recognised that trust and credibility were themselves analytically derivative of social relations and identity-negotiation. 'Thus, like risk', Wynne concluded, 'they too should not be treated as if they have an objective existence which can be unambiguously measured and manipulated' (p. 300).

Sociologist Mike Michael, provided a further critique of both the Royal Society's analysis of the relationship between science and public, and of what he called, the 'dominant academic

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[211] Wynne, B. (1992b), 'Misunderstood misunderstanding: Social identities and public uptake of science', *Public Understanding of Science*, 1: 3, p. 281.

approach to the public understanding of science'.[212] Drawing on his interviews conducted with members of the lay-public, he argued that the manner in which these members of the public constructed science in their own discourses was much more complex than the dominant approach to public understanding of science had considered. Locating himself in the tradition of the sociology of scientific knowledge, Michael also distanced himself from quantitative academic studies, and flagged up his social constructivist approach as more appropriate to studying the public. Michael differentiated between two main discourses of science constructed by the lay public: science-in-general, 'in which science is talked about as a coherent entity and emphasis is placed upon ... its knowledge domain of technological and natural phenomena' (p. 313); and science-in-particular, specific examples of science involving particular knowledges and identifiable, and often practical, goals. With respect to science-in-general, Michael had found that lay-members often constructed scientific knowledge as 'other', thus also actively constructing themselves as ignorant, though not necessarily, he argued, in a negative sense. Michael also referred to Wynne's research on Cumbrian sheep farmers to argue how the status of official scientists was diminished in a science-in-particular, local context, by the scientists displaying their own lack of knowledge of farming methods, while still framing their pronouncements in terms of certainties. A less negative construction of science-in-particular was also suggested to Michael by electricians working at the Sellafield nuclear fuel processing plant, who freely admitted their own ignorance about the inner workings of the power plant, as that was the role of other people, and if they knew too much it would only lead to panic in an emergency. Ignorance of science, Michael argued, ensured that in this context, practical procedures were followed and all parties concerned were working towards a common goal, with science not necessarily privileged above other knowledges or discourses. Michael concluded that his findings held important implications for 'the tacit claim, contained in the Royal Society's report on the public understanding of science, that more understanding of science's basic principles would lead to a greater 'rationality', more 'informed' debate and, ultimately, to increased social consensus' (p. 331). Knowledge, or lack of knowledge, of science could be something that was actively constructed by members of the lay-public as a means of maintaining the social status quo,

[212] Michael, M. (1992), 'Lay Discourses of Science: Science-in-General, Science-in-Particular, and Self', *Science, Technology and Human Values*, 17: 3, p. 314.

and the public were capable of discursively manoeuvring around science in ways which could on the one hand 'sustain the mystique and status of science, and, on the other, undermine them' (p. 330).

Institutional endorsements

An address by Neil Cossons, Director of the Science Museum, to the American Association for the Advancement of Science, and later published in *The Guardian* in the UK, suggests that, despite growing criticism of their approach, public understanding of science activity had changed very little within the scientific community. The Science Museum had become a focal point for discussions on the public understanding of science with a research team now based there under Durant, and the journal also being administered from there. The Museum also had more practical concerns regarding PUS, in terms of how best to communicate and represent science through its exhibits. In what appeared to be half a defence of public understanding of science, and half a call to redefine, or at least represent more forcefully, the position taken by the scientific establishment, Cossons, echoing Holton's fears of an increase in anti-science sentiment from the public, focused his address on what he perceived as negative cultural attitudes towards science:

> Science is perceived as part of something bigger, more insidious, threatening, inaccessible and sinister ... fashionable people want little of science. And people who want to be fashionable people will distance themselves from science in case they become tainted.[213]

Cossons appeared to be making a case for C.P Snow's 'two cultures' still being in operation in British society, if he was equating 'fashionable people' as being those without a science education, yet in jobs of high political influence.[214] The case for public understanding of

[213] Cossons, N. 'What do people mean by 'the public understanding of science'?' *The Guardian*, 28 February 1992, p. 28.

[214] Lewis Wolpert and cultural critic Fay Weldon had also engaged in a similar argument in the *Daily Telegraph* in 1991; see Weldon, F. 'Thoughts we dare not speak aloud', *Daily Telegraph*, 2 December 1991, p. 12. and Wolpert, L. 'So much for artistic license', *Daily Telegraph*, 9 December 1991, p. 14.

science as something more than simply an amateur pursuit of the scientist, was not, Cossons felt, being put across well:

> If there is an intellectually defensible justification for promoting the public understanding of science then it has yet to be articulated in a compelling way. For most, the public understanding of science, like information technology, is a non-specific umbrella term for unfocused good intentions that causes mild embarrassment amongst those less than already committed. When someone gets passionate about the public understanding of science without telling me what it is, I have difficulty looking them in the eye. I have the bruises where the ancient mariners of the public understanding of science movement have gripped me in order to state their devotion to the future of the "wide-eyed children of the world". (p. 28)

There was an indication that he, at least, was aware of the criticism of the scientific establishment's approach to PUS, which he characterised as charges of PUS being either 'an empty concept or one with an undeclared agenda not made explicit by its supposed aims'.[215] This criticism of scientific institutions was a misunderstanding, but, Cossons felt, a perfectly reasonable response to the promotion of confusing aims consisting of both science education and concerns about social attitudes to science and technology. As he argued:

> The only political leverage to be had for science is perceived public benefit, so the "public" in "the public understanding of science" gives it the appeal of egalitarian and altruistic worthiness. But it is not self-evident what the title - The Public Understanding Of Science - refers to ... It clearly has a vivid meaning for its protagonists, but this is imperfectly conveyed through its title and through the actions of its proponents. This sows seeds of doubt about how rigorous, candid or capable are its supporters. (p. 28)

Far from promoting a fundamental re-think of COPUS's aims of public understanding of science, however, Cossons was calling for a greater education of the public, more so even than those proponents he had criticised. Cossons made a case for science being something special, akin to religion, recognising that it had 'sacred objects which give it validation and immortality', and therefore was something which should rightly be set apart from other cultural pursuits such as art, which was solely concerned with personal subjectivities.

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[215] Cossons (1992), op. cit.

In 1993 the importance of the scientists' public understanding of science agenda was given a firm endorsement by the UK Government with the publication of the first science White Paper for twenty years. It was written under the supervision of William Waldegrave, who, as Chancellor of the Duchy of Lancaster, was the first Cabinet minister with a primary responsibility for science to have been appointed since Lord Hailsham in 1964. The White Paper, *Realising Our Potential: a strategy for science, engineering and technology,* proposed several changes to the way science funding was organised and administered, all geared towards 'improving the nation's competitiveness and quality of life by maintaining the excellence of science, engineering and technology in the United Kingdom'.[216] The paper made it clear that a profit motive was central to the new science blueprint being proposed, and the public understanding of science was a vital part of enabling this new vision for science. The Research Councils were split up into six new bodies, each focusing on a specific area of scientific research, and a Council for Science and Technology, directly answerable to the Prime Minister, was to be set up to ensure that research was directed along profitable lines. A Technology Foresight programme was also set up, which would involve government, industry and science in anticipating, and exploiting, emerging markets. Getting maximum value for money, by ensuring strong links between industry and science, was the key message, though this did not come with a promise of any extra money for science, which, after years of lobbying, some in the scientific community felt was disappointing. Bodmer, welcoming some of the proposals, was reportedly alarmed at the lack of provision for basic physical sciences.[217] The White Paper did, however, promise much in the way of financial support for public understanding of science activities, so for the first time the UK Government was endorsing what, up until now, had been an activity and concern of the science and social science communities.

To the Government the 'problem' of PUS was similar to COPUS's conception: a lack of awareness of science and technology on the part of the public. An increase in public understanding of science was seen as beneficial to both government and science, so it is not

[216] Office of Science and Technology (1993), *Realising Our Potential: A Strategy for Science, Engineering and Technology*, (London: HMSO), p. 68.
[217] Radford, T. and Knewstud, N. 'Profit Motive Central to Science Blueprint', *The Guardian*, 27 May 1993.

surprising that the White Paper echoed much of the same language from the Bodmer report, promising support for the ongoing activities of COPUS. The language suggests that cultivating a pro-science and technology public was seen as crucial to preparing new business and consumer markets:

> The understanding and application of science are fundamental to the fortunes of modern nations ... [strength in science and technology] has been, and remains, an immense national asset. It should be protected. But it will not be properly utilised unless further efforts are made to break down the barriers which still exist in the United Kingdom to the acceptance and recognition of the importance of science and technology to our future.[218]

The White Paper announced that there would be a new campaign to 'spread the understanding of science and technology in schools and amongst the public' (p. 7). And, in a similar tone to the arguments of T. H. Huxley a century earlier,[219] the White Paper justified its endorsement of attempts to improve the public understanding of science as a matter of general education:

> As a country we have suffered in the past from a culture which placed too low a value on education and training in general, and which gave insufficient recognition to the importance of knowledge and understanding of scientific and technological issues. (p. 53)

Again echoing the Bodmer report, the White Paper saw public understanding of science in instrumental terms, both as crucial to the economic success of the country, but also critical to increase the scientific workforce:

> The economy needs an adequate supply of specialist scientists and engineers ... over the long-term, the Government expects that its reforms of the education and training systems will lead to an improvement in the general level of understanding of scientific and technological issues across the population, and give a corresponding boost to the supply of scientifically literate manpower to industry. (p. 65)

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[218] Office of Science and Technology (1993), op. cit., p. 4.
[219] See for example Roos, D. (1977), 'Matthew Arnold and Thomas Henry Huxley: Two Speeches at the Royal Academy, 1881 and 1883', *Modern Philology*, 74: 3.

The consultation which had preceded the paper had included all the founding members of COPUS, and unsurprisingly, given the self-interest of their organisations, had identified a need to raise the general level of public awareness and understanding of science and technical issues as a major subject of concern. As the Royal Institution's contribution to the preceding consultation had argued, 'any national policy for science and technology must contain, as a necessary foundation, the diffusion among the public at large of an appreciation of what science is' (p. 65). COPUS had recommended to the OPSS (Office of Public Service and Science) that it provide £1m per year to increase activities, using COPUS as the means to manage the programme in cooperation with other participants.[220] While the Government endorsed the public understanding of science, it felt it would not be sensible to attempt any central direction of this diverse activity.[221] Instead, the Government wished to encourage and increase the activity which was already occurring in this area. A fund was set up, to be administered by COPUS, from which small grants would be given to cover part of the costs of activities designed to increase public understanding and appreciation of science and technology. The new Research Councils were also charged with the task of improving scientists' skills at communicating with the public. When the Science and Engineering Research Council later split into the Engineering and Physical Sciences Research Council (EPSRC), and the Particle Physics and Astronomy Research Council (PPARC), both set up PUS Advisory Committees as part of their internal structures.

The 1993 White Paper therefore gave a stamp of approval to the ongoing activities of COPUS and other scientific organisations in improving the public understanding of science, through better communication, education and public outreach. The Government, it could be argued, were also borrowing the already established discourse of PUS from within the scientific community to legitimate their own policy. The public, viewed as being ignorant and often anti-scientific, were an obstacle to scientific and economic progress, and therefore it needed to be more aware and better informed of all scientific matters. The PUS agenda was given further endorsement in March of the following year when the Government awarded money towards a national science, engineering and technology week, to be overseen by the

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220 COPUS minutes (1993), *PUS/3(93)*, (London: The Royal Society).
221 Office of Science and Technology (1993), op. cit., p. 66.

British Association for the Advancement of Science. The first National Science Week, SET7, was held in 1994. It featured more than 1000 different events in 235 towns across the United Kingdom, some of them small local events organised in schools, and others large-scale, and high-profile exhibitions and events at a national level. The science communication events included lectures, debates, exhibitions, plays, television programmes, workshops, competitions and quizzes. BBC Radio 1 went around the country with a *Science of Sound* Roadshow, and the Science Museum held a Science Poetry exhibit.[222]

Lewis Wolpert, Professor of Biology as Applied to Medicine at University College London, felt that the commitment to the public understanding of science by the Government signalled that things were 'getting better'; science was starting to be appreciated again.[223] Biologist Steven Rose also reflected at this time how scientists should be pleased about how far the Government had supported their PUS agenda:

> Waldegrave does deserve unstinting praise for his most imaginative act, increasing his Department's budget for something called 'the public understanding of science'. A few hundred thousand pounds for the Royal Society, the British Association and the Edinburgh Science Festival, and the successful national Science Engineering and Technology week (SET7) in March, lifted, albeit temporarily, the despondency among the country's scientists.[224]

He was, however, also critical of the approach at the same time, arguing:

> Although spending money this way fits the government's approach of manipulating image rather than addressing substance, the way researchers threw themselves into organising SET7, and the 200,000 visitors to the Edinburgh Science Festival's Easter fortnight, speak to a real concern, on the part of scientists and lay public, to comprehend one another better. Of course, the Royal Society sees this as ensuring the public love scientists, while lay people find out what scientists are up to and inform their critiques. In a democracy, that is how things ought to work.[225]

Following Waldgrave's move to the Department of Agriculture the following year, the incoming Minister with responsibility for science, David Hunt, in his first major speech on

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222 Durant, J. 'Science Thrust to Centre Stage', *The Sunday Times*, 13 March 1994.
223 Wolpert, L. 'Science makes the world go round', *The Sunday Times*, 20 March 1994.
224 Rose, S., 'Reshuffle: Cabinet's Hungry Walrus', *The Guardian*, 4 August 1994.
225 ibid.

science, reportedly told the British Association that science and technology were central to Britain's daily life. "If we fall behind in science", he argued, "we fall behind in almost every other area. It is as simple as that". He added, "If we are each to play a full part in public debate, we increasingly need to understand science".[226] Signalling straight away that the public understanding of science remained a priority, he announced he was giving £140,000 to the British Association for a second national science week, £150,000 to COPUS and £85,000 for a Science Museum exhibition.

The nature of science and society

Wolpert succeeded Bodmer as Chair of COPUS at the start of 1994. As one of a few 'visible scientists' in the UK, Wolpert had been active in popular lecturing, writing, and television and radio broadcasting for many years. He was also no stranger to the public understanding of science having, a year earlier, discussed the nature of science, in his book *The Unnatural Nature of Science*.[227] He had argued that science had a problematic relationship with society because it involved an 'unnatural' way of thinking that was in direct conflict with common sense. Therefore, as Wolpert explained in his book, 'the best and probably only way to understand science is to do scientific research' (p. 177). Lay-persons, he argued, lacked any familiarity with scientific thinking and science should therefore be left for scientists. The implications of this statement, as Durant outlined in an editorial in *Public Understanding of Science,* was that the task of popularising science would be very difficult, if not 'downright impossible'.[228] Wolpert was dismissive of the claims of sociologists and philosophers of science as to the nature, and the public understanding of, science so Durant commissioned several different reviews by scholars working in the academic fields that Wolpert had addressed in the book, or who were involved in the popularisation of science.[229] The ensuing

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226 ibid.
227 Wolpert, L. (1992), *The Unnatural Nature of Science*, (London: Faber).
228 Durant, J. (1993), 'Editor's introduction to Multiple Book Review: *The Unnatural Nature of Science* by Lewis Wolpert', *Public Understanding of Science*, 2: 3, p. 257.
229 The reviewers were Jon Turney, Features Editor for the *Times Higher Education Supplement* and Course Director for the Diploma of Science Communication at Birkbeck College, University of London; Physicist Paul M. Clark at the Open University; Harry Collins, Professor of Sociology and

conflict highlighted the very different stances not only toward the public understanding of science, but towards whose definition of science it was deemed appropriate to popularise.

Jon Turney argued that if one believed that there was, as Wolpert argued, an irreconcilable gulf of understanding between scientists and the rest of society, this had grave consequences for the public understanding of science:

> [PUS] would be reduced to understanding the superiority of the scientific mode of investigation. Scientists would not be the final arbiters on matters of politics or morality, nor would they be able to solve all the world's problems. But they would have a special claim on truth about the world, and that truth would be arrived at in such an unnatural way that most of the population could hope for the dimmest grasp of the results.[230]

Turney criticised Wolpert for not addressing these implications, and instead simply promoting the need for more scientists to devote their time to popularisation, without managing to reconcile this with his claim that science was beyond most people's comprehension.

Harry Collins said the book was not 'witty, informative, or stylishly written' (p. 259). As Collins continued:

> On first reading I found the book chilling because it seems not so much an academic enterprise, nor even a popularization of difficult ideas, but a rallying point for the 'Colonel Blimps' in the analysis of science. On further reading it seems, rather, that it is motivated by a series of misapprehensions. (pp. 261-2)

Collins devoted much of his review to countering Wolpert's attack on sociologists and historians of scientific knowledge. Wolpert had argued that the use of a symmetrical analysis of science by sociologists was akin to giving an equivalent status to 'wrong' or pseudoscientific thinking. Collins, however, argued that sociologists and historians of

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Director of the Science Studies Centre at the University of Bath; Simon Schaffer, historian of Science at Cambridge University; James Cornell, a science journalist based at the Harvard Smithsonian Center for Astrophysics, and Michael Shortland, at the Department of History and Philosophy at the University of Sydney.

[230] Turney, J., *et al.* (1993), 'Multiple Book Review: *The Unnatural Nature of Science* by Lewis Wolpert', *Public Understanding of Science*, 2: 3, p. 259.

science, aside from the fact that they were paid to unpick and cast doubt on the way science had developed, used this principle of symmetry to put themselves in the shoes of a historical contemporary who had opposed a scientific theory that had later become accepted. This helped, he argued, to understand how the scientific theory became accepted over any others. Many of Wolpert's conclusions were, claimed Collins, close to the conclusions of sociologists and historians of science, and, though their methodologies differed, Wolpert misunderstood the discipline by characterising it as 'anti-science' (p. 262). Collins finished his review arguing that Wolpert was trying to portray an image of science that did not actually exist, and was instead describing science as how scientists would like it to be:

> Now one can see how brilliant scientist, Lewis Wolpert, came to write a book so casually argued and so packed with *ex-cathedra* declarations. The contrasting notions of common sense and scientific thought are all mixed up with what he believes about what others don't know. Everything reads outwards and backwards from there. Those who cannot see the world the way he sees it are not in need of examples of better reasoning, they simply need to be given the facts. (p. 264)

Other reviewers in *Public Understanding of Science* also took a very critical stance towards Wolpert's book. Historian Simon Schaffer argued that Wolpert took a carefree attitude to the history of the sciences, and as such might not have understood the processes used to construct and deconstruct historical accounts of scientific knowledge. Science journalist James Cornell called it an 'elitist argument for the specialness of science – and scientists' and argued that Wolpert's main interest in public understanding of science was simply that science needed public acceptance (p. 276). Michael Shortland argued that Wolpert's views would possibly only serve to increase the perceived tensions between science and its cultural critics and undermine the mission towards a greater scientific literacy in the general public:

> By severing science's links with common sense, society and culture – to say nothing of religion – Wolpert's book seems to me to make the job of promoting science far more difficult and its purpose less pointed than needs to be. Once science is ethereal, individual, the stuff of far-sighted leaps and bounds, what role for lesser mortals? To clap from the sidelines? (pp. 270-1)

Wolpert, having been given the opportunity to respond to these reviews, regretted that his views may have had grave consequences for the public understanding of science, but rejected the criticism that he was suggesting that the public could have nothing to do with science. While he did not go as far as to suggest that they could understand science, he argued that non-scientists could appreciate and enjoy science. Wolpert felt that social scientists should have no role in communicating their view of science in the public domain, calling the sociology of scientific knowledge 'pretentious'. Sociologists, according to Wolpert, claimed that science was a social construct which therefore did not provide special knowledge of the world, a view-point Wolpert found distasteful. Following on from this, Wolpert, expressed his confusion as to why, when science was not special, should the reviewers argue that the public understanding of science was important? The whole exchange highlights the boundary work between the different professions. All had very different conceptualisations of science, social science and the public understanding of science, yet all claimed ownership and authority over the PUS issue.

The UK was experiencing a boom in popular science writing in the early-1990s with Stephen Hawking's book, *A Brief History of Time*, and others by Richard Feynman, Stephen Jay Gould, and Richard Dawkins being published and widely available. So Wolpert's book was one among many which brought scientists' definitions of science into the public domain. In opposition to these, later that same year Harry Collins, along with long-time colleague Trevor Pinch, Professor in Science and Technology Studies at Cornell University, published their book *The Golem: What everyone should know about science*, which advanced a very different idea of the public understanding of science. Like other popular science books, *The Golem* was aimed at a general reader who, according to its authors, wanted 'to know how science really works and to know how much authority to grant experts'.[231] Selecting a range of scientific case-studies, based on their own original research into gravity waves and solar neutrinos, as well as on the work of other scholars, the authors' aims were to liken science to the powerful yet unpredictable creature from Jewish mythology, the Golem:

> We aim to show that it is not an evil creature but it is a little daft. Golem Science is not to be blamed for its mistakes; they are our mistakes. A golem cannot be blamed if it is doing its best. But we must not expect too much. A golem, powerful though it is, is the creature of our art and our craft. (p. 2)

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[231] Collins, H. and Pinch, T. (1993), *The Golem: What Everyone should know about Science*, (Cambridge: Cambridge University Press), p. xv.

The book had several main messages, the first of which, as can be seen from the quote above, was an attempt to correct a public image of science as something which produced certainty. This image, the authors felt, was promulgated by heroic histories of science and school science, neither of which portrayed the activity of social negotiation that surrounded scientific discovery. The inevitable product of this sort of model of science in public, the authors argued, was that science would be viewed as all good or all bad, which was dangerous and misleading:

> The overweening claims to authority of many scientists and technologists are offensive and unjustified but the likely reaction, born of failed promises, might precipitate a still worse anti-scientific movement. Scientists should promise less; they might then be better able to keep their promises. Let us admire them as craft persons: the foremost experts in the ways of the natural world. (p. 142)

Similar to many of the scientists within the public understanding of science movement, Collins and Pinch were concerned about anti-science sentiment, and they admired any attempts at disabusing the public about unsupported claims. Similarly, the public should still be educated, as citizens needed, they argued 'to know enough to come to some decision about whether they prefer more coal mines, or more nuclear power stations' (p. 144). However, they argued that it was ridiculous to expect the public to be educated with scientific facts, and then be able to make better sense out of science at the messy research frontier, where all sides had expertise 'way beyond what can ever be hoped of the person in the street' (p. 144). Thus, what was different in their formulation of PUS, as opposed to the more traditional conceptualisation of Bodmer's, was simply a matter of what sort of education was given to the public. Rather than the content of science, it was the relationship of experts to politicians, to the media, and to the rest of us in which the public needed to be better educated. As they argued:

> To change the public understanding of the political role of science and technology is the most important part of our book and that is why most of our chapters have revealed the inner workings of science. (p. 145)

The book was controversial to many outside of science and technology studies, indeed *Nature* called it 'perverse but entertaining', and Lewis Wolpert stated it gave a 'distorted and highly biased image of science'.[232] As sociologist Steve Fuller later reflected, the boundary work performed by Collins and Pinch - a combination of publicly suggesting an approach to public understanding of science which conflicted with the official institutional approach, while also arguing that sociologists of science understood science better than scientists themselves - was unwelcome to many:

> While it is clear that Collins and Pinch meant to give friendly advice to scientists, the book — and Collins in particular — were taken to be hostile by the scientists most closely identified with the public understanding of science. At least part of the misunderstanding here can be traced to a subtext of The Golem that became increasingly prominent in Collins's public exchanges. Collins was at least as interested in defending the autonomy of science studies as in advising scientists on how to improve their public image. This led to a positive feedback loop: the more that Collins insisted on drawing a sharp distinction between the sociologist's and the scientist's work, the more that scientists took him as in fact encroaching on their work, and thus the more they felt emboldened to reciprocate by pronouncing on what sociologists of science should be doing.[233]

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232 Hendry, R., et al. (1994), 'Multiple Book Review: *The Golem: What Everyone Should Know About Science* by Harry Collins and Trevor Pinch', *Public Understanding of Science*, 3: 3.
233 Fuller, S. (1995), 'Two Cultures II: Science studies goes public with Bibliographic guide', *EASST Review*, March 1995.

4 Two Tribes go to War

Phase II

Academic discussions over definitions of science and the public understanding of science, exemplified by both Wolpert's book and *The Golem,* continued into the next year when, in September of 1994, Collins and Wolpert shared a stage at the British Association's Annual Meeting in Loughborough. Wolpert's attack on sociologists and philosophers of science had continued to stimulate counter-attacks from members of the academic science studies community in the years since publishing *The Unnatural Nature of Science.* The most recent of these, from Steve Fuller and published in *Social Studies of Science,* had suggested that the motivation of Wolpert (and Fuller's other target, physicist Steven Weinberg) in attacking science studies was the fear that the field would have 'a dangerous effect on the thinking of non-scientists who make science policy'.[234] So what had become a highly charged debate within the review section of journals, reached its pinnacle at the Lougborough meeting in what was later described by a reporter for the *New Statesman* as an 'extraordinarily vituperative and horrible' argument between the two men,[235] which left a considerable impression on those who witnessed it.[236]

All of this debate should be viewed against the backdrop of what was later dubbed the 'science wars', which, though more of a phenomenon in the United States, brought the field of science studies (or science and technology studies in the UK) under scrutiny and gave it media attention. While an in depth historical account of 'who said what, to whom' in the science wars would take this thesis somewhat off track, it is a relevant context for the debates over the public understanding of science between social scientists and scientists that were also occurring in the UK at this time. Concerns over a potentially subversive impact on the public of definitions of science that were not from the scientific community were at the

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[234] Fuller, S. (1994), 'Can Science Studies be Spoken in a Civil Tongue?' *Social Studies of Science*, 24: 1. p. 143

[235] Johnson, J. (1995), 'Science Friction', *New Statesman and Society*, 13 January 1995.

[236] Rose, H. (1996), 'My Enemy's Enemy Is, Only Perhaps, My Friend', *Social Text*, 46/47, p. 65.

core of the science wars. In the UK many of those actors involved in the public understanding of science, both in an institutional, and academic, context entered into the debate. What was partly at stake was the legitimacy to define and promote one's definition of science in public. Thus the whole episode is one where the boundary work between the professional disciplines becomes explicit.

While, as the last chapter has shown, there had already been conflict over definitions of 'science', and 'the public', and, more importantly, who subsequently had the authority to construct and influence the relationship between the two, a few specific events can be identified as mobilising and sustaining the conflict. Firstly, certain scientists, such as Holton, had expressed concern at the Smithsonian Institution's 1994 exhibition *Science in American Life,* and branded the exhibition as anti-scientific, claiming it would engender anti-scientific attitudes in its visitors.[237] The exhibition, which showed science in its social and historical context, had included images of atomic destruction and chemical pollution. It was too negative for its financial backers, the American Chemical Society, and they disowned the exhibition's representation of science a year later, blaming post-modernist sentiments among some of the curators and members of the advisory board.[238] Picking up where Gerald Holton had left off, mathematician Norman Levitt and Paul Gross, former director of the Woods Hole Marine Biology research station, published *Higher Superstition: the academic left and its quarrels with science.*[239] In the book the authors defended science against what they perceived as the 'anti-scientific' attitudes proffered by what they called an 'academic left' of social constructivists, cultural theorists, feminists, multiculturalists and some extreme environmentalists. The book was followed by a conference hosted by the New York Academy of Sciences in the following year entitled 'The Flight from Science and Reason' which rallied many scientists together to decry those same academics perceived to be taking up 'cudgels against science'. Later, in 1996, Alan Sokal, a professor of physics at New York University, submitted a paper of what he called 'outright nonsense' for publication in cultural

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237 Gieryn, T. (1996), 'Policing STS: A Boundary-Work Souvenir from the Smithsonian Exhibition on "Science in American Life"', *Science, Technology and Human Values*, 21: 1, p. 106.
238 Thomas Gieryn was a member of said advisory board. Gieryn (1999), op. cit., p. 338.
239 Gross, P. R. and Levitt, N. (1994), *Higher Superstition: the academic left and it's quarrels with science*, (Baltimore and London: John Hopkins University Press).

studies journal *Social Text*, as an experiment to see if a journal in that field would, 'publish an article liberally salted with nonsense if (a) it sounded good and (b) it flattered the editors' ideological preconceptions'.[240] The ensuing debate centred on both the intellectual rigour (or lack there of) of the social sciences, and the ethics of Sokal's attempt to defraud a journal.

Wolpert, in a similar fashion to his American counterparts, appeared to have found science studies threatening enough to the public reception of science to devote time and effort to trying to deny the authority or legitimacy of science and technology studies' academics in proposing their own definitions of science. The fact that Collins and Pinch had presented *The Golem* as a contribution to the public understanding of science (indeed the book's subtitle was *What Everyone Should Know About Science)* had also posed an implicit challenge to the dominant role that scientists had, up until this point, enjoyed in conducting activity in this area. A line was therefore being drawn between differing approaches to PUS, and Wolpert, as the Chair of COPUS at this time, was almost duty bound to respond to such challenge. Earlier that same year, in a sign that Wolpert was indeed concerned about 'anti-science' thinking, he had, as a member of the BBC Science Consultative Committee, attempted to stop BBC Television from making a six part series on scientific 'heretics',[241] for fear it gave the wrong impression of science, and was reported in *The Sunday Times* to have said:

> This is an absurd series. The whole way these programmes are being presented just fills me with rage. It's a grotesque distortion. It's disgusting. It's just sensational anti-science, and anti-science is the rationalization for ignorance.[242]

It was therefore in this already heated and emotive context that the stage was set for Collins and Wolpert to meet at the British Association's Loughborough meeting. The morning session at the meeting was scheduled to explore the sociology of science, and the first two speakers were Brian Wynne and John Ziman, followed by Lewis Wolpert and finally Harry Collins.

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[240] Sokal, A. (1996), 'A Physicist Experiments With Cultural Studies', *Lingua Franca.*
[241] BBC Series, 'Heretics', broadcast on BBC 2, written and produced by Tony Edwards, 1994.
[242] Margolis, J. 'Heretics', *The Sunday Times*, 3 July 1994.

Wolpert, confirming that he was very much aware of the work of Gross and Levitt, recommended their book in his talk and, taking a very similar line of attack as they had in *Higher Superstition*, described any comment on science by those from within the social sciences as being motivated by a resentment on their part. As he said:

> "What it seems to me is, that in some sense the sociologists have won. There's this curious view about the nature of the world and the nature of science that is presented to the non-scientific world which is totally at variance as to what I consider to be science ... what I want to talk about really are the sociologists of science, who ... have not only obfuscated, but they have been extremely hostile to science. And I think that one of the characteristics of the post-modern world is that many in the humanities have failed to come to terms with the enormous success of science. Now that's not a nice thing to say, but I regret to say that it's probably true."[243]

To back up his claim, Wolpert had quoted Howard Newby, who was chairman of the Economic and Social Research Council in the UK: "It is not surprising", Newby had said, "because of the massive inferiority complex, social scientists have ... demystified the official credo of science, and ... have sought to demonstrate that science is but one means of creating knowledge. I regret to say that it is little more than envy". Social studies of science, continued Wolpert, were intellectually bankrupt:

> "If you are in my field you are wildly excited, new results are coming out everyday, we're really making tremendous progress. I feel that that's not necessarily the case in the sociology of science. I've heard Brian Wynne recycle that particular story of sheep, I think at least three times now, where's the really new evidence?"[244]

The 'relativist' methodological approach employed by some sociologists of science was, to Wolpert, interpreted to mean that they simply saw science as a social construct and therefore not any better a means to understand nature than any other form of knowledge. While some sociologists did take this ontologically relativist position, many did not and, as Collins pointed out in response, most simply used it as a methodology, a distinction that Wolpert did not make in his general characterisation of social scientific views. His attacks on all sociologists as being anti-scientific and motivated by envy, and his claims that their discipline

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[243] The British Association for the Advancement of Science (1994), *Meeting on the social sciences, Annual Meeting Loughborough*, transcribed by Simon Lock, May 2005.
[244] ibid.

was empty of any evidence, were, as Collins and Pinch themselves had argued many years before, typical of scientists wishing to reject anything they saw as unorthodox, and maintain a boundary of expertise around science.[245] Furthermore, by making personal attacks on the 'accused' rather than engaging with the academic content of their claims, Wolpert was explicitly denying any authority to those claims, and indeed, in another personal slight, even went as far as to dismiss sociology of science as something which was so trivial it did not even concern most scientists. As he told the audience:

> "If you think that this type of debate is happening within the scientific community then you are wrong. Scientists, as a community know absolutely nothing about this whatsoever, and have no interest in it whatsoever."

The attack by Wolpert was, as the video of the session shows, shocking to some in the audience. Several audience members in the question session afterwards criticised him for having a lack of understanding of sociology.[246] John Ziman denounced Wolpert's talk:

> "I'm not sure that what Lewis is saying has much content to it other than rejecting a view from his own emotional stance ... I am actually appalled by Lewis Wolpert's anti academic way of dealing with these matters, I regard that as really inappropriate and really rather scandalous, and I hope that he will mend his ways. I do think that that is something that we should not tolerate in our senior academics and intellectuals."

Harry Collins, who, on the video was visibly angry and, as he claimed, "embarrassed" as he stood up to follow Wolpert's talk, accused Wolpert of lying to the audience, and tried to defend the sociology of science from his charges of being anti-scientific:

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[245] Collins, H. and Pinch, T. (1979), 'The construction of the paranormal: nothing unscientific is happening', in Wallis, ed., *On the Margins of Science: the Social Construction of Rejected Knowledge*, (Keele: University of Keele Press). This rejection according to Collins and Pinch happens in two different contexts. The constitutive forum, which is seen to be the part of science that contributes to scientific knowledge: conferences, journals, any of the normal channels that are used by trained scientists to receive recognition of their work. The other is the contingent forum, which does not necessarily hold to the scientific objectivity that must be seen in the constitutive forum. Therefore it can include personal views exchanged between scientists, gossip, and the views of popular science publications all contribute, though these are not generally thought to contribute to scientific knowledge.

[246] Personal observation from video footage of debate.

> "Now if you'd spoken to myself, or to some of the other people that you've mentioned in your talk, you would know that far from being hostile towards science, we are all ... science lovers. We love nothing better than to be in science laboratories, speaking with scientists, seeing how it works, trying to understand it. And again if you'd read books like this more carefully you would have read that quite explicitly one of the things that we think we're doing is trying to make the world a bit safer for science, trying to protect it against those who might react against science, because they see the failures of some of the over the top promises that have been made."[247]

Collins continued with a defence of both the relativistic approach of sociologists of science as a methodological principle, and the charge that there was no evidence in the field. The defence was as much a personal attack on Wolpert as it was a defence of SSK:

> "I've been asked to speak on a platform with you before and I've refused because it seems to me that what you're engaging in is a pantomime act rather than a scientific methodology ... They're [sociologists] honest, they provide evidence, they argue among themselves, like cats and dogs, and we feel ourselves to be going into science as Merton described it, although there is this slight irony at the same time because it's not quite like Merton described it and you of course demonstrate the point quite adequately."

Many of the audience members accused Wolpert of not behaving as an academic should and the meeting concluded with John Ziman urging the audience to remember that neither academic represented the scientific community or the social scientific community at large, and there was a middle ground for more fruitful discussion.

It is noteworthy that the subsequent *THES* coverage was constructed around the question of whether science was a social construct, a narrow interpretation of the debate, which also, in a similar fashion to Wolpert, ignored the many sociologists who would not take this view. As Wynne had argued at the end of the meeting, "sociological explanations of science do not mean that nature doesn't have a role in the construction of knowledge", yet the press coverage presented the extreme sides of the argument.[248] This, however, says as much about standard media practice of reporting a controversy, as it might about any particular stance the paper may have had.[249] As sociologist Hilary Rose later reflected, this focus had left little

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247 The British Association for the Advancement of Science *(1994) Loughborough meeting transcript.*
248 ibid.
249 Media studies scholars have argued that it is common media practice to portray a scientific debate as a two-sided conflict, despite the two-sidedness not necessarily reflecting the real life situation. See

scope for a meaningful debate about the sociology of science, nor did it reflect the diversity of opinion or approaches within either discipline:

> The options for those sociologists who disagreed with Collins or those biologists who disagreed with Wolpert (to say nothing of those who as feminists thought both were unreconstructedly macho in thought and style) were shrivelled down to the binary choice of either Collins or Wolpert.[250]

The coverage both prolonged the debate, and moved it further into the public domain. While Wolpert's and Collins' positions were extremes the multitude of replies to the *THES* revealed many tensions and ensuing boundary work between certain science studies academics and scientists over who had the expertise and legitimacy to discuss science in public. Collins continued his defence of the social studies of science in the coverage, here resorting to similar *ad hominem* tactics to Wolpert, branding the conflict a witch-hunt and suggesting that the violent attacks on sociology were a result of a newfound insecurity of science, in a world where scientists did not enjoy unquestioned authority. Richard Dawkins on the other hand called the sociology of science 'chic drivel', and accused sociologists of hypocrisy, suggesting that the role of the sociologist of science should be limited to defending the claim that scientists were influenced by their own social and cultural background.[251] Peter Atkins, a lecturer in physical chemistry at Oxford University contributed a commentary, which argued that science was independent of society. Painting a picture of science as progressive, objective, and universal, he argued that those who suggested that science could be any other way were 'motivated by jealousy in one of its disguises (such as political correctness) or by a wish to see science's progress tripped'.[252] Thus despite Wolpert's claim that science studies was not the concern of scientists, the coverage suggests this was not the case. There were many other scientists concerned about the influence that science studies may or may not have had on the publics' views on science,

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for example debates around climate change in the early 21st century or debates around the MMR vaccination in the UK. The setting up of an apparently evenly sided debate provides what media studies scholars call more "newsvalue". See for example: Goodell, R. (1987), 'The role of the mass media in scientific controversy', in Engelhardt and Caplan, eds, *Scientific controversies: Case-studies in the resolution and closure of disputes in science and technology*, (Cambridge: Cambridge University Press).
[250] Rose (1996), op. cit., p. 65.
[251] Dawkins, R quoted in Irwin, A[isling] 'Science's social standing', *Times Higher Educational Supplement*, 30 September 1994, p. 17.
[252] ibid.

particularly, it seems, if the discipline was advancing a view of science which conflicted with the public image that they felt had been popularised by scientists over many centuries. Conversely, this vocal response could also lend support to Fuller's argument that all the attention these critics gave to science studies suggested that the discipline had acquired a recognisable voice in the general intellectual discourse that helped shape public opinion and policy.[253]

In the following year the ongoing debate was covered in the *New Statesman*, a popular magazine on the left of the political spectrum. Taking a more sympathetic view towards sociologists of science than the *THES* had done, the article claimed that the debate had little to do with philosophical matters, and more to do with scientists becoming 'aware of a public mood that has turned distinctly against science' and 'more mundane concerns like status and the contest between disciplines for a diminishing pot of funds'.[254] Indeed Wolpert appeared to agree with this view, but only in reference to the sociologists, attempting to downgrade their stance as political, while scientists' was not:

> They have a political agenda ... and that is to show that science does not have the authority to describe, in any particularly reliable way, the external world. By propagating this dangerous nonsense, they are undermining science, and since they do not understand science, they should be stopped. I think they want to get control of science funding.[255]

Sociologist Andrew Pickering was reported in the *New Statesman* article to claim that while scientists tended to think that they knew how best science was carried out, the way they presented the process of scientific inquiry was a 'story they trot out' and 'nothing more than Sunday theorising'.[256] What was at stake, the article also quoted one historian of science as saying, was 'the right of non-scientists to comment on the way science seems to work', and, I would further argue, who was allowed to popularise these views to the public. Certainly this whole episode showed that many scientists felt that it was their right to maintain control over their own narrative.

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253 Fuller (1994), op. cit., p. 143.
254 Johnson (1995), op. cit.
255 ibid.
256 ibid.

PUS as social research

The Loughborough debate had focused certain scientists' attention on the field of science and technology studies. However, these debates had been on only one aspect of the field's contribution to questions of science and technology, that of SSK and Collin's and Pinch's 'golem science'. Alongside these contributions, as activity in *Public Understanding of Science*, *Social Studies of Science* and *Science Technology and Human Values* at this time shows, was a growing body of other social science academics all engaging in the public understanding of science debate. Many of these were critics of the scientific institutions' conceptualisation of the 'problem' of public understanding of science. Furthermore, many of them also put forward their own conceptualisation of what PUS was. These alternative conceptualisations, largely borne out of the work by the qualitative and contextual studies commissioned as part of the ESRC programme, were becoming more prominent in the discourse of PUS, mobilised as an alternative to the efforts of COPUS and others towards educating the public. Evidence that this 'contextual perspective' on the public understanding of science was becoming more formalised, and perhaps a more dominant part of science and technology studies can be seen in Wynne's chapter entitled 'Public Understanding of Science' in the edited *Handbook of Science and Technology Studies*, published in 1995.[257] The book served as a guide to the different areas of research that STS covered, thus PUS research, by virtue of having a chapter devoted to it, was here legitimated as a valid area of social scientific inquiry. Wynne admitted at the start of his chapter that PUS was 'a wide and ill-defined area involving several different disciplinary perspectives', with 'no coherent paradigm having gained sovereignty' (p. 361). The fact that Wynne had been chosen as its author is also significant, as the chapter provided Wynne the opportunity to critique other institutional and social research perspectives on the public understanding of science, and present his own research as STS canon, in this important work of reference. In a drawing together of many of his ideas published in separate papers over the previous years, Wynne's most explicit criticism was addressed again to what he called the 'dominant political paradigm' which 'shaped a particular framing of the PUS problem' (p. 361). As he had continued:

[257] Wynne, B. (1995), 'Public Understanding of Science', in Jasanoff, et al., eds, *The Handbook of Science and Technology Studies*, (Thousand Oaks CA: Sage).

> Vague though powerful concerns about "public understanding of science" have been woven into ideological programs of various kinds ever since science entered public discourse. A common thread has been anxiety among social elites about maintaining social control via public assimilation of "the natural order" as revealed by science. (p. 361)

Wynne argued there was confusion within this dominant formulation of PUS, which he attributed to a 'neglect of the distinctions between public appreciation of, interest in, and understanding of science' (p. 363). Furthermore, he re-iterated his, and other social scientists', argument that this dominant approach was shaped by 'problematizing publics, and their cognitive processes and capabilities, thereby implying scientific knowledges, practices, and institutions to be unproblematic' (p. 362). Problematising science to Wynne, however, was a 'central part of any serious attempt to define the overall research and public policy issues of public understanding of science' (p. 384). As he noted later in the chapter, many outside the scientific community had observed that the public was positive about science, but had been alienated from it by most scientists' reluctance to communicate with the public. This, he argued, ignored the 'challenging sociological finding' that PUS problems were as much to do with 'institutional and epistemic characteristics of dominant forms of science' as they were to do with the public themselves (p. 385). By suggesting that much social scientific work was either misrepresented or misunderstood, Wynne used similar boundary work tactics to those scientists who identified a deficit on the part of the public. His criticisms, however, though largely focused on the institutional formulations of PUS, as can be seen in his use of the words 'perverse', 'patronizing' and 'confusions' to describe these efforts, were also aimed at other social scientists. Here he laid out more clearly his criticism of quantitative studies into PUS, arguing that surveys only went some way towards 'convergence with the insights of qualitative research' (p. 367), due to the fact of 'inevitably building normative assumptions about the public, about what is meant by science and scientific knowledge, and about understanding' (p. 370). Rhetorically linking quantitative research to a deficit model of PUS, Wynne argued that attitudinal surveys, 'uncritically assumed that 'better public information' would lead to greater 'understanding' and this would also mean greater acceptance of science; but the competing information or 'understanding' that might be in play were rarely discussed' (p. 369). Hinting at the difficult relationship between quantitative and qualitative researchers, he suggested that there were some potentially fruitful correspondences and complementarities between the two approaches. However, he characterised the relationship between the two groups as a mirror of the relationship between 'universal' science and local cultures; the former employed a dominating universalist discourse, whereas the latter attempted to negotiate in a more reflexive manner. Wynne was uncomfortable with the idea that qualitative studies simply served to flesh out the picture within the framework of objective accounts of public knowledge as measured in large-scale quantitative surveys. As he argued:

> The role of qualitative studies is not to identify more refined and 'sensitive' questions for surveys to test on an objective level. Rather the relational constructions of 'understanding', 'science', 'knowledge', and 'trust' that the qualitative studies identify and explore are simply not accessible to large-scale survey methods. (p. 369)

Turning the concept of 'understanding' on its head, Wynne argued that it was, 'patronizing' of scientists to describe public reactions as 'subjective irrationality', as science could be rejected on grounds other than technical ignorance, such as trust in, and identification with, the institutions controlling and deploying it.

Wynne did maintain a reflexive perspective on his own position, and questioned how far micro-social qualitative studies could be used to draw general conclusions on public interactions with science. He also conceded that there was, like the institutional approaches to PUS, a normative commitment within his own, and other social scientific, formulations, which held that pluralism in public science should be possible, and would be beneficial. He concluded however that there was a 'tacit cultural politics of legitimation of science, and of related institutions, being conducted under the language of public understanding of science' (p. 388). I would argue that there was also a similar process, seen within this period, of a tacit cultural politics of legitimation of certain social scientific perspectives, being conducted within his and others' discourses of public understanding of science.

A new direction for PUS?

Another sign of the growing professionalisation of social research into the public understanding of science was the creation of the first university chair in the area. Having been working as a visiting professor at the Science Museum and Imperial College, London since 1989, Durant was given a personal chair in the Public Understanding of Science in 1995. The Science Communication group at Imperial, he stated, had grown into a large research centre, which, as he pointed out in his inaugural lecture, had two full-time lecturers and three dozen post-graduate students working and studying there.[258] Reflecting on the decade since the Bodmer report, he felt that COPUS deserved a good deal of credit for much of the expansion in science broadcasting, lectures, festivals and other initiatives that had sprung up in the intervening years. The rest of his lecture, however, echoing many of the same arguments from Wynne, added to a growing criticism of the status quo in PUS, as he argued:

> "One weakness had been a tendency towards what I would call a 'top-down' approach – that is a tendency to view things from the point of view of the scientific community rather than of other key groups (such as mediators and audiences); and another, related weakness has been a tendency towards what might be called a celebratory approach to science and technology." (p. 2)

Durant continued with a call for change in the direction of public understanding efforts, though was less critical of those within the scientific community than Wynne had been:

> "... the scientific community should not be blamed too much for tending towards [these] approaches. At the same time, I want to suggest that so long as it confines itself to what might be termed the missionary role – going out, if you like, and looking for converts – the scientific community risks failing to address some crucially important issues to do with the changing place of science and technology in our culture ... the time has now come to move on in the public understanding of science. What we need is a new agenda and a new programme."

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[258] Durant, J. (1995a). 'A new agenda for the public understanding of science: An inaugural Lecture given by John Durant, Professor of Public Understanding of Science, on 28 November 1995 in the Clore Lecture Theatre'. Imperial College, London).

The impetus for Durant's plea for change had come from several joint-pieces of research that he had published with colleagues at the Science Museum, and other academics, all of which had suggested an ambivalence in public attitudes to science and technology.[259] He also cited his involvement in the UK's first consensus conference in the previous year as a reason for the need to rethink the current dominant approach to the public understanding of science.[260]

The research had, to Durant, suggested that the relationship between science and the public was not, as he pointed out, simply to do with knowledge and ignorance, but also to do with "trust and distrust; and, needless to say, with the various compounds of trust and distrust that are best described as ambivalence".[261] Further evidence that the relationship between public attitudes to science and technology and understanding was not as simple as previously assumed had also been published in *Public Understanding of Science* earlier that year, in a paper by Geoff Evans and Durant. The authors had argued that, despite the widespread idea that greater knowledge of science leads to a greater support for science, there was 'relatively little evidence in the literature to show whether or not the argument is correct'.[262] Challenging the central tenet of the scientific institutions' PUS efforts, they argued that from their analysis of quantitative survey results there was 'at best, a weak correlation between knowledge and attitudes' (p. 57). The real situation was more complex, and they also argued that measures of general attitudes were 'inadequate as a guide to what the public may think of specific areas of scientific research' (p. 70). The public were more likely to take into account 'practical considerations, and values other than those relating to science itself' (p. 59). Their research had also argued that people who were well informed in a particular area of science were as likely to express less support for the research as they were to express more. So they suggested 'it would be unwise for scientists and science policy-makers to presume that a

[259] See Bauer, M., *et al.* (1995), *Science and Technology in the British Press, 1946-1990. Final Report to the Wellcome Trust*, (London: Science Museum) for details of the media analysis.
[260] For a discussion of the consensus conference see Joss, S. and Durant, J. (1995), 'The UK National Consensus Conference on Plant Biotechnology', *Public Understanding of Science*, 4: 2.
[261] Durant (1995a), op. cit.
[262] Evans, G. and Durant, J. (1995), 'The relationship between knowledge and attitudes in the public understanding of science in Britain', *Public Understanding of Science*, 4: 1, p. 57.

better informed public is automatically a public that is more supportive of any and all forms of scientific research' (p. 70).

The experience of being involved with a consensus conference had also suggested, to Durant, how the relationship between science and the public could be conducted in a different manner. The consensus conference, an innovation in public participation in technology policy pioneered by the Danish Board of Technology, had been designed to allow two-way communication, or dialogue between lay people and experts. During the process a panel of lay volunteers conducted an investigation of a scientific or technological issue, cross-examined experts, and arrived at a point of view, which was published and presented at a press conference. In the previous year, the Science Museum and the Biotechnology and Biological Sciences Research Council had organised the first UK National Consensus Conference on Plant Biotechnology.[263] Durant's experience of the consensus conference had apparently proven to him that the public's judgement on scientific issues, despite having had no prior acquaintance with plant biotechnology, was often similar to the scientists', and the few areas of divergence were rooted in value differences rather than expertise. This experiment, and other participatory models on trial in other parts of Europe and North America, such as citizen advisory panels, citizen's juries, and deliberative opinion polls, were, according to Durant, trying to find new ways of closing a credibility gap between science and the public by fostering citizen involvement in science and technology policy-making.

All of the these findings, experiences and experiments, as Durant had argued in his inaugural speech, suggested that the public understanding of science needed to be refocused:

> "Our current agenda for the public understanding of science is dominated by the twin aims of inspiring interest and fostering learning ... I suggest that alongside them we should add the aim of cultivating trust between scientists and non-scientists."[264]

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[263] Joss, S. (1998), *The Role of Participation in Institutionalised Technology Assessment: A Case Study of Consensus Conferences*, (PhD Thesis: Imperial College London, University of London).
[264] Durant (1995a), op. cit.

This new agenda for public understanding of science, he argued, would involve learning to think about the subject in an entirely different way, not least about the role and concepts of its constituent parts:

> "Rather than thinking of the public as 'the great unwashed' ... we need to think of it as an arena or forum in which scientists and non-scientists meet as equals to consider questions together openly and honestly. Rather than thinking of understanding as formal knowledge ... we need to think of it as mutual appreciation between equals who have respect for one another's various competences, interests and points of view. And rather than thinking of science as a closed body of definitive truths that are handed down to the public from on high, we need to think of it once again as 'public knowledge'; as a body of evolving findings whose scope, limits, applications and implications are always open to public scrutiny, public debate and public criticism."[265]

Durant knew that what he was suggesting would be difficult for many in the UK to accept. Yet he argued strongly that this new approach to the public understanding of science should be given a fair hearing:

> "There will be sceptics, I am sure, who will find the ideal of public participation in science absurdly utopian. Is it really possible, they will ask, to engage the public in serious debate and decision-making about some of the most complex matters facing our society today? Surely, they will say, we must leave these things to the experts? Well the fact is that interest in public participation in science is growing around the industrialised world; and to my knowledge, wherever the ideal has been put into practice the experience has been positive. In other words, my practical response to the sceptics is: please don't tell us it can't work, because we've tried it and it does."[266]

Misunderstanding science?

While alternative academic approaches to PUS were coalescing into a more substantial and coherent body of work than had existed previously, it was still a debate occurring mostly within an academic context. The institutional efforts towards PUS had so far remained unchanged, or unaware (wilfully or otherwise) of this growing body of knowledge, continuing to focus instead, when social research was required, on constructing and carrying out surveys of public opinion. Part of the scepticism of social science by scientists and

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[265] ibid.
[266] ibid.

policy-makers, claims Mark Dyball, who was Head of the Public Understanding of Science Programme at the Office of Science and Technology at this time, was that social scientists were failing to communicate their own research in a manner which could be understood by them. There was perhaps then an issue of 'the "public" understanding of social science', as their findings got lost in translation from one specialised setting to another:

> "The barrier was in microcosm exactly the same barrier that public understanding was trying to address - that you have an elite talking a language of their own with other people saying, I can't actually frame the question and you're certainly not giving me an answer. Well, I think that was always where the breakdown came, that the natural scientists trying to do science communication were trying to do something practical, whether it was right or wrong, whether it's the least right or wrong, are different questions, but they were trying to do something practical and the studiers were studying."[267]

In 1996 Alan Irwin and Brian Wynne published an edited collection of the qualitative studies funded under the ESRC/SPSG programme.[268] Many of the theoretical commitments represented had already been expounded by Wynne in his chapter in the *STS Handbook*. This book, however, was intended by the authors to be read by a wider audience than students and scholars.[269] An exclusion of the quantitative work funded by the same programme was controversial, and the publication highlights the continued animosity between particular qualitative and quantitative social researchers. As Irwin later reflected:

> "In terms of the book, we then had various decisions to make. One was, should we put some of the quantitative analysis in? But I think the argument at the time was, given the quantitative analysis was getting huge amounts of airtime. They were everywhere and our sort of stuff was just being trivialised. Hostile is too strong but it was just ignoring it, basically."[270]

The book provided a multitude of case studies backing up what, they argued, was a better method to that of other scientific and social scientific approaches of examining the public understanding of science:

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[267] Dyball, M. (2004), *Interview, 19 August 2004*, transcribed by Simon Lock.
[268] Irwin, A. and Wynne, B. (1996), *Misunderstanding Science? The Public Reconstruction of Science and Technology*, (Cambridge: Cambridge University Press).
[269] Irwin *Interview, 29 June 2004.*
[270] ibid.

> Implicit in our collection is that only a proper sociological approach to contemporary science can give us a real insight into the issues of 'public understanding'. Otherwise, we are doomed to a sterile and even counter-productive juxtaposition of 'science' against 'non-science' rather than an appreciation of the diversity and social interdependence of different forms of science, knowledge and expertise.[271]

A clue perhaps to the reasons why there was an absence of survey research in the book was also provided in the book's concluding chapter, authored by Irwin and Wynne:

> ... at the outset of the ESRC/SPSG public understanding of science initiative ... there existed an assumption amongst some that the role of the qualitative studies was to help elaborate the survey questionnaires ... Qualitative social research on public understanding of science was seen only as intellectual embroidery within the 'objective' macro-social patterns revealed by large-scale surveys. (p. 216)

The editors were apparently struggling with a legitimacy deficit on the part of those social scientists investigating PUS qualitatively. Interestingly, while Irwin's rationale above for publishing the book was that the qualitative research was being ignored, those on the other side of the divide felt the opposite was the case, as Martin Bauer later reflected:

> "... it happened to be that the three projects which were more or less marginalised were the survey by Glynis Breakwell on children in adolescence 12- 17, the national survey which was the general public, and, I believe, an analysis by Anders Hansen ... the other projects considered us alien."[272]

Misunderstanding Science served therefore as a position statement of sorts for a group of academics committed to a very particular conceptualisation of PUS, and who wished to move beyond a problematisation of the public to consider, as the editors outlined, the 'operation of science in everyday situations – and, in particular, the different forms and representations of science which confront different groups'.[273]

As Irwin and Wynne's introductory chapter and conclusion highlighted, all of the social scientists that had been funded by the ESRC, though they came from different disciplinary

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[271] Irwin and Wynne (1996), op. cit., p. 8.
[272] Bauer *Interview, 26 May 2004.*
[273] Irwin and Wynne (1996), op. cit., p. 9.

areas, had arrived at a very similar conceptualisation of 'science', 'the public', and what constituted a 'scientific understanding'.[274] As Hilary Rose, one of the contributors, remembers, this convergence in research findings had been a welcome, but surprising, result:

> "Half way through the field work the teams had a meeting. Here we confessed to one another that none of our informants, whether they were talking about post-Chernobyl radiation in Cumbria, genetic disorders, or chemical factory hazards used the word 'science'. As we talked about our disappeared research topic, what had been something of a researcher's private nightmare became a public conceptual advance: In everyday conversation about the assessment and management of scientific and technologically defined risk, the word science is too large, too all encompassing to have a place. The everyday conversation is indeed expert; it talks about the problem of finding reliable facts about nature."[275]

Irwin and Wynne's book took an explicitly political stance: the editors proposed new policy implications that arose from the collection of case studies, and also called for the dominant idea of public understanding of science to be re-thought:

> The chapters in this book seek to move the analysis of 'public understanding of science' away from the prevailing science-centred framework ... (and also from a simple oppositional or 'anti-science' stance). Instead of assuming that the problem is only or mainly with the public, we examine *both* the operation of scientific expertises/institutions and different 'publics' in relation to one another ... In doing so, we interpret both 'science' and the 'general public' as diverse, shifting and often diverging categories. We also adopt a critical-reflexive stance on the current debates over public understanding of science in order to consider their motivation and underlying concerns. The general argument in this book is that we need to rethink and reconceptualise the relationships between 'science' and the 'public' if we are to make progress at the level either of understanding or practical intervention.[276]

The editors, ultimately, were calling for the concept of public understanding of science to be turned on its head:

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[274] The book included chapters for example by Wynne, Irwin, Lambert and Rose, Yearley.
[275] Rose, H. (1998), *Reflections on PUS, PUM and the weakening of Panglossian cultural tendencies: a speech at the public understanding of mathematics seminar*, (Institute of Education), 25th June 1998.
[276] Irwin and Wynne (1996), op. cit., p. 9.

> Now that the discussion over the 'public understanding of science' has been initiated – and, at least partly, researched – it is important that it should be released from its orthodox restrictions and developed as a major opportunity for a society-wide debate of a more fundamental kind than has so far been officially recognised ... Scientific institutions – and individual scientists – have an all-important role to play in these necessary developments, albeit one which differs markedly from that which had dominated so far ... this will be an uncomfortable conclusion for the scientific community ... It will lead us to consider not just the 'public understanding of science' but also the scientific understanding of the public and the manner in which the latter may be enhanced. (p. 221)

The book received positive reviews in some academic journals.[277] However, many reviewers disliked the editors' attempts to exclude and criticise the quantitative PUS research.[278] Martin Bauer, who himself had been part of the quantitative side of the ESRC funded research, argued that the book was 'rich in concepts and observations', yet it was also 'careless, unfortunately selective and reflects the posturing within an outdated methodological debate'.[279] His frustrations were on several fronts. The book had excluded the three quantitative surveys from the original programme which, as Bauer argued, served to reinforce the boundaries which existed already between social scientists committed to one or other of the two different methodological approaches:

> It may be that the authors want to continue an anachronistic 'drole de guerre' over qualitative or quantitative analysis of public understanding of science which blocked serious dialogue for much of this research initiative on PUS in the 1980s. (p. 157)

Irwin and Wynne were, in disregarding the quantitative work attempting to draw clear boundaries around their own work, and the work of other academics, committed to a quantitative analysis. As Bauer suggested, Irwin and Wynne had also attempted to draw these boundaries so that quantitative studies were part of the same territory as deficit model thinking:

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277 See for example: Jasanoff, S. (1997b), 'Public Knowledge, Private Fears', *Social Studies of Science*, 27: 2., Mulkay, M. (1997), 'Review: Misunderstanding Science? The public reconstruction of science and technology', *Science, Technology and Human Values*, 22: 2.

278 As well as Bauer's review, see Horlick-Jones, T. (1998), 'Review Essay: Science - The Language of the Powerful?' *Journal of Risk Research*, 1: 4.

279 Bauer, M. (1997), 'Review: Misunderstanding Science? The public reconstruction of science and technology', *The British Journal of Sociology*, 8: 1, p. 157.

> The rhetoric of the book is dialectically enmeshed with the significant but absent other: the 'quantitative approach' it is argued is getting it wrong, and the 'Deficit Concept' is serving the wrong purposes. The exclusion of these studies is unfortunate for the PUS research enterprise; the book is a missed opportunity to present a unique collection of research as a whole albeit held together by fracture and conflict. It would have required little effort for the editors to work towards a comprehensive presentation of all twelve projects of the ESRC initiative, but that would have meant to listen to develop a critical exchange.
>
> In this implicit debate the stooge 'survey' embodies the deficit concept of the public in the interest of legitimatization, and is juxtaposed with a simplistic link between case study ethnography and emancipatory-reflexive knowledge interests. (p. 157)

Finally Bauer, in his own attempt at boundary-drawing, questioned the robustness of the methodology of the case studies and the academics' integrity as researchers, accusing them of being closer to activists than academics:

> ... the procedural detail of these reports is insufficient. Knowledge is contextual in time and space, so are narratives about knowledge; only two out of the nine reports mention the time of the data collection, only one elaborates on the numbers and the situations of interviewing. PUS research as a public good, if it is not more than activist ruminations, is not served without attention to minimum procedural standards. Public accountability of research requires more details about primary sources to make a warranted claim of authority. (p. 157)

Reflecting on the reviews almost a decade later, Irwin indeed conceded that the exclusion of the quantitative data had indeed been done as a means of drawing a line between the sociological accounts of PUS:

> "I'm sure some egos were bruised over that qual/quant thing, but it was a creative stimulus. It definitely was a way of saying, well, what are we about if we are not about number crunching, over these things. What is it that our argument about science really is? So it was a way of pulling that together. I don't think any of the qualitative people are sensitive about it at all, but I know, every now and again, from talking to people who were around, who felt that the qualitative kind of abused their position in a way, in the sense of not really understanding the finer points of the quantitative analysis."[280]

Bauer also, reflecting later on this period, felt that the deficit label became a useful tool with which to draw boundaries between different approaches to the public understanding of science within the social sciences:

[280] Irwin *Interview, 29 June 2004.*

> "I think that the deficit concept became a battle cry, where you could kind of hover around and you had to decide on which side of the fence you would sit. What became very funny was that although the deficit concept is a very crucial preconception about whatever you study, society or a group or an individual ... this became associated or equalised with a particular methodology. If you used a questionnaire or a survey you were doing deficit research, if you talked to people you were not doing deficit research. So this is a strange kind of thing which still today puzzles me, but I think that this had to do with the fact that the conflict was so ingrained and dogmatic."[281]

Durant also, remembers the use of the deficit model label to draw divisions within the community:

> "... the deficit model was a term of criticism from the very beginning ... it was a term used to describe pejoratively what some sociologists of science took some other people, both sociologists and natural scientists, to be doing."[282]

Horlick-Jones, in his review questioned what exactly would constitute the 'proper sociological approach' that Irwin and Wynne had called for, and whether their book should actually be regarded as an exemplar of that category, arguing it was 'a highly idiosyncratic book, in terms of methodological approach... empirical focus and the politics of its conceptual framework'.[283] Lewis Wolpert's view agreed with some of these criticisms, arguing that Irwin and Wynne's editorial appeared 'to be more of a political agenda' than anything else.[284] Wolpert's review of the book, published in the *THES,* also rehearsed many of his previous arguments against the social studies of science. He questioned the value of this approach to the public understanding of science, and, attempting to reinforce the primacy of the dominant approach as he saw it, argued:

> It is unclear how best to pursue the public understanding of science...the most satisfactory approach at present is to focus on providing access to science and scientists and to encourage engagement. One might have hoped that those who study science and its public understanding professionally could provide some helpful and much needed insights and guidance ... The results are limited.

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[281] Bauer *Interview, 26 May 2004.*
[282] Durant *Interview, 28 June 2004.*
[283] Horlick-Jones (1998), op. cit., p. 325.
[284] Wolpert, L., 'Wooly thinking in the field, review of Irwin and Wynne', *The Times Higher Educational Supplement: Risk Supplement,* 31 May 1996.

> No suggestions are offered as to what might be done. While all are consistently hostile to the 'deficit model' of the public understanding of science, there is nothing to suggest that any of the authors themselves would not benefit from a better understanding of science. For they provide little evidence that they understand it.[285]

The review prompted Irwin to forcefully respond to Wolpert in the letters section the following month:

> ... he nicely exemplified our argument that the scientific understanding of the public is at least as important as the public understanding of science. At the same time, he illustrated (albeit inadvertently) the difficulties of establishing an open and critical dialogue between social scientific researchers and those such as Wolpert who claim to speak for the scientific community ... the various case studies in our book deserve the serious academic discussion they have received elsewhere.
>
> The people at the sharp end of interactions between science and society recognise the complexities which Wolpert seems to think can be legislated out of existence by his dogmatic and self-satisfied polarisations. While social science is ready to engage in serious, critical but open-minded debate as to how to sustain the cultural and instrumental benefits of science, Wolpert appears to be undermining the very enterprise he claims to be defending.[286]

Irwin, again reflecting later on the reviews the book received, remembered feeling that the book was neither treated fairly, nor kindly:

> Some reviews of *Misunderstanding Science* were not generally positive. I remember we got it a lot [of] "isn't this ironic that a group of people are criticising science communicators for not being more straightforward and they end up using this technical jargon of their own." That was Lewis's critique, but we were never saying the problem of public understanding science was that you need to speak in words of one syllable. That was never what was said, because they always made that kind of jokey thing and they always got a good laugh. And Lewis used it again and again. But I saw other reviews as well – "these obscure social scientists who no one can understand, think they can tell us how to do science communication better." This was a reasonable one line. The reviews were not kind, definitely not kind.[287]

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[285] ibid.
[286] Irwin, A., 'Letter: Lessons at the sharp end', *The Times Higher Education Supplement*, 21 June 1996.
[287] Irwin *Interview, 29 June 2004.*

5 Professionalising PUS

Phase II

In attempting to frame the research and the case studies in *Misunderstanding Science?* Irwin and Wynne, in their introduction, had drawn upon an earlier crisis over BSE in the UK, triggered by the regulation of cattle feed and specified bovine offal in 1988 and 1989. They had used this episode as a case study of how the communication of the certainty of science in the public domain was an inadequate means of dealing with public concerns. As the House of Commons Select Committee on Agriculture had pointed out at the time, 'Scientists do not automatically command public trust'.[288]

Wynne and Irwin's book was published at the height of a second and far more politically damaging public crisis over BSE in 1996, which resulted in an upheaval in British health and safety policy. On 20 May 1996, scientific advisors to the British Government publicly announced that ten new cases of Creutzfeldt-Jakob disease, the degenerative human brain illness, had been confirmed as linked to BSE. The announcement led to a European ban on the import of British Beef and beef products, calls for the wholesale slaughter of contaminated herds, and a drastic drop in the consumption of beef. Government policies for disclosing, or, in this particular case, failing to disclose, the risk information to the public were blamed for the breakdown in consumer confidence. Politicians had claimed that beef was safe, when the evidence had not allowed scientists to make this claim with certainty. Rather than discuss the uncertainties of the science, these politicians had relied on a discourse of science as certain and apolitical knowledge that could be used to make the decision.[289] There was, argued Irwin and Wynne, much criticism of the public for their '"emotive and irrational" response to the risks of BSE'.[290] All of this confirmed to them that science should not be the sole arbiter in structuring everyday choices such as eating habits

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[288] Quoted in the *Guardian* 13 July 1990, cited in Irwin and Wynne (1996), op. cit.
[289] Jasanoff, S. (1997a), 'Civilization and madness: The great BSE scare of 1996', *Public Understanding of Science*, 6: 3.
[290] Irwin and Wynne (1996), op. cit., p. 2.

and that straight-forward science communication was inadequate as a response to scientific uncertainty.

A Shift in focus... ?

Wolpert's repeated attacks on certain social scientists had attempted to deny any legitimacy to their contextual approach to the public understanding of science, which placed trust between the public and institutions as central to the 'problem'. However, he appeared to be shifting away from his earlier PUS rhetoric when he described the aims of the public understanding of science in his review of *Misunderstanding Science?.* Wolpert had used the term 'engagement' rather than 'understanding', and while criticising the lack of meaningful input from Irwin and Wynne, appeared to have taken on board one of their central arguments by admitting that there had been a 'recognition that scientists and technologists need not only to be much better communicators but also to try understanding public concerns'.[291] Similarly, in a debate on 'Science and Society' with Alan Irwin, hosted jointly by the Japan Society for the Promotion of Science and the UK Research Councils, Wolpert had changed tack in response to criticisms of a deficit model approach, as he argued:

> We in COPUS are very strongly committed with the idea that it's not just a one-way process; we do not believe that if only the public understood us, everything would be all right and we are committed to the idea that we scientists have to understand the public.[292]

Graham Farmelo, Head of Science Communication at the Science Museum in a comment piece in *The Guardian,* argued that an oppressive climate of political correctness had taken hold in the science communication world and many felt that there was a need to change the aims of PUS activities:

[291] Wolpert, 'Wooly thinking in the field, review of Irwin and Wynne'.

[292] Wolpert, L. (1995), 'The Public Understanding of Science', paper presented at the conference *Science and Society: A JSPS - UK Research Council Symposium.*

> The recent UK National Science Week was not only a celebration of science, engineering and technology, it was also a 10-day orgy of PUS political correctness. It was as if the entire British scientific community had been given a Madison Avenue make-over, mandated to keep smiling and be on its best behaviour for fear of upsetting the clients.[293]

Farmelo suggested in the commentary that those funded by scientific institutions to carry out the PUS agenda were being tacitly directed to continue to promote science and the public understanding of science programme as it stood. However, he felt that it would be 'good to hear much more from those who are prepared to go against the grain, those who dare to criticise the status quo' (p.12). Farmelo admitted that he had, only after the event, felt able to highlight what he saw as the shortcomings of this centrally controlled, and normative, approach to PUS. Scientists, he argued, should not be told to 'peddle caricatures of what we ought to think, but rather ... encourage open discussion and, therefore, disagreement about science and its relationship to society' (p.12). Questioning whether he was the only practitioner to doubt this firmly controlled direction of PUS, he was 'ashamed to confess to having lacked the courage to say so on the record for fear of appearing disloyal or slighting to colleagues in the field of science popularisation' (p.12). John Durant, reflecting on the recent United States' science wars phenomenon, joined in with this criticism of the status quo in the PUS community, arguing that if scientists wanted the public to be interested in their work, they must 'learn to take criticism and give up control'. As he continued:

> There is a deep irony about some scientists' simultaneous desire for a greater presence within mainstream culture and their dissatisfaction with some of the more striking ways in which science has come to be represented in that culture. Part of the price that science must pay for a more central place within culture is a willingness to tolerate comment and criticism from far outside the scientific community ... The real choice to be made by the scientific community is whether it will stand aloof from the debate (which means leaving the field to others), or whether it will join in so as to ensure that scientific voices are heard alongside others. Science is too important be left out of our culture; but, by the same token, culture is too important to be left in the hands of scientists alone.[294]

Durant and Farmelo were in an ambiguous position. On the one hand, Durant wanted to be taken seriously as a social researcher, and not be labelled as merely an agent of the scientific

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[293] Farmelo, G., 'The perils of being too popular', *The Guardian*, 15 June 1995.
[294] Durant, J., 'Who owns science? ' *The Independent*, 20 June 1995.

institutions' approach to PUS; on the other hand, he worked for the Science Museum, which was, to all intents and purposes, the largest institution in charge of popularising science in the UK. Farmelo was in a similarly difficult position: to question the PUS agenda would be to criticise those people he worked with and who funded him. Equally to do this would be to step outside the orthodox boundaries of PUS, as defined by scientific institutions, something neither was happy about doing for fear of professional repercussions.

... or institutional business as usual?

Despite this questioning, and change within the language used by some scientists, nothing signalled that this had permeated at a government level. In 1995 the 'Wolfendale Report', the full title of which was the *Report of the Committee to review the contribution of scientists and engineers to the public understanding of science, engineering and technology*,[295] had been commissioned by the Office of Science and Technology, in the wake of their 1993 White paper on science. The Committee, chaired by Sir Arnold Wolfendale, the former Astronomer Royal, and President of the Institute of Physics, had been asked by the Government to make proposals, consistent with available funding, for measures to assist the efforts of the scientific community towards the public understanding of science, engineering and technology. The Committee had defined the public understanding of science, engineering and technology as 'an important goal'. This was very much in line with the stated objectives of the Government's policy on public understanding of science, which were:

> ... to contribute to the economic wealth and quality of life of the Nation, particularly by drawing more of our best young people into careers in science, engineering and technology [and] to strengthen the effectiveness of the democratic process through better informed public debate of issues of public concern arising in the fields of science, engineering and technology.[296]

PUS policy, as the Wolfendale committee re-iterated, was about 'changing public attitudes', and the perceived 'obstacle' to achieving the objectives was a 'relatively low status of science

[295] Office of Science and Technology (1995), *Report of the committee to review the contribution of scientists and engineers to the public understanding of science, engineering and technology*, (OST).
[296] ibid.

and engineering in the eyes of the general public relative to other competitor nations'. As the Committee also added, the increased take-up of science and engineering subjects by people of all ages would depend on public appreciation of science and engineering and their practitioners. Thus little appeared to have changed in the decade since the Bodmer report had been published. The Committee did recognise that these matters also had 'non-science dimensions, such as economic, political or environmental' factors.[297] 'Public Understanding' was, however, interpreted by the Committee to include not just scientific concepts, terms and issues, but also an 'awareness and appreciation on the part of the general public' of the contribution that science, engineering and technology had on national life. The Committee's report put forward new ways in which methods of communication, through which scientists and engineers could enhance the public understanding of science, could be improved. One proposal argued that it should become mandatory for applicants for Research Council grants to declare how they would communicate their research to the general public, and why their work was important. Indeed, one outcome of the Wolfendale report was that the Research Councils each took public understanding of science on as part of their mission statement, offering media training and grant incentives to all research council funded scientists.

In the following year the Department of Trade and Industry, to assist this effort, published a booklet entitled *Going Public: An Introduction to Communicating Science, Engineering and Technology*, written by Michael Kenward, one of the original members of COPUS and former editor of *New Scientist.* As Sir Robert May, the Chief Scientific Advisor and Head of the Office of Science and Technology, asserted in the foreword, scientists and the Government had to 'remind an often sceptical public of the value and relevance of science and technology'.[298] They must also, he added, 'convince young people that a career in scientific research is for them'.[299] The DTI report provided information about how the media worked and how to communicate to different audiences, and pointed scientists towards resources available to researchers who wanted to help 'improve the public understanding of science', such as COPUS grants, or the British Association for the Advancement of Science Festival. The

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297 ibid.
298 Department of Trade and Industry (1996), *Going Public: An Introduction to Communicating Science, Engineering and Technology*, (Department of Trade and Industry).
299 ibid.

report argued that science communication was needed to 'reduce the ignorance, and sometimes fear, with which many people approach science', and, with a more instrumental aim, it also argued to scientists that 'give science a higher profile and you might help ensure your own job security'.[300]

Again we can see that the idea of marketing science to the public was still prominent in the minds of those promoting PUS within scientific and governmental institutions. The Wolfendale report had also put the onus of science communication on universities, who were told to appoint staff to run a media/public relations department, as this was, according to the Committee, 'an essential focus through which the public understanding of science can be promoted'.[301] Within universities there should also be an 'increased emphasis on the acquisition of communication skills and their use for the benefit of the public'.[302] His committee had also recommended that the Office of Science and Technology should make periodic surveys of public attitudes towards, and understanding of, science and engineering, to evaluate the success of public understanding of science activities. Writing about his report in the UK press, Wolfendale confirmed that the report signalled a continuation of the status quo, as laid out by Bodmer a decade earlier, and argued that "much of science is very technical", thus "care must be taken with 'understanding' – a better word is perhaps 'appreciation"'.[303]

The Wolfendale report might have charged the Research Councils by forcing them to take on a public understanding of science agenda, but this had not, however, in Hilary Rose's opinion, signified any innovation in approach. As she recalled:

> That the Public Relations staff serving the Research Councils were overnight designated PUS staff does provide a clue that PUS … [was] seen as handmaiden activities to persuade the public to accept the sciences and mathematics in their present cultural form.[304]

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300 ibid.
301 Office of Science and Technology (1995), op. cit.
302 Wolfendale, A., 'Explain or die: why science can't afford to keep secrets from the people', *The Independent*, 24 October 1995.
303 ibid.
304 Rose (1998), op. cit.

Certainly several scientists continued to promote this agenda in a public context. Nobel Prize-winning pharmacologist Sir John Vane argued in the *Daily Mail* that the status of science in the UK was at an all time low. Vane mobilised an image of science as something where only rationality and objectivity reigned and was separate from the public and social domains. He also represented the public as passive and subject to emotion:

> ... everywhere there is a flight from reason. Rational explanations and conclusions are rejected. Analysis and logic are decried. In their place superstition, myth, mysticism, emotion and make believe put themselves up as acceptable substitutes – and are widely and publicly accepted... . Although science permeates all aspects of our lives, appreciation of science does not.[305]

Geneticist and popular science writer, Richard Dawkins who was, in 1996, appointed Simonyi Professor of the Public Understanding of Science at Oxford University, had also felt that anti-scientific thinking was on the rise and wrote, in *The Independent,* a scathing attack on astrologers, and called any members of the public that believed in their columns 'stupid'.[306] In his Dimbleby Lecture for the BBC he had also denounced television shows such as the *X-Files* for peddling anti-science to the public.[307] Brenda Maddox, author, and the wife of *Nature* Editor, John Maddox, argued in *The Times* that 'public misunderstanding of science has never been greater', and suggested that those working within PUS go on the offensive, and attack the media for its misrepresentation of science.[308]

Ten years of COPUS

To mark the decade that had passed since the publication of the Bodmer report in 1985, COPUS published a review of its activities. It argued that the science communication and popularisation approach to PUS was not only flourishing under the guidance of COPUS but would continue to be encouraged and promoted. The Media Fellowships, Training

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[305] Vane, J., 'A triumph for the forces of ignorance', *Daily Mail,* 22 June 1995.
[306] Dawkins, R., 'The real romance in the stars', *The Independent,* 31 December 1995.
[307] Dawkins, R., 'The Richard Dimbleby Lecture', 12 November 1996.
[308] Maddox, B., 'Let's say goodbye to Frankenstein', *The Times,* 20 March 1996.

Workshops, and the Books Prize were still going strong, and the grants programme was receiving more applications every year to, in COPUS's words, 'prime-pump new and imaginative events and projects aimed at bringing science to the public'.[309] COPUS had also, it reported, collaborated with other organisations, such as the Wellcome Trust, with whom it had organised a series of lectures for civil servants on pressing scientific issues; and the Research Councils, to develop a course to train all science and engineering students in science communication. The review also flagged up the forthcoming release of their report *To know science is to love it?*. The report, written by Jon Turney, now a lecturer in science communication at University College London, provided a synthesis of social research into PUS which, COPUS suggested, those with immediate, practical concerns in the field might want to know about.[310] COPUS had also been successful at inserting questions into the 1996 British Social Attitudes Survey on attitudes to, and knowledge of, science. Many of these questions were repeated from John Durant's 1988 survey so that a comparison could be made. COPUS had helped to determine what questions to ask by arranging a consultation between science communicators and researchers. The review document made it clear, however, that the 1996 study would ask less knowledge-based questions than the 1988 survey, and instead include questions on different attitudes, particularly issues of trust. Thus we have another sign that some scientists were starting to change their language of PUS; accepting that some of the social research findings were perhaps valid, and promoting them as part of their own programme.

An external evaluation of all the schemes and projects commissioned by COPUS revealed a large change in commitments to the public understanding of science since 1985, highlighting the large number of organisations and individuals now involved in public understanding of science. Fifty-four per cent of Royal Society Research Fellows had taken part in public understanding of science activities since starting their Fellowship.[311] The report therefore concluded that there was no need to still be concerned, as Bodmer and his peers had been,

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[309] COPUS (1995), *COPUS Snapshot: A review of activities in 1995*, (London: The Royal Society), p. 2.
[310] Turney, J. (1996), *To know science is to love it? Observations from public understanding of science research*, (London: Royal Society).
[311] Evaluation Associates Ltd (1995), *COPUS: The committee on the public understanding of science, an evaluation of schemes and projects*, (Evaluation Associates Ltd).

that there were not enough scientists involved in communication with the public. The only negative part of the evaluation was, what the evaluators described as, a 'tension between the need to integrate science into everyday life with the desire to preserve and enhance the respect and status of science and scientists'.[312] This impression, it seems, had come from a few of the respondents, who had not wanted to see science 'trivialised', in the pursuit of greater science communication. These respondents thus identified a tension within the PUS agenda: the need for a firm boundary between scientists as experts and a 'lay' public, while simultaneously making that boundary more permeable by communicating scientific knowledge to the public and promoting it as understandable. These respondents were, however, in the minority, and most others praised the efforts of COPUS over the past decade to take science to the public.

An unpublished part of the review, circulated only to members of the Committee, does show that there were concerns within COPUS in 1996 as to the ability of the Committee to maintain control over the public understanding of science efforts in the UK. They were, as the review shows, worried that the Office of Science and Technology's involvement and funding of PUS activities could take the agenda away from COPUS. Also the review shows that the Committee members were more aware of academic criticisms of their actions than they let on in their public pronouncements. One of the solutions to the concern, proposed in this review, was to turn COPUS into a networking and consensus-building body, which would ensure that the public understanding of science remained high on the Government and science community's agenda. COPUS in this model, it was proposed, would 'remain an innovator, piloting new approaches to communicating science, but would transfer successful initiatives to its partners'.[313]

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[312] ibid.
[313] ibid.

Professionalising science communication

Freelance researchers, River Path Associates, published another review of public understanding of science activities in 1997, entitled *now for the science bit – concentrate!*. This report first and foremost provides an insight into the consultants' representation of the state of PUS in the UK. Yet we can also use it to provide a snapshot of the positions of those interviewees involved in PUS activities and research at this time. River Path conducted forty interviews with what they called 'experts in the field' as preparation for a brief presentation at the Science Communicator's Forum at the 1997 British Association's Festival of Science.[314] What they suggested in the report was that a new agenda was emerging, with 'concepts like context and trust taking on greater importance'.[315] Following the Festival they wrote up the findings as a full report.[316] Alongside this sense of a shift in focus, the report suggests that there was still a diversity of opinion on what the 'problem' of public understanding of science actually was, and how to approach 'solving' it. To Peter Cochrane, Head of Research at British Telecom, the issue was how to remove a "fear of technology"; the public were, in his formulation, therefore still the 'problem' and changing their concerns was key. Many of the interviewees talked about the recent BSE controversy as an indication of declining confidence in democratic structures, and by extension of this, public confidence in science, as the report's authors observed:

> The BSE issue was repeatedly cited as an example of bad science communication, described as "a fiasco", "a disaster" and "a mess" ... Roger Highfield, Science Editor of the Daily Telegraph, reports that if you look at BSE we know that the public are more mistrustful of scientists as a result of that saga.

How it was 'known' what exactly the public felt about scientists at this point is unclear, but it certainly appears that the BSE issue had represented, to many, a new low, or indeed a

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[314] As the report said, most of the 'experts' were: academics, journalists, politicians, policy-makers and members of research councils and professional bodies. They also talked to people in the private sector. The fact that there were now 'experts' in 'the field' shows also just how far PUS had become discursively embedded in various professions.
[315] Pollack, J. and Steven, D. (1997b), 'Don't patronise the public', *New Scientist*, 27 September 1997.
[316] All quotes taken from Pollack, J. and Steven, D. (1997a), *now for the science bit - concentrate! communicating science*, www.riverpath.com/library/pdf/now_for_the_science.pdf, accessed November 2003.

turning point, in the relationship between the public and scientists. Bodmer, however, blamed the Government for the mishandling of the issue:

> "I think the Government made a huge mistake with BSE. How on earth can a Minister talk about this rather than a scientist? You talk to civil servants and say this and they're incredulous ... the Government should rethink completely the way it presents that kind of science."[317]

Bodmer was identifying a new problem in the way of a successful PUS programme here. The Government was, to him, now to blame for public misunderstanding, harking back to similar sentiments in the 1830s. River Path argued that the political pressures highlighted by that episode called for a 'new approach – one that stressed context, transparency and trust'. This view, they felt, was already 'percolating through at all levels'. Colin Morton, Head of Information at the Forestry Commission, also detected 'a new attitude emerging from government', arguing that it was now making more effort and developing policies on communication which talked of openness and transparency. A relevant consideration here is the election of a New Labour Government, under Tony Blair, in May of 1997. New Labour came into power with a new set of operating rules, and one of these was the prominent use of public opinion and focus groups in setting their agenda priorities. This also changed the way in which public understanding was talked about within government, as Dyball reflected:

> "The critical factor was the 1997 election because it provided a break point for officials, but most important it brought in ministers with different perspectives so John Battle on the science communication, was the first minister that I recall saying if science has no understanding of the public, what's the importance of the public's understanding of science? So that whole change of emphasis was a very critical factor."[318]

The recollection of Suzanne King, who at the time had been in charge of Public Understanding of Science activities at the Wellcome Trust, also suggests an uptake of this discourse:

[317] Bodmer, W. cited in Pollack, J. and Steven, D. (1997b), ibid.
[318] Dyball, *Interview, 19 August 2004.*

> "... the '97 government was all about public consultation, public involvement in anything and everything. Therefore modernising government was about bringing in that perspective across the board ... that element is never given any credence ... I've never heard anybody talk about that. Because people are in their own little boxes, but actually that got to be an important underpinning of why they're putting in money into it. I mean the fact that you've got rafts of guidelines on the cabinet office website about research, consultation engagement, and good practice and all those sorts of things had not been developed for ... public understanding of science."[319]

Alan Irwin, also reflecting on this period, represented it as such:

> "Labour came in ... with the sense of openness. The language of democracy [had] the sort of ideological ring of that made sense. In a way it was probably hardened. And there was quite a sense of just excitement. Different people coming into government and a different style."[320]

Identifying this new political climate, the River Path authors argued it was not surprising that many interviewees were questioning some of the fundamentals of the Public Understanding of Science movement.[321] 'Understanding' was now seen, by some of their respondents, as an inappropriate word. However, the implications of this were different for each person. Graham Farmelo, at the Science Museum, felt that the public were incapable of such understanding:

> "Notice I don't say 'understanding' because there are more appropriate words in the thesaurus. If 'understanding' is used as the norm, it sets up unreasonable expectations of what the public is expected to achieve."[322]

Barbara Knowles, Senior Communications Officer at the Natural Environment Research Council (NERC) disliked the deficit connotations of the word, arguing that 'most of our activities are aimed at awareness and appreciation rather than going out to teach an 'ignorant' public'. It therefore appears that there were multiple agendas emerging for science communication in the UK. Far from the cohesive Royal Society, or COPUS driven agenda envisaged in the Bodmer report, and indeed in the recent reviews of COPUS, here we can see that the many different professional interests of actors and organisations involved in

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319 King, S. (2004), *Interview, 19 August*, transcribed by Simon Lock.
320 Irwin *Interview, 29 June 2004.*
321 Pollack and Steven (1997a), op. cit.
322 Farmelo, G. cited in Pollack, J. and Steven, D. (1997b), ibid.

PUS and science communication activities meant that PUS was framed differently. What is clear, however, is that a need for a change in approach towards the audience for science communication was heavily signalled by many of River Path's interviewees:

> "...it's just as important for scientists to be listening to the public, as for the public to be listening to scientists" (Helen Wallace, Senior Scientist, Greenpeace)
>
> "...opening up a dialogue with the public about science is of crucial importance" (Frank Burnet, Senior Lecturer in Science Communication, Faculty of Applied Science, University of West of England)
>
> "...to communicate with people you have to put together a contract with people and accept that it isn't a one-way street." (Jane Bevan, Head of Marketing and Development, Natural History Museum)

Roy Porter, Professor in the History of Science and Medicine at the Wellcome Institute for the History of Medicine, urged for the involvement of the public in scientific decision-making to be taken even further:

> "The ultimate purpose is the old cliché that science is too important to leave to the scientists. It must, somehow or other, be the public at large which decides if we go ahead on these new ventures. The public also, crudely speaking, foot the bill – and you don't write out blank cheques for anybody."[323]

While, to Lewis Wolpert, the belief that the public should be encouraged to question and have some input into science was, in his words, 'monstrous', and something that would 'restrain scientific research', River Path argued that overall there was a widespread sense from their interviewees that science communication needed to shift towards a two-way dialogue, based on trust and transparency. In practical terms, the authors suggested that this meant that science communication had to be professionalised and move away from what, up until now had, to many, been an amateur approach. River Path also argued that much of the effort put toward PUS activity was simply reaching the same easily obtainable audience time and again, thus (in an unsurprising recommendation from professional evaluators) more evaluation was also needed to assess whether these were the right people as well as to get information about who was being communicated to, rather than just the numbers of people

[323] Porter, R. cited in Pollack, J. and Steven, D. (1997b), ibid.

in the audience. Thus the evaluators, alongside many of their respondents, were pushing for the establishment, or at least recognition of, a professional class of PUS practitioners. They were keen to move away from the old ways of doing things, and to define people such as themselves as the rightful and authoritative experts in science communication. As their conclusion to the report stated, '"the old school" had had its day' and if the public was to be genuinely engaged, then a more professional approach was needed.

Publicising their report in *New Scientist,* the authors further argued that science communication organisations had 'failed to move with the times' and that the old order was being forced to change.[324] Their research had suggested to them that if scientists were to be frontline participants in a radically changing Britain, then 'we must change every level of the communication process'. How far science organisations with, they argued, 'an almost religious attachment to the amateur', would change, despite many science communicators now talking about two-way dialogue, remained to be seen. However, these calls for a 'change of tack', away from what the authors characterised as an 'us and them' approach to the public understanding of science, were growing, as their report had concluded:

> Many recognise that if science and scientists are not to lose credibility as politics and politicians have done, then they need to renew their mandate with the public. They need to set out a more attractive stall, to work hard at building up trust – and to reveal more of the 'backstage operations' (including the politics). In essence, scientists need to look outwards more – to build bridges of understanding.[325]

Calls for a professionalisation of science communication came at a time when there were more people than ever gaining professional qualifications from a growing number of science communication courses providing training in this area. Jane Gregory, along with Steve Miller, a science journalist and physicist at University College London (UCL) had set up the first accredited courses in science communication at UCL several years earlier. Imperial's science communication MSc had now been running for five years, and elsewhere within the University of London, Birkbeck College was running a part-time diploma in science communication for practising scientists and engineers and UCL continued to provide short

[324] Pollack and Steven (1997b), op. cit.
[325] Pollack and Steven (1997a), op. cit.

communication courses for science undergraduates and post-graduates. Two new MSc courses had also been launched in 1996, one in Ireland and one based at Techniquest, the science centre in Cardiff. Thus there were many with formal qualifications in what was an expanding new professional body of science communicators. These new science communication practitioners were trying to define themselves as members of a legitimate profession by staking their own claims on science communication and PUS activities, just as the 'visible' scientists such as Wolpert and Bodmer, and the social scientists, such as Wynne or Irwin had done previously.

Reflecting on the first six years of *Public Understanding of Science*, as he stepped down as editor in 1997, John Durant argued that the launch perspectives published in the first issue of the journal in 1992 still seemed to reflect the significant positions that were on offer in the field.[326] What had become known as the 'deficit model', Durant argued, continued to find favour among natural scientists, and science communicators yet, he reflected, it was 'hard to find social scientists who have a good word to say for it'.[327] Debate around the deficit model had, according to Durant, been 'the single most significant area of theoretical discussion in the field over the past six years'. Reflecting on the acrimonious exchanges between Wolpert and Collins in the pages of the journal, which Durant had commissioned as editor, he also revealed that a member of the editorial team had resigned on a separate yet related matter. Durant stated that this acrimony between particular scientists and social scientists had stopped research into the public understanding of science making real progress, though he could perhaps have also been talking about the existing divisions within the social sciences:

> Somehow, it seems particularly difficult to engage in a good-willed and constructive discussion about the nature of science across the natural/social science divide. Yet so far as the public understanding of science itself is concerned, such discussion is surely essential if we are to make real progress. Whatever we may take the public understanding of science to be, one thing is evident: it is too culturally, socially and politically important to become the victim of mere in-fighting among rival groups of academics anxious to protect the dignity and perceived worth of their particular specialisms.[328]

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[326] Durant, J. (1997), 'Editorial', *Public Understanding of Science*, 6: 4.
[327] ibid.
[328] ibid.

In the following year, in a continued commitment to fund social research into the public understanding of science, the ESRC launched a new research programme. It was an ESRC New Opportunities Programme which provided resources to build on previous investments in the social sciences where the ESRC believed there were both policy needs for knowledge, and a knowledge base that could be usefully enhanced by a short-term concentration of effort. The Programme on Public Understanding of Science ran from February 1998 to April 1999. Its coordinators were Irwin and Peter Healey, who now ran the Science Policy and Society Research Group. The ESRC, according to Irwin, had wanted 'to dip their toe in the water and try and do things a little bit different', to scope out whether capacity could be built within the social sciences community for another, bigger programme, with more policy impact.[329] The timing of the project, in terms of wishing to have a policy impact was, according to Irwin, good. There was a growing consensus within policy circles that the current science communication efforts were not sufficient to bridge a perceived gap in public trust in science, and with a growing shift in focus onto matters of public participation, rather than simply science education, Irwin recalls, there was a definite sense now that something had changed, if only in terms of the language used by government and policy officials, though perhaps also in their willingness to listen to social scientists:

> "In Science Week there was a breakfast meeting in the House of Commons. John Battle introduced me ... by saying it's about scientific understanding of the public. You could just feel it, because I did my theme about the idea of a new social contract between science and society. It was just a speech ... but you could just see certain comments were being made, which were just dismissed. The old ones about the most important thing is get the science right. Or criticisms of the public. Suddenly you couldn't say it any more ... for me to be there, sitting next to the minister and the things that I say suddenly... 'yeah well that's common sense'. It was quite a shock from two or three years earlier ... there was that mood of the door being opened, social science had come to save us kind of thing."[330]

Furthermore, their research programme was well received by those within the policy world who appeared to be searching for new, and useful approaches to deal with this perception of negative public attitudes. Social scientists, according to Irwin, were suddenly being perceived in a new, useful and more relevant light:

[329] Irwin *Interview, 29 June 2004.*
[330] ibid.

> It was during that programme that it really came home to me that the policy interest in this was sky high. When we set up we would do the usual thing of thinking, 'oh my god, how are we going to get policy people interested?' I was really quite anxious. And then I found Bridget Ogilvie from COPUS welcomed us with open arms, couldn't be more helpful and friendly.[331] And we had that treatment over and over and over. It was a real shock to discover it was an absolute open door ... by that point in time, there was this, 'it's fantastic, you've come to help us, that's great, come in'.[332]

A deficit of trust?

There had been alongside these PUS debates, a developing academic and policy discussion of public values, public communication and trust in risk decision-making processes. An influential report by the US National Research Council's 1996, *Understanding Risk*, had cited examples of science and technology issues, such as radioactive waste disposal, in which issues of public and stakeholder trust were paramount.[333] Furthermore it argued that public participation and deliberation were key to good risk management and policymaking. While full coverage of these debates is, again, beyond the scope of this project, it is likely that such parallel developments were a key influence on the PUS debates occurring in the UK, particularly as many key academics were involved in both risk and PUS arenas. The similar stance taken later by the UK Royal Commission on Environmental Pollution's report *Setting Environmental Standards* in 1998 (discussed in the next chapter) appears to confirm this.

Indeed, issues of trust, or specifically, a perception of a lack of trust in scientists and science, continued to be flagged up in more conversations around the public understanding of science. The recent announcement by scientists in Scotland that they had cloned a sheep, named Dolly, had also prompted much media speculation as to the role of science and scientists in society, and questions of whether the public can trust scientists not to go "too

[331] Briget Ogilvie was the Chair of COPUS from 1998 to 2002
[332] Irwin *Interview, 29 June 2004.*
[333] Commission on Behavioral and Social Sciences and Education, (1996), *Understanding Risk: Informing Decisions in a Democratic Society*, (US National Research Council)

far" were common.[334] Notably, the Science Minister, Ian Taylor, in a departure from his scripted celebration of science at a Science Week pre-event in 1997, posed the question to his audience, "why should the public trust science? I think that's one question we should answer".[335] Taylor appeared to be blaming scientists, as much as Bodmer had blamed the Government. His question was not, as systems biologist Tom Wakeford, reported it in *The Guardian*, a welcome deviation to some of his fellow scientists:

> The Science Week representative laughed nervously. Sir Ron Oxburgh, president of the British Association for the Advancement of Science, maintained his fixed grin, and the minister returned to his brief, as if nothing had happened. Despite the labours of their spin-doctors, many scientists realise that their social position is under threat.[336]

It appears that it was an established discourse within policy circles by now that science had lost the trust of the public, or society. This appeared to be dominated by discussion of how to restore, or improve, trust. Finding new ways of dealing with public attitudes and opinions was also emerging as an important issue, as Wakeford asserted, in what is almost a reformulation of Bodmer's plea to scientists from 1985:

> Rebuilding society's trust in science can only begin when enough scientists emerge from their bunker and admit that non-scientists have both valid and valuable contributions. With the trenches of dogma filled in, both armies may find a common ground, freed from notions of deficits on either side. If this chance for détente is lost, scientists could increasingly be perceived as alienated, self-serving and narrow minded.

Alongside this new terminology we can also identify new allegiances between the different professional groups involved in PUS. Government appeared to be more accepting of those social scientific arguments which placed trust as an important factor in shaping the relationship between science and the public.

The only place where issues of trust were barely mentioned was COPUS, where public understanding appeared still to be a matter of increasing understanding of scientific

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334 For examples of these sorts of media discussion see Dalyell, T. and Dyson, E., 'Why Should the Public Trust Science?' *The Guardian Online*, 13 March 1997; Radford, T., 'Scientists Scorn Sci-Fi Fears Over Sheep Clone', *The Guardian*, 24 February 1997.
335 Wakeford, T., 'Too far, too fast?' *The Guardian*, 5 March 1997.
336 ibid.

principles and of the value of science to society. Another review, this time of its funding and activities, entitled *So did it work?* had, however, revealed a chaotic picture of what was now a large community of professional science communicators running many public understanding activities in the UK, all of which COPUS was, according to the evaluators, failing to co-ordinate coherently.[337] COPUS had several different initiatives running by 1997. Their programme of 'promoting a better understanding of science, engineering and technology in society' had four strands: a 'COPUS forum' to enable networking and consultation; a major conference called *Building Bridges to Science* which was run every year; events at the Science Festivals around the UK; and a series of *Sharing Best Practice* guides, offering advice on how to run, or evaluate, science communication events. The grants scheme funded by the Office of Science and Technology and administered through the Royal Society, was now well established and provided support and encouragement for individuals and organisations to provide public access to science, engineering and technology. However, a lack of funding was cited in the review as a major problem for the continuation of public understanding activities in the UK, together with the increase in activities, and subsequently, in participating actors and institutions. A lack of coherent direction was also blamed, with the evaluators observing that the Committee could no longer 'reach a consensus on what it should achieve'. As they continued:

> There is confusion and duplication of roles, poor communication and networking with new entrants, and a lack of strategy and leadership. Activists rush chaotically rather than stride strategically and push new frontiers before consolidating existing gains.[338]

Perhaps as a response to the River Path review, which had suggested that these old approaches were amateur, we can see in the quote above that the report's authors identified 'activists' as 'rushing chaotically' and without 'strategy'. Thus boundary work continued over who should have control over the PUS agenda in the UK, and thus who was a legitimate expert in science communication and who was not. The COPUS evaluators called on the Science Minister to help equip the field of science communication for the millennium and beyond. Suggestions of how to do this ranged from launching a 'ten or twenty-year

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[337] Boddington, A. and Coe, T. (1996), *So did it work?* (London: COPUS).
[338] ibid.

campaign to solve the problem of public understanding of science, a revitalisation of COPUS, or an extended role for the British Association to guide development and formal recognition of the need to develop science communication as a profession'.[339] COPUS and its constituent scientific organisations therefore wanted to secure money to continue with their existing plans, albeit on a larger scale, at the same time representing themselves as the site of professional science communication. A declaration by neuroscientist Susan Greenfield, who became Head of the Royal Institution in 1998, also suggests that not only did some in the scientific institutions not feel the need to change their approach to the public understanding of science, but they still felt that they headed up a firm consensus on it:

> Everyone agrees that the Public Understanding of Science initiatives are among the most important for the education not just of the new generation, but for late twentieth-century society. There are some notable full-time professionals who write books and, via the media, reach out as never before to excite those for whom the word "science" used to be the ultimate turn-off.[340]

COPUS and 'visible' public scientists such as Greenfield and Wolpert continued to rehearse these arguments for the public understanding of science.[341] Richard Dawkins continued to bemoan public ignorance, and blamed the media for 'whipping up ignorant hysteria over scientific matters'.[342] Yet Neil Cossons, writing a review in *Nature* of a book by Gregory and Miller on science communication, argued that others had abandoned this sort of language. As Cossons reflected:

> Over the past 15 years or so, the aims of practical public-understanding initiatives have changed. In the 1980s there was an emphasis on what science the ignorant public needs to know (the 'deficit model'), but this has been superseded by a concern to facilitate dialogue between scientists and lay people to encourage mutual trust.[343]

In their book, *Science in Public,* Gregory and Miller brought together the work of scientists, sociologists, historians and philosophers on the public understanding of science. The book

[339] Boddington, A. and Coe, T. 'Jamboree has had its day', *The Times Higher Education Supplement,* 14 March 1997.
[340] Greenfield, S. 'The absent-minded professor is turning into the well-organised professional', *The Independent,* 15 May 1997.
[341] For example Wolpert, L., 'Hypotheses', *The Independent,* 31 March 1996.
[342] Dawkins, R. 'Letter: Engineered crops', *The Independent,* 14 August 1998.
[343] Farmelo, G. (1998), 'Selling science against the odds ', *Nature,* 394.

provided their assessment of the history of science in public and provided a critique of both scientific and social scientific approaches to the public understanding of science. The authors called for some balance to be restored in what had been a continually fractious relationship between the two groups:

> ... it is right and proper that science should be subjected to detailed social scrutiny, by academics and the public. Carrying out social, cultural and historical critiques of science does not equate with being "anti-science". Scientists themselves should be part of this questioning process ...[344]

At the very end of the book, the authors proposed their own approach to science communication, which they hoped would further the public understanding of science in a manner that would meet the requirements of all concerned, thus suggesting that what had occurred up until this point was far from desirable or adequate. Key to this change was recognition by scientists, and scientific institutions, that behind much of the activity conducted under the rubric of public understanding of science lay many different motives:

> The purpose of science communication may be to empower its recipients, to enhance existing democratic processes or help develop new ones where they do not exist, or to prevent the alienation of sections of society; but it may also be to serve the interests of the scientific community and their paymasters. Scientists communicating science to the public should therefore make their motivations clear. (p. 245)

The authors stressed, however, that acknowledging this would not invalidate a 'deficit model' of science communication. This model was simply only appropriate for very specific circumstances such as 'a straightforward talk, article or broadcast' (p. 247). Gregory and Miller also felt the public understanding of science was entering new territories, which presented the opportunity to change the way in which science, the media and the public interacted. Drawing on social scientific research, and acknowledging that these three entities were more complex than the current rhetoric implied, would be a first step towards some mutual understanding:

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[344] Gregory and Miller (1998), op. cit., p. 248.

> Like unworldly tourists these groups are inclined to believe that if they speak their own language slowly and loudly, they will make themselves understood; sometimes, like imperialists in an annexed land, they presume that everyone else is a savage. Just as travellers abroad have learnt to understand another culture on its own terms … so might scientists, journalists and the public tread a little more lightly on each others toes if they got acquainted first. (p. 250)

The authors concluded that the type of communication 'designed to bring about an awestruck admiration for the mysterious men in white coats', was not, 'what we need for the challenges of the twenty-first century' (p. 250).

So by mid-1998, several actors within both academia and elsewhere it seemed were sensing that it was an opportune moment to move beyond the acrimony that had characterised interactions between scientists and social scientists up until this point. We also start to see many actors within the scientific community openly questioning a PUS agenda which solely advocated greater science communication. Gregory suggests this also was in part due to a British Social Attitudes Survey in 1996 which had shown that levels of scientific literacy and attitudes to science had remained static since the previous survey in 1988:

> "There was one very strange time ... after the original Oxford survey, [when] some of those same questions were repeated in a British Social Attitudes survey. And there was no change whatsoever, or something like three per cent more people knew that DNA was to do with genes and not rocks, and this was a bit of a shock I think. Either all the activity hadn't helped the public understanding of science, or the way we were conceptualising public understanding of science was just wrong. We were either not changing it in a way that would cause change or we were trying to change the wrong thing. That I think woke up some people … ."[345]

Gregory suggests there was a sense that 'it clearly wasn't working' and scientists had not managed through a vigourous promotion of PUS to affect the change they desired. Alan Irwin expressed similar sentiment to Gregory and Miller on an academic online newsgroup discussion on the public understanding of science, arguing that it was time to go beyond 'simply polarising 'science' and the 'public', and to try doing things differently. Calling for new practical approaches he argued:

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[345] Gregory *Interview, 20 September 2004.*

The challenge now is to find a more open and constructive basis for discussion about social and technological development. We need fresh thinking and new ideas. In practical terms also, new approaches are needed.[346]

[346] Irwin's comment was part of the global cyberconference on PUS held in February 1998, archived at http://vita.org/technet/archive.html/. For more details on the conference see Fuller, S. (1999), 'The first global cyberconference on public understanding of science', *Public Understanding of Science*, 7: 4.

Phase II: Conclusions

Overall this phase was characterised by the institutionalisation of PUS activity both in academic and non academic settings. This research and activity was dominated by conflict and boundary work, both between individuals in different professional groups, and within professional groups, involved in debates over science in public. These boundary disputes, as I have shown, were predominantly concerned with who had legitimacy and expertise to define 'science', 'the public', the 'public understanding of science' and also who was a legitimate science communicator. Furthermore, these battles over definitions and conceptualisations of the 'problem' of public understanding of science can also be attributed to concerns over resource allocation, professional authority, and the advancement, expansion or continuation, of control of specific practical efforts to address this 'problem'.

Chapter 3 detailed the rise of a different formulation of the public understanding of science, and of 'the public', and 'science', from within the social sciences. This challenge, in the 1990s, to the scientific conceptualisation of PUS marks this episode out as different from scientists' earlier attempts to address the 'problem' of their relationship with the public (as detailed in Chapter 1). In these earlier episodes there was no formally recognised institutional or professional basis with accredited social and cultural legitimacy within the discourse of knowledge producing activities from which a critique could come. With the growth of the social sciences, and, here particularly, science and technology studies, within universities in the mid- to late-twentieth century, such a basis was now available. The social scientific critiques of science relied on them mobilising a very different discourse of science from the one that scientists had been mobilising for centuries, drawing the boundaries of science and public and sources of expertise and authority in a very different manner.

Science had, as part of its professionalisation, mobilised and popularised, definitions of science and the scientist in public contexts to construct and maintain boundaries between themselves and the public, with science as the authoritative party. We can, in the early-1990s, see certain social scientists using similar tactics, particularly those within science and technology studies, who mobilised their own expertise in attempts to colonise or, as Gieryn would argue, *expand* the space in which debates about PUS were taking place. The public and science as a social activity was an area which they felt fell under their purview as experts and thus they mobilised their own conceptualisations of the problem of public understanding of science. Much of the boundary work in this phase, conducted by the social scientists who colonised this area, can be seen as part of their own 'expansion' and professionalisation, i.e. the establishment of legitimacy and authority. The establishment of a journal for PUS, in which they were the major contributors, was one part of this larger goal of expansion of resources and authority. Equally, the criticism of the public understanding of science as operating within a 'deficit model' drew a sharp distinction between the dominant social scientific and natural scientific approaches to the 'problem'.

Wynne had asserted that the preoccupation of certain scientists with the public understanding of science should be read as a reflection of the social neurosis of science over its authority, public credibility and legitimation. I suggest that perhaps the same was also true for certain social scientists as they too entered into the PUS arena attempting to gain greater funding and public legitimacy over matters relating to the public and science. Lewenstein, as I have also highlighted, argued that scientific institutional interests concerned with their image and public standing were often the driving force behind the rhetoric of improving the public understanding of science. The launch perspective piece by Bodmer and Wilkins in *Public Understanding of Science*, is an example: the problem of public understanding of science was one of image in their paper.[347] They called on social scientists to provide research that would assist COPUS in marketing science, or better representing science and scientists to the public, but did not acknowledge the social scientists' expertise in defining science, or indeed the public understanding of science. This suggests that there was a need for the social scientists to have their public and professional legitimacy in this area recognised, at least by scientists, and government bodies. If they were to have any influence over the activities being funded by government which addressed the public understanding of science they needed to claim ownership of the issue. However, I would suggest that certain social scientists, felt that this was their terrain and area of expertise, and it is this territorial conflict which precipitates the ensuing boundary conflict. It is worth noting that Wynne's, and to a

[347] Bodmer and Wilkins (1992), op. cit.

lesser extent Wolpert's, arguments here are also preoccupied by the challenge to the normative values attached to science as an elite authority, and thus we must not characterise this conflict solely as a disciplinary one, but also acknowledge that it is also an overtly political one. It is equally possible to identify certain actors, such as Wakeford, or Steven Rose, both natural scientists by training, who mobilised contrasting arguments to scientific institutions such as COPUS in this period, which would confirm this observation.

Chapter 4 located the growing conflict between certain social scientists and natural scientists in the wider phenomenon known as the 'science wars'. We can again view this conflict as boundary work. The scientists wanted to remain in charge of their own discourse and maintain their cultural status as sole experts on matters scientific, what Gieryn characterises as *protectionism* boundary work. With the rise of many different social scientific disciplines all defining and critiquing science and its methods, many scientists went on the offensive. The rise, over the latter half of the twentieth century, of a body of expertise – social science – that claimed ownership over the specific issue of the public, meant that the public became a key battle-ground over the legitimacy of these differing expertises. Each professional group, particularly within debates over PUS, defined 'the public' differently while attempting to align themselves with it. The boundary work here serves to construct each professional group as 'on the side of the public', or working towards their interests; a normative assumption that members of each profession know what is best for the public. For scientists this was largely a continuation of the *protection* boundary work strategy that I have already discussed: science is at one and the same time separate from the public, yet is also something which can help to restructure society and the public for the better. This alignment is particularly pronounced during the so called 'science wars' where many scientists argued for a need to act to save the public from both itself (or its ignorant uptake of 'pseudoscience') and from social scientific approaches that they felt undermined their expertise and objectivity. Particular social scientists, on the other hand, were mobilising what they believed was a more honest and realistic construction of science, which portrayed social interests as part of the scientific enterprise, and questioned the hegemony over public authority that science was perceived to hold.

We also see in Chapter 4 boundary work continuing to occur within the social scientific community. This was largely a debate about competing methodologies, and therefore subsequently how the public was constructed by quantitative and qualitative methods, but we can also view it as a rhetorical fight for legitimacy and expertise, and the allocation of funds. Wynne and colleagues particularly attempted to draw a distinction between themselves and those scientists and quantitative social scientists operating under a 'deficit model'. We can view this as boundary work in keeping with Gieryn's idea of *expulsion*, qualitative social scientists, by advancing a view of the 'correct' form of social scientific inquiry, were also denying authority or membership of this domain, to actors whose expertise or views did not chime with the prevailing paradigm.

Ryan has argued that those constructing social problems in terms of particular deficiencies in certain actors leads naturally to programmes aimed at correcting those deficiencies. As he argues, the formula for action thus becomes extraordinarily simple: 'change the victim'.[348] A critiquing of a 'deficit model' position, is a strategy that occurs frequently in this phase, and is not limited to social scientific arguments against scientists' construction of PUS. The analytical usage of this term to describe the position of others, tends to imply a normative position of the analyst, to the effect that the perception of the deficit is wrong. For example, Ziman and Wynne deployed it to criticise the dualism in scientific formulations of PUS between those with and without scientific knowledge. Those without could be considered Ryan's 'victims' in this particular case. Locke has criticised both Collins and Pinch's 'golem science', in which the public is constructed as having a deficiency of social scientific understanding, and also Wynne's construction of the PUS problem, in which scientists and the scientific establishment are deficient in social knowledge and expertise. A reverse reading is also possible here which could suggest that those asserting a deficit on the part of others indicates a deficiency of understanding on the part of those doing the ascribing.

Within this history deployment of the term 'deficit model' is used by different professionals to challenge and critique the inherent dualism, and subsequent boundary set up between certain social groups by others. At the same time it can be seen as part of a repertoire of

[348] Ryan, W. (1971), *Blaming the Victim*, (New York: Pantheon Books).

argumentative practices used to draw boundaries between differing expertises and constructions of the relationship between science and public.

Chapter 5 detailed new allegiances between the professional disciplines while the role of government became more explicit in issues of public understanding of science, mobilising its own interests. The public controversy over BSE certainly drew attention to issues of scientific certainty and authority, and matters of risk and expertise, something over which many social scientists felt they had greater epistemological claim. The BSE episode also allocated blame to government in managing (or mismanaging) the relationship between science and the public and, in 1997, the New Labour Government brought with it a different political ideology legitimising the idea of public consultation and openness as a new means of managing the public. This also apparently brought government policy-making much more in line with many qualitative social scientists' conceptualisation of how to manage the science and public relationship. The 'problem' of public understanding of science thus became rhetorically less about one-way science communication and science education and more about relational issues of trust and governance.

I have also identified the rise of a new group of actors in these debates: professional science communicators. This was a growing group of practitioners who were engaging in boundary work in what Gieryn would call *expansion* mode, to define their role and increase legitimacy in managing the science and society relationship, at the same time as drawing a line between what they saw as their territory and that of those they branded as scientific amateurs, charaterisable as *expulsion* boundary work.

We are left at the end of this phase with a variety of attitudes and approaches within the scientific and academic communities in the UK, with many different constructions and interpretations of 'PUS', 'the public', 'science' and 'science communication' in operation. For example, the 'problem' of PUS, depending on who was defining it within this phase, could be assigned to the public, to scientists and their institutions, to the media and also to the Government. The public, within the multiplicity of constructs of PUS, were constructed variably as ignorant of science, ignorant of social science, irrational, or lay-experts. 'Science' within this phase can be identified as being common-sense, not common-sense, public knowledge, private knowledge, free from social and political values or constructed by them. Equally 'science communication' could be one-way pedagogic communication, or two-way communication whereby scientists understand the public, which also raised implications in terms of who was an expert in managing such communication exercises. Depending on who was drawing the boundaries, any one of these definitions was mobilised to protect, enlarge, critique professional groups' autonomy and authority, or indeed expel those deemed to be acting counter to the interests aims and ideology of a group.

6 Governing science and the public

Phase III

Public values and science

A sign that a different, and more participatory, conceptualisation of the relationship between science and public was gaining ground outside of a growing professional science communication arena came in late-1998, from the Royal Commission on Environmental Pollution's report *Setting Environmental Standards*. The report argued that public values were an essential element in decision-making about environmental policies and standards, and 'to ensure that such values are articulated and taken into account, less familiar approaches need to be used to extend and complement present procedures for consultation and participation'.[349] Furthermore, it argued that a simple top-down communication of the science and risks was inadequate, and that participation and dialogue with the public was required, as the report stated:

> Environmental and social values, in particular, are not necessarily pre-formed or fixed but, for many people, emerge out of debate, discussion and challenge, as they encounter new facts, insights and judgements contributed by others. (p. 101)

This formulation of communication as a dialogue suggests, on the one hand, that public values were, as certain social scientists had been arguing for some time, contingent on the specific circumstances, but also could suggest that public values could be managed by facilitating the right sort of debate and producing the right sort of facts. The language in the report, however, also showed a shift in rhetoric, away from the need to be educating the public about scientific issues, towards a focus on public trust and confidence, and public participation. Launching the Report, the Chairman of the Royal Commission, Sir Tom Blundell, said:

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[349] RCEP (1998a), *Setting Environmental Standards*, (HMSO), p. 101.

> For environmental policies to be successful, people must have confidence in the way they are being protected against risks. That is best achieved if they are involved at every stage. Controversies over the last few years in this and related fields show clearly that governments, industry, the public and scientists all need a much better understanding of the relationship between policies, science and values.[350]

Similarly, explaining the Royal Commission's approach to the study, Sir John Houghton, the previous Chairman of the Commission who had led the report, said at the launch:

> [We] must recognise that scientific assessments, and analyses of technology, economics and risk, must inform policy decisions, but cannot pre-empt them. Setting a standard or target is not only a scientific or technical matter, but a practical judgement which has to be made in the light of all the relevant factors. People's values must be taken into account from the earliest stages of defining the problem and framing the questions that need to be addressed.[351]

The Commission argued that traditional public opinion polling on scientific issues was inadequate for the purposes of setting environmental standards, as they did not believe that survey research could provide useful information about values. A 'failure to provide an opportunity for interaction, and for clarifying the values underlying the responses made', the report argued, was 'a major shortcoming of traditional forms of consultation'.[352] Instead, the methods suggested for articulating public values were qualitative. The Commission also argued that public values should be articulated at the earliest stage possible in the policy-making procedure, which would allow people to 'question assumptions about the character of environmental issues and the scientific understanding upon which the analysis is based'.[353] Thus we can see a conceptualisation of a public that could question scientific understanding in operation here, rather than one who had to have this improved.

Another method of promoting the interaction of expert knowledge and lay values, suggested in the report, was to break down the barriers between public and expert and introduce lay membership into expert bodies. These, it was argued, would provide an alternative viewpoint, and could suggest alternative ways of framing issues, or how issues can be

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[350] RCEP (1998b), *Press Release: New Millennium needs new approach to making environmental policies*, (HMSO).
[351] ibid.
[352] RCEP (1998a), op. cit., p. 105.
[353] ibid.

communicated in a meaningful way to a wider audience. Warning that such expert bodies should be careful of tokenism, however, the Commission continued:

> There is ... a danger that they may be appointed for presentational reasons, and may not provide a sufficiently effective or representative reflection of people's values. Appointment of lay members is certainly not a substitute for making expert bodies more transparent and open in their working methods. The real requirement is that expert bodies themselves should develop a sensitivity to questions of values. (p. 109)

Overall, the report was proposing a new type of relationship between scientific experts and the public, apparently moving away from the top-down deficit model communication. This was couched in instrumental terms, to improve what was being conceptualised as a new 'problem' in the relationship between science and the public, that of a lack of public trust. As the report concluded:

> This approach, based on partnership rather than confrontation, makes transparency and openness even more crucial. Ways must be found to maintain accountability and improve public trust.[354]

The Royal Commission argued that bodies setting environmental standards should now operate in an 'open and transparent way' as a basic requirement for public trust. However, in what amounted to a new public deficit problem, the public perception of openness and transparency was as important as its actual operation, this time to be solved by the communication of trustworthiness. Once the public saw these requirements were met, the presumption was that openness and transparency would help 'satisfy the public about the expertise, objectivity and impartiality of the bodies involved in dealing with environmental problems'.[355]

Thus the report provided slightly contradictory conceptualisations of the public and its relationship with science. On the one hand, efforts should be encouraged to allow the public to question the assumptions behind the science; yet on the other hand, if the public could be assuaged with a display of policy-makers and scientists working in an open and transparent

[354] RCEP (1998b), op. cit.
[355] RCEP (1998a), op. cit., p. 126.

manner, they would be satisfied, and thus allow science and policy to continue without the need for input. Irwin criticised the report, for calling for an end to top-down scientific assessment of new technologies, while also marginalising the social and ethical.[356] Most of the report was concerned with how to ascertain a proper scientific understanding of environmental risks, as the following passage exemplifies:

> A clear dividing line should be drawn between analysis of scientific evidence and consideration of ethical and social issues which are outside the scope of a scientific assessment.[357]

Though one chapter was devoted to public values, the overall report maintained a focus on technocratic management and policy-making, and continued to enforce a distinction between the social world of values and morals and the scientific world of technical, cognitive knowledge.

Despite this caveat, the RCEP report did, according to Irwin, raise the issue of public input into scientific developments and policy as a central component in the relationship between science and the public. This, he felt, lent 'weight to arguments for a more democratic and open treatment of science' and, I would argue, thus conferred legitimacy on his, Wynne's and others' discourse, which gave this issue importance in debates concerned with PUS.[358] With the explicit acknowledgement that ethical issues and public trust in scientific institutions were important, it suggested to Irwin, a 'newly harmonious relationship between UK policy processes and social scientific research' into science and publics, as the language of the two, previously quite separate institutions, converged onto similar areas of concern.[359] Gary Kass, a policy advisor in the Parliamentary Office of Science and Technology at the time, also cites the report as significant in bringing this issue to the fore within government.[360]

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[356] Irwin (2006), op. cit.
[357] RCEP (1998a), op. cit., p. 26.
[358] Irwin, A. (2001), 'Constructing the scientific citizen: science and democracy in the biosciences', *Public Understanding of Science*, 10: 1, p. 2.
[359] ibid.
[360] Kass, G. (2004), *Interview, 21 May 2004*, transcribed by Simon Lock.

The public and biosciences

A further example that those within the science policy environment were questioning the traditionally closed, and scientific expert led, manner in which science policy was formulated had been signalled with an announcement the previous year by John Battle, the Minister for Science, Energy and Industry, of a public consultation on the biosciences. Battle was concerned that while he was receiving a good deal of correspondence on bioscience issues, it was almost exclusively from those with a particular interest or preconceived perception.[361] He believed it to be important that the debate about biotechnology should also include members of the public with no such preconceived views. The Minister wished to go beyond those who normally lobbied him on policy issues to tap into an untouched public. Battle wished to hold a public consultation exercise which, he argued, 'allowed a deeper exploration of the wider, including ethical, issues associated with developments in the biosciences; and provided an opportunity for the general public to participate'.[362] The intention, as Battle's announcement stated, was 'to construct a project that allowed lay people to identify their hopes and concerns, and to feed this information into policy-making'.[363] The Minister stressed also, however, that the exercise was not designed to explore whether participants felt that a particular technology should go ahead.

Battle convened a preparatory meeting in early 1998 with people from science communication and the biosciences. Irwin argued that from the outset there was an apparent tension between those wishing to use the exercise as a means of educating the public, and those trying to access what the public felt about the issue.[364] The official documentation stated that the main topic of conversation in this meeting was 'access to and use of information ... this included the information available to policy-makers and to the general public, as well as any mismatch between the two and the way that people used this

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[361] Office of Science and Technology (1998d), *Public Consultation on the Biosciences*, (London: DTI), http://dtiinfo1.dti.gov.uk/ost/ostbusiness/puset/public.htm.
[362] ibid.
[363] ibid.
[364] Irwin (2001), op. cit.

information to inform their judgements relating to risk and trust'.[365] The minutes of the meeting show, however, that several of the attendees, specifically those from a social science, or public lobby group background, were concerned that the consultation avoid trying to educate people in a deficit style manner, and, most importantly, should be framed by the public's attitudes and concerns and not the Government's. The planned consultation was designed to incorporate both a qualitative stage of research, which would then be scaled up into a quantitative survey. The rationale behind this, as a Government official explained, was that the Government needed quantitative results 'in order for the study to be taken seriously by ministers and other observers'.[366] Thus quantitative work into the public, their views, and attitudes were still, this suggests, prioritised within policy circles over qualitative methods.

The qualitative research ran from December 1998 to February 1999, previous to which the new incoming Science Minister Lord Sainsbury had stated clearly that his aims for the consultation were to ensure that optimum use was made of 'scientific advice to inform decision-making, both by government and the general population'.[367] Moreover, Lord Sainsbury accepted a perception that there was a general lack of faith in the Government's use of science, and declared that the exercise was to be used as a means of restoring public confidence, as he told the advisory group:

> ... this Government has to ensure that not only are its systems appropriate, but that their existence and role are communicated. To restore public confidence in the Government's use of scientific advice requires people to understand the mechanisms used to arrive at decisions and accept that those were appropriate and based on sound principles.[368]

Thus, in a similar fashion to the Royal Commission's report, the ultimate aim of the consultation exercise, for Lord Sainsbury at least, was to address this perceived new deficit problem: a lack of public confidence in science and scientists. The general aims for the consultation were changed to assessing the levels of public knowledge of the Government's

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[365] Office of Science and Technology (1998a), *Bioscience Consultation - minutes of 10th March 1998, Meeting to discuss public consultation on developments in the biosciences - hosted by John Battle*, (DTI).
[366] Irwin (2001), op. cit.
[367] Office of Science and Technology (1998b), *Biosciences Public Consultation Advisory Group, Minutes of Third Meeting: 20 October 1998*, (DTI).
[368] ibid.

regulatory process, and to assess what information people needed to plug any gaps in this knowledge.[369] A press release publicising the consultation stated that the exercise served the dual purposes of 'seeking the public's views and promoting informed debate'.[370] Irwin criticised this concept of informed debate as meaning that subsequent conversation would be centred around officially recognised scientific issues and would likely not allow for the public participants to speak about other areas or frame the discussion within their own terms of reference.[371] The House of Lords Select Committee criticised the whole exercise for much the same reasons a year later, arguing that it was closer to market research than to public consultation. Irwin later reflected that in the late-1990s there appeared a remarkable congruence between official policy statements and social scientific research on the way to manage the relationship between science and the public. Yet within this 'more attentive policy audience', there was still a large discrepancy between his ideal of public dialogue, deliberation and communication, and the more conservative policy-making environment which relied on scientific framings of issues first and foremost.[372]

The effects of the controversy over BSE continued to be felt across government throughout 1999. The Government established a group of experts to provide advice on communicating risks in a bid to restore public confidence in its ability to handle issues such as food safety.[373] The group's creation coincided with the publication of a report from the UK Consumers' Association, which concluded that a science-based approach could not, on its own, be relied upon to reach 'socially acceptable decisions on issues involving the communication of risk'.[374] Echoing the views of the Royal Commission on Environmental Pollution, the Consumers' Association report had also concluded that the Government needed to be more open and transparent in the way it managed risk, including as many people - particularly from the public - as possible in the decision-making process. Thus we can see two different

[369] Office of Science and Technology (1998c), *DTI Press Notice: Lord Sainsbury announces public consultation on the biosciences*, (DTI).
[370] ibid.
[371] Irwin (2001), op. cit., p. 9.
[372] Irwin *Interview, 29 June 2004.*
[373] Masood, E. (1999), 'UK Panel formed to rebuild trust in government science advice', *Nature*, 397, p. 458.
[374] Consumers' Association (1999), *Confronting Risk - A New Approach to Food Safety*, (London: Consumers' Association).

approaches being promoted: one arguing for opening up government processes to allow more public input; and the other, relying on a better communication of risk and uncertainty to correct public misunderstandings. The former constructed the public as having values to bring to bear on science and science policy; the latter did not, constructing scientists and government as the authoritative parties in the policy process.

GM crops in the UK

The relationship between science and the public was put under a harsh spotlight at the beginning of the same year when genetically modified (GM) crops became a controversial issue, drawing the Government, scientific institutions, the public, the media and industry into a public debate about scientific uncertainty, risks and how best to communicate science to the public. GM crops had been rapidly introduced in the UK market over the previous few years, prompting unease amongst activist groups. Media coverage grew, and GM became a political issue in the House of Commons. On 12 February 1999 *The Guardian* published a letter from twelve scientists supporting the unpublished research of Dr Arpad Pusztai on the harmful effects of GM potatoes fed to rats, and the issue became front-page news for almost two weeks. Many of the media outlets initiated high profile campaigns against GM crops, and this, as the House of Lords Select Committee later reflected, 'drove the debate in ways that both the UK Government and significant sections of United Kingdom science and industry found extremely uncomfortable'.[375] The episode also echoed the BSE controversy. Despite the change in language within government about dealing with scientific uncertainty and risks, we can see that there remained different conceptualisations of the public and how to manage their relationship with science. The Prime Minister was quoted in a national newspaper as being happy to eat "Frankenstein Food" and to feed it to his children and it

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[375] House of Lords Select Committee on Science and Technology (2000a), *Science and Society*, (HMSO), p. 83.

was reported that he was frustrated that the potential benefits of GM food were being ignored in the escalating row.[376] Irwin, reflecting on the period, argued:

> The rather depressing implication seemed to be that, despite the widely held view that science/public relations had been badly managed in the BSE case, very little had actually been learned at the highest political level. Once again, an uncertain field of science was being employed as the basis for categorical assurances over safety while public concerns were arrogantly dismissed as irrational and emotional.[377]

A few months later *Nature* added its own calls for scientific and governmental efforts to restore public trust with an editorial which blamed the recent 'public outcry' on exaggerated claims and the mass-media market drive for newspaper sales – a problematisation here of the media as the cause of public misunderstanding of science. *Nature* accepted that public values might have an input into the decision-making process, but only so far as 'the soundest possible science' underlied any attempt to regulate GM foods and the editorial also argued:

> Broad public concerns, however "irrational" they may appear to some, must be taken into account in food safety regulations if they are to maintain their credibility. Industry complains that the public has lost trust in its scientific experts, but it will only make matters worse by declaring its own loss of trust in the judgement of the consumer.[378]

In May 1999 the House of Commons Audit Select Committee issued a report proposing, as the Royal Commission on Environmental Pollution had recommended, that members of the public be appointed to the advisory bodies responsible to the oversight of GM crops. The following week the House of Commons Science and Technology Select Committee issued its own report on the role of science advice in regulating GM crops, and argued conversely that the make-up of scientific advisory bodies should only include suitably qualified experts from 'other, not necessarily scientific, disciplines'.[379] Furthermore, the Committee emphasised that any scientific advice should be free of any direct input from environmental or consumer groups. 'Scientific advice should not', argued the chairman of the Committee, 'be tinged with ethical and consumer concerns. Scientists should concentrate on the

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[376] The headline of the *Daily Mail* on 16 February 1999 read: "THE PRIME MONSTER. Fury as Blair says: I eat Frankenstein food and its safe."
[377] Irwin (2001), op. cit., pp. 1-2.
[378] Editorial (1999), 'GM Foods debate needs a recipe for restoring trust', *Nature*, 398.
[379] Dickson, D. (1999), 'UK debates public's role in science advice', *Nature*, 399.

science'.[380] The environmental campaign group Greenpeace disagreed, and, writing in *Nature,* argued that the only way to manage GM crops, and crucially to try to 'restore public trust in science', was to accept that 'sound science' was not enough.[381] Science could not determine which questions should be posed, nor could it determine what the public considered an acceptable level of risk. Scientists, Greenpeace argued, were 'no longer perceived exclusively as guardians of objective truth, but also as smart promoters of their own interests in a media-driven marketplace' (p. 499). Thus many different groups were constructing a 'problem' of a lack of public trust or confidence in science, or government, but they proposed different ways to solve this, which, again, relied on how the public and science were represented.

Following calls for openness and transparency, and a perception that public confidence in the Government's handling of science needed to be improved, two new bodies were established to manage scientific advice on biotechnology. The results of the Biosciences Consultation in 1999 had fed into a review by the Cabinet Office and the Office of Science and Technology of the advisory and regulatory framework for Biotechnology, and in June 2000 the Agriculture, Environment and Biotechnology Commission (AEBC) was set up with a remit to 'offer strategic advice to Government on biotechnology issues which impact on agriculture and the environment ... [and] keep under review current and possible future developments in biotechnology with actual or potential implications for agriculture and the environment.[382] Its terms of reference also stated that it would: 'advise Government on the ethical and social implications arising from any new developments and their public acceptability; and seek to involve and consult stakeholders and the public on a regular basis on the issues which it is considering'.[383] The second body in this new independent, and at-arms-length, format was the Human Genetics Commission, which was set up to advise the Government on new developments in human genetics and how they impacted on people's lives. It, like the AEBC, was to focus particularly on the social, ethical and legal issues. As its website stated, it would operate in an open and transparent manner, with one of its key roles

[380] ibid.
[381] Haerlin, B. and Parr, D. (1999), 'How to restore public trust in science', *Nature*, 400.
[382] AEBC website, *AEBC: Terms of reference*, www.aebc.gov.uk/aebc/terms.shtml, accessed June 2000.
[383] ibid.

being to 'actively seek input from the public and other stakeholders'.[384] These bodies both still enforced, however, a boundary between science on the one hand, and social, ethical and 'public' knowledge on the other.

[384] Human Genetics Commission website, www.hgc.gov.uk/about_approach.htm, accessed May 2000.

7 'Crisis Point' 2000?

Phase III

A new 'humility on the part of science...'?

In April 1999, the Science and Technology Select Committee of the House of Lords appointed Lord Jenkin of Roding to conduct a study into society's relationship with science. The impetus for the study had primarily come from experience of an earlier Lords report into the management of nuclear waste,[385] which had devoted a chapter to considering the public acceptability of the issue. That report had acknowledged the complexity of public attitudes and values with respect to science and technology, the influence of the media, and the importance of public trust in institutions. Following the controversy over GM foods, and the changing nature of the scientific advisory processes within government in response to the BSE affair, the Select Committee asked Lord Jenkin to examine both the sources of information that shaped public attitudes to science, and the mechanisms for facilitating dialogue between scientists and the rest of society.

Over the course of the next year the Committee took oral evidence from many different sources, and received written evidence from 80 different individuals, and organisations, many of whom had been involved in public understanding of science activities or research over the previous decade. Two notable aspects of the Committee's constitution, however, suggested that it might produce something different from previous reports. The first was that the phrase 'public understanding of science', was not mentioned in the Committee's brief. As John Durant later remembered:

[385] House of Lords Select Committee on Science and Technology (1998), *Management of Nuclear Waste, 3rd Report, Session 1998-1999, HL Paper 41*, (London: HMSO).

> "Patrick Jenkin himself was already in a seriously questioning frame of mind about this whole area in a quite constructive way ... at the time he was appointed and that's clearly evidenced by his reluctance to have the Committee brief be described as public understanding of science. He would not accept that from the beginning, so it's telling us something about where he's coming from. I mean, quite a number of his committee members would not have questioned that description at all."[386]

A further sign of difference was the appointment of two special advisors to the Committee: Durant and Wynne. Both academics had been critical of the institutional status quo in recent public understanding of science activities.[387] They had ostensibly been on opposite sides of the quantitative/qualitative divide within the social scientific PUS research community, yet both had been vocal in calling for a change in focus. As Durant reflected, he sensed the report would be different:

> "... they chose Brian and me as advisors. I do think that was significant. Brian probably had more time to give to detailed drafting assistance than I did ... he did a lot more work between them than I did. But the thing that really I think made a difference is that he and I ... found ourselves largely in agreement about issues as they arose before that committee, so the Committee were not only hearing a different perspective from one of their advisors, they were hearing both their advisors encouraging them in particular direction and the chairman himself was sympathetic to that direction. The report did seem at the time, I think, to many of us to capture something of the spirit of where things were moving rather than where things had come from."[388]

Irwin, who gave evidence to the Committee, reflected that at the time there were signals that the report would listen to social scientific approaches to PUS in a way that past initiatives in the public understanding of science had not:

> "Looking at the report ... it seems to be quite influential. Again the role of social scientists, of course John and Brian were there behind the scenes. But it was quite a joy to give evidence, there was a real sense of, they're really taking this in. Again, you wouldn't expect this ... but there was a real sense of, yeah, this is what we want."[389]

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[386] Durant *Interview, 28 June 2004.*
[387] Though Wynne's general criticism of the status quo in policy institutions' management of science and technology issues dates back much further to at least the mid-1970s. For example, he was a prominent academic critic of the Windscale Inquiry. See, for example, Wynne, B. (1975), 'The rhetoric of consensus politics: a critical review of technology assessment', *Research Policy* 4: 3, pp. 108 – 158, Wynne, B. (1982) *Rationality and ritual: The windscale inquiry and nuclear decisions in Britain,* (British Society for the History of Science: Meyer, J. W. & Scott).
[388] ibid.
[389] Irwin *Interview, 29 June 2004.*

Jon Turney represented the turn to social science as a direct effect of recent problems the Government had experienced with scientific issues:

> ... some public crises helped the social science find an audience within Whitehall, because over such tremendous crises they were reaching out for any help they could get. Starting with salmonella, and right through to really horrendous things like BSE.[390]

Dyball also located the drivers for a change in focus to multiple factors:

> BSE, change of government, GM, the whole thing was going to flip around, because it was all about finding an answer to make people trust us, whoever the 'us' was.[391]

The House of Lords report drew on a lot of social scientific research, both qualitative and quantitative. So the involvement of two social scientists in drawing up the report does appear to have had an effect. Indeed, the Committee acknowledged that in reaching their conclusions the inquiry had taken them further than it would usually go into the realms of social science, which speaks of the status of social science in other scientific enquiries within Parliament.[392] Several social scientists who had been conducting research into the public understanding of science also gave evidence to the Committee.[393] Other professionals involved in PUS, not from the social sciences, also argued that these disciplines had much value to bring to bear on this issue. Chief Executive of the British Association Peter Briggs, for example, acknowledged that the area was one where scientists needed to acknowledge that they might need help from the social scientists, which suggests there was a new found legitimacy for social scientific perspectives in the eyes of some involved in this area.[394]

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[390] Turney *Interview, 11 August 2004.*
[391] Dyball *Interview, 19 August 2004.*
[392] House of Lords Select Committee on Science and Technology (2000a), op. cit., p. 14.
[393] For example Jon Turney, Professor Alan Irwin, and Peter Healey all gave oral evidence. Many other social scientists gave written evidence.
[394] House of Lords Select Committee on Science and Technology (2000b), *Science and Society - Evidence*, (HMSO), p. 37.

The report, entitled *Science and Society,* was published in February 2000, and concluded that society's relationship with science was in a critical phase.[395] It put forward many different recommendations as to how this relationship could be improved, not least by advocating a shift away from 'simply giving information', to 'engaging the wider public in dialogue about what science could and should be doing' (p. 13). The report reveals a mixture of different, and sometimes conflicting, representations of the public and their relationship with science, mobilising many of the original conceptualisations of what the 'problem' in public understanding of science was and where the boundary between science and society should lie. The public, the Committee believed, as evidenced in large-scale survey results and the high sales of popular science books, were interested in science, but they were also more sceptical and questioning of its uses.[396] As the Committee stated:

> ... public confidence in scientific advice to Government has been rocked by a series of events, culminating in the BSE fiasco; and many people are deeply uneasy about the huge opportunities presented by areas of science including biotechnology and information technology, which seem to be advancing far ahead of their awareness and assent. In turn, public unease, mistrust and occasional outright hostility are breeding a climate of deep anxiety among scientists themselves.[397]

A 'crisis in confidence' on the part of the public, was how the Committee characterised the relationship between science and society; the public still therefore being constructed in this report, as in the Bodmer report, as a 'problem'. This, as already discussed, conceptualised a deficit on the part of the public, though now of trust and confidence in scientists and/or government, instead of scientific knowledge.[398] Thus the publication of the Lords report gave further official 'recognition' and legitimation of this perceived new problem. Of interest here also is the mention in the House of Lords report of a 'deep anxiety among scientists themselves' (p. 11). Again, as in 1985, we can identify that an underlying reason for dealing with a perceived problematic public was based on tensions within the scientific community,

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[395] House of Lords Select Committee on Science and Technology (2000a), op. cit., p. 11.
[396] For example Office of Science and Technology and The Wellcome Trust (2000), *Science and the Public: A Review of Science Communication and Public Attitudes to Science in Britain,* (The Wellcome Trust).
[397] House of Lords Select Committee on Science and Technology (2000a), op. cit., p. 11.
[398] In the previous year the Office of Science and Technology had issued a consultation paper, within which there were also questions which asked how to improve public confidence by creating greater transparency in the regulation of science.

and the need to address their relationship (or indeed manage their image or boundary with the public) head on with some sort of 'corrective', and communication-based, measure.

The Committee identified many different reasons why this perceived crisis of confidence was important to address and, in the process, mobilised many older arguments for an increased public understanding of science though with some notable new caveats. 'Democratic citizenship in a modern society', the Committee argued, 'depends, among other things, on the ability of citizens to comprehend, criticise and use scientific ideas and claims' (p. 12). Issues of public understanding were therefore still present, despite the phrase not being used; however, the public here were conceptualised in a less passive manner than before, with communication referred to as a two-way process. It was also, the Committee believed, up to government and industry to handle complex and ethical social questions in ways which 'command public confidence' (p. 12). A concern with public resistance to science and new technology was discussed at length in the report highlighting a conceptualisation of public attitudes and opinion as something which had a negative impact on science. As the excerpts below exemplify:

> ... resistance, whether well founded or misguided, on the part of the public whether as citizens or consumers, may inhibit technological progress.
>
> Public hostility to a product or process may drive industrial investment in production or research overseas.
>
> Public misunderstanding may lead to technology being rejected; it may also lead to technology being abused. (p. 12)

The Committee also argued that, 'the future wealth and welfare of society depends critically upon the enthusiasm of young people to pursue scientific careers' (p. 12). Thus the promotion of a positive attitude towards science was also still desired. Little therefore appeared to have changed in the way of arguments for improving the public understanding of science since Thomas and Durant had commented on them in 1987.[399]

[399] Thomas and Durant (1987), op. cit.

Having characterised the 'problem', and the importance of remedying it, the rest of the report recommended ways to, as they put it, 'improve the dialogue on both sides'.[400] This could be achieved through what they called 'public understanding of science activities': improving the communication of uncertainty and risk, and by changing the nature of policy-making so that it became normal to bring science and the public into dialogue about new developments at an early stage' (p. 13). Public understanding of science activities were therefore still, it appears, seen as central to the improvement of science's relationship with the public. The Committee identified public understanding of science as a shorthand term for 'all forms of outreach by the scientific community, or by others on their behalf ... to the public at large, aimed at improving that understanding' (p. 25). The Committee elsewhere in the report, however, stated how the usefulness of this term was now questionable, after considering much of the evidence submitted:

> Despite all this activity and commitment, we have been told from several quarters that the expression "public understanding of science" may not be the most appropriate label. Sir Robert May [the Chief Scientific Adviser] called it a "rather backward looking vision"... . It is argued that the words imply a condescending assumption that any difficulties in the relationship between science and society are due entirely to ignorance and misunderstanding on the part of the public; and that, with enough public-understanding activity, the public can be brought to greater knowledge, whereupon all will be well. This approach is felt by many of our witnesses to be inadequate; the British Council went so far as to call it "outmoded and potentially disastrous" (p. 25)

The Committee felt that language was important, and while COPUS had argued during the inquiry that PUS activity should retain this name, so many of the witnesses had expressed doubts about it that the Committee felt a new name would, in their view, acknowledge a fresh start. As they argued:

> we have found that the title of our inquiry, "Science and Society", has had wide appeal ... this is perhaps because it implies a dialogue, in a way that "public understanding of science" does not. (p. 27)

[400] House of Lords Select Committee on Science and Technology (2000a), op. cit., p. 13.

There was still much talk, despite this, of needing to improve the public's understanding of science in certain respects. For example, the Committee argued that within the context of communicating risk and uncertainty, the public's understanding of the nature and processes of science needed to improve.

Public understanding of science to the Committee, however, was not now enough to solve the perceived problem in science/public relations, and they argued that the need for scientists to engage the public was the right means to restore public confidence. Identifying what they called a 'new mood for dialogue' within the public and the PUS community, they argued:

> Today's public expects not merely to know what is going on, but to be consulted; science is beginning to see the wisdom of this, and to move "out of the laboratory and into the community" to engage in dialogue aimed at mutual understanding. Several of our witnesses agree that a shift along these lines is taking place. (p. 37)

What 'dialogue', or 'engagement' entailed, however, is formulated in different ways. Evidence of this 'new mood' was attributed to the growing body of experience in the UK at staging consultation exercises, for example, consensus conferences, deliberative polls, focus groups and citizen's juries. The Committee, however, stressed that they felt many of these consultation exercises were more akin to market research than public engagement, and provided only a sample of the public's attitudes and opinions, rather than allowing the public to be actively engaged. Only certain types of dialogue were therefore acceptable to the Committee, and conducting more of these event-based initiatives would not be a 'meaningful response' to the need for more and better dialogue between the public and science. They required a larger change, arguing that 'the United Kingdom must change existing institutional terms of reference and procedures to open them up to more substantial inputs from diverse groups' (p. 37). Government science advisory bodies, they clarified, should conduct as much of their proceedings in public as possible and, echoing the earlier RCEP report, appoint 'lay' members to their advisory groups or committees to allow 'lay-values' to enter into the policy making process (p. 44). Thus a 'change in the culture' of existing institutions was being called for, not simply public dialogue as an optional add-on. The

Committee argued that these exercises and approaches were not substitutes for decision-making, but aids to it; engaging with the public should secure science's 'licence to practice', and not restrict it. Again a boundary between science and the public was being constructed here. Science was the cognitive content, provided by scientific experts, and values were provided by the public involved in these exercises. Dialogue, though costly and difficult, would, the Committee argued, avoid other perceived difficulties:

> Listening has a cost. But so does not listening, and this cost may be far higher, paid in hostile headlines and ground lost to single-issue groups in consumer boycotts and lost jobs. (p. 42)

There is therefore a tension within the report: dialogue and engagement appeared to mean assigning a level of legitimacy to the public, allowing public values to be considered, and opening up the policy-making process; whereas in other senses it appeared more to do with listening to the public's attitudes, and then, having done so, science could be trusted to get on with scientific research. As the report emphasises, dialogue was intended to secure science's licence to practice, but not to restrict it: thus the scientific experts maintained authority and responsibility over science. However, new methods of communication needed to be sought to allow this to continue. All of the new language did, however, imply a two-way communication of some sort, rather than the one-way, top-down communication, which had, up until then, been carried out by most political and scientific organisations.

What also came out very strongly in the report were mixed feelings about the role of the media in influencing the relationship between science and the public. Many of the academics and journalists who gave evidence to the report had stressed that scientists needed to understand how the media operated, rather than blaming it for misleading or irresponsible headlines about science.[401] The Committee concluded that much of the reporting on science by science journalists was very good, but expressed concern at the manner in which science was treated by non-specialist journalists, and recommended that the Press Complaints Commission adopt a set of guidelines, already drawn up by the Royal Society, for journalists

[401] See for example, Turney, J, p. 25; Irwin p. 16; Conner, S and T. Radford, p.50

reporting on science. These guidelines stressed the need for accuracy, balance, credibility and legitimacy in the reporting of science in the press. Jon Turney, reflecting on this verdict, argued that it showed little had changed since Bodmer in the way the relationship and boundary between science and the media was conceptualised:

> ... the same language then as now, about being distorted, sensationalist, irresponsible, scandal-mongering alarmist, what you like, not getting their facts straight, not enough science and what there was, not a good medium, not a good enough quality or fidelity.[402]

However, having endorsed the guidelines, the Committee concluded with a pragmatic approach to the media and argued that science should learn to work with the media as they are and could not expect 'special treatment from the media, or a special code of practice', any more than any other specialist subject which was covered in the press.[403]

Taken as a whole the report made a lot of arguments for the need for the established public understanding of science agenda to be reconsidered and renewed, with a new goal of restoring public confidence in science and scientists. What is evident, however, is that despite the Science Minister having pronounced the 'demise of the deficit model' at the 1999 meeting of the BAAS, there remained many old and new 'deficit style' ideas within official discussions of science and society, particularly around conceptualisations of the public.[404] In comparison to the Bodmer report we can see that, to the House of Lords, the issue of the publics' relationship with science was to be managed less through educating them and more by 'engaging' them in the policymaking process. Also much of the language and concepts used in the report were similar to that found in an academic PUS context.

The House of Lords report exemplifies the multiplicity of conceptualisations of 'science', 'the public' and science communication and engagement now operating within the PUS

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402 Turney *Interview, 11 August 2004.*
403 House of Lords Select Committee on Science and Technology (2000a), op. cit., p. 58.
404 Miller (2001), op.cit.

arena. The dominant language of public understanding of science activity appeared to have shifted away from science communication and education and now referred more to science policy and governance, risk management, public dialogue and engagement as the key factors on which to focus to improve the relationship with the public. The way the relationship was characterised, or indeed, what an improvement entailed, was still varied.

Official responses to the House of Lords report

The Government, in its response to the report, committed itself to a more open style of regulatory process, and agreed that any change in COPUS should reflect, they stated, 'the change in emphasis from public understanding of science towards dialogue between scientists and society in general'.[405] Science communication was mentioned in their response only in the context of arguing that training courses for scientists should be changed to allow scientists to become aware of 'the social context of their research and its applications'.[406] The main focus of their response was firmly placed upon regulatory issues and scientific advice, with public dialogue now a priority. The Government pointed out that the Food Standards Agency and the two new biotechnology commissions, the Human Genetics Commission and the Agriculture and Environment Biotechnology Commission, all had a specific remit to involve and consult stakeholders and the public.

The need for the public to have greater confidence in science and technology and, more specifically, the Government's handling of science and technology was underlined again that year, with the publication of the first science White Paper of the New Labour Government. Throughout the White Paper, entitled *Excellence and Opportunity: A Science and Innovation Policy for the 21st Century*, we see the use of the terms 'the public' and 'consumers'. At points the two

[405] Department of Trade and Industry (2000b), *The Government Response to the House of Lords Select Committee on Science and Technology Third Report: Science and Society*, (London: HSMO).
[406] ibid.

terms are used separately, at others, they appear to mean the same thing.[407] A 'consumer' is someone whose relationship with science and technology is solely defined by their consumption of its products and services, which is a different conceptualisation from a public which brings values to, and was engaged in, the science policy process. The White Paper laid out its vision of innovation in the UK, placing science and technology at the centre of a vibrant economy in a successful nation:

> To be a successful nation we must make sure our science base is strong and excellent, that we have the facility to quickly transform the fruits of scientific research and invention into products and services that people need to improve their well-being and quality of life. And we must do all of this in a way that has public support and involvement. We must have the ability to generate, harness and exploit the creative power of modern science. (pp. 2-3)

Throughout the White Paper the public, and its confidence and support, was identified as a key component of the innovation process, which would, as the excerpts below exemplify, subsequently determine the success, or otherwise, of the UK's fortunes:

> An innovation will only succeed if it is desired and accepted by consumers and the public ...
>
> Companies will invest in new products if they recognise that consumers are open to innovation and quick to adopt new services. (p. 5)
>
> ... public support is a key part of the process of innovation. Public support for science underpins the Government's investment in the science base, refuelling the cycle of innovation by allowing research to go in new directions. (p. 8)

Public confidence, as the House of Lords Select Committee had argued, was of high importance, so much so that a quarter of the White Paper on science and innovation was devoted to the issue of 'confident consumers'. In contrast to the White Paper published in 1993, where public understanding of science had been the heading under which issues of the public were discussed, public controversy over scientific issues had evidently suggested the need for a different approach. As the Government argued:

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[407] Department of Trade and Industry (2000a), *Excellence and Opportunity: A Science and Innovation Policy for the 21st century*, (London: Department of Trade and Industry).

> Science must be our servant and not our master. Public acceptance of science cannot be taken for granted. The challenge for scientists is to engage with people in debate about the benefits of what they do ... .(p. 8)

> ... public confidence in the whole notion of science must be strong and well founded. People must feel that science is serving society and that it is properly regulated, open and accountable. The BSE crisis and the controversy over GM foods have raised questions about the value of scientific progress in society. These are questions we should ask. It is in the public interest, in the interests of scientists and in the interests of companies seeking to exploit science commercially that they are addressed. We need a more systematic and independent approach to satisfy public concerns about the risks created by scientific innovation ... Science and innovation need a stable and transparent framework of public support within which they can develop. (p. 5)

Again we can see a boundary between science and scientists, and 'people' being rhetorically constructed here. Also, in a similar fashion to the earlier House of Lords report, much of the language in the White Paper which referred to the relationship between science and the public was couched in terms of 'engagement', 'trust', 'dialogue' and 'confidence'. One can see, however, a tension implicit in the paper between the idea that the public, or consumer, should not inhibit innovation (at several points the paper stresses that the Government 'must' press ahead with the development of new technologies) and the idea that public views should be taken into consideration, exemplified in phrases such as 'science is too important to be left only to the scientists', or 'when science raises profound ethical and social issues, the whole of society needs to take part' (p. 54). This suggests that science was conceptualised as something separate from society; society was where ethics and values were located. The tensions imply that the Government saw the mission of restoring public confidence and engagement to be about finding ways to bring the public on board so that innovation could continue unabated, therefore public input was desired, but only if it was positive. Throughout the report the public is conceptualised as having only 'concerns' about science, and as being a potential brake on scientific progress. Companies, for example, were only likely to invest in research, the Government argued, if they could 'see the possibility of recouping its investment in consumer markets', thus by implication the public needed to show willingness to accept whatever new product was being marketed, otherwise the companies would not invest (p. 49). Equally, the White Paper argues elsewhere, 'were a climate of distrust to build up around science, it could drive scientists away from the UK and in the long run impoverish us' (p. 51). Thus again the public seems only conceptualised in a negative and problematic manner, and public engagement is a means of reversing this 'problem'.

The Government made many different suggestions as to how it would restore public confidence in the scientific advice process within government. This was essential, it argued, to allow innovation to develop successfully. As Stephen Byers, the Secretary of State for Trade and Industry announced in the introduction to the White Paper, the Government would introduce a framework of proper safeguards, information and accountability, which would provide 'the public trust which scientific developments must secure in order to benefit society' (p. ii). As a first step it promised to implement stronger guidelines from the Chief Scientific Adviser on how scientific advice would be used in drawing up government policy; and to publish a new code of practice for scientific advisers to government, which would 'commit them to high levels of openness and transparency in their work' (p. 11). The updated version of the Chief Scientific Adviser's guidelines on scientific advice and policy-making within government was published alongside the Government's White Paper. These also represented the 'problem' of the public understanding of science (discussed here under the more general heading of 'science and society') as a problem of public mistrust of, and confidence in, scientists, especially those within government. As the other official bodies had argued before it, key to addressing this lack of confidence was, to the Government, to open up policy-making procedures, allowing a broader range of views, and, vitally, being 'open and transparent' when communicating science to the public. The *Guidelines 2000* built on this view arguing that, when forming scientific advice, government departments should draw on a wide range of sources, and should consult on these sources with 'interested stakeholders and stakeholder groups representing the interests of consumers and members of the public'.[408] Thus we can see a distinction being made between different types of public: stakeholders, consumers, and members of the public.

The conceptualisation of 'expert advice' in the guidelines was wider than had previously been seen. Now members of the public and public groups were being granted an input into the

[408] Department of Trade and Industry (2000c), *Guidelines 2000: Scientific Advice and Policy Making*, (London: DTI).

formation of expert policy advice. It is worth noting, however, that the lay members of the advisory group were being invited as something separate from the advisory committee itself, which highlights some boundary work, constructing them as different from a 'scientific expert'. As the guidelines stated, 'scientific advice is only one element among the considerations which may need to be taken into account by decision makers, which might also include social political, economic, moral or ethical concerns', the lay-members were thus being included specifically to bring in these social concerns, rather than any scientific, or other, knowledge or understanding.

Communication of scientific advice to the public was also identified as very important and, the guidelines argued, it would be 'important that sufficient early thought is given to presenting the issues, uncertainties and policy options to the public so that departments are perceived as open, well prepared and consistent'. Again the perception of openness and transparency, if not the actual presence of it, was deemed a crucial way of managing any potential adverse public reaction and, as the White Paper had argued, restoring public confidence in science. These guidelines, and the White Paper, suggest a shift in styles of policy-making and communicating scientific uncertainty to the public, both of which had previously relied solely on scientific advice. The main problem, however, in effective and trustworthy scientific governance remained, in these reports, the public, and efforts to address this problem were still concerned with managing public attitudes and opinion, and the image of scientists and scientific organisations.

Further evidence of a managerial approach to the public in relation to science and technology came in early 2001 with the publication of the Phillips Report on the Government's handling of BSE. One of the key findings of the report was that concern over an irrational public reaction to the risks of BSE had shaped the manner in which the Government dealt with the issue, and this had dented public confidence. As the report concluded:

> The Government did not lie to the public about BSE. It believed that the risks posed by BSE to humans were remote. The Government was preoccupied with preventing an alarmist over-reaction to BSE because it believed that the risk was remote. It is now clear that this campaign of reassurance was a mistake. When on 20 March 1996 the Government announced that BSE had probably been transmitted to humans, the public felt that they had been betrayed. Confidence in government pronouncements about risk was a further casualty of BSE.[409]

BSE had therefore highlighted a failure of scientific advice within government to deal with communicating uncertain science to the public. The failure also implied that the Government had conceptualised the public as passive and deficient in scientific understanding. As Sir Robert May the Chief Scientific Adviser at the time of the inquiry described in his evidence, the prevailing instinct in these situations up until this episode had been "to hold the facts close" so that a "simple message can be taken out into the market place". BSE, however, had suggested to him that the "full messy process whereby scientific understanding is arrived at, with all its problems, has to be spilled out into the open".[410] One other lesson put forward by the Phillips Report is also relevant here. The report argued that the public should be trusted to respond rationally to openness. This suggested that previous assumptions which existed within government - that an admission of uncertainty would only confuse the public, and therefore sticking to only 'rational' expert advice, and giving out reassurances of safety, despite no evidence of no risk, was the best way to manage the situation – needed to change. The Phillips Inquiry argued that a line must be drawn under this style of governance, and this way of conceptualising the public; 'trust', it concluded, 'can only be generated by openness'.[411]

The Government's response to the Phillips Report agreed with many of the 'lessons learned'. The report, the Government stated, had 'rightly commented that the Government should trust the public with information and treat people like adults' and pointed to its new

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[409] (Lord) Phillips, N., *et al.* (2000), *The BSE Inquiry Report: evidence and supporting papers of the Inquiry into the emergence and identification of Bovine Spongiform Encephalopathy (BSE) and variant Creutzfeldt-Jakob Disease (vCJD) and the action taken in response to it up to 20 March 1996*, www.bseinquiry.gov.uk, accessed July 2006.

[410] (Lord) Phillips, N., *et al.* (2000), *The BSE Inquiry Report: evidence and supporting papers of the Inquiry into the emergence and identification of Bovine Spongiform Encephalopathy (BSE) and variant Creutzfeldt-Jakob Disease (vCJD) and the action taken in response to it up to 20 March 1996*, www.bseinquiry.gov.uk/report/volume1/chapt142.htm, section 1297, accessed July 2006.

[411] ibid., section 1301.

guidelines on scientific advice, and the establishment of new arms-length science advisory bodies like the Food Standards Agency, to show that it was changing the policy approach to reflect this new need for openness and transparency.[412] A consultation to the Government's interim response to the Phillips report had apparently confirmed that openness was seen as essential to regaining public trust and the Government also pointed out that following the General Election in June 2001, a Cabinet Ministerial Committee on Science Policy, chaired by the Secretary of State for Trade and Industry, had also been established and was attended by all of the Departmental Chief Scientific Advisers. This Committee's terms of reference were 'to consider the Government's policies in relation to scientific advances and public acceptance of them'.[413] Thus 'public acceptance' of scientific advances again appears to have been the ultimate goal of the Government, with openness and transparency a means of restoring public trust to allow this to occur. This new language of dialogue was widespread, and can be seen not just in the UK, but also in the European Union's *Science and Society Action Plan* published in the following year, the stated objective of which was to 'change the relationship between science and society'.[414] Again alongside arguments for increasing the flow of good quality scientific information to the public and enthusing the public about new technology, sat the argument that 'a true dialogue must ... be instituted between science and society' (p. 12), and with a commitment to 'improving transparency and consultation' (p. 14).

The OST/Wellcome report

This shift in policy language away from a top-down approach to the science communication of facts and knowledge, towards a focus on issues of trust, risk, dialogue and policy-making, placed many of the PUS organisations in a new terrain. Having consistently maintained that key to managing the relationship between the public and science was the communication of a greater understanding of science, all were now faced with having to respond to this new

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412 HM Government (2001), *Response to the report of the BSE inquiry*, www.defra.gov.uk/animalh/bse/general/response.pdf, accessed July 2006.
413 ibid.
414 Commission of the European Communities (2002), *Science and Society: Action Plan*, (European Commission), p. 24.

dominant rhetoric, and with this, embrace the idea that one-way science communication was no longer a main focus of governmental concerns; dialogue and engagement in the policy process had taken primacy.[415] The first sign that some members of the scientific community were dealing with these changes came with the publication of a joint survey report in 2000, by the Office of Science and Technology and the Wellcome Trust, entitled *Science and the Public: A Review of Science Communication and Public Attitudes to Science in Britain.* In the forward to the report, Lord Sainsbury, Minister for Science, and Mike Dexter, Director of the Wellcome Trust, affirmed how attitudes had changed towards science communication in recent years, stating:

> Most of us agree that the 'deficit' model of the public understanding of science is less relevant today. This report is intended to start the process of discussion that will take us forward into the 'engagement' model of *Science and Society*.[416]

Furthermore, as was clearly stated at the outset of the report, to these institutions the main issue in science communication policy was now described as 'how best to develop a dialogue between scientists, policy-makers and the public, and to bring public opinion into the development of policy and practice in science communication' (p. 4). As the two organisations continued:

> The Wellcome Trust and the OST believe that an 'engagement model' of science communication – a two-way dialogue between specialists and nonspecialists – is more appropriate than the 'deficit model', which just gives people information about science. (p. 10)

The report formed part of a Government review of activity in the public understanding of science, in order to target government resources more effectively. The survey was also intended to set a baseline for public attitudes to science, engineering and technology so that future changes in these areas could be measured. Along with the earlier House of Lords

[415] It is worth noting that both COPUS, the Royal Society and the British Association all received large parts of their funding from Parliament or from the Office of Science and Technology, thus were all in a position of having to reformulate their own objectives if they wished to continue to receive patronage from their benefactors.
[416] Office of Science and Technology and The Wellcome Trust (2000), op. cit.

report and the Government's White Paper, this report began a period of consultation. The Government and the Wellcome Trust hoped that scientists and science communicators would consider what role they could now play in 'informing the debate about those aspects of science which are of concern to the public' (p. i). The definition of public understanding of science in the report shows a change from previous usages of the phrase. The term 'science communication' was used in preference to public understanding of science. Science communication, the report laid out, encompassed:

> ... print and broadcast media activities; traditional museums; Government and voluntary sector public understanding of science programmes; existing and new science centres; efforts of private industry; and the scientific community's activities more widely. (p. 11)

As the report acknowledged, this wide definition included 'any and all activities that intend to educate or engage people in science, engineering and technology' (p. 11). The deficit model of public understanding of science was supposedly no longer appropriate, yet this broad definition of activities, most of which were largely still in a one-way information provision mode, suggests that in practice 'deficit model' activities were acceptable so long as they were not labelled as such. As the report stated, the institutions were 'concerned with the communication of science to the nonspecialist public' (p. 12). Elsewhere, however, the report identified science communication to mean communication between various different groups such as: scientists and the public, the scientific community and the media, the scientific community and the Government. Thus the suggestion that it was only one-way was less pronounced. What is apparent in this report are the multiple definitions of 'science and society' and 'the public', and the tensions that existed within the scientific community at this time while they took on board new aims and new language, and reformulated and put into practice their communication activities. Indeed the report itself acknowledged 'tensions within and between these players about what, why and how they are communicating with the public', as it stated:

> A desire to communicate definite 'facts' about science can conflict with the need to communicate how the scientific process works. The former aims to provide relatively clear-cut scientific information, while the latter tries to give the public an insight into the continually questioning method of scientific discovery. (p. 12)

In a similar call to Collins and Pinch's a decade before, an understanding of how science works was now seen as essential to head off public disenchantment with, or misunderstanding of, scientists. Thus the image and acceptance of science was still an important facet of science communication activities, as the report suggested:

> Greater understanding of the scientific process is important if nonscientists are to appreciate how accepted theories can be overturned and new interpretations or results take precedence. This should prevent science and scientists being dismissed as confused or confusing when new findings are announced. (p. 12)

Further tensions were also acknowledged in the report within the motivations of some organisations for conducting science communication:

> Organizations often have more than one reason for embarking on science communication activities – reasons such as raising the profile of an institution or cause, recruitment or fundraising. Overt public relations masquerading as science communication can lead to scepticism among the public. (p. 13)

Furthermore, these more self-interested motivations, the report argued, stood in the way of a joined-up and strategic approach to science communication between all of the organisations. The 'historical tendency' for activities to be driven by the needs of the provider of the science communication rather than the needs or desires of 'potential consumers', was blamed in part for this.

Multiple, and often conflicting, definitions of 'the public', 'science communication', and what a good relationship between science and public meant, can be identified in this report. Again, the 'deficit model', according to both institutions, was now 'inappropriate', and the objectives of their own public understanding of science activities, they stated, embodied this belief. However, the objectives of both institutions still maintained that information provision was important. So on the one hand science was being described as a much more open and public enterprise; and on the other, a boundary between science and the public was rhetorically enforced. Both of these institutions were struggling to define their role in the 'new' area of science and society, and we can see this diversity of definitions as part of the shifting boundary work strategies they were engaged in, in what was now a crowded field of 'expertise'. The Wellcome Trust's objectives were to:

> ... stimulate and inform debate about the social and ethical issues arising from current biomedical developments; and to make information about biomedical science and its achievements and applications more widely accessible. (p. 10)

The Office of Science and Technology's objectives were to:

> ... increase public understanding and awareness of: scientific facts and more importantly, scientific and engineering processes; the role played by science, engineering and technology in everyday life; the benefits brought by science, engineering and technology and an appreciation that these benefits are not without potential drawbacks. (p. 10)

Thus while both appear to have acknowledged that science presented social and ethical issues, and/or potential drawbacks, which signalled a shift away from purely promoting science as a positive force, OST's objectives particularly highlight that they wished also to engineer a change in knowledge and attitude within the public. Differences in the extent to which both institutions had changed are exemplified further when they turned to discussing the role of science communication. The Wellcome Trust believed that some scientific developments were so fundamental that there needed to be a national debate, and that 'politicians and scientists should not be making decisions without wider public discussion' (p. 13). The Office of Science and Technology, on the other hand, was not so inclusive, arguing that public perceptions of science played an increasingly important role in developing policy, and dialogue with the public and informed debate were essential. This suggests that a deficit model, and the social hierarchy that this maintained, was still in operation. The Government appeared to conceptualise 'dialogue' more as a means of changing the public's perceptions of science to something more positive, whereas the Wellcome Trust's approach appeared more to do with a promotion of a two-way discussion of scientific issues, so that public views and attitudes could feed into the policy-making process.

'The public' was categorised in the report in a very specific manner. It was, as in the House of Lords report and the White Paper that had followed it, generally conceptualised in a negative way, with the public expressing concerns that needed to be somehow dealt with by these institutions. The public were also referred to as 'consumers', this time of science communication rather than the products of science. Thus we can see again a mix of discourses defining the public: one of democratic citizenship, and one of the market. To help target science communication exercises more effectively, six attitudinal groups, with differing socio-economic profiles, were identified in the OST/Wellcome report, which were based on the results of a large survey of public attitudes.[417] The way in which these discrete groups were conceptualised suggests there was a belief that once identified, all science communication activities could be targeted at these individuals. As the report argued, there were many organisations that needed to 'improve their understanding of their audiences and of traditional marketing techniques if they are to gain maximum benefit from their efforts' (p. 13).. Thus, again, the point of science communication here appears to be more about improving marketing techniques to target the right audience for the scientific community's message whether through communication or dialogue.

As the Wellcome/OST report exemplified, and as Briggs, reflected at the time, 'since the Lords report was published, dialogue had become the "in thing" in science communication', with, he reflected, 'most organisations with public programmes planning to get involved'.[418] Briggs also pointed, however, to what he thought was the worrying uptake of this new approach without much thought as to what it actually meant, as he recalled:

[417] See p.7 of the report for full descriptions of the six attitudinal groups.
[418] Briggs, P. (2001), 'A recipe for dialogue', *Science and Public Affairs*, June 2001.

... I have sat through one lengthy talk, with little time for questions, on the importance of two-way communication between science and the public. I have been at an hour-long lecture followed by a few questions, which was described as a major contribution to public debate. And I have been told that the BA should get more involved in dialogue because that is the way better to get our message across! Perhaps there are as many interpretations of 'dialogue' as there are of 'public understanding of science'.[419]

[419] ibid.

8 From Deficit to Dialogue?

Phase III

The renegotiation of definitions of public understanding of science, the public, dialogue and science communication, in the year following the House of Lords report, resulted in almost all initiatives previously labelled as public understanding of science being re-launched with a new 'Science and Society' rhetoric at their core. The Royal Society's response to the report was the establishment of a five-year 'Science in Society Initiative', funded with a grant of £1 million from the Kohn Foundation.[420] It was set up as part of the Royal Society's commitment to respond to their growing concern and perception that 'the public's confidence in certain areas of science was failing'.[421] The Society's aim was to offer 'leadership in addressing the underlying causes of this concern, which were set out clearly in the House of Lords' Science and Society report'. These causes, according to the Royal Society, included 'poor communications between scientists, the public and the media, lack of recognition of public values and the need for transparency'. While the Government had identified the problem as one of scientific governance, and was subsequently promoting a dialogue agenda to restore public confidence in the handling of science, many within the scientific community interpreted the problem as one in which the public's confidence in science, and scientists, needed to be restored. This suggests a shaping of 'the problem' as being guided by each institution's own immediate interests and concerns, precipitating boundary work to construct their identity and the boundary between themselves and the public, and each other.

The aim of the Royal Society's new Science in Society Programme was to 'take forward the Science in Society approach', which aimed for openness, transparency, dialogue and

[420] I worked as the Project Officer on this Programme in the first year of this five-year programme from May 2001, to January 2002 therefore much of this section is based on my impressions and experiences of being inside the Society and 'backstage' to the public discussions.
[421] The Royal Society *Science in Society Website*, www.royalsoc.ac.uk/scienceinsociety, accessed September 2001.

accountability as well as responsiveness to the concerns and values of the public. More specifically, the original aims as set out by the Society were:

- To help restore confidence in science
- To find and develop new, interesting, widespread and effective ways of communicating with the public
- To make sure that the voice of the public is heard when discussing and shaping science policy[422]

The new programme also coincided with a re-branding of the Society's Science Promotion Section, now called the Science Communication Section which, again, highlights how scientific organisations were attempting to move away from any association with a top-down, 'deficit model style' language. An explanation of the Society's response to the House of Lords report, and the internal changes, was provided by a new Science in Society Committee which oversaw the programme, as detailed on the Programme website:

> The Science in Society Committee has recognised that the Royal Society itself needs to be more accessible to the public and transparent to the outside world. The more society desires to know about scientific research, medical advances, and technological developments, the more the role of the Royal Society will have to evolve to meet the public's needs. It is largely through the Science in Society Programme that this can be made possible. Such an exciting initiative will, we hope, place the Royal Society at the forefront of efforts to ensure that scientific research in the UK will continue in a supportive, open and understanding way.[423]

So again the suggestion here was that this new Science and Society agenda had a goal of ensuring that science research went ahead, with the guaranteed support of the public. The need for the change was also characterised by a knowledge deficit on the part of the public.

Alongside the promise of a culture change in how the society operated, Lord May, former Chief Scientific Adviser and now President of the Royal Society, argued in a Presidential Address that science had nothing do with values or politics and it should be allowed to

[422] ibid.
[423] ibid.

present the facts before the public were engaged. Thus we see a continuation of boundary work by scientists attempting to distance science from social influences:

> Society needs to do a better job of asking what kind of tomorrow we create with the possibilities that science offers. Such decisions are governed by values, beliefs, feelings; science has no special voice in such democratic debates about values. But science does serve a crucial function in painting the landscape of facts and uncertainties against which such societal debates take place.[424]

In contrast to this, Sir Paul Nurse, Nobel Prize winner and the Chairman of the Society's Science in Society Committee, was concerned about dialogue and the involvement of public values being "bolt-on", adding dialogue where it was easy to do so but leaving the scientific activities of the Royal Society untouched.[425] He also disagreed with Lord May that science alone should set the terms of any dialogue with the public, and argued that people's concerns even when they, as scientists, did not believe that these were justified, should be considered. Thus the adoption of a new language of dialogue, openness and transparency by Fellows and staff within the Royal Society did not signal a similar adoption of consistent definitions of 'science', 'the public', or 'dialogue'.

The Science in Society programme embarked on its 'dialogue initiatives'. The main activity in 2001 was a series of 'dialogue meetings' around the country culminating in a National Forum in London. In the first year of the programme, participants invited from local businesses and community groups were asked whether they trusted scientists. Other initiatives of the programme included an MP/Scientists Pairing Scheme which, the Committee argued, showed scientists the constraints of being a politician, and politicians the way in which science was conducted. There was also a new website which would have an online dialogue facility to allow members of the public to 'have their say'. Much discussion was had amongst staff running the programme as to whether the public could be trusted to use this online facility in a responsible manner, and it was eventually decided that all comments (of which

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[424] May, R. (2001), *President's Anniversary Day Address*, (Royal Society).
[425] Nurse, P. (2001), 'Primary Roles of the Science in Society Programme, included with the minutes of the Science in Society Committee meeting, 17th September 2001', (London: The Royal Society).

there were few) would be screened first, to avoid negative and critical comments dominating the website.[426] Much of the work of the Science in Society programme was experimental and their own dialogue exercises were designed to display the Society's leadership and authority in this area. In the initial years of the programme therefore, much activity appears designed to show that the Royal Society had changed, and could be perceived to be open and transparent, and was engaging with the public. Little, if anything, was done with the results of their conversations with the public. Indeed, the National Forum was conceived as a day which would provide national media coverage for the Society, including an evening debate with BBC Radio 4 listeners, the meaning of the dialogue results appearing almost secondary to these goals.[427] Just as previous efforts to improve the public understanding of science were also concerned with improving the public's attitudes to science, again we can see here that part of the agenda of these new dialogue efforts was to improve the public's view and attitudes towards science and scientists, and, in this particular example, towards the Royal Society itself. So the language and methods of communication had changed, but the boundary work was attempting to achieve a similar outcome to previous formulations.

What is this thing called 'Science and Society'?

Several of the Research Councils also reformulated their initiatives to fit in with, as the Natural Environment Research Council (NERC) described, the 'new approach to what was previously called "Public Understanding of Science", but which we now term "Science and Society"'. NERC acknowledged that 'Science and Society' was a very broad concept and, they argued, was 'even less amenable to definition than the "Public Understanding of Science"'. They used the term to 'describe the interfaces between the science which NERC funds and carries out and the public in its widest sense'. They stated that where previous

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[426] Observation based on my personal experience at the Royal Society. The Programme was overseen at this time by Shona Falconer, ex Head of PR for Shell, and Dr David Boak, chemist and Director of Communications for the Royal Society. Despite the explicit idea that dialogue should inform policy, there were no links with the Science Policy unit of the Royal Society in the initial couple of years.
[427] Personal notes from planning meeting November 2001.

attempts at science communication had tended to be one way, i.e. scientists informing the public about their findings, they would now engage more in dialogue with the public, asking for responses, feedback and views as well as promising to take those views into account.[428] The Biotechnology and Biological Sciences Research Council (BBSRC) established a Science and Society Programme. Taking on almost all of the recommendations set out in the House of Lords Report, their programme encouraged public debate about the potential applications and implications of their research, as well as promising to respond to issues of public concern and to make sure that its processes were transparent to the public.[429] The Engineering and Physical Sciences Research Council (EPSRC) continued with their Public Awareness Programme without reworking a new Science in Society angle into it. Equally, the Particle Physics and Astronomy Research Council (PPARC) set up a new Science and Society programme, which did involve public engagement and public accountability, but only as part of its overall communications strategy to promote 'the understanding, appreciation and awareness of their science'.[430] The Medical Research Council stood apart from the others in not responding to the report at all. Rather it continued with its already established 'public interest' approach, to 'share its work with the public in order to increase awareness of the way in which medical research affects each of us, and to promote dialogue and debate on major issues'.[431]

The Economic and Social Research Council, on the back of its New Opportunities Public Understanding of Science Research Programme in 1998, launched a new Science in Society Research Programme in 2001, after a long consultation period amongst social scientists about what it should address. Alan Irwin, who had drawn up the initial proposal for the new programme recalled that the ESRC had also argued that the label public understanding of

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[428] NERC website, *Programme on Science and Society - A NERC policy paper*, www.nerc.ac.uk/insight/openness/scisocpolicy.asp, accessed October 2002.
[429] BBSRC *Science and Society webpages*, www.bbsrc.ac.uk/society/overview/Welcome.html, accessed October 2002.
[430] PPARC website *Science and Society Programme*, www.pparc.ac.uk/Rs/Fs/Pu/PUSTPanel.asp, accessed October 2002.
[431] Medical Research Council website, Public Interest Pages, www.mrc.ac.uk/index/public-interest.htm, accessed November 2001.

science was "far too backdated".[432] The Programme took the issue of scientific governance, with its primary goal being 'to explore and facilitate the rapidly changing relations between science (including engineering and technology) and wider society'. In so doing, the programme sought to 'place British social science at the heart of international debates and practical interventions concerning the public understanding of science, science and technology policy, science studies, and the nature of citizenship and expertise within contemporary society'. Like all other research council programmes, the ESRC cited the House of Lords Report, and its claim that the relationship between the public, scientists and government was in crisis, as impetus for the research. However, unlike the other science-based institutions which represented scientists and scientific research, the ESRC's programme was established to examine these relationships and influence the renegotiation of them through research that engaged 'major public, private, and voluntary sector stakeholders with practising scientists and institutions'.[433] Unlike the early ESRC public understanding of science programme in 1986, social scientists would therefore not just examine what was going on, but were expected to change and influence the relationship between science and public.

The Parliamentary Office of Science and Technology, which was charged by the House of Lords with keeping a watching brief on the state of science and society activities in the UK,[434] produced a report which gave a snapshot of how institutions were responding to the call for dialogue, and it highlights the variation in the objectives and methods of those activities being undertaken in 2001. The report, entitled *Open Channels,* concluded that while there was a growing interest in engaging the public more directly in policy and decision-making, the quality of these exercises was variable, and scientific institutions may not have the necessary commitment, skills or resources to plan and undertake suitable public dialogue.[435]

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[432] Irwin *Interview, 29 June 2004.*
[433] ESRC *Science and Society Research Programme website,* http://sbs-xnet.sbs.ox.ac.uk/scisoc, accessed November 2001.
[434] House of Lords Select Committee on Science and Technology (2000a), op. cit., p. 9.
[435] Parliamentary Office of Science and Technology (2001), *Report No. 153: Open Channels: Public Dialogue in Science and Technology,* (HMSO).

Perhaps the most obvious sign of all institutional changes to PUS at this time, and a sign of how much the House of Lords report had changed both the landscape and language used in a short space of time, was the reformulation of COPUS. Following extensive reviews of the Committee in the previous two years, it was agreed by all the partners that COPUS should be remodelled in this new climate as 'an inclusive partnership between the many sectors now involved in communicating science'.[436] This remodelling was to respond to the increase in science communication activity in recent years, and the fact that the House of Lords had themselves suggested that COPUS change.[437] As a COPUS position paper argued, the professional arena of science communication had not formally existed at the time the Bodmer report was written, thus things had changed remarkably. COPUS, in its old guise, had been struggling to maintain its influence over the myriad of new schemes and science communication activities, which, as the position paper noted, encompassed a range of different aims and objectives:

> What began largely as an exercise in improving levels of public understanding of science has since matured into a more complex series of activities whose aims include: improving public confidence in science; raising the profile of science as a career; and improving public support for research.[438]

The final impetus for the review, however, had apparently been the realisation by members of COPUS that 'the pattern of its activities and membership had not changed to meet developments in an increasingly critical public', and many of the institutions designed to make science more accessible had been 'left behind'.[439] Thus the public was problematised here also as a reason for the change in approach. COPUS was now no longer to be used as an acronym, but as a brand 'Copus', with a new expanded Council overseeing it, reflecting a broader range of stakeholders in science communication than the original three founding bodies. Chaired by Bridget Ogilvie, previously Chief Executive of the Wellcome Trust, the new Council was established with members who represented the science communication interests of several sectors, including research funding bodies, learned institutions, museums,

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[436] Copus website (2001), *A new direction for Copus*, www.copus.org.uk/copus_councilpaper.htm, accessed November 2001.
[437] House of Lords Select Committee on Science and Technology (2000a), op. cit., p. 8.
[438] Copus website (2001), op. cit.
[439] Ogilvie, B. (2001), 'View From the Top', *Research Fortnight*, 1 August 2001.

science centres and the media. The new body intended to oversee science communication at a national level, but made it clear that this was not to be one-way science communication, but was to be focused on 'supporting ways of increasing public engagement with the issues and processes of science'.[440] The Copus grant schemes were also reformulated under this new agenda, to fund efforts at dialogue with the public. As Copus acknowledged, what counted as good dialogue, and what was self-promotion for those conducting the engagement, was complicated:

> The dividing line between public relations and public engagement activities is not an easy one to draw, and very often one organisation's public relations is another's public engagement. We do, however, need to recognise the different reasons for communicating science and find ways of using them to our advantage. This will become increasingly important under the new Science and Society agenda as we seek to identify ways of establishing constructive dialogue with stakeholders.[441]

Copus stated further that they intended to 'represent the interests of the scientific community by focussing interactions with target audiences that include business, media, education (schools and universities), single-issue groups and politicians, as well as general public audiences'.[442] Thus we can see the implication that science communication was still being used to manage the boundary between scientists and other professional and social groups.

Another new initiative from within the scientific community geared towards managing just one of these boundaries, was the launch of the Science Media Centre in November 2001. Housed at the Royal Institution yet independent from both it and the Government, the Centre proposed to take a pro-active stance by providing science stories, and scientists, to the media where they felt there was 'a public interest or a developing controversy'.[443] Its mission statement claimed to 'provide a focal point for scientists to explain the nature of their work, discuss its consequences, and engage in public discussion over the benefits and

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[440] Copus website (2001), op. cit.
[441] ibid.
[442] ibid.
[443] Science Media Centre (2001), *Invitation to the launch of the Science Media Centre*, sent to author.

risks'.[444] The House of Lords report had largely concluded that the scientific community should deal with the media the way it was, and the establishment of the Science Media Centre was, on the one hand a sign that members of the scientific community were trying to deal with the media on its own terms - through effective lobbying - yet this could equally be interpreted as suggesting that some within the community were still angling for more control over media messages about science, for example by being able to field the 'right' scientists to communicate particular messages through it. Communication of accurate science was seen as the means of improving the relationship between the two, as the Centre proposed:

> Our ultimate goal is to facilitate more scientists to engage with the media, in the hope that the public will have improved access to accurate, evidence-based scientific information about the stories of the day.[445]

All this new activity within the scientific community shows that those institutions that were dealing with science and the public were changing, yet how this manifested itself within the different institutions varied and there were many definitions and understandings of what dialogue was, how and why engagement should be used, what science communication now meant, and who 'the public' was. By this time there was a substantial 'industry' around 'public understanding of science' and science communication activities, consisting of organisations (several were government funded), private companies and freelance individuals whose livelihoods relied on others giving them money to conduct science communication exercises or events and unsurprisingly the need for more science communication, or dialogue was not questioned by them.

Critiquing dialogue

Not everyone embraced this call for dialogue, indeed, some were explicitly critical of it. An article by Bill Durodie, Director of the International Centre for Security Analysis at King's

[444] Cookson, C. 'New independent media centre aims to give scientists a voice', *Financial Times*, 30 January 2001.
[445] Science Media Centre, *Invitation to the launch of the Science Media Centre.*

College London, and published at *Spiked- online*, argued that the Government should stop 'hiding behind participation' and let scientists maintain their authority of expert decision-making.[446] As he argued:

> Comparing the subjective opinions of the public to the considered deliberation denigrates science, and panders to the conceit of those who claim to represent the public. And if things go wrong, rather than be held accountable for their decisions based upon the available scientific evidence, politicians and officials are able to point to other participants in the decision-making process who should now share responsibility for any problems that ensue.[447]

Durodie did not believe that the public had the relevant expertise to make decisions over scientific matters, and argued that:

> ...scientific expertise at the highest level is crucial, to inform democratic decision making. But consequent decisions should be taken by democratically accountable politicians, not by hand-picked officials or self-appointed interest groups.

Durodie was representative of a wider questioning by a few new organisations of these recent calls for openness, transparency and engagement by scientists with the public over scientific policy. He was a member of the Advisory Board for an organisation called the Scientific Alliance, which was formed in 2001 as a non-profit membership-based organisation that brought together both 'scientists and non-scientists committed to rational discussion and debate on the challenges facing the environment today'.[448] Suggesting therefore that other attempts to discuss science in public were not rational, it had, the Alliance claimed, been set up to redress what they saw as a misrepresentation of science in public:

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[446] *Spiked-online* (www.spiked-online.org) describes itself today as an independent online phenomenon dedicated to raising the horizons of humanity by waging a culture war of words against misanthropy, priggishness, prejudice, luddism, illiberalism and irrationalism in all their ancient and modern forms.
[447]Durodie, B., 'To help build a more advances world, the government should stop hiding behind 'precaution' and 'participation', and encourage scientists to experiment and to think big', *spiked-online*, 7 June 2001, www.spiked-online.com.
[448] Scientific Alliance website (2003), *About the Scientific Alliance*, www.scientific-alliance.org, accessed October 2003.

> Members of the Scientific Alliance are concerned about the many ways in which science is often misinterpreted, and at times misrepresented, within both policy circles and in the media. The Alliance thus works to overcome this misunderstanding by aiming to: promote sound science in the environmental debate; ensure that scientific arguments remain prominent throughout the policy making process; and facilitate an informed dialogue between all stakeholders involved in the environmental debate through events and publications.[449]

The idea here, was couched in similar terms to Lord May's earlier Presidential Address: that policies should be based upon sound and reliable scientific evidence alone, and any debate surrounding science should be 'rational and informed'.[450] Thus the scope for public dialogue was slim to the Scientific Alliance. They believed that the media distorted science in the public domain or that it was misinterpreted by single-issue groups, despite the fact that to all intents and purposes the Scientific Alliance was itself a single-issue lobby group, albeit one which believed that science should be promoted and communicated only by scientific experts.

Another organisation, Sense About Science, was formed in 2002 to campaign from a similar standpoint of combating public misunderstanding. It had been set up in response to what they perceived as a challenge to reasoned debate:

> Back in 2001, the newspaper front pages were ablaze with headlines about mobile phones 'frying your brain', genetically modified 'Frankenstein foods', the MMR vaccine, experiments using animals and the dangers of cloning. Scientists seemed very much on the fringes of many of these debates, and their scientific evidence and data had even less of a presence.[451]

Lord Taverne, a Liberal Democrat peer and member of the House of Lords Animals in Scientific Procedures Committee, had written and published a series of articles damning the manner in which scientific evidence was being ignored in these debates.[452] At the end of 2001 he convened a meeting of other concerned parties who had 'resolved that scientists need to take more responsibility, and do so immediately, for putting evidence at the centre

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[449] ibid.
[450] May, R. (2002a), 'Address of the President, Given at the Anniversary Meeting on 29 November 2002', *Notes and Records of the Royal Society of London*, 57: 1.
[451] Raphael, E. (2005), 'Sense About Science', *Healthwatch News*, 56.
[452] Taverne, D. (1999), 'Against anti-science', *Prospect*, 47.

of debates about scientific issues'.[453] Sense About Science was formed as, in its own words, an 'organisation to promote an evidence-based response to matters of science and risk among institutions, government, the media and NGOs'. They operated in a proactive manner, encouraging scientists to enter into controversial public debates, responding to inaccuracies in public claims about science, medicine, and technology, and promoting the 'benefits of scientific research to the public'.[454] While some have cast doubts on the impartial nature of the organisation, Sense About Science argued against public engagement vociferously, based on its belief that scientists and science should maintain primacy in decision-making and communicating science.[455]

While these new and, one could argue, idiosyncratic scientific groups were critical of new 'dialogue' approaches to managing the relationship between science and the public, elsewhere there had been a wide uptake of terms, such as 'trust', 'dialogue', and 'engagement' which had previously been used only by certain social scientists when constructing the science/public relationship within both government and the scientific community. There remained, however, a flexibility in these terms. The public was formulated as deficient in scientific knowledge, or trust, or confidence, but also as an active, knowledgeable and important part of decision-making in science policy. Equally 'dialogue', and 'science communication' served a variety of purposes, and could be used to construct clear boundaries around science and its expertise, keeping public values out or to facilitate a more unified formulation of science and public in forming science policy.

In 2001 a Public Perceptions of Agricultural Biotechnologies in Europe (PABE) report, an EU funded research project conducted by Brian Wynne and colleagues, had argued that

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[453] Raphael (2005), op. cit.
[454] ibid.
[455] Lobbywatch.org has argued that both the Director and the Programme Manager for Sense about Science, having been previously employed by the biotech PR firm Register Larkin, were more interested in promoting the interests of particular science and scientists, some of which also funded Sense About Science. They also make explicit connections between some members of Sense About Science, Spiked-Online, the Institute of Ideas and Global Futures, the Science Media Centre, for example, Bill Durodie and claim that all of these groups were a front for advancing the libertarian views of the Living Marxism Group, which advanced a view that scientific progress should not be hampered. Members of all of these organisations had apparently been involved with this group at some point. See www.lobbywatch.org/profile1.asp?PrId=151.

there was a 'persistence of a number of entrenched views about the public shared by numerous policy actors' which had not been backed up by their own focus group research involving members of the public. The authors characterised these views as ten 'myths' held by dominant stakeholders about public responses to GM organisms. The report argued these myths, five of which are listed below, had important policy implications; mistaken interpretations of public perceptions played an influential role in shaping the communication strategies and policies of all institutional stakeholders:

> It's the fault of the BSE crisis: since then, citizens no longer trust regulatory institutions
>
> The primordial cause of the problem is that lay people are ignorant about scientific facts
>
> Public opposition to GMOs is due to "other - ethical or political – factors"
>
> The public demands 'zero risk' - and this is not reasonable
>
> The public is a malleable victim of distorting sensationalist media[456]

If the perception of the public as the problem to be overcome did not change, the authors argued, 'new policies and strategies - even if they are innovative and sincerely seek to integrate public views are likely to fail' (p. 7). These social scientists took a different critical stance on the new dialogue agenda, and were far from satisfied that their conceptualisation of public dialogue had been embraced by the scientific and policy-making communities.

Deficits and dialogues

An indication that the older rhetoric used by scientists and scientific institutions to construct the boundary between science and the public had not disappeared is provided by a report in *The Financial Times* in 2002. In the middle of a media controversy about the MMR vaccine,

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[456] Marris, C., *et al.* (2001), *Public Perceptions of Agricultural Biotechnologies in Europe, final report of the PABE research project funded by the European Communities*, http://csec.lancs.ac.uk/pabe/, August 2005, p. 9.

the Chair of the House of Commons' Select Committee on Science and Technology, Ian Gibson, was quoted as blaming "ignorance about science" for hampering the Government's efforts to engage the public in policy debates. *The Financial Times* quoted Gibson as describing the Government's policy on the mumps, measles and rubella triple vaccine as almost impossible because "people do not understand the arguments".[457] He was not alone in making this claim; in the same article Fiona Fox, the head of the Science Media Centre, claimed entrenched public misconceptions about science needed to be dispelled if public dialogue on scientific issues was to move forward:

> We need to be able to debate issues [such as] genetically modified foods, but if the public is expecting a guarantee of 100 per cent safety, how can we have an informed debate?[458]

Fox's view is interesting, in that she identified the exact opposite problem to the one that social scientists had in the PABE report as a barrier to effective public dialogue. The shadow science Minister Robert Key went further, for in his view (which echoed Holton's stance a decade earlier) we were experiencing the effects of a whole generation of people who had grown up in a "culture that was anti-science".[459] He also blamed journalists for reporting 'scare stories' which, he argued, confused the public. The public were being represented as only having concerns about science, whereas some social scientists had argued that public attitudes were complex and both positive and negative views could be held with regard to different areas of science, different institutions of science and wider social issues.[460] The six attitudinal groups identified in the OST/Wellcome report (2000) had also highlighted a prevalence for conceptualising the public into large homogeneous groups which held static attitudes to science in the aggregate sense, as opposed to having multiple attitudes to many different types of science at the same time.[461] So again we can see that 'the public' was being

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[457] Lee, N. 'Public ignorance 'limits debate' on science policy', *Financial Times*, 15 July 2002.
[458] ibid.
[459] ibid.
[460] See for example Kerr, A., et al. (1998), 'The new genetics and health: mobilizing lay expertise', *Public Understanding of Science*, 7: 1; Grove-White, R., *et al.* (2000), *Wising Up: The public and new technologies*, (Lancaster: Lancaster University); Durant, J., *et al.* (1998), *Biotechnology in the Public Sphere: A European Sourcebook*, (London: Science Museum).
[461] Office of Science and Technology and The Wellcome Trust (2000), op. cit.

constructed in certain ways that enabled particular boundary work. A deficient public was constructed in opposition to scientists who could fill the gap, or a concerned public could be used to justify a different sort of intervention, just as a social scientific construction of a deficient science required an intervention by the public, or social scientists.

A high profile example of the different boundary work around science and the public occurring within the UK can be seen in a speech made at the Royal Society by the Prime Minister, Tony Blair, in April 2002, entitled 'Science Matters'. Though Blair reiterated the House of Lords' rhetoric of renewing a dialogue between science and society, his speech was in many other respects a reiteration of many older arguments for improving the public understanding of science, drawing on discourses of science that affirmed its separate and expert status. He claimed that his impetus for giving the speech came from a group of Indian academics telling him that Europe had gone 'soft on science', that the debates on GM were considered to be astonishing, and that we in the UK were overrun by protestors and pressure groups who used emotion to drive out reason. He argued that if we did not get "a better understanding of science and its role", they may be proved right.[462] His main rationale for improving this understanding was that science was vital to the UK's future prosperity. Blair went on to promote 'cutting edge' UK scientific endeavours, declaring how exciting they all were and, crucially, how vital it was that this new science continued with "strong funding and strong public support". His argument echoed the most recent White Paper on science, again suggesting that the public had little scope to influence or change technological advancement; it was simply a matter of bringing them on board so that scientific progress could continue. Blair argued that science was "posing hard questions of moral judgement and of practical concern", which, if addressed in the wrong way, could lead to "prejudice against science", which he believed would be profoundly damaging. In this context, he noted the previous Government's handling of the BSE crisis. He also argued that the media often amplified public concerns into fear.

[462] All quotes cited from Blair, T. (2002), *Science Matters - Speech made at the Royal Society, 10 April 2002*, www.number-10.gov.uk, accessed June 2002.

Science, through the speech, was left unscathed and unproblematic - perhaps unsurprising given the main audience. Science may have posed ethical questions and these should be discussed. But Blair asked that scientists be left to provide government with the best possible science, on which a judgement could be made as to how it was to be used or acted upon. His final argument was that the benefits of science would only "be exploited through a renewed contract between science and society, based on a proper understanding of what science is trying to achieve", which implies that, in Blair's opinion, 'society' - described as a different cultural space from 'science' - did not have a proper understanding, thus suggesting a deficit of knowledge. The dangers, as Blair perceived them, were "ignorance of each others' point of view"; his solution was understanding them through "a robust, engaging dialogue with the public". Arguing that vital work could not be stifled simply because it was controversial, he claimed that the Government needed "to re-establish trust and confidence in the way that science can demonstrate new opportunities". This, to Blair, meant embedding a more "mature attitude towards science in our society". Again, the idea of dialogue here seemed to be to allow the scientists and government to convince an 'immature' public that what they were doing was uncontroversial, and should not be stopped.

While the Royal Society welcomed the attention the Prime Minister's speech gave to UK science, not everyone agreed with his representation of the status quo. Sue Mayer, Executive Director of Genewatch UK and a member of the AEBC, argued that the Prime Minister's speech had 'portrayed science as providing the 'facts' and public questioning as being emotional and trying to obstruct emergence of the "facts"'.[463] Others also later criticised Blair for misrepresenting the public and its concerns.[464]

[463] Mayer, S. (2002), 'Misrepresenting public concerns', *Science and Public Affairs.*
[464] See for example Wakeford, T. (2002b), 'Blair's Bangalore blinkers', *Science and Public Affairs*, August 2002; Irwin (2006), op. cit.; Wilsdon, J. and R. Willis (2004), *See-through Science: Why public engagement needs to move upstream*, (London: Demos).

The demise of Copus

In May 2002, Bridget Ogilvie unexpectedly resigned as Chair of Copus.[465] Exisiting tensions between the three institutions came to light in a House of Commons Science and Technology Select Committee report investigating all the learned societies funded by Parliament, and then attracted the attentions of some scientific publications.[466] These reports suggest conflict between the original three founding bodies for control over the definition, direction and funds of a national science communication agenda. At the British Association's Festival in September of that year Lord Sainsbury asked the British Association to conduct a study looking at how the Government should proceed with science communication policy and activity. Launching the study Sainsbury said:

> ... we need today, in a period of rapid scientific advances, a more effective dialogue between scientists and the public. We have moved decisively away from the era in which it was enough for science communicators simply to educate the public about science and its benefits. What is needed now is an effective two-way dialogue and debate between those who do scientific research and the public.[467]

The press release went on to state that the British Association would 'consult with a wide range of those involved in science communication including representatives of the public' and then report back to the Department of Trade and Industry on how best to take forward dialogue on science and technology. The heads of the British Association, the Royal Institution and the Royal Society (the original three founders of Copus) all welcomed the study. This might have appeared to be a strange endorsement for a report which would potentially conflict with their own efforts in this area and with the work of Copus, and indeed was being conducted by only one of the founding members. However, following the

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[465] Ogilvie, B. (2002), *Resignation Letter to Copus,* dated 17 May 2002.
[466] House of Commons Select Committee on Science and Technology (2002), *5th Report: Government Funding of the Scientific Learned Societies,* www.publications.parliament.uk/pa/cm200102/cmselect/cmsctech/774/77402.htm, accessed July 2005; Gavaghan, H., 'Royal Society called to account', *The Scientist,* 13 June 2002. May, R. (2002b), 'Copus futures', *Research Fortnight,* 10 July 2002.
[467] Department of Trade and Industry (2002), *Press Release 'Science Communication Study', 10 September 2002,* (London: DTI).

publication of the report by the British Association a month later, it was announced that Copus would cease to exist. This suggests that an agreement had been made behind the scenes for the organisations to go their separate ways. Thus, amidst this struggle for control of Government funded-science communication activity, Lord Sainsbury removed the responsibility for overseeing science communication activities in the UK from inside the Royal Society, signalling, after 15 years, the demise of Copus. In their joint statement the Copus founders said:

> We have reached the conclusion that the top-down approach which Copus currently exemplifies is no longer appropriate to the wider agenda that the science communication community is now addressing. We believe it will be more effective to allow organisations to seek their own partnerships and develop their own activities, within the strategic framework outlined by the British Association in its report. For this reason, we have decided not to appoint a new Chair for Copus and to stand down the Council as it is presently constituted.[468]

The report by the British Association had been informed by consulting a wide range of individuals through a web-based questionnaire, and a half-day meeting with individuals and organisations involved in, what was now, the large science communication community in the UK. They were asked to propose a process that would enable Government to know: what science communication activities were taking place; their quality and how effective they were in meeting the interests and needs of the public; how organisers of activities could best co-ordinate their efforts to avoid duplication and potential confusion; and how the Office of Science and Technology's own Science in Society programmes might be developed.[469]

This report includes a formal definition of the term 'science in society activities', which had referred in a vague sense to the recommendations of the House of Lords report, or had been self-explanatory, sometimes being used as something which stood in opposition to the 'deficit model' approach, sometimes encompassing it. The British Association defined such activities as:

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[468] Copus (2002), *Press Release: Statement on Copus by the British Association, the Royal Institution and the Royal Society, 9 December 2002*, (The Royal Society)
[469] The British Association (2002), *Science in Society – Advice to the Office of Science and Technology from the BA, 21 November 2002*, (The British Association), p. 3.

> … all activities, relating to both the public and private sectors that have an impact on the public's understanding of, attitudes towards, and engagement with science, engineering and technology and the issues they raise. In particular, we include within their scope all activities that enable the public to engage with, and to influence, the people and processes by which policy is determined and implemented including the directions and priorities for science-based research in the public and private sectors. (p. 3)

'Dialogue in itself', the report argued, could 'not be assumed to result in increased support for existing policies nor in increased public trust in government' (p. 3). Instead it should help to ensure that the public was 'well-informed about the nature, potential benefits and risks of developments and that those engaged in these developments take public views into account in establishing their priorities' (p. 3).

The research for the report was carried out by Science, Policy and People Ltd who, in their own words, were 'an independent science policy consultancy that specialises in science and society issues'.[470] The rise of 'science and society' consultants highlights the professionalisation of science communication which had now, over the eighteen-year period since the Bodmer report, grown to encompass many professional roles. Many of the actors were also graduates from university science communication courses. A criticism of this increasing professionalisation of science communication, which relied on increasing use of consultants, came from the Royal Geographical Society in its submission of evidence to the British Association's report. It argued that the 'overall thrust of the report [was] misguided', and went on to state:

[470] People, Science and Policy Ltd. highlights an increasing trend at this time for consultants to claim they specialised in "doing dialogue". Since its conception PSP had conducted many reports for government departments and other organisations in the PUS/Science and Society arena. This is perhaps in no small part due to the fact that its directors both moved, from positions at the Wellcome Trust and OST where they had been heavily involved in setting the PUS agenda, to establishing their own business addressing the same issues. With this move they managed to direct high-level policy agendas while presenting themselves as neutral and independent from governmental or corporate influence. See http://www.peoplescienceandpolicy.com/

> It is perhaps not surprising that when a body like the British Association is asked to suggest a range of actions, its answers will be couched in terms of those things that the organisation in question tends to do. This lies at the root of what we perceive to be the problem with this document. The question is – will the mapping exercises, conferences and consultations outlined above produce practical answers, or are they more likely to merely subsidise further the growing Public Understanding of Science (PUS) industry? ... Despite its commitment and the best efforts of its staff, much of what the Royal Society's Committee on the Public Understanding of Science has done over its long lifetime we believe to be of limited value.[471]

The 'PUS Industry', the Royal Geographical Society argued, consisted of certain scientists, government and other bureaucracies, who understood 'meetings and mapping exercises, but nothing about communication proper, and a clutch of self-interested commercial pollsters, conference organisers and PR agencies eager to supply their services'.[472] Unlike Bodmer's conceptualisation of more scientists doing science communication, this role had increasingly been taken over by these new professional actors, and we can see yet more boundary work here between institutions conflicting over what proper 'science communication' was as a practice, or an academic discipline, and also who was serving the public's interests. As the Royal Geographical Society argued, while criticising 'professional science communicators' in their submission to the British Association:

> Events organised by this group – a perfect example of which is the so-called Science Communicator's Forum, held each year at the British Association's Annual Festival – succeed largely in allowing these groups to whinge ineffectually at each other while other actual science communicators (other scientists, science journalists and media relations officers) stay away.[473]

This commentary also suggests that the reformulation of science communication, with its grant schemes and other support now focusing on dialogue that would inform policy, was supported by those institutions who were able, or wanted, to do this; those who wanted to continue to communicate science to the public had no grants scheme to facilitate this, nor perhaps the contacts with, or the relevance to, current science policy concerns. The criticism

[471] The Royal Geographical Society (2002), *Response to the BA report to the Office of Science and Technology, Science and Society*, www.rgs.org, accessed November 2002.
[472] ibid.
[473] ibid.

also raises the distinction between, and multiple meanings of, communication and dialogue. While most institutions previously involved in science communication had simply broadened its meaning to encompass dialogue as a two-way form of communication, there was a distinct difference between those institutions wishing to engage in either one-way or two-way conversations with the public and those institutions trying to influence science policy, or restore confidence or trust. For example, the explicit aim of the Royal Society's Science in Society programme was to allow the public to feed into government policy. Their public dialogue exercise were promoted by the Society as an example of "doing dialogue", but they had no pathway by which to feed their results into policy-making, begging the question of whether this was the 'dialogue' the House of Lords committee had recommended.

In a separate endeavour from its Science in Society programme, the Royal Society announced that it had formed a working group that would look at the ways in which science reached the public via the media.[474] The focus of the review was an examination of the peer review process, and whether this process managed to facilitate the communication of credible research. Communication of 'good science', rather than engagement was seen here as part of the way to control the manner in which science was represented in the media. This suggests that what Hilgartner termed a 'dominant model' of science communication was indeed still commonplace, and that scientists felt it was their responsibility to ensure that the media only covered research which had first been approved by them.[475] We can also identify a reliance on a deficit model, which suggests that the representation provided a useful repertoire when performing particular boundary work to make a distinction between science and other cultural spaces. Susan Greenfield, writing in *The Guardian* in 2003, in an echo of C. P. Snow's arguments nearly half a decade before, lamented a 'widening gulf' between a science cognoscenti and everyone else. The public, according to Greenfield, now feared science, as it became ever removed from the ordinary person. As she argued:

[474] The Royal Society, 'Press Release: Royal Society to investigate how research results are communicated', 11 August 2003.
[475] Hilgartner (1990), op. cit.

> Small wonder there is a knee-jerk to veto all this confusion and scary technology in one go. How can Joe Public, after a hard day at work, come home and be expected to tease out the pros and cons, weigh up the risks, consider all the implications, and differentiate the "yuck" from the reality?[476]

The only way to evaluate the implications of science was, she continued, to be scientifically literate. Jon Turney, responding to her arguments the following week, claimed Greenfield, in making the arguments for a greater scientific literacy on the part of the public, was simply joining 'a long line of well-intentioned but not very well informed scientists', who were the only people that had believed in an anti-science movement in the first place.[477] Thus the boundary work between certain social scientists and scientists over definitions of 'the public' and the 'problem' still continued four years after Lord Sainsbury had declared that the deficit model was dead.

GM Nation: Opening Pandora's lunchbox?

Despite the plethora of reports, meetings and new initiatives that had occurred since the publication of the House of Lords report, the commitment within governmental circles to public dialogue, had extended as far as discussion. In 2003, this commitment was put to the test and the ensuing activity highlights the multiple meanings of 'the public' and 'engagement' that existed within the new dialogue agenda for science and technology policy within the UK Government. In 1999 GM foods were withdrawn by all the UK's food retailers and producers after consumer pressure, and the Government then agreed that GM crops would not be grown commercially in Britain until the results of the Farm-Scale Evaluations (FSEs) were known. The AEBC, charged with advising the Government on GM crops, had in their 2001 report *Crops on Trial* argued that the results of the FSEs alone would be an insufficient basis upon which to make a decision, and public concerns would need to be addressed. The AEBC therefore recommended that the Government hold a public debate

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[476] Greenfield, S. 'A new kind of literacy', *The Guardian*, 10 April 2003.
[477] Turney, J. 'How Greenfield got it wrong', *The Guardian*, 17 April 2003.

on the issue. The Commission had stressed the importance of encouraging this broader national debate:

> It will be crucial for the public to be involved in the important decisions which need to be taken. We have to find a way to foster informed public discussion of the development and application of new technologies.[478]

The AEBC had also expressed the opinion that a different kind of consultation was needed for GM crops, arguing that the public should be given the opportunity to guide the way in which the issue was debated, rather than respond to an agenda set by others.[479] Drawing on the advice of many social scientists, the recent work on public engagement in science by the Parliamentary Office of Science and Technology,[480] and the earlier report by the Royal Commission on Environmental Pollution,[481] in early 2002 the AEBC made specific recommendations on how a public debate might be conducted.[482]

The Government, facing wide-spread media controversy over GM foods, accepted the AEBC's advice and the design of a public debate began in July 2002. *GM Nation?* was run in parallel with two other strands of activity established by the Government: a review of the science behind GM to be conducted by Sir David King, the Chief Scientific Adviser, and a study into the overall costs and benefits associated with the growing of GM crops by the Prime Minister's Strategy Unit. Kass, a member of the steering board, claims that from the outset the relationship between these three strands, and how they inter-related, was not very clear. There was discussion amongst members of the Steering Group as to whether the results of the public debate would inform the other strands, or whether the public debate was being sidelined in terms of shaping subsequent policy.[483]

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[478] AEBC (2001), *Crops on Trial: A Report by the AEBC*, (London: AEBC).
[479] PDSB (2003), *GM Nation? The findings from the public debate - Report by the Public Debate Steering Board*, (London: Department of Trade and Industry).
[480] Parliamentary Office of Science and Technology (2001), op. cit.
[481] RCEP (1998a), op. cit.
[482] AEBC (2002), *A debate about the issue of possible commercialisation of GM crops in the UK*, (London: AEBC).
[483] Kass *Interview, 21 May 2004*. See also Mason, J. 'Doubts over GM crops debate', *Financial Times*, 21 March 2003.

The purpose of the public debate was represented in a variety of ways in Government statements: it was an opportunity for the public to voice their concerns and feed these into the policy process, or it was an opportunity to educate the public on the science of GM crops. Announcing the debate in 2002, Environment Secretary Margaret Beckett stated:

> The Government wants a genuinely open and balanced discussion on GM. There is clearly a wide range of views on this issue and we want to ensure all voices are heard ... the public debate will deepen public understanding of all the issues surrounding GM. If there are gaps and uncertainties in knowledge these need to be ascertained, acknowledged and addressed.[484]

The aim of the debate as expressed by the independent Steering Board,[485] which had been convened to run the debate, was to:

> ... promote an innovative, effective and deliberative programme of debate on GM issues, framed by the public, against the background of the possible commercial production of GM crops in the UK and the options for possibly proceeding with this. The debate [would] provide meaningful information to Government about the nature and spectrum of the public's views, particularly at grass roots level, to inform decision-making.[486]

Further communication from Beckett to Malcolm Grant, Chairman of the AEBC and the GM Debate Steering Board, suggested that there was a discrepancy between their conceptualisations of what the debate was for:

> The Government's ambition, at the end of this process, is to have achieved a broader and deeper understanding of what genetic modification is, how it can be used, and what the risks and the benefits are. We also want to have a clearer picture of the questions that most interest or concern the public within the UK on GM issues.

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[484] Department for Environment Food & Rural Affairs (2002), *Press Release: "Public to Choose Issues for GM Debate" - Beckett*, (DTI).

[485] The GM Debate Steering Board was comprised of members with a wide range of expertise and perspectives on GM issues, which was to avoid the debate being perceived as biased in one way or another. These included some members of the AEBC, scientists, social scientists, and representatives of environmental and consumer NGOs.

[486] GM Nation website, *GM Nation Public Debate website*, www.gmnation.org.uk, accessed July 2006.

> The starting point is that decisions are based on the scientific evidence as to whether there is a risk to human health or the environment. It is, however, important that these decisions are taken in the context of a full understanding amongst the public of their implications.[487]

The manner in which the output of the debate would be considered by the Government was not formally laid out, and after a request from the Steering Group the Government agreed, in January 2003, to respond formally to the report from the debate, and to demonstrate how it had taken into account the public views expressed in developing policy on GM. The Government had originally allocated only a budget of £250,000 for the debate. In response to much criticism, including concerns from ten senior social scientists during the planning of the debate, the Steering Board advised the Government that this would be insufficient to fund a credible debate, and the overall budget was doubled to £500,000.[488]

Further questioning of the Government's commitment to ensuring that the results of the public debate would influence policy came, a few months later in early 2003, with the announcement that the EU approval process for the import or cultivation of GM crops was to be restarted. As Grant pointed out in a letter to Beckett, this would mean that the Government would begin to give opinions on GM products before the public debate had finished taking place. As he continued:

> The public may wonder, however, why the Government is participating in approval processes while the programme of GM debate activities is underway. They may think that if the approvals process seems to be carrying on regardless, it undermines the credibility of calling for a debate.[489]

On the eve of the debate, Grant expressed his concern that the Government might not take the results into account. A group of eight NGOs also criticised the organisation of the

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[487] Beckett, M., *Letter to Malcolm Grant*, 7 November 2002, www.gmnation.org.uk, accessed January 2004.
[488] Burgess, J., *et al.* (2002), *Some observations and proposals on the 2002-2003 Public Dialogue on possible commercialization of GM crops in the UK*, (For the Public Debate Steering Board meeting, Nov 7th 2002).
[489] Grant, M., *Letter to Margaret Beckett*, 18 March 2003, www.gmnation.org.uk, accessed January 2004.

exercise as being 'chaotic', and the Government for not giving enough time, or the right quality of information, for people to properly engage in the debate.[490]

GM Nation? began on 3 June 2003, with the first of six regional public meetings, and over the following six weeks more than six hundred public meetings took place and 37,000 questionnaire forms were returned. Alongside the public meetings a series of discussion groups had been convened and reconvened to provide more in-depth analysis, and to act as a control group for the results that came out of the wider debate, to avoid the potential for the public groups to be solely comprised by members of 'special interest groups' who were campaigning on GM issues. The Steering Board reported the views on GM that emerged from the debate to the Government in September 2003. Their analysis of all of the data concluded that there were far more people, in both the focus groups and the wider public meetings, who were 'cautious, suspicious or outrightly hostile to GM crops' than there were supportive towards them.[491] There was also little support for the early commercialisation of them.[492] Thanking the Steering Board for the report, Beckett acknowledged that the process had been 'long and sometimes difficult', as she continued:

> I recognise that the debate was a new and innovative way of engaging the public on a complex policy issue, and that it has helped to raise awareness and understanding about GM.[493]

The extract above highlights the multiple conceptualisations of 'dialogue' and 'the public' within the Government. The AEBC had conceptualised *GM Nation?* as an opportunity to ascertain public views and values, and feed these into the policy-making process, yet Beckett conceptualised it as something which had increased awareness and understanding of GM. The process of getting the Government to commit to the idea of taking the debate, and

[490]BBC News, 'Public needs voice on GM issue', *BBC News Online*, 2 June 2003, http://news.bbc.co.uk/1/hi/uk_politics/2955150.stm, accessed November 2003.
[491] PDSB (2003), op. cit.
[492] Later evaluations of the data , however, have questioned the validity of these overall assertions. See for example, Campbell, S. and Townsend, E. (2003), 'Flaws undermine results of UK biotech debate', *Nature*, 425; Rowe, G. *et al.* (2005), 'Difficulties in evaluating public engagement initiatives: reflections on an evaluation of the UK GM Nation? public debate about transgenic crops', *Public Understanding of Science*, 14: 4.
[493] Beckett, M., *Letter to Malcolm Grant*, 6 November 2003, www.gmnation.org.uk, accessed January 2004.

public opinions and values seriously, had, according to Kass, been a battle throughout.[494] Thus we can see that the Government was here rhetorically reinforcing the idea that the 'expertise' that was applicable to policy-making, was something that could be located within science or government, but was not something within 'the public'. The Government response to the outcomes of the public debate, however, stated that the Government took public concerns very seriously, and that it had recognised the need to address the people's anxieties about GM crops.[495] We can identify several different versions of 'the public' within their response, each of which performs its own boundary work, legitimating the Government's views. Stating that it had carefully considered each of the concerns raised in the debate, the Government acknowledged that general negative opinions on GM crops existed but then appeared to downgrade the negative views of those participants in the debate on the grounds that they were not representative of a general public's views. As the report stated:

> We accept that the findings of the public debate broadly reflect the current state of public opinion on GM crops. We acknowledge that people are generally uneasy about GM crops and food, and that there is little support for early commercialisation of GM crops in this country. However the results suggest that the general public may have a lower degree of outright opposition to GM than the participants in the debate, while still being very cautious. (p. 5)

The Government also committed itself to providing better information on GM products and application, and also continued openness and transparency in this area, stating that the EU regulatory framework now required mandatory public consultation on any new GM application. What remained unclear, both with respect to future consultations, and in this response, was how the Government intended to use the data gained. Much of the response suggests that the Government perceived holding the public debate as the main achievement and had not considered what would then be done with the results. The flexibility in the term 'the public' allowed the Government to define what, or who, that was, and then do so in a manner which discounted the results of the public dialogue as not legitimate for not representing the 'true' public. The National Consumer Council, later argued that:

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494 Kass *Interview, 21 May 2004.*

495 HM Government (2004), *Government's response to the GM Nation? public debate*, accessed at www.genewatch.org/sub-531175 February 2007, p. 5.

> ... the Government has proved unable to deal with the scope of public questioning about the trajectory of GM technology. Whilst it had the courage to hold a public debate, it did not have the maturity to deal with the outcomes in any depth.[496]

GM Nation? was an 'unprecedented', and therefore experimental, national event in public engagement. A semi-official evaluation which was not funded by Government, or part of the debate process itself, but did have access to all the proceedings and was recognised by the debate steering board, concluded, like the genetics pressure group GeneWatch,[497] that there had been some problems with the conduct of the debate.[498] This evaluation did not, however, go on to look at how the findings of the debate were used by Government, or how they influenced policy.

Engaging or managing the public?

Kass reflected that by 2003 there had been a noticeable change in attitudes towards science communication and the public, and managing risk and uncertainty. These encompassed ideas of public dialogue and engagement and precaution, however, this change had not, within government, spread far beyond those within the Office of Science and Technology.[499] Barbara Knowles also characterised the situation in a similar manner:

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[496] National Consumer Council Memorandum submitted as evidence to the House of Commons Environment, Food and Rural Affairs Committee (2003), *Conduct of the GM Public Debate, Eighteenth Report of Session 2002-03*, (London: HMSO).
[497] Mayer, S. (2003), *Avoiding the difficult issues: A GeneWatch report on the Government's response to the GM Nation? public debate*, www.genewatch.org/sub-531175, accessed February 2007.
[498] Rowe, et al. (2005), op. cit.
[499] Kass *Interview, 21 May 2004.*

> "I think we're certainly not at the stage where what you might call Science and Society thinking has become embedded in the rest of the DTI, but that depends which bit of DTI you're talking about actually. So the area of DTI that's most obviously thinking about these sort of issues is the Biotech part. I guess because there's fear that there won't be a Biotech industry in the UK if the public doesn't support it and the public is generally viewed as not supporting it. I don't think there should be any conflict actually, what the DTI is about, is the UK being great at innovation, and at exploiting the outputs of academic research into industrial outputs and new products, new services. Except that none of these things are actually going to lead to wealth creation unless the public, in their role as consumers, buy the products or the services or allow the research to be done."[500]

Another extreme, though telling, episode also begs the question of how much the discussion and legitimacy of academic perspectives outside of the natural sciences were accepted in a science policy-making context. Policy Researcher Andy Stirling had been appointed to the GM Science Review panel one of the three GM reviews the Government had undertaken in 2003. He had taken a sceptical and precautionary approach to GM crops and as a result a senior scientist had attempted to undermine Stirling's standing, and research, and threatened his funding if he continued to make such views known to the panel. The event, as environmental group Friends of the Earth argued at the time, threatened to undermine the public's confidence in the scientific advisory and regulatory process.[501] An investigation was launched into the matter as another member of the panel - a social scientist - had also resigned, for fears that his own research funding might be threatened by his views challenging GM crop approvals. The Chief Scientific Adviser made it very clear that the Government deplored the attack on Stirling.[502] Jeff Thomas, lecturer in science communication, reflecting on this period questioned how far scientists were willing to take onboard perspectives from other disciplines and whether these were legitimately welcomed wholeheartedly into the scientific advice process:

[500] Knowles, B. (2004), *Interview, 9 August 2004*, transcribed by Simon Lock.
[501] Friends of the Earth, 'Press release: "Deplorable" attack on GM Scientific Critic', 25 July 2003.
[502] GM Science Review Panel Minutes (2003), *Minutes of the Science Review Panel 24 June*, (London: DTI).

> "If I was being sceptical I would think that the deeply ingrained, embedded philosophies of at least the practicing scientists has not shifted a great deal and how significant and also how real is this apparent change on the surface?"[503]

Knowles, however, claimed that the lack of uptake within government of much social science research into science and the public was due to civil servants and science communication practitioners not being able to understand the social science. This, apparently had facilitated the separation between them:

> "... [there is] quite a gulf between the social science theory and the public engagement practice. The public engagement practitioners have looked to social science in the past for advice 'what should we be doing differently then?', and most social scientists don't, can't, answer that question. And the practitioners have stopped asking, there's this sort of feeling that some of the social science research that's being done, while probably hugely academically valuable is actually of no practical use at all to any of the science communicators, or if it is, it is too late. And there's also a problem about the communicating of it, so the social sciences will be talking in their own groups about Science and Society and often aren't talking to the policy-makers or science communicators."[504]

The multiplicity of understandings within institutional circles as to the role of dialogue and science communication, and just who was the public that should be engaged with, can also be seen in the Department of Trade and Industry's *Forward Look 2003* report.[505] Much of the report discussed the need for innovation to be increased, and the desire for science to be forging ahead. Only in a few places did the idea of public engagement arise, and these were generally within the departments charged with conducting it, which suggests that public engagement with science was not something that permeated the Government's approach to science and innovation. There was some discussion of the public, and public engagement which suggested some level of acceptance of this approach. Lord Sainsbury argued that the public must be given opportunities for dialogue with scientists and policy-makers, 'to learn about and express their views about the possible directions of science and its impacts on

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[503] Thomas, J. (2004), *Interview, 14 July 2004*, transcribed by Simon Lock.
[504] Knowles *Interview, 9 August 2004.*
[505] Office of Science and Technology (2003), *The Forward Look 2003: Government Funded Science, Engineering and Technology*, (DTI).

society'.[506] No mention was made of what would be done with these views. Thus engagement could be undertaken to make the public feel that they had been listened to or to allow these views to influence the policy-making process. The issue of public engagement would be addressed, Lord Sainsbury argued, by the Office of Science and Technology's Public Engagement with Science and Technology programme (previously the Public Understanding of Science Programme), and the Research Councils. These programmes aimed, he argued, to 'raise public awareness of the outcomes of publicly funded science and the role of science in everyday life, encourage dialogue between the public and scientists, and increase the impact of public engagement activities' (p. 8). The first of these aims mobilised a deficit model conception of the public; the latter two aims, however, were more in keeping with social scientific ideas of a 'dialogue model' of science and society relations, and the public. A telling final sentence, however, which followed Lord Sainsbury's declaration that the DTI would be implementing most of the British Association's recommendations on science and society, suggests the ultimate aim, to him at least, for all these activities was a change in public attitudes towards science and scientists:

> It is my firm aim that the steps that we and others are taking should help to ensure that science becomes an even more relevant, valued and understood part of society in its widest sense. (p. 9)

[506] ibid., p. 8.

Phase III: Conclusions

This phase is dominated by the emergence of a new language, used by scientists and policy-makers, which suggests that the relationship between science and the public was being constructed in a different manner from previous accounts. What is evident within this new language, however, is a multiplicity of meanings of 'the public', and 'science', as well as different usages of the terms 'science communication', 'dialogue' and 'engagement'. While much of the new language used by scientists and policy makers was similar to that used by social scientists, thus suggesting some convergence of the rhetoric of public understanding of science, I would argue that instead we see the specific meanings assigned to these terms in a social scientific context getting 'lost in translation' as they were taken up by other professions and used to achieve other purposes. Thus the new dominant discourse of 'science and society' was as contested a cultural space as PUS had been. We can see that these new terms were being rhetorically employed in boundary work just as earlier ones were. The legitimacy now afforded to some social scientific research into science and the public by policy-makers - particularly the idea that there is not one public which must be dealt with but multiple publics - I would suggest allowed a greater flexibility in the rhetorical usage of this term. Thus we see many different conceptualisations of these multiple publics, often used by the same actors, but drawing the boundaries between science and society in different ways to suit their specific interests at that moment. For example the results of GM Nation were able to be discounted by the UK Government for not being representative of the 'true' public, who in this case were those perceived not to have a special interest in GM. In other instances, for example, in pronouncements by the Department of Trade and Industry, the relevant 'public', or 'consumer' is variably constructed, however, as the whole nation, or anyone who will be buying scientific products. The OST/Wellcome, on the other hand, divided the public up in their 2000 report into distinct categories on the basis of their interest in science, and which media sources they consumed, thus serving the 'marketing' interests of the specific science communication industry the report was aimed at.

Chapter 6 detailed a rhetorical redrawing of the boundaries between science, policy-making and the public. Here we can see a different construction of the problem between science and the public, within which a new deficit model operated, predominantly concerned with a deficit of 'correct' attitudinal responses in the public (trust and/or confidence) rather than a knowledge deficit. The 'problem' was variably defined as a need to restore, rebuild or manufacture these public attitudes with respect to science, or science policy-making. That the 'problem' of 'science and society' was couched in terms of 'rebuilding', or 'restoring' confidence also assumes that these attitudes were present in the first place, and almost explicitly acknowledges that the efforts were about engineering a public attitude change, where before the explicit aim was to engineer an increase in knowledge. This discourse of 'restoration', again problematises the public, suggesting that the way things should be was how they once were.

New boundaries become more prominent, particularly in the wake of controversy over BSE, particularly those between the Government and the public, and the Government and science. Equally, where before the boundary work around issues of the public understanding of science can be interpreted as concerned with promoting an expert or authoritative notion of science and scientists, here we also see the Government concerned variably with expanding, rebuilding or manufacturing its own authority to govern over scientific matters.

Communicating that science was open and transparent to the public was seen as a means of addressing the 'problem' of a lack of trust or confidence, and thus managing the relationship between science and the public. I would argue that the implication of the use of this new discourse by scientists and policy-makers, was that it put the public back in a passive role of the 'modest witness': if the public was satisfied that science was operating in an open and transparent manner then science would be left alone to continue its work. Alongside this, the idea that 'public values' should feed into policy-making around science and technology was discussed at length in policy-making circles. Again, however, public values and attitudes were largely constructed as separate, and secondary, from scientific information in the process of decision-making, thus this construction of the public as having values, simultaneously reinforced the primacy and authority of science as something that is separate from these, in keeping with Gieryn's definition of *protection of autonomy* boundary work. Thus much of the variety in language seen in policy-makers' and scientists' arguments can be seen as them rhetorically redrawing the boundaries around their professions to appear 'open' and 'transparent' in the way they communicate with the public, while simultaneously attempting to reinforce the separate social space, and authoritative role of, science and scientists in decision-making.

Chapter 7 detailed the continued renegotiation of boundaries within the PUS arena. This can be seen most strongly in the House of Lords Report *Science and Society* which almost overnight appears to have legitimised a 'new' orthodoxy in science and public relations. The inclusion of Wynne in drafting this report suggests a new legitimacy for certain social scientific views, and actors, within scientific and policy-making circles and the final report did reflect a change in language, discarding the label of 'Public Understanding of Science' in favour of 'Science and Society', alongside official proclamations that the deficit model of the public understanding of science was 'dead'. We can interpret this as an indication that scientists and policy-makers were attempting to redraw, or renegotiate, their boundaries around this thing that had been called PUS and, with the new name, to discard the deficit model and methods of communication associated with the former. With this uptake of terms previously used only by certain social scientists, we can, however, identify an increasing variety of definitions of the problem of science and society relations. Alongside this we also see different constructions of 'the public', 'science communication', 'science', 'public engagement', and 'dialogue' which were used, sometimes simultaneously by the same individuals or organisations, to rhetorically construct themselves and the boundaries between science, government, the public, and social scientists in different ways.

While the deficit model of PUS was acknowledged as 'deficient' itself, or indeed 'dead', by many actors, the construction of the public as 'deficient' is still present within these new 'problems' of science and society, albeit now the deficiency being allocated was a different concern. Most prominent is the allocation of a deficit of trust and confidence, which was now a central focus of many scientific and policymaking individuals and organisations. However, again we see deficiencies being allocated by, and applied to, many different professional groups. Certain scientists and policy-makers were also identified as deficient in terms of their efforts to engage and communicate with the public. Equally the media was problematised by the House of Lords committee as being deficient in its role as a science communicator, while at the same time scientists were told to work with it as it is. The deficit label remained then a useful rhetorical weapon to be deployed against rival professional groups competing over the same epistemological space. It is worth noting also, that alongside these newer uses of the deficit label, we can still identify within this period that there was also much discussion of improving the public's understanding of science, risk, and of the processes of science. Thus again multiple interpretations of the public are identifiable within the phrase 'science and society'.

Chapter 8 continued to show the variety in framings of the 'science and society' problem and/or relationship. Blair's speech, I would argue, succinctly displays the manner in which a particular social scientific discourse of 'dialogue', 'trust', 'openness', 'uncertainty', had been taken up and used within government and scientific institutions, yet the boundaries these organisations were drawing with their usage were very different. Much of the original work by academics such as Wynne and Irwin had specifically called for science itself to be problematised, yet at no point is this suggested in any of the discussion by government, policy-makers or scientists. Thus the rhetorical strategies may have changed to utilise new language, but the boundaries being constructed were very similar to those we have seen in earlier phases, with science and the public kept bounded off from each other, the latter being problematised, and the former not. Indeed Blair explicitly argued for a reliance on "sound science", on which to make decisions, the alternative being a "culture of unreason" where public opinions would hamper much needed innovation.

We also can identify a growing conflict and boundary work within science, or, more specifically, the science communication community, over the authority of particular organisations to define and act upon this new science and society agenda. One-way 'dominant model' methods of science communication had served to position scientists in an expert, and therefore authoritative role, with respect to the public. However, this new conception of 'science and society' and dialogue was formulated in a manner which potentially put scientists on an even level with the public, and encouraged two-way communication, and a mutual understanding of each other. Much of the activity at this time suggests that the organisations were attempting to construct, expand, or protect their role within this new landscape of science and society in a way that did not compromise their authority over scientific communication and decision-making. Equally many were dealing with an expansion in the field of professional science communicators and consultants who were also positioning themselves as the legitimate actors to manage the relationship between science and the public.

Furthermore, while the language of dialogue was now ubiquitous across government and the science communication arena, there was still little interaction or involvement of social scientists in the running, designing, advising or evaluating of these dialogue or engagement exercises. Given that for some time social scientists had been engaged in running participatory exercises, or, as in the case of Lancaster University running training courses in how to conduct them, this brings us back to the science/social science boundary issue which was prominent in Phase II.[507] One should be careful, however, not to characterise this divide in a general and overtly dichotomous nature. Though it is significant, as in the previous Phase, one can find examples of protagonists mobilising and adopting critiques of other's from within their own, or related disciplines.[508]

The redefinition of 'Public Understanding of Science' into 'Science and Society' meant that those scientific institutions previously promoting the former, simply took on responsibility for the latter as their primary task. The rationale behind the new 'science and society' agenda, as identified in the House of Lords report, put the impetus for most of these institutions on 'restoring', or 'improving' the public's confidence, or trust, in 'science', 'scientists', or 'the

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[507] The Centre for the Study of Environmental Change, where academics Brian Wynne and Robin Grove-White were based had run in 2000 a 2-day training course entitled 'Listening to the Public: Consultation, Participation and Deliberation', which covered amongst other subjects, training in how to run participatory exercises which would help shape policies, both local and national. www.lancs.ac.uk/users/profession/programme_outline.htm, accessed October 2003

[508] Biologist Steven Rose, for example, had, in 2003 (op. cit.), criticised scientific PUS protagonists for not understanding the public. Biologist Wakeford (2002a), now working in a social science research centre had argued that the use of citizen's juries could be as used to advance a public relations agenda as much as it could be to allow citizen input into a scientific policy decision. Mayer and Stirling (2001), equally, had advocated caution on the part of those who might assume that new participatory models of engagement would necessarily remove the obstacles inherent in the regulatory appraisal of technological risks.

governance of science'. Contrary to this, many of the social scientists critical of a traditional public understanding of science agenda had always largely been arguing for the democratisation of science and its institutions to allow public values to play a role in shaping the scientific agenda, and science policy. They were not, nor had they ever been, arguing for the restoration of the authority of science and scientists; they were specifically wanting to change this power dynamic, while also in the process advancing their own professional expertise. This could explain why many within the two groups were still, in 2003, largely operating within different spheres of influence and expertise despite using much more similar language than before.

'Engagement' or 'dialogue' with the public became an official approach to dealing with the relationship between science and society by many scientific and political organisations in this phase. Yet, again we can identify that these terms are used flexibly to achieve different goals. The end-goal of engagement with the public, as already identified, could be very different: restoring or building confidence or trust in science, scientists or government policy-making, allowing public values to feed into policy-making, or to make better decisions in science policy. The *GM Nation?* exercise also highlights another formulation of 'the public' within conversations of science and society. Previously the public had been problematised for having no scientific knowledge; but here, the legitimate public participant in such an exercise was characterised as exactly one who does not have any knowledge, or, more importantly, any entrenched social or political views. Thus emerges an idea of an ideal public, what Lezaun and Soneryd call 'the idiot public',[509] untouched by any previous attitudes towards science. This suggests again a departure from Wynne and others' conceptualisation of the public as having just this sort of expertise, but also reinforces the idea that scientists were not, or should not be, 'tainted' by social and ethical values, harking back to Boyle's idea of the scientific 'gentleman'.[510]

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[509] Lezaun, J. and Soneryd, L. (2007), 'Consulting Citizens: Technologies of Elicitation and the Mobility of Publics', *Public Understanding of Science*, 16: 3.
[510] Shapin, S. and Schaffer, S. (1985), *Leviathan and the Air Pump: Hobbes, Boyle and the Experimental Life*, (Princeton, NJ: Princeton University Press).

The desire to involve this idealised public in engagement or dialogue is open to the interpretation that these methods had attitudinal engineering as a primary goal. If a member of the public did not hold any particular views on an issue, and those who did were not desired, then the implication was that the ideal participants could be led to the 'proper' or desired outcome. Thus public engagement in this formulation is conceived as a tool with which to manufacture public consent for established innovation and technological trajectories, and not to allow the public to shape these. Further to these constructions of the public, we can also identify many others being mobilised by actors within this phase, each rhetorically drawing the boundaries between the public and science in a different manner. Some, as in previous phases, conceptualised the public as 'ignorant', or 'irrational', whereas now we also find other 'deficient' characterisations, which relate to a lack of the right kind of attitude, be this trust, or confidence in science, scientists or scientific governance. Further to this we also find the public variably being defined as a 'mass public', 'consumers', 'citizens', or multiple and variegated 'publics'. Furthermore, 'science' continued to be mobilised by certain scientists and policy-makers in this phase, as something that was separate from social and ethical values, albeit as something that needed to be influenced by them.

Thus in this phase, though it is characterised by a general shift towards a dominant, and more unified, language, we see a variety of understandings and motivations behind a single phrase 'science and society', as we also saw behind 'public understanding of science' in the previous 15 years.

9 Going 'upstream' without a paddle?

Phase IV

As we approach this last phase, this history enters a period which was developing as I carried out my research. This phase therefore relies on far less interview data and secondary sources as it post-dates the period in which I carried out my primary research. Furthermore, it is a period in which I was professionally involved in some of the events and reports,[511] thus the evidential basis is slightly different to previous phases. As discussed in Chapter 1, my status as 'researcher' in this period is more akin to a 'participant observer'. While I do not feel that this invalidates an attempt at a faithful account or interpretation of the proceeding events, it is important to both acknowledge and be reflexive about this change in perspective which entailed a more structured approach to the data analysis. To reiterate, I had to accept that being an actor in the history I was writing will, by necessity, influence the way in which I interpret it. Thus I had to ensure, when using different sorts of data, such as media coverage collected during the period, or subjective observational data, that I cross checked and triangulated the events and arguments to ensure a fair and accurate representation.

It is a period in which the debates over the relationship between science and the public continue to evolve and we will see that many social scientists were now engaging in policy discussions surrounding the question of whether dialogue between science and society was a viable alternative to one-way science communication.[512] Significantly, as the last chapter showed, the social scientific language surrounding 'the public', 'dialogue' and 'public engagement', which had been ignored during the earlier phases of public understanding of science when led by the scientific institutions, had now been taken up and was being used by those same institutions, as well as within government and policy-making circles. Indeed, as Irwin and Michael argued in 2003 in their book *Science, Social Theory and Public Knowledge,* very

[511] I worked as a researcher at the RSA between 2002 – 2005, and also within the Office of Science and Technology for four months in 2005.
[512] Wynne and Durant had been involved in the House of Lords report. Andy Stirling and Robin Grove-White had sat on committee's involved in the government's GM review.

often, arguments from social scientists were now being drawn upon as support for public dialogue ventures. They called the language of restoring public trust and confidence 'the new orthodoxy' within scientific and science policy-making organisations.[513]

Many social scientists were not wholly welcoming, or at least were sceptical, of this apparent shift in focus with respect to the relationship between science and public. With respect to gene technology specifically, sociologist Anne Kerr argued that despite the recent shift in efforts to engage the public over the technology, many attempts at dialogue seemed structured simply to identify deficits in knowledge in an effort to persuade the public to align their views with the technical experts, rather than to understand the wider social context. Kerr concluded, 'it would be naïve to assume that present relationships between professionals, patients, publics and genetic diseases are fundamentally different from those of the past'.[514]

Irwin and Michael also argued that it would be important to 'take a critical and informed look at the supposed shift from deficit theory to 'dialogue theory'.[515] Their book addressed both the practical public understanding of science movement and the use of social science to study it:

> The truth is that *Science, Social Theory and Public Knowledge* has been written as much in frustration as in celebration. When we looked to the practical sphere of 'scientific and public governance', we found understandings and techniques still largely uninformed by the significant insights yielded by 'public understanding of science and technology' and 'social theory' ... . We have written this book, however, in the conviction that things could be an awful lot better. (p. xi)

The book reiterated the authors' earlier criticisms of the deficit model of public understanding of science,[516] as well as Irwin's scepticism at new governmental approaches to public engagement having moved away from the deficit model.[517] As they explained:

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[513] Irwin, A. and Michael, M. (2003), *Science, Social Theory and Public Knowledge*, (McGraw Hill: Open University Press), p. x.
[514] Kerr, A. (2003), 'Rights and Responsibilities in the New Genetic Era', *Critical Social Policy*, 2.
[515] Irwin and Michael (2003), op. cit., p. x.
[516] Irwin and Wynne (1996), op. cit.; Michael (1992), op. cit.
[517] Irwin (2001) op. cit.

> ... we detect a partial shift away from this model and pointed to several examples where public groups were seemingly afforded a far more prominent role in the process of negotiation and discussion. Despite this, closer inspection suggested that, even those instances where the public were invited to 'participate' or were 'consulted', the notion of the public as deficient was still very much in evidence.[518]

Problematising social studies of science also, particularly those that studied science and lay-publics as distinct spheres, they called for a more complex and sophisticated approach to the public understanding of science and scientific governance. This approach, they urged, would accept that science, publics and knowledge were all co-constructed and fluid entities, with the line between them blurred constantly. What then, they asked in their concluding chapter, were the implications of their arguments and approach for the multidiscipline of public understanding of science? The answer, they suggested, would perhaps not be a welcome one to the many professional bodies and individuals involved and invested in the area after twenty years of activity:

> At one level, the proper response is that this should be disbanded (if that is possible for a multidiscipline). Our approach has so problematised the categories of public and science (not to say understanding), that it seems that a rather different intellectual and political project is called for. (p. 157)

Sociologist Rob Hagendijk also argued that it remained to be seen to what extent governments would distance themselves from a "'deficit' perspective". Discussing the recent European Commission's paper entitled 'Science, Society and the Citizen in Europe' he argued that two different voices were struggling to be heard:

> The dominant voice is the inclusive voice, assuring the reader that citizens' concerns should be taken seriously, and ought not to be treated in a condescending way. In contrast with this, however, a second, more 'scientistic' voice argues that the public can only contribute properly if it is adequately educated and instructed.[519]

He argued that in the same document one found sentences such as: 'The dialogue between society and science needs to be a two-way street where each listens as much as he talks' and:

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518 Irwin and Michael (2003), op. cit., p. xi.
519 Hagendijk, R. P. (2004), 'The Public Understanding of Science and Public Participation in Regulated Worlds', *Minerva*, 42, p. 46.

'The dialogue will be all the more rewarding...when [the public] has a thorough knowledge and understanding of science and technology, of scientific 'facts', of the results of research, of scientific action and of the way in which research operates in practical terms' (p. 46). This does suggest that there was still a tension within policy circles over how best to manage the relationship between science and society, and a reluctance to give up previous convictions as to how it might operate.

An official move 'upstream'

One of the criticisms which had been levelled at the 2003 *GM Nation?* debate was that it had taken place too late to influence the direction of GM research, and thus it had failed as a example of 'true' public engagement.[520] Addressing this concern in a paper for a Progressive Governance conference at the No. 10 Policy Unit towards the end of that same year, the think-tanks Demos and Green Alliance explored the possibility of conducting public engagement at an earlier stage in the innovation process, within the context of nanotechnology:

> Much nanotechnology is at an equivalent stage in R&D terms to biotechnology in the late 1970s or early 1980s. The forms and eventual applications of the technology are not yet determined. We still have the opportunity to intervene and improve the social sensitivity of innovation processes at the design stage – to avoid the mistakes that were made over other technologies.[521]

This idea that public engagement should move to an earlier point in the innovation process, where there might still be time to influence the outcome of the technology in question, was echoed by other organisations. The Forum for Technology, Citizens and the Market, a collaborative project between the Royal Society of Arts and the Department of Science and Technology Studies at UCL, had been exploring the interactions between science-based businesses, their product development and their publics, and promoted this same idea. Their

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[520] Mayer (2003), op. cit.; National Consumer Council Memorandum submitted as evidence to the House of Commons (2003), op. cit.

[521] Wilsdon, J. and R. Willis (2004), *See-through Science: why public engagement needs to move upstream*, (London: Demos).

research showed that there was, however, very little conception of a wider public, or social and ethical issues, in science-based companies beyond that of the immediate customer.[522] This suggests that many of the businesses had a similar conception of the public as the Labour Government, as demonstrated by the rhetoric of the market in its White Paper, and Blair's speech to the Royal Society in 2002. The idea of businesses engaging with citizens at an earlier stage of the innovation cycle was a strange one to many managers within the companies that took part in the research.[523]

Despite this lack of awareness of public engagement in the business sector, it was becoming more common to hear this term being used within government and policy-making circles. When the Treasury published its science and innovation investment framework for the next ten years in July 2004, a chapter was devoted to the subject of public engagement under the heading 'Science and Society' - a signal of the importance now placed on public engagement by the UK Government as a part of the innovation process. The chapter argued for the importance of taking action to achieve 'greater public confidence and improved engagement in science and technology'.[524] Achieving these goals included the 'intelligent regulation of research, openness, dialogue, effective communication with the public and responsiveness to public priorities and concerns' (p. 103). Unlike the report from the House of Lords, the Government did not identify a 'crisis of confidence' in science, at least in a general sense. Instead, the Government drew on the data from the OST/Wellcome survey published in 2000 to argue that the public was 'generally supportive of science' as a whole.[525] Despite this, the Government also acknowledged that there was sometimes unease about scientific and technological developments, and whether government was able to regulate and control these effectively:

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[522] Gregory, J., et al. (2007), 'Public engagement in the private sector: a new form of Public Relations?' in Bauer and Bucchi, eds, *Science Communication for the 21st Century*, (London: Routledge).
[523] I worked as Researcher on this project alongside Jane Gregory and Jon Agar, at UCL. Royal Society for the encouragement of Arts Manufacturers and Commerce (2004), *What's There To Talk About? Public engagement by science-based companies in the UK*, (RSA Forum for Technology, Citizens and the Market).
[524] HM Treasury (2004), *Science & innovation investment framework 2004 - 2014*, (HMSO), p. 103.
[525] Office of Science and Technology and The Wellcome Trust (2000), op. cit.

> Recent controversies, such as those surrounding BSE and mobile telephone masts, have exposed deep public concerns over the governance and regulation of science and the quality and use of scientific advice in government, and have illustrated how citizens can feel disconnected from decision-making on important issues.[526]

The Government also recognised that it had had to change its approach to engaging with the public. As Barbara Knowles claimed at the time:

> We all want the public somehow to feel that science and technology are important for the UK, that the public feels comfortable with the sort of pace of change that's happening, that they feel well enough informed to take part in debates, that they feel that their views are being taken seriously, but we're all struggling actually to know how to get there and how to know we've got there.[527]

It is possible to identify a mixture of different ideas in the Treasury report about what public engagement was to be for. The aim of public engagement, as put forward in the passage below, appeared to be as a means of managing a negative public response to government science by promoting the benefits:

> ... over recent years the focus of the Government's Science and Society public engagement activities has moved forward from simply promoting public understanding of science to the wider agenda of facilitating public engagement with science and its application. This has the aims of: government and scientists responding proactively to public priorities and concerns; people having greater confidence in the benefits offered by science. (p. 103)

Furthermore, science and society activities, it argued, should be able to support science activities that could achieve a 'positive national impact' and promote 'best practice in the media coverage of science and technology' (p. 104). The report, as had earlier government reports, characterised the public as a potential obstacle to scientific progress. Thus public engagement was again seen to be a solution to avoiding this situation:

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[526] HM Treasury (2004), op. cit., p. 103.
[527] Knowles *Interview, 9 August 2004.*

> To ensure that areas of science that could yield important quality of life and economic benefits are not held back the Government's next steps in this field will be in two key areas:
>
> Understanding, through careful monitoring, and then responding, to the population's developing concerns and expectations of science and technology; and
>
> Working harder on horizon scanning to identify key upcoming developments in science and technology and any likely concerns surrounding them. (pp. 104-5)

An example of this characterisation of public engagement can be seen in the report in its very brief discussion of nanotechnology, which, we were told, the Government was already 'committed to supporting' (p.107). It was vital to the Government that as this technology developed the public 'felt confident' about it' (p. 107). There appeared therefore no room for a wider discussion about whether this technology was desirable to the public; the task was to find a way of ensuring that the public were satisfied that it was being developed responsibly. While this was still a different idea of 'communication' from earlier efforts of trying to educate the public about a new science, no consideration appeared to have been given to what the Government would do were the public to express their unease at the technology in the course of a public engagement exercise. Contradicting this, however, the Government also argued that the public must feel that their views were taken into consideration:

> To better understand concerns and expectations, efforts will be focussed on enabling public fora where the ethical, health, safety and environmental impact of new science and technology can be debated. The Government wants constructive, inclusive and open public debate and dialogue on these issues, so that the public can be satisfied that science and technology is being developed responsibly and responsively, and that their concerns are being addressed. To do this, the Government will work to move the debate forward – beyond simplistic notions of the public being ignorant of science, or being either pro-science or anti-science; and beyond crude notions of a particular technology being either 'good' or 'bad'. (p. 105)[528]

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[528] The idea that the public should not be viewed as either pro-science or anti-science does appear to contradict the earlier use of the OST/Wellcome statistics to back up their claim that the public was overall positive about science. Thus the report shows the variety of ways in which the representations of 'the public' shift and were used to make different arguments by different individuals and institutions.

What marks this report out as different from earlier government discussions of dialogue is the idea that engagement happening earlier in the innovation process was considered more appropriate:

> The Government will also work to enable the debate to take place 'upstream' in the scientific and development process, and not 'downstream' where technologies are waiting to be exploited but may be held back by public scepticism brought about through poor engagement and dialogue on issues of concern. (p. 105)

To the Government then the idea of 'upstream' public engagement appeared to have been a means of avoiding expensive and failed public engagement processes which had, until now, for example, in the case of GM crops, been happening too late to change the public's impression or confidence. The priority given to public engagement as a key component of policy-making was also signalled with the announcement that the budget for the Office of Science and Technology's Science and Society expenditure would be increased, from £4.25 million per year in 2005-06, to over £9 million per year by 2006-07. As part of this, a new grants scheme was to be launched to 'build the capacity of citizens, the science community and policy-makers to engage in the dialogue necessary to establish and maintain public confidence in making better choices about critical areas in science and technology' (p. 108). This again suggested that the public were not to be given a say on matters of science policy, but needed to have confidence that others were able to do this. Thus here, the idea of public engagement was conceived as a tool which could maintain a boundary between experts who had control and power over scientific matters, and those who did not, and were there to witness (though in a manner filled with confidence) the science policy-making. The grants scheme was also to be shifted away from a responsive mode of funding public dialogue exercises, as the previous Copus schemes for PUS and dialogue had been, towards a directed scheme, focused around government policy objectives and based on the results of horizon scanning exercises. Again, this put control of which scientific and technological issues would be discussed in the hands of the Government.

Nano-nation?

The new term 'upstream engagement' became more widely used throughout 2004. A second report, also published in July of that year, discussed the importance of placing public engagement exercises 'upstream' in the innovation process. In June 2003 the UK Government had commissioned the Royal Society and the Royal Academy of Engineering, to carry out an independent study of likely developments in nanotechnology and whether it raised, or was likely to raise, new ethical, health and safety or social issues which were not covered by current regulation.[529] As the report argued, 'most developments in nanotechnologies, as viewed in 2004 were clearly "upstream" in nature'.[530] From the outset the way in which the issues were to be investigated, and reported on, suggested that the final product would be a more open and wide-ranging report than would normally be produced by the Royal Society. The working group was comprised of many scientists working in all different aspects of nanoscience, but also included Baroness Onora O'Neill, a member of the House of Lords, and lecturer in philosophy; Nick Pidgeon, a social scientist concerned with issues of risk and science communication in public; and Sir Jonathon Porritt, the environmental campaigner. The science advice process had therefore been opened up to include those with social and political expertise in addition to the scientific experts. Barbara Knowles, Science and Society Manager at the Office of Science and Technology claimed that the inclusion of social scientists was "partly to provide credibility", suggesting that social scientists held more legitimacy in these discussions now, than they had previously.[531] The inclusion of Pidgeon was significant, in that it signalled a shift in the Royal Society's approach to risk and uncertainties. His earlier work on the social construction of risks in 1992 had not been endorsed by the Society, and yet now he was being included on their expert panel. As he observed at this time, "a new understanding of science and society is

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[529] That both the Royal Society and the Royal Academy of Engineering are wholly, as they claim, 'independent' when both received large grants from the Government, is questionable. One could perhaps see this term 'independent' being used in a similar way to the idea that all gentlemen in Boyle's time were 'independent', of certain social beliefs and roles.

[530] The Royal Academy of Engineering and The Royal Society (2004), *Nanoscience and nanotechnologies: opportunities and uncertainties*, (London: The Royal Society), p. 64.

[531] Knowles *Interview, 9 August 2004.*

spreading through the work of the Royal Society...these perspectives are finally being mainstreamed".[532]

Much of the report was concerned with the scientific potential of nanoscience and the uncertainties surrounding its possible applications. However, as the report stated, it seemed 'highly likely that some nanotechnologies will raise significant social and ethical concerns',[533] and, one chapter was devoted to a discussion of the social and ethical issues. It further acknowledged that new developments in science and technology did not 'take place in a social vacuum' (p. 51). A chapter of the report was also allocated to exploring issues of stakeholder and public dialogue, and public attitudes, which were deemed to play a 'crucial role in the realisation of the potential of technological advances' (p. 59). During the writing of the report, on top of the usual call for written and oral evidence, two public workshops had been held by the Committee to explore public attitudes and understandings of nanotechnology, and questions had also been added to a social attitudes survey to gauge the level of public awareness of nanotechnology.[534] Both the survey questions and the workshops had reported a low awareness of nanotechnology in the public, and the report argued 'that much will hinge upon how attitudes to nanotechnologies are shaped over the next few years'.[535] At other points in the report, the rhetoric suggests that the idea that the public could have an input into technology policy was far more accepted than it had been previously. Public attitudes and uncertainties were explored and, using arguments from social scientific researchers, the report suggested that public concerns should not be dismissed:

> It can be helpful to separate governance into two strands. The first involves the role and behaviour of institutions, and their abilities to minimise unintended consequences and adequately regulate. Such questions are not, as Wynne points out, the product of a mis-informed or 'irrational' public. Rather, they are legitimate questions touching upon areas of very real potential risk ... Nor should such questions be seen as the product of views that are anti-science or anti-technology. (p. 61)

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[532] Wilsdon and Willis (2004), op. cit. p. 15.
[533] The Royal Academy of Engineering and The Royal Society (2004), op. cit., p. 51.
[534] BMRB (2004), *Nanotechnology: Views of the General Public*, (London: BMRB International Ltd).
[535] The Royal Academy of Engineering and The Royal Society (2004), op. cit., p. 61.

In setting out a more general case for wider societal dialogue about new technologies and more open science policy formulation, the working group drew again on social scientific research, using the work of Daniel Fiorino,[536] to characterise the different rationales for public engagement: 'normative', 'instrumental' and 'substantive':

> The normative argument proposes that dialogue is a good thing in and of itself and as such forms a part of wider democratic processes through which controversial decisions are made. The normative argument suggests, in particular, that it is important to make decisions sensitive, as far as possible, to the ethical and value concerns of directly affected groups or populations. The instrumental argument suggests that dialogue, as one means of rendering decision-making more open and transparent, will increase the legitimacy of decisions and through this generate secondary effects such as greater trust in the policy making process ... Finally the substantive argument is that dialogue will help to generate better quality outcomes.[537]

There was also some discussion that upstream engagement would lead to a non-conflictual outcome where the development of new technologies was concerned, avoiding a similar episode to the GM crops controversy of five years earlier. This appeared to be a widespread view and there was much hope expressed in the evidence submitted to the working group that 'methods for upstream deliberation may help society to find appropriate resolutions for potential conflicts in advance, by better anticipation of sensitive issues'.[538] It is unclear whether 'society' here included science, or was used to demarcate it from a troublesome public. This also suggests that one outcome was the development of a positive consensus regarding any technology under deliberation:

> One can make the argument that with many of these more mature technologies public dialogue has typically arrived too little too late, only being seen as an optional 'add-on' when the decision-making surrounding an issue (for example radioactive waste siting) has become pressing, difficult or uncomfortable for regulators or governments. Under such circumstances the existence of highly polarised positions can make it very difficult, if not impossible, to take any real dialogue forward. (p. 64)

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[536] Fiorino, D. (1990), 'Citizen participation and environmental risk: a survey of institutional mechanisms', *Science, Technology and Human Values*, 5: 2.
[537] The Royal Academy of Engineering and The Royal Society (2004), op. cit., p. 63.
[538] ibid.

Similar concerns over *GM Nation?* having been 'hijacked' by interest groups with firmly held beliefs about GM suggests several different ideas about public engagement and 'the public'. First, upstream engagement would not create people who were vehemently 'anti' any given technology, so the public would be persuaded to accept the views of the Government, or whoever was running the public engagement exercises; and second, that upstream engagement would necessarily lead to consensus regarding any given technology. Third, there is an implicit suggestion here that those groups advancing polarised views did not have a valid place within these exercises, as had been suggested during *GM Nation?*, and thus were not considered to be 'the public'. This in turn suggested that only those with the potential to be persuaded, one way or another, were to be involved in these sorts of exercises. Thus public engagement was not, it appeared, about listening to the range of opinions that existed within society, but to engage those members of the public who had no formed opinions, again suggesting a particular deficit model of the public. Furthermore, there is a final implicit suggestion that if members of the public were exposed to scientific information at an early stage, before they were influenced by the polarised views of special interest groups, they would reach a more 'mature' decision. Indeed, echoing Blair's earlier argument that a "mature attitude towards science" needed to be embedded in society, the working group identified the need for a 'mature debate' that would 'discriminate between the many ... and ... sometimes exaggerated claims for the technology' (p. 64).

The role of scientific information in the process of engagement was also explicitly discussed, and while, as the report stated, the development and incorporation of 'good-quality, independent scientific information' would be central to the success of any analytic-deliberative process, this was not to be communicated to the public in a manner previously associated with the deficit model of PUS:

> Information provision has to aim at more than just 'educating' the public as a presumed means of avoiding controversy, a view embedded in the so-called 'deficit model' of much traditional public understanding of science and science communication practice. Meeting such an objective has proven unrealistic time and again: in particular because people resent attempts at direct manipulation, greater knowledge does not necessarily bring greater acceptance of risks, and one-way communication without genuine dialogue about science issues may not address people's wider concerns. (p. 64)

Thus particular social scientific rhetoric had been adopted by these scientific organisations regarding ideas about the way in which the public should be communicated with. We can see this even more clearly in the Royal Society's *Science in Society Report* published at the same time, which argued that:

> The public understanding of science approach has been questioned as a deficit model of understanding. The implied relationship that support for science can be achieved through better communication overlooks the fact that different groups may frame scientific issues differently. The approach did not adequately conceptualise how publics' views and attitudes towards science were embedded within wider social, political and institutional understandings, and risks discounting the role of local knowledge and different public values in science debates (see Irwin 1995; Irwin and Wynne 1996).[539]

While the Royal Society and Royal Academy of Engineering report used social scientific research and language to make the case for no longer operating under a deficit model and for upstream engagement around nanotechnology, there appears also to be an assumption that the public would want nanoscience, and thus what was up for debate was simply the manner in which this technology would develop.[540] Ultimately, although public engagement was now endorsed by institutions such as the Royal Society, no-one appeared sure how to embed it into normal policy-making practice.

See-through science

In September 2004, Wilsdon and Willis, having earlier promoted the idea of 'upstream' engagement to Government, provided a lengthier articulation of why it was needed in a Demos pamphlet, entitled *See-through science: why public engagement needs to move upstream*.[541] The involvement of a political think-tank in what had previously been the domain of scientists and science communicators highlights the way in which the discussions about science and

[539] The Royal Society (2004), op. cit., p. 2.

[540] The report also discussed deliberative engagement, and what lessons it had learned from *GM Nation?*.

[541] Demos had come to this issue via an active involvement in issues of participatory democracy. See for example: Leadbeater, C. and Mulgan, G. (1994), 'Lean democracy and the leadership vacuum', *Demos Quarterly*, 3; Adonis, A. and Mulgan, G. (1994), 'Back to Greece: the scope for direct democracy', *Demos Quarterly*, 3.

society had changed to include different institutions and individuals, and thus embodied different ideas of this relationship. The Demos report drew heavily on academic work by Wynne, Irwin and other social scientists. Reflecting on the four years that had passed since the publication of the House of Lords Report, Wilsdon and Willis felt that there had been a perceptible change, with consultation papers, focus groups, stakeholder dialogues and citizens' juries having been 'grafted onto the ailing body of British science, in the hope that they will give it a new lease of life'.[542] While they accepted that not everyone had embraced this new mood for dialogue entirely, Wilsdon and Willis felt those in disagreement were now rare:

> Every so often, a few drops of PUS still dribble out from a Lewis Wolpert or a Lord Taverne, but these voices are now a dwindling force. The science community has embraced dialogue and engagement, if not always with enthusiasm, then at least out of a recognition that BSE, GM, and other controversies have made it a non-negotiable clause of their "licence to operate". (p. 18)

Barbara Young, the Head of the Environment Agency, who wrote the foreword to the pamphlet, speaking at the launch event at the RSA in early September 2004,[543] also reflected on how her perception of interacting with the public had changed:

> "... scientists really have adjusted and changed over the years, they've started to involve the public in their work. First of all it was very much a sort of sell and tell and educate approach. I used to be a member, and I must confess, having read the pamphlet I'm feeling slightly ashamed about this, I used to be a member of the Committee of the Public Understanding of Science, and we were a bit in tell and sell mode in those days I must confess."[544]

Wilsdon, presenting the main points from the pamphlet at the launch, argued to the audience, which was comprised largely of actors who had been involved in the area of PUS/Science and Society over the last twenty years, that the UK activity in this area might finally have moved away from what had been, in his opinion, a 'flawed' project:

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[542] Wilsdon and Willis (2004), op. cit., p. 18.
[543] I worked on the report launch while at the RSA.
[544] Demos Launch Event (2004), *'See Through Science' launch event at the RSA*, transcribed by Simon Lock. comment by B. Young

> "... we sit on the cusp of a new phase of debates around the public engagement in science. The first phase was all about educating the public following the publication of the Bodmer report in 1985, the language of public understanding of science, or PUS for short, oozed across the face of British science policy. But rather than lubricating an understanding, PUS clogged the pores and cracks that might have allowed genuine dialogue to breathe. Implicit within it was a flawed understanding of science, a flawed understanding of the public, and a flawed understanding of understanding."[545]

Wilsdon also argued that the PUS agenda was actually partly to blame for the difficult relations between science and the public over the last decade:

> ... [the agenda] relied on a deficit model which has been widely discussed, which assumed that the more the public knew about science, they'd fall into line behind it. As a result relations between science and society festered throughout the 1990s and unsurprisingly an occasional rash of blisters erupted; BSE, GM, mobile phones, now nano.[546]

The controversy over GM crops, Wilsdon and Willis argued, had had a very strong influence on shifting the opinion of those people who had previously not accepted the need for public engagement:

> ... policy-makers and the scientific community are desperate to avoid new developments, especially nanotechnology, becoming the next GM. The wounds of that battle are still very raw and there's little appetite on any side for a rerun.[547]

The *GM Nation?* exercise, as they argued in the pamphlet, had occurred too late in the innovation process for the public to influence the trajectory of the technology.[548] Now because of this, there seemed to be a new commitment to the idea of public engagement upstream in the innovation process, shown by the prevalence of the phrase in both the Treasury 10-year strategy document and the Royal Society and Royal Academy of Engineering's report on nanotechnology. As Wilsdon and Willis explained, their rationale for publishing the pamphlet at this point was to ensure that the lessons from previous attempts to manage the relationship between science and society were learned and the mistakes

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545 ibid., comment by J. Wilsdon
546 ibid., comment by J. Wilsdon
547 ibid., comment by J. Wilsdon
548 Wilsdon and Willis (2004), op. cit., p. 19.

avoided. Their own rationale for promoting upstream dialogue with the public on science and technology issues was defined here as such:

> Downstream, the flow of innovation has absorbed numerous engagement processes. Yet few of these have any real connection to the upstream questions that motivate public concern: Why this technology? Why not another? Who needs it? Who is controlling it? Who benefits from it? Can they be trusted? What will it mean for me and my family? Will it improve the environment? What will it mean for people in the developing world? (pp. 28-9)

The challenge – and opportunity – for upstream engagement, as Wilsdon and Willis saw it, was to try to force some of these questions back onto the negotiating table, and to do so at a point when the public were still able to influence the trajectories of scientific and technological development. The danger, they argued, was that one deficit model would be replaced by yet another - as Wilsdon argued, "a misunderstanding of what's at stake in these discussions, and what forms the basis of public concern".[549] Though one should note that, while scientific organisations where blamed for misrepresenting the public without the appropriate engagement, the authors appeared to already know what questions the public would want to ask.

While Wilsdon and Willis praised the fact that the Royal Society/Royal Academy of Engineering report on nanotechnology had happened at all, they were sceptical of just how far they had embraced a new approach to the public, arguing that it had instead focused largely on the risks of the technology as if these were the main basis for public concern. They drew on the work of Andy Stirling, who had been critical of the way in which many of the favoured participatory modes of social appraisal could actually be used to justify existing political objectives in the same way conventional expert scientific forms of appraisal could, rather than open them up to some of the deeper framing questions (such as those cited on the previous page). Arguing that decisions made about the type of process used, the participants, the questions asked, or the information provided, could lead to inadvertent bias

[549] Demos Launch Event (2004), op. cit., comment by J. Wilsdon

or deliberate influence,[550] Wilsdon and Willis therefore questioned the motivations behind the nanotechnology report's authors' promotion of upstream engagement:

> There's a lot of positive noises in the report about public engagement, but it doesn't seem entirely clear in the report what purposes that engagement is designed to serve. Is the motivation normative? Is it the right thing to do? Because dialogue is a healthy ingredient of a healthy democracy. Or is the motivation more instrumental? A way of building trust in nanotech, and to remove any obstacles that may upset the innovation applecart. Or is it substantive? Does it actually aim to improve the quality of decision making by incorporating new forms of public knowledge, new forms of social intelligence into the very design of the technology from the start?[551]

Defending their nanotechnology report at the Demos pamphlet launch, John Enderby, Deputy President of the Royal Society, argued that the Royal Society was still catching up with the times, and still learning how to deal with the public:

> I believe that our most recent report jointly with the Royal Academy of Engineering is indeed part of an evolutionary process. It's what theologians would call progressive revelation. I also feel that poor old Walter Bodmer, and his report has been rather badly treated ... it's true that it was believed that by educating people then they would understand the validity of what scientists were saying in the 50s and 60s, but in my view it was the first step towards redemption.[552]

Regardless of how sincere or effective those scientific institutions' attempts to change their approach to managing their relationship with the public were, Wilsdon and Willis were still sceptical as to whether those same institutions and government had sufficient expertise in, and commitment to, running good dialogue processes:

> Simply slotting deliberative processes into existing ways of doing things will not result in any real change. Some of the more naïve proponents of public engagement seem to assume that the way to resolve difficult issues is by bringing together the concerned parties, adding a mix of methods and a family pack of post-it notes, and then allowing the facilitators to save the day.[553]

Tracey Brown, Head of Sense About Science felt that this criticism, however, hid self-serving professional interests:

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550 Wilsdon and Willis (2004), op. cit., p. 40.
551 Demos Launch Event (2004), op. cit. comment by J. Wilsdon
552 ibid., comment by J. Enderby
553 Wilsdon and Willis (2004), op. cit., pp. 46-7.

> I find it odd that some of the organisations that have been drawing our attention to things like low voter registration and a general lack of civic participation, were so determined about public involvement in scientific research priorities ... it really only makes sense to me when I think about it as describing an enhanced policy role for those who present their ideas in the language of public engagement ... I think that some of these suggestions that are in this pamphlet are really about expanding the opportunities in policy making for those particular groups of people. Everything is very much focused on that, in fact, I think it's become quite a self-referential discussion, and a highly jargonistic one.[554]

Her criticism suggests that professional boundaries were being challenged once more by this new focus on 'upstream engagement', and certainly the nature of the launch event itself suggested that things had changed in the PUS/Science and Society arena. The pamphlet had been published by a political think-tank, and launched at the RSA, which had also been engaged in promoting upstream engagement in the business sector for the previous three years.[555] Not only did this highlight the political focus of this new public engagement debate, but the inclusion of speakers from Greenpeace, the Green Alliance, and Forum for the Future shows that the professional groups now influencing the debate were also not the same individuals and organisations that I have treated as central to the PUS debate in previous phases. Responding to Tracey Brown's criticism of the upstream engagement agenda, Wilsdon was openly critical of the scientific establishment, blaming them again for not moving away from their old ways of managing their relationship with the public:

> ... the science establishment, if it could be described as such, funds organisations like Sense About Science, whose job it is to stand up and dribble PUS over this debate, on an ongoing basis. ... they perpetuate a particular rebarbative view ... and I think that's a problem in this debate, that perhaps needs to be opened and aired for discussion too.[556]

What the authors wanted, like many of the social scientists whose work had featured in the pamphlet, was to change the whole relationship between science and society, rather than simply finding a better way to manage the existing one, which maintained certain professional power for selected groups. As they concluded:

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[554] Demos Launch Event (2004), op. cit. comment by T. Brown
[555] Gregory, et al. (2007), op. cit.
[556] Demos Launch Event (2004), op. cit. comment by J. Wilsdon

> Taken to its logical conclusions our argument in this pamphlet has profound implications for the future of science. At its most ambitious, can upstream engagement reshape not only the way that science relates to public decision-making, but also the very foundations of knowledge on which the scientific enterprise rests? Five years on from the House of Lords report, this is the question that the science and society agenda now needs to address.[557]

Finally, they challenged those scientific and policy organisations to back up their stated commitments to upstream engagement with meaningful actions. It was, the authors' felt, still too early to say whether this would actually happen. Throwing money at the 'problem' was one thing, but a meaningful cultural shift in the way in which these organisations dealt with the public was what was truly desired:

> An extra £1bn was allocated in the latest spending review towards science. But a big question remains unanswered in that document; will all of this extra cash, and the innovation it seeks to unleash, actually improve, or worsen relations between science and society. So looking across this landscape, as we see some sort of shift is underway, but it is still unclear whether this new vogue for upstream engagement will prove ephemeral, or develop into something more meaningful and promising. (p. 20)

Shortly after the launch of the Demos pamphlet, an editorial in *Nature* lent further support to the idea of upstream engagement, though acknowledged that it would be a difficult concept for many in the scientific community to accept. For many researchers, *Nature* argued, the Demos pamphlet would make 'frightening reading', and for those scientists who believed the public to be easily swayed by 'misleading media' on scientific issues, the proposal 'must seem close to giving the lunatics the key to the asylum'.[558] However, *Nature* felt that there were good reasons why scientists should 'ignore these fears and embrace upstream engagement'. As the editorial concluded:

> Upstream engagement is no panacea. On its own, it won't solve Britain's crisis over trust in science. Nor will it resolve thorny questions about what types of science are worth pursuing, and which should be avoided...but it is worth doing.

[557] Wilsdon and Willis (2004), op. cit., p. 56.
[558] Editorial (2004), 'Going public', *Nature*, 431: 7011.

Nature also felt that it was only worth doing provided that the processes were first, long-term and properly funded, and second, that the funding organisations made a genuine commitment to react to the results of engagement processes. This did not mean simply accepting the outcomes, but explaining why some public advice was taken into consideration and some not. Criticising *GM Nation?* the editorial argued:

> The UK Government ran a public debate on genetic modification last year and is widely believed to have ignored the results – something only a little less offensive than talking about babbling hags.[559]

Lord Taverne, Chair of Sense About Science, responding to *Nature's* support of Demos and what he called 'the fashionable demand by a group of sociologists for more democratic science', argued that 'unthinking subservience to the principle of participation', should not be given by the scientific community.[560] This would lead to greater involvement of special interest groups, and research priorities being set onto the wrong problem by the public. As he concluded:

> The fact is that science, like art, is not a democratic activity. You do not decide by referendum whether the Earth goes around the Sun.

What is this thing we call 'dialogue'?

The new and promised grants scheme for public engagement, Sciencewise, was launched by the Office of Science and Technology in September 2004, with a budget of £1.2 million over two years to provide matched funding for projects that brought public dialogue into policy. All bids were assessed by an independent steering panel, which made recommendations to government on the awarding of grants. The chair of the panel was Kathy Sykes, the Collier Professor in the Public Understanding of Science and Technology at Bristol University. By

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[559] The editorial had started with a quote from the seventeenth century researcher William Gilbert, describing discussions with the public as little better that listening to the 'maunderings of a babbling hag', ibid.
[560] Taverne, D. (2004), 'Let's be sensible about public participation', *Nature*, 432: 18 November 2004.

now her title had been changed to Chair in Public Engagement in Science and Technology. The press release announcing Sykes' appointment a couple of years earlier had stated she would:

> ... seek to communicate scientific and technological research in a user-friendly way to the general public. She will find out what the public is interested in, and concerned about, and find ways of getting scientists to talk face-to-face with them about ethical and controversial issues in science.[561]

Sykes, a physicist by training, moved into science communication and is well-known for presenting television shows on scientific issues. It may have appeared a strange choice for a professorship in the public engagement of science, as Sykes had no publications or experience of social scientific practices, nor a history within the academic fields of public understanding of science or science communication. One could argue that again this was an indication of how institutionally, the issue of managing the public's relationship with science was still thought of as the domain of professional science communicators and natural scientists, while social science academics were conceived as providing external help only when it was required. The fact that Sykes' appointment was press released, and she was subsequently appointed to Chair of the Sciencewise grants panel, and onto the Council for Science and Technology - the highest science advisory panel within government – perhaps shows also an attempt, through the appointment of a 'celebrity' to raise the profile of the issue of public engagement.

Discussions continued into 2005 about what dialogue meant, and what it was for among the many different professional groups involved in addressing (or managing) the relationship between science and society. In a response to Durodie's earlier attack on the idea of public dialogue in science,[562] three members of the British Association - the Chief Executive Sir Roland Jackson, Fiona Barbagallo, and psychologist Helen Haste of Bath University - published their own defence of public engagement, in the process defining what they meant

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[561] University of Bristol (21 October 2002), *Media Release: Sykes to bring science to the people.*
[562] Durodie, B. (2003), 'Limitations of Public Dialogue in Science and the Rise of New 'Experts'', *Critical Review of International Social and Political Philosophy*, 6: 4.

by 'dialogue' and the context within which it could take place in relation to science.[563] They cited social scientific studies in their paper to back up their own arguments, many of which had previously been ignored by the British Association, as one of the founding members of Copus.[564] While the paper largely argued for the value of dialogue in scientific matters, against Durodie's more sceptical position,[565] the authors also questioned how much progress had been made in the UK in the last five years:

> ... although the language has changed, the sentiments of the House of Lords report have not been readily endorsed. Sociologist Brian Wynne has stated that that deficit model is more an 'ideological construct than a research method' and it is not simply avoided by changing the format of public engagement activities.[566]

Dialogue should not, the authors argued, be primarily about 'providing a platform for scientists to explain to the receptive lay person how the world works', but should be:

> ... an open exchange and sharing of knowledge, ideas, values, attitudes and beliefs between stakeholders (e.g. NGOs, commercial organisations, interest groups), scientists, publics (e.g. members of the general public, farmers, consumers) and decision-makers (local, regional and national). (p. 350)

However, dialogue should also not, they stated, 'remove authority or expertise from science'. Instead it should locate scientific developments in a wider social context, enabling the inclusion of a wider range of relevant expertise with regard to the implications of such developments. Thus on the one hand Jackson *et al.* wished to allow a two-way exchange of communication, yet on the other hand, the primacy of scientific authority and expertise was to be maintained.

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[563] Jackson, R., *et al.* (2005), 'Strengths of Public Dialogue on Science-related Issues', *Critical Review of International Social and Political Philosophy*, 8: 3.
[564] The paper not only quotes Brian Wynne, but also specifically mentions the qualitative work of Wynne, Michael, Irwin, Kerr, and Jasanoff to make the point that local and contextual knowledges were important and should be taken into consideration by policy-makers and scientists.
[565] Durodie's position can be taken as largely representative of the view taken by many of the closely-knit organisations with which he was involved. See footnotes 450 and 459 for discussion of these.
[566] Jackson, *et al* (2005), op. cit., p. 350.

Jackson *et al.* also, while arguing for public dialogue on scientific matters, specifically with respect to nanotechnology, stated what questions they believed the public dialogue would cover:

> The public is likely to want to see that the issue of who controls the technology will be discussed, and be confident that regulation balances societal and consumer benefits with rewards to businesses exploiting the technologies. It will want to ask about ethical implications (especially regarding health and the human body), equity of access to technologies, long-term effects, known and unknown areas of consequences, and impact of life and our environment.[567]

The phrase 'It will want to ask', suggests that the dialogue would still largely be about an information flow from experts to the public, who once satisfied that their concerns were being addressed, would allow the technology to continue.

Despite the mixed messages over the role of the public in dialogue exercises the paper attempted to dismantle Durodie's argument against public dialogue in science: that scientific facts should not be subject to democratic decision-making. As the authors retorted, the implication that the validity of scientific knowledge itself could be democratically decided was misleading. The kind of future that society wanted could, however, be democratically decided and, within this, what type of science and technology would shape that future. Finally, Jackson *et al.* argued for a need for scientists and policy-makers to acknowledge public views and opinions as legitimate, something they clearly felt was still lacking within UK scientific and policy-making cultures. This was difficult to achieve in practice, as Alan Irwin's recollection of attending a National Dialogue Event, run as part of the Royal Society's Science in Society Programme, in 2004, suggests:

> "... there was someone from the Royal Society... and every time someone from the public said, "I'm really worried about this." The response would be: "Oh no, no, no, that's not a problem at all, I really don't think we should be afraid of that." So in the end it was, "okay, you tell us, you're the Royal Society experts, you tell us what it's going to be." And I sat there thinking, just beam me up, I really felt I didn't want to be a part of it.[568]

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[567] ibid.
[568] Irwin *Interview, 29 June 2004.*

Durodie, rather than publish a response in the peer-reviewed journal, issued a response on his website, suggesting, perhaps, this was less an academic exercise for him and more a personal or political one by this point. He argued that Jackson *et al.* were being presumptive in themselves defining what the public would want to discuss in any given public dialogue, arguing, 'it seems as though those who speak the loudest of the need for evidence-based uncertainty and humility are amongst the least able to practice it'.[569] Durodie also questioned the value placed on public dialogue in science, and suggested that perhaps the process was more important than the content:

> Dialogue is variously described as 'an open exchange and sharing', something that 'enables' inclusion and seeks to 'recognise' other factors. As dialogue 'does not remove authority' from science or 'somehow set public opinion as equal', there appears to be no requirement to act upon it, just to 'respect' and 'acknowledge'. Adopting the therapeutic language of our times, dialogue is no longer a means to an end, but rather an end in itself. So much for the possibility of real change then.

Durodie was not the only academic to note the therapeutic language and nature of public dialogue. Bauer also argued that the work of Wynne specifically took the relationship between science and the public more into the realms of psychoanalysis than social science and policy:

> "I think Brian Wynne operates in mainly a psychoanalytic notion ... he wants to talk about institutional neurosis, that the scientific community has an institutional neurosis with the public, they are ... afraid of the public and the deficit concept became a way of elucidating that and I think that that's important. So you become an action researcher, you work on people ... which is a sociological psychoanalysis. But the problem is if you think that through then you end up becoming mediators, and all you have to do then is create, or to make people become reflexive, you have to organise psychoanalytic cultures, or you have to organise encounters of people who have conflict to come together and talk nicely to each other and don't walk out, so it's mediating. Now this is very important, but it's self-defeating, it eradicates social science, there's something more than just becoming mediators ..."[570]

While Bauer suggests that this approach to managing the relationship between science and public would diminish the role of social scientists, Durodie felt differently, and like all the closely interlinked organisations he was closely aligned with such as the Scientific Alliance,

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[569] Durodie, B. (2005), Inclusion versus Experimentation, www.durodie.net, accessed January 2006.
[570] Bauer *Interview, 26 May 2004.*

and Sense About Science,[571] suggested that this shift towards public engagement had placed social scientific authority higher than ever before, and unlike the scientific expertise, went unquestioned:

> Ironically, whilst preaching the virtues of humility in science, Jackson *et al.* confidently tout the input and relevance of social scientists who 'can and should offer valuable specialist expertise'. Notably, this claim to authority is not associated with any calls for public dialogue in the social sciences. This tacitly accepts the input of such experts as having no real and lasting impact upon the world in the way they believe science does.[572]

A further sign of dissatisfaction with the new 'orthodoxy' of public engagement in science came from a scientist writing in *The Guardian* in June 2005. Again, it is worth noting that this criticism was discussed in a public forum rather than within the peer-reviewed literature, as much of the positive commentary had. This suggests perhaps, the politically oriented nature of the comments, rather than them being intended as additions to the ongoing social scientific research in this area. Equally it could suggest that these scientists were attempting to downgrade the social scientific work which they had been involved in by bypassing the usual channels of professional research communication. Dr John Warren, from the Institute of Rural Sciences at the University of Wales, Aberystwyth, had been involved in a government funded project designed to find out how much the public valued biodiversity. The experience had clearly not been welcome, nor was the idea that scientists should now be engaging with the public, as he was quoted as saying:

> As a scientist in the 21st century I am not only expected to unravel the mysteries of the universe, but also to engage the public in dialogue. Unlike my predecessors, who were simply encouraged to go forth and educate the masses – or more politely "enhance the public's understanding of science", I am told to be involved in a two way process.[573]

The trouble with dialogue was, Warren argued, that 'for a meaningful two-way discussion to occur there must be at least some understanding on the part of the non-specialist'. Thus the problem appeared to be that of an uninformed public being obstructive to a discussion with

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571 See, for example, Tracey Brown's comments at the *See-through science- launch*, on p. 266.
572 Durodie (2005), op. cit.
573 Warren, J., 'End this two-way process', *The Guardian*, 8 June 2005.

the public about science. Again, we see here that the idea of public engagement with science was assumed to mean that the public should decide whether a scientific fact was or was not valid, as Warren also argued:

> ... the real craziness of this kind of focus group involvement in science; [is] much of what scientists do is just about discovering facts, but there is little scope for meaningful dialogue in a fact.

Warren did, however, identify certain issues involving science - the risks of nuclear power versus its benefits for climate change, the ethics of embryo research, the environmental and health implications of GM crops - that were 'worthy of public discussion and debate'. 'Scientists', however, were 'too busy discovering hard facts to inform debate in all these controversial areas', and were also frustrated, 'not because no one is listening to our opinions – but because public debate is occurring but no one is listening to the facts'.[574]

Warren was not the only scientist to publicly question the value of public engagement as a means of informing government policy. Criticising the public consultation exercises carried out by the Committee on Radioactive Waste Management (CoRWM), David Ball of Middlesex University, and member of the Committee, writing to Elliot Morley, the Minister responsible for nuclear waste, argued that the Committee was 'deciding the fate of hazardous material ... in the way that one might decide on the location of next year's village fete'.[575] CoRWM had been constituted in 2003 as a result of a previous government public consultation.[576] It had a specific remit to conduct public dialogue and then recommend a socially and technically acceptable solution to the problem of waste management. Drawing on academic research and advice from social scientists at University College London, it had embarked on a programme of public dialogue to ascertain the most acceptable idea for

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[574] ibid.
[575] McKie, R. and Townsend, M. 'Ministers denounced for nuclear waste 'spin'', *The Observer*, 24 April 2005.
[576] HM Government (2001), *Managing Radioactive Waste Safely - proposals for developing a policy for managing solid radioactive waste in the UK*, (London: HMSO).

managing the nuclear waste.[577] Ball's letter, which was reprinted in *The Observer*, called the public engagement exercises 'a dangerous and surreal fantasy', which he felt had substituted expertise with 'insubstantial PR gloss'. The methods of engagement were, he argued, 'out of kilter with all known government and regulatory advice on decision-making'. Ball, as one of the scientific experts on the Committee, clearly felt that the exercise was 'window dressing' to provide political legitimation for any decisions made in what had been a long running and polarised debate:

> ... we wasted 17 months pretending to consult the public about the idea before dismissing it. If this is the new way the government is making policy then it should be stopped right now. It is misguided and harmful.[578]

CoRWM's report had, indeed, revealed that the choices for nuclear waste management had been narrowed down to deep burial of waste with an option of storing some on the surface for a few decades. Ball had accused the Committee of wasting time by unnecessary public engagement arguing that they 'should have come to that conclusion in the first few weeks of our deliberations'.[579] CoRWM continued, however, to maintain that the public engagement was necessary to inspire public confidence in the way in which it worked and to inspire confidence in the final decision.[580]

Singing from the same hymn sheet?

The variety of representations of 'upstream' public engagement came to light again in the Government's *Response to the Royal Society and Royal Academy of Engineering Report* on nanotechnologies. Under the heading of 'Public Dialogue', the Government argued that as a society we needed to be 'aware of the social and economic benefits to be gained from science-derived technologies, but also aware that inevitable scientific uncertainties will mean

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577 Burgess, J. *et al.* (July 2004), *Citizens and specialists deliberate options for managing the UK's legacy intermediate and high level radio-active waste: a report of the Deliberative Mapping Trial. Initial Report to CoRWM*, (London: UCL).

578 McKie and Townsend, (2005), op. cit.

579 ibid.

580 CoRWM (July 2006), *Managing Our Radioactive Waste Safely: CoRWM's recommendations to Government*, (London: CoRWM).

that new technologies may carry risks'.[581] Properly targeted and sufficiently resourced public dialogue was 'crucial in securing a future for nanotechnologies' (p. 20). Thus engagement was conceived as a way of managing the public and their reactions to the ends of a technological innovation process, and not, as many social scientists and Demos, had been arguing, a means of eliciting social intelligence to inform the technological trajectories themselves.

Much of the Government's response mobilised a negative view of the public, as a potential barrier to technology and a managerial style of governance. However, Annex B in the report gave a slightly different picture. The Annex outlined the Government's *Principles for Public Dialogue on Science and Technology*, and argued that public dialogue should focus on both the 'aspirations and concerns held by the public, scientists in the public and private sector, and policy-makers', thus this part of the report had a less managerial tone and negative conceptualisation of the public. The Government also stated that all public dialogue should clearly feed into public policy, and participants should be provided with a wide range of information from a range of perspectives and sources.[582]

The second round of the Sciencewise grants for public engagement on science and technology moved in early 2005 from an open scheme to a commissioning scheme, allowing the Government to specify in detail the areas in which they wished to conduct public engagement, and ensure that these were linked into policy priorities. Perhaps unsurprisingly all subsequent engagement activities were held on issues such as nanotechnology, animal testing and other scientific issues the Government was already funding and committed to pursuing. This highlights how far the management of the science/society relationship had shifted away from the encouragement of more one-way science communication, as the old COPUS scheme had funded, towards a problem about political legitimacy of decision-making. As Jane Gregory, a Sciencewise panel member, noted, this change in focus highlighted the political and financial motives leading the activities:

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[581] HM Government (2005), *Response to the Royal Society and Royal Academy of Engineering Report: 'Nanoscience and nanotechnologies: opportunities and uncertainties'*, (London: HMSO), p. 7.
[582] Department of Trade and Industry (2005), *Annex B. Response to the Royal Society and Royal Academy of Engineering report: nanoscience and nanotechnologies: opportunities and uncertainties*, (DTI).

> I think it acknowledges that public understanding of science is about politics ... it was a political movement ... European Commissions do not give money for PUS research because it wants everybody to be happy, it gives money for PUS research because it wants a thriving biotech industry, or a thriving computer industry ...
>
> Why else would they do it? It's trying to prepare a common culture in which these industries can survive. You only have to look at the kind of projects that get funded in PUS, they're the ones with the commercial potential basically. Speaking as someone who has never been funded for work on public understanding of cosmology! It is a political thing. There's nothing else to it.[583]

In March 2005, the results were published of an Office of Science and Technology/MORI national public survey on public attitudes to science and to public engagement with science and technology. The survey had been recommended by the British Association's review of science and society activities, and was intended to follow up the OST/Wellcome Trust survey of 2000. It was to provide data that would enable the Government and other institutions to 'improve dialogue' between science and the public, creating a mutual understanding and thus also target their public engagement exercises more effectively.[584] The Government had predominantly asked about attitudes to 'science' as if this was a homogeneous entity. The main finding of the survey was that 86 per cent of people thought that science 'makes a good contribution to society' – up 5 per cent on a similar poll two years previously, and widely reported by the Government as proof that the relationship between science and society was both a healthy one, and improving.[585] Qualitative focus groups were used to frame the questions in the national survey, but many of the same questions that had been asked in the previous incarnations of the national public attitudes survey were repeated. In the results the public was characterised as having fixed views on 'science', which could be measured and represented by a percentage value of 'trust' or 'confidence'. This highlights a difference in the use and understanding of these terms between policy-makers and social scientists. Wynne had argued that 'public trust' was not a fixed and discrete value that could be measured independently of other social factors but was negotiated in specific social contexts. The Royal Society's Science in Society Programme had

[583] Gregory *Interview, 20 September 2004.*
[584] MORI (2005), *Science in Society: Findings from Qualitative and Quantitative Research,* (MORI).
[585] I worked on both the MORI report and the press releases and speeches related to the report, as part of a four month ESRC/OST Fellowship scheme.

also, through the use of a survey, taken a similar approach to monitoring the impact of their own engagement exercise on Cybertrust and Information Society in 2004.[586] They wanted to show the specific percentage increase in public interest and trust on several different scientific areas after the dialogue event had occurred, which again lends credence to the idea that many of these organisations viewed engagement exercises as a means of changing public opinion rather than understanding what the public felt or thought about an issue or developing social relationships.

In March 2005 the Council for Science and Technology, the Advisory Board to the Prime Minister which scrutinised the Government's work on scientific matters, in their report analysing public dialogue within Government, argued that public concerns should not be viewed in terms of scientific issues.[587] Yet again in this report two different voices can be heard: one based more on social scientific approaches; and the other trying to balance the more technologically deterministic voice of government.[588] The Council's report, reflecting on the history of science and public relations, argued, as had so many other scientific and government reports, that public confidence in the way in which science is used by government had been rocked by its handling of such issues as BSE, GM and MMR.[589] On the other hand, the report suggested that this decline in confidence could be part of a 'wider trend of disengagement from government and a decline in deference to authority' (para. 4).[590] Regardless of the cause, this situation had, the report argued, apparently begun to inhibit decision-making by government:

> Unless this trend can be stemmed or reversed, there is a risk that many of the economic and social benefits that might otherwise flow from the government's ten-year investment framework for science and innovation will be jeopardised. (para. 4)

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586 The Royal Society (2004), op. cit.

587 Council for Science and Technology (2005), *Policy through dialogue: informing policies based on science and technology*, (Council for Science and Technology).

588 Brian Wynne was co-opted onto the sub-group of the Council so was influential in the writing up of the report.

589 For an account of the controversy over MMR, see Horton, R. (2004), *MMR: Science and Fiction: Exploring a Vaccine Crisis*, (London: Granta Books); Leach, M. (2005), *MMR mobilisation: citizens and science in a British controversy. IDS working paper 247*, accessed February 2008

590 Council for Science and Technology (2005), op. cit.

The problem was, however, not framed in a way that blamed the public, as previous proclamations from any government advisory body had largely done, and instead brought the rationale for the situation closer to social scientific formulations of the public than ever before, as the report argued:

> Three issues lie close to the heart of the problem. Firstly, government, and some scientists are inclined to misrepresent science as certainty. This is far from the case for much of the new science that drives innovative technologies and underlies many policy initiatives. Secondly, public concerns have often been assumed to focus around the risks that arise from scientific uncertainty. Thirdly, scientific inputs to the policy making process often hide unstated assumptions, for example based on personal values, that need to be questioned and openly discussed in debates about policy. (para. 5)

The Council welcomed the guiding principles for public engagement on science and technology that had been recently set out by the DTI.[591] These were, however, not enough, and the report argued that not only should they be adopted across government, but was now time to create a cultural change, in which more systematic approaches to public engagement and dialogue were adopted:

> We believe that they will prove to be more efficient means of developing broadly acceptable policies for issues where the problem of public consent is real, and which cannot be readily sidestepped by a quick fix or political sleight of hand. (para. 11)

The report also made it clear that the type of engagement that they were promoting was not simply any sort of encounter between the public and science, such as a visit to a science museum, which other institutional definitions of engagement encompassed, but was specifically 'those processes that: on the one hand enable the public to act as better informed citizens and thereby inform democratic decision-making; and on the other enable those charged with decision-making to be more aware of public interests' (para. 12). The public still, it seemed, required information about science and technology to be able to act as better citizens. The purpose of dialogue processes, however, was not to allow citizens to determine government policy but to inform it. So the Government retained control over decision-making as long as, the Council argued, they could explain how the results of any given

[591] Department of Trade and Industry (2005), op. cit.

dialogue process had been used. The Council accepted that at this time many were sceptical of the Government's desire for genuine, deliberative engagement. It was also believed, however, that the more dialogue processes were used by government, the more their credibility would grow. More dialogue would have, they argued, two effects:

> It will have a *foreground* effect of increasing the probability of public acceptance of specific policy decisions, and a *background* effect of changing the culture within which policies are developed. Thus it will help create an environment of greater trust in the processes of science-based decision-making, which in turn may diffuse some of the tensions and suspicions surrounding individual issues. (para. 15)

One major function of dialogue processes then, to the Committee, was that they would remove the polarised views that had arisen around issues such as GM or Radioactive Waste Management. There is an assumption in the above extract that the fact that these processes were happening would show the public that the Government could be trusted. The quote below further suggests that upstream engagement was conceptualised as a means of heading off future possible conflict:

> One purpose of dialogue that anticipates emerging issues is to ensure that, as far as possible, these do not become legacy issues for the future. At the same time, greater upstream engagement with the public about the implications of new science and technology must avoid impeding the creativity of UK science.

We also see above an explicit assumption that public engagement might actually act as an obstacle to scientific progress. The report also made it very clear that dialogue around science and technology would only be effective if it were linked into the related government departments or Ministers responsible for that area; it was, after all, an issue of governance. The implications of this, for all those other groups attempting to conduct public dialogue on science and technology, were that they were unlikely to have the resources from government unless they were tied-in to current government technological priorities.

The change in availability of funding for science communication to processes that engaged the public over policy-relevant issues had had its effect on the science communication community. The British Association itself was struggling to know how to change itself to fit with the new dialogue and policy oriented approach to managing the relationship between science and the public. A review of strategy had developed a new purpose for the Association, 'to create a positive social climate in which science, and organisations dependent on it, advances with public consent, involvement and active support', moving it away from strictly science communication and issues of public understanding as it had been previously.[592] Their Annual Science Communication Conference 2005 was a fractious affair with a clear division between those individuals and organisations there to discuss practical efforts to improve science communication and those interested in discussing dialogue and influencing government policy.[593] The closing session of the conference proved antagonistic, with many audience members criticising the British Association for being "stifling, old school and traditional" by running a conference about dialogue without managing to facilitate any dialogue within the sessions itself and allowing no one but the "same old people" to speak and to finalise recommendations to government.[594]

Another critical turn?

Demos's earlier pamphlet *See-through Science* had contributed to the discourse of public engagement within policy-making circles, and focused attention more specifically on how these efforts might be shifted 'upstream' in the innovation process. The think-tank brought out a further pamphlet in 2005, which addressed a similar theme and the feedback and criticisms of the original work. The pamphlet called for a 'fresh injection of energy' into the science and society debates,[595] otherwise, argued Wilsdon, Wynne and Stilgoe, 'we would end up with little more than the scientific equivalent of corporate social responsibility: a well-meaning, professionalised field, propelled along by its own conferences and reports, but never quite impinging on fundamental practices, assumptions and cultures' (p. 19). Their

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[592] Jackson, R. (2005), 'Letter from Roland Jackson to all members of the British Association, 20 April 2005'.
[593] This observation is based on my own attendance at the conference.
[594] Un-identified audience member, as written up in the minutes of the conference session: The British Association for the Advancement of Science (2005), 'Session 9 - Closing Session', *Science Communication Conference*, 23-24 May 2005, p. 6.
[595] Wilsdon, J., *et al.* (2005), *The Public Value of Science: Or how to ensure that science really matters*, (London: Demos), p. 19.

concern was also that BSE and GM were now being talked about as 'aberrant blips, rather than episodes which highlight deeper, more systemic problems in the governance of science and technology' (p. 17). They argued that the public engagement was now seen as the answer to these problems and science and its relationships with other individuals and institutions was not where the problems lay. As they continued:

> There is a creeping sense of complacency within some sections of government and the scientific community: a belief that we can return to business as usual, with a few new committees and a little extra public consultation, but without any fundamental reform of scientific culture and practice. (p. 17)

They quoted Steve Rayner, sociologist and manager of the ESRC Science and Society Research Programme as blaming in part the social scientists for this perceived turn of events. Having positioned themselves as pro-public engagement, Rayner argued that he and other social scientists had sidestepped the wider issues of responsibility and culture. The authors of the Demos pamphlet, to address this lack of a wider consideration of what public engagement might be for, and the context in which it operated, introduced the idea of 'public value'. They argued that discussion about science should go beyond simply the ends and the means, and talk about the wider social good. Viewed through a 'public value lens', they argued, 'public engagement might no longer be seen as a 'brake on progress', but instead as a way of maintaining and renewing the social contract that supports science' (p. 29).

The foreword to the Demos pamphlet written by physician and science communicator Lord Winston, represented the scientific community as having already reformulated its views on the best means of forging the relationship between scientists and society. As his perspective on the history of PUS outlined:

> The scientific community once believed it could assuage public concerns over the misuse of science by better communication of the benefits of scientific knowledge. There has been gradual, sometimes grudging, recognition that mere communication – whilst important – cannot alleviate justifiable anxieties. Now the scientific community is beginning to realise but often reluctantly accept, that we scientists need to take greater notice of public concerns, and relate and react to them. Expressions of despair at public ignorance, impotent polemics about the advantages of technology, assertions

> that our economy is threatened by reactionary attitudes, attempts at manipulation of the press, are all totally inadequate responses. Neither will mere lip-service about the value of public engagement be helpful. (p. 29)

Engineer Alec Broers, in his 2005 Reith Lectures, *The Triumph of Technology*, also argued that it was time "to move away from the old concept of 'the public understanding of science' to a more dynamic 'public engagement'".[596] Minutes later, however, in response to a question of whether the public was well informed enough to be involved in planning around new nuclear reactors, he answered:

> I don't know how quickly we can educate the public, to bring the evidence forward in a calm and rational way.

Thus ideas of a deficitent and/or irrational public still sat alongside other models and rhetorical constructs of the relationship between science and society. Equally, another repeated rhetorical strategy in the maintenance of these boundaries had remained: a continued blaming of the media for negatively influencing public opinion. As Sir David King, the Chief Scientific Adviser to the UK Government, described to attendees at a workshop entitled 'Improving Science Coverage in the Media' in 2005, he had become:

> ... increasingly concerned at the media's adverse portrayal of science in the news. From the scant media coverage of the MORI poll, which showed the extent to which people support science, to the negative coverage surrounding brain drain ... these stories continue to run and run. We have to take action now, and demonstrate that we have a good story to tell, and raise the reputation of science in the media.[597]

Thus despite Lord Winston's claim that the scientific community had learnt lessons over the previous twenty years, there remained a variety of representations and meanings within debates around science and the public.

In 2005 we can identify continued and growing criticism by some social scientists to stake their ownership over the territory of science/public relations. For example, dissatisfaction

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596 Broers, A. (2005), 'Risk and Responsibility' (Lecture 5), The Triumph of Technology, (London: Reith Lectures).
597 King, D. (2005). 'Improving science coverage in the media - invitation to a stakeholder communications workshop - dated July 2005'. sent to author.

with the current approach to public engagement is to be found in the writings of Brian Wynne. He called the publication of the House of Lords Report in 2000 an 'apparent watershed' moment in attitudes towards public engagement. He described how over the last five years there had been a huge flowering of both practical and analytical work aimed at nurturing a mutual understanding between science and society, and he was optimistic that this shift could embody the potential for more constructive practices of citizenship and knowledge. But the shift needed to be more than simply a change in language. The radical potential of all of these activities was compromised by what Wynne called the 'deeper, less manifest cultural assumptions and commitments' that framed the initiatives.[598] Wynne pin-pointed two factors that contributed to this problem: the first was that most public participation had been focused on downstream risks or impacts, which reflected a false assumption that these instrumental consequences were what concerned the public. The second factor was the assumption that the task of defining what the salient issues were should automatically fall to experts, leaving the rest of society with no role in creating or negotiating more diverse public meanings.

Much had changed since his early critiques of the public understanding of science agenda, yet, essentially, Wynne was asking why those same 'problematic foundations' he had characterised, then and now, had still not been 'identified, confronted and changed' (pp. 66-67). The ideologies and assumptions within this new engagement agenda in science and technology had not been changed,[599] and he blamed this failure on the 'extravagant investments of enthusiasm, energy and expectation pouring relentlessly into new participatory initiatives by which citizens may influence science.' (p. 67). As Wynne continued:

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[598] Wynne, B. (2005), 'Risk as globalising 'democratic' discourse? Framing subjects and citizens', in Leach, et al., eds, *Science and Citizens: Globalisation and the Challenge of Engagement*, (London: Zed Books), p. 66.

[599] Something which he was also keen to point out was that this perspective was not new to the UK and though not recognised by those within the science and technology arena, they had been playing catch up. Similar moves begun a decade earlier in development work, such as agriculture and land-use.

> … with dogmatic insistence, unspoken internal institutional insecurities are externally projected in models of the 'public' and the 'public world' (for example, claims of media and non-governmental organization misinformation of those publics) as scapegoats for these institutional problems of public mistrust and resistance to 'science'. Thus enmeshed in this culture, powerful institutions of science and policy tend simply to circulate in their own self-perpetuating myths, including myths of the 'public' and of their own openness to them. (pp. 79-80)

Wynne also believed that 'reified scientific discourses' were being privileged, while their constructed and contingent character was 'systematically misunderstood and misread instead as purely innocent object representation, untouched by any performative, normatively potent models of the human' (p. 81). Thus with these same myths in place and the same unreconstructed institutions, Wynne concluded critically that:

> … virtually all of the mushrooming commitment to public citizen engagement in 'science policy' or 'scientific-technical issues', or to 'democratizing science', is something of a mirage, at least thus far. (p. 68)

Almost twenty years after the renewed enthusiasm in the UK for PUS, his criticisms remained very similar, with challenges not just to the management of that relationship but calls for a breakdown of the existing boundaries between, and conceptualisations of, public and science.

Harry Collins, in contrast, had expressed his belief in the previous year that the idea that the public should be involved in science, or as he branded it, "a dewy-eyed, mass romantic movement to bring in the public to say whatever they like about technology",[600] had been taken too far:

> "In 1983 that problem was to bust open the scientific community in some way and get some sort of wedge in there so that other sorts of opinions could go through that sort of arrogant carapace. So that's been solved but now it's kind of opened up too much…in the Golem we talk about flip-flop reasoning and it's as though we've gone from the flip right over to the flop."[601]

At the same time Gregory also remained sceptical of the new language of engagement:

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600 Collins, H. (2004), *Interview, 3 August 2004*, transcribed by Simon Lock.
601 ibid.

> "This engagement thing is the latest flash in the pan, it's not going to last, it's another kind of parading of the resources, it's people wanting to go out there and say 'I'm a nice guy, and I'm listening to you' ... it will demonstrate a point that the literature has been making for a long time, which is that the public think about things about a much broader range of criteria than the experts do. So what the experts will learn ... is that there's this broader criteria along which they may have to judge things if they want to be successful socially. If experts can think along that broader range of criteria then they don't need to go out and ask the public, they can do it for themselves. And that's what I hope will come out of this: the experts will take responsibility, (which is a word which is never used in these discussions), and understand their social role better, because they've been reminded of it by society, in the process of engagement."[602]

Thus by the end of 2005 there remained a multiplicity of constructions of science, the public and ideas about how to manage their relationship, and equally, continued boundary work between actors over who had the legitimacy to mobilise such constructions.

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[602] Gregory, *Interview, 20 September 2004.*

Phase IV: Conclusions

I have identified this period as a separate phase characterised by a widespread uptake, by scientists, policy-makers and political and NGO organisations, of the term 'upstream engagement'. Yet again, this term is as contested as was 'science and society' or 'public understanding of science', and allows for a flexibility in meaning by different actors engaged in boundary work to define 'science', 'the public', and the relationship between the two. We continue to see a variety of uses of these terms in this phase, many of which draw on previous and established interpretations and forms of boundary work.

Several different interpretations of the term 'upstream engagement' exist within this period. To some scientific and policy-making organisations, upstream engagement was a means of managing public concerns, or indeed, heading off public concerns, so that the public did not obstruct technology and innovation. Thus the public is problematised as a potential 'brake on progress' and upstream engagement is conceptualised as a means of dealing with potential impacts of particular technologies. Science is characterised within this as a realm of asocial and apolitical knowledge, and the public are characterised as having values and social concerns that need addressing before science can proceed, or that need addressing to avoid conflict later.

Other interpretations of the term 'upstream engagement' suggest it was viewed as a tool to break down the boundary between science and the public, and reconstruct it in a different manner. Upstream engagement should allow public values, concerns and aspirations into the policy-making process to discuss the role of science in shaping society and vice-versa. In the formulation of Demos, for example, upstream engagement reflected a desire to stop public concerns being reduced to solely those concerned with risks, and, furthermore, to stop the public being problematised as having a negative impact on scientific progress. The public here is thus conceptualised as having legitimate expertise and a role in the scientific sphere and science is seen as one type of knowledge and expertise within a larger conversation about visions of the future of society.

The idea that upstream engagement can manage public opinion and attitudes before social concerns are entrenched, and views are set, suggests that it was viewed as a means of manufacturing consent. A controversy about a technology can then be blamed on a lack, or deficit, of upstream public engagement, rather than being a sign that valid social issues are being discussed. Thus upstream engagement here is viewed as a legitimating process: if the engagement is successful, it should affirm the preset technological trajectory.

A striking aspect of this phase was the role of different individuals and organisations in mobilising constructions of science and society. Whereas twenty years before, discussions of PUS, or of the relationship between science and the public, had been dominated by scientists and scientific organisations, here we can see that NGOs, and political think-tanks, in combination with social scientists, have much greater involvement. What also emerged was a renewed criticality from certain social scientists of scientific and political formulations of science and society. Having had their ideas taken up, and their expertise co-opted by government, to retain their status as an autonomous expert and critic of government and science this critical turn could be interpreted as *protection of automomy* boundary work on their part. Thus despite a marked unification in language, and changing activity, over this period, the boundary work by scientists, policy-makers and social scientists was trying to manufacture a different society, and construct different boundaries between science and public. A few scientists, and scientific groups, such as Sense About Science, continue to argue against public engagement, upstream or otherwise, preferring that scientific decision-making be left to scientists. Thus despite a widespread change in rhetoric by many scientific institutions, there were still some, who wanted to keep the public at arms' length and deny them any say in scientific decision-making.

10 Conclusions

> Scientists, engineers, social scientists, politicians, NGOs and wider publics tend to think and talk about science and technology in different ways, so that shared meanings and potential common ground are often missed and genuine differences are fudged or misrepresented. The language that we use can obscure the values, assumptions and interests that we bring to the conversation.
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> (Wilsdon, Wynne and Stilgoe 2005, pp. 24-25)

This thesis has documented the historical development of debates around the public understanding of science in the UK. Specifically, I have detailed how this issue was problematised by scientists in the mid-1980s, and how this issue developed into a contested field of activity, political interest and academic research through to 2005.

This thesis, in providing a richer and more detailed historical account of this period, has aimed to move away from a narrative which represents the recent concerns over the relationship between science and the public in the UK as being characterised as a 'deficit to dialogue' story. I have identified, in contrast to this simplistic interpretation of events, that the issue of the public understanding of science, and later, science and society, have consistently been contested spaces in which different definitions of science and the public, and different models of society, have been mobilised. The rhetorical flexibility within terms such as 'the public', 'science' and 'society' has, as the quote at the start of this chapter suggests, allowed several groups to advance their own agendas, while also maintaining a sense that they are doing the same thing. Thus where the 'deficit to dialogue' story suggests a linear progression of objectives and epistemology, I have identified the manner in which multiple definitions of 'science', and 'the public', have been continually defined and mobilised throughout this history of PUS.

Ideas of public understanding of science are also ideas about how the relationship between science and the public operates, or should operate and about the best way to manage this relationship (which often is tied up with ideas of communication) and various versions of these ideas have also existed and been subject to negotiation. Thus this history of the public understanding of science in the UK has highlighted the complex nature of an ongoing debate in the UK, where multiple positions on, and constructions of, 'science', 'the public', 'society' and 'science communication', have existed, and continue to exist, simultaneously.

Furthermore, there is a tendency, at least within a scientific and policy context, to locate concerns over the public understanding of science as originating in the mid-1980s.[603] I have situated the debates over PUS in a longer history of debates over science and public. As the historical section in Chapter 1 shows, actions over concerns with this relationship have, in many ways, been crucial to the development and professionalisation of science and many similar arguments concerned with the public's understanding of science, and constructions of the relationship between science and public, have been identified in this earlier history.

Over time the constructions of scientific authority in public can become 'naturalised', so that science's authority is no longer seen publicly as constructed, but as immanent and therefore less challengeable (if at all). However, this history of debates about public understanding of science, from the mid-1980s, has highlighted the conflict and negotiation between competing professional groups over public definitions of what, and who, is scientific. I outlined in Chapter 1 the analytical framework of boundary work which provides a useful way of bringing to the fore the social interests which can be inherent, yet often invisible, in the specific demarcations of science from non-science, or scientist, from non-scientist.

We can see that the types of rhetorical boundary work identified by Gieryn - *expulsion*, *protection* and *expansion* - which scientists have spent centuries engaged in to construct their profession as a specific and/or distinct cultural domain - are similarly utilised by them when

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[603] The Royal Society's *Science in Society Report* (2004) makes just such a claim, unsurprisingly crediting the Society with starting, and leading this debate in 1985. It is also interesting to note that their activities in 1985 are located in a history of the Society's involvement in 'Science and Society', which points again to how scientific institutions reconstruct their own history to fit with contemporary rhetoric around PUS.

turning to address the public understanding of science in the mid-1980s.[604] The construction of science as a public source of expertise and cognitive authority has been achieved by mobilising it in contrast to a separate 'public', or 'society' where, for example, ethics, irrational thought and politics occur, and which is filled with people who are passive recipients of scientific knowledge and popularisation. Thus a co-construction of science and society has taken place. I have identified that very similar boundary work tactics are used, in the period under study, and the boundaries are rhetorically constructed in line with scientists' previous attempts at managing their relationship with the public.

The demarcation of science from other cultural domains, particularly the public, society or politics, has been achieved by the communication of differences, and the promotion of science by scientists, as a distinct bounded area of knowledge and practice. We can see this most clearly in their continued reliance on mobilising a discourse of science which is free from public knowledges, values, and politics. In continually drawing the boundary in this way, scientists are also, however, careful not to construct the boundary so strictly as to be irrelevant to society and lose a course of social legitimation, thus science remains semiotically 'public', yet to all intents and purposes separate from it. This is what Gieryn identifies as *protection* boundary work and I argue that this is the most common type of boundary work being performed within this history. Science is constructed by scientists as separate from, but also essential for, a properly functioning society.[605]

Scientists, as a professional group, are not, however, the only actors in this recent history of PUS to engage in such boundary work, and promote themselves as the best placed to shape society and to tell the public what is in their best interests. Several professions approach the issue of public understanding of science with a normative assumption that they are acting in line with public or societal interests, in opposition to other professional groups. Social scientists have argued for institutional change within government and science to reshape the

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[604] See for example Gieryn (1999), op. cit., Shapin and Schaffer (1985), op. cit., Jasanoff (1987), op. cit.

[605] Shapin and Schaffer have argued that Boyle and his colleagues conceived the newly formed Royal Society as just such an institution to help restructure society along rational lines, after the Civil War in the seventeenth century. Shapin and Schaffer (1985), op. cit.

way in which science constructs society. The UK Government has also argued that it is acting in the interests of the nation, the population, society or consumers.

Returning to Gieryn's boundary work typology, we can see that as well as *protection* boundary work, another common form is *expansion*, and this applies to several of the professional groups in this history. Scientists, social scientists, science communicators, and government officials all, at points, mobilise their expertise in competition for jurisdictional control over the contested domain that is PUS – in both an epistemological and a practical sense. Thus the history of public understanding of science is also a history of the way in which scientists, and other professional groups, have addressed the 'demarcation problem', particularly focusing on how scientific authority or expertise in its cultural setting has been demarcated from other forms of professional, or 'lay', authority and expertises. Thus, demarcation continues to be as much a social and political issue as an epistemological one.

I have divided the time period under study into four historical phases. Each phase has a dominant discourse of public understanding of science and, during each, different actors come to challenge this dominant conceptualisation of the 'problem of PUS', and mobilise their own as they engage in boundary work. These phases further our understanding of the history of public understanding of science in the UK, by showing how the dominant discourse of, and debates over, PUS/Science and Society has developed and changed over time, and how this has subsequently shaped the activity and the institutions involved.

Phase I

Phase I is characterised by the concern within the scientific community that science was not appreciated enough by society. A lack of funding and governmental support led to a crystallisation of the term 'public understanding of science', which problematised particular sections of society for not having enough understanding, or appreciation, of science, and equally problematised scientists for not conducting enough science communication to correct this perceived problem. In many ways the activity within this phase mirrors earlier attempts by scientists to engineer societal attitudes through a campaign of communication. As discussed in Chapter 1, in the 1830s and the 1940s, scientists, perceiving a lack of public or governmental support, or perceiving themselves to be under financial strain, turned to the idea of managing their relationship with the public. Furthermore, I have argued that their actions should be considered as boundary work. By communicating a definition of science, how scientific knowledge can help shape society, and that the public should know it, scientists were constructing themselves as separate from society, yet indispensable, and free from social values, which is part of their justification in claiming that science and scientists should be given greater respect and financial support. Tied up in their rhetoric were also ideas that science, and scientists, could help make society and the public better, create a better citizenry, and a better functioning democracy, and improve the nation's industry. Equally it constructs in opposition, a public which is passive, often irrational, and in need of scientists' help.

Phase I should, therefore, be considered a continuation of scientists', and scientific organisations', attempts to mobilise this particular discourse of science. Scientists presented the issue of PUS to be one that was theirs to manage and control, and themselves to be the legitimate experts in communicating science to the public. However, this phase is also different from the previous historical episodes of scientific concern over the public in that many social scientists, who had been researching the relationship between scientific knowledge, scientists and the public for many years by the 1980s, were given research funding by the Government under programmes specifically identified as dealing with PUS. Whereas scientists conceptualised these social scientists as experts who would help them identify gaps in the public's knowledge of science, and thus enable them to promote science more effectively (in keeping with the aims of organisations such as COPUS's construction of PUS), much of the research took a different approach to the issue, and constructed a very different idea of the public understanding of science itself. Therefore, I have identified another body of experts – social scientists - who also felt that this issue, or problem, was legitimately theirs to define and manage, and they began to colonise this space, mobilising their own knowledge and expertise, and doing their own boundary work.

Phase II

Phase II is dominated by both the institutionalisation of PUS activity and the increasingly public encounters between scientists and social scientists in the PUS-domain. Members of these two groups mobilised very different discourses of science and the public, and their relationship. Many social scientists characterised scientific approaches to PUS as operating within a deficit model, criticising the focus on a perceived cognitive deficit on the part of the public. Social scientists advanced several ideas about the public and science. Collins, for example, characterised the public as having a lack of understanding of the social processes of science; and Wynne characterised scientific organisations as having a lack of sociological understanding of what the public is and how they relate to scientists and scientific matters. Wynne put the focus on social relationships, particularly trust relationships, and problematised science, scientific framings of PUS, and the implied scientific hegemony over matters of science and public.

There is a sense in which both scientists and social scientists felt that their area of expertise was being colonised by the other, and I have identified the explicit conflicts that occurred within the UK (as elsewhere in the context of the science wars) between scientists such as Wolpert and Dawkins, and social scientists such as Collins, Wynne and Irwin. Again, all of these conflicts can be characterised as boundary work: each individual, or group, was advancing their particular conceptualisation of science, the public and the relationship between them. Scientists continued to mobilise a 'science' which was separate from the public, but needed to combat public misunderstanding of pseudo-science, or relativist social scientific claims. Social scientists were rhetorically reconstructing these boundaries, and thus the relationship between science and public, in a very different manner. Wynne, and others, advanced a model of the public which conflicted with a deficit model characterisation of them as ignorant and passive, and argued that the public could mobilise their own expertise in social situations involving science, and though their framing of issues could be different (drawing on a wider criteria of ethical, social, political, and moral perspectives), this should enrich the relationship between the two, and allow for more fruitful, and equal, discussion of scientific matters.

In crude terms we can identify a fundamental difference in the perspectives taken by organisations such as COPUS and social scientists such as Irwin and Wynne: each was mobilising a different meaning of 'society'. This boundary work does not simply construct 'science', or 'the public', or PUS. Constructs of the boundary - the relationship between science and public – also embody particular normative ideas of 'society' and the balance of power, legitimacy and expertise within it. Many scientists, in this instance, can largely be characterised as engaging in *protection of autonomy boundary work,* attempting to maintain what they perceived as the status quo, with respect to their position of cognitive and political authority, whereas many of the social scientists were trying to deconstruct this, and establish a different type of relationship between science and the public, attempting to *expand* their resources and influence, and promote themselves as the best placed to define and intervene in this relationship. In each construction communication is seen as key to maintaining or enabling these boundaries, but the type of communication, and the hierarchies implied by the models of science communication being used, is different.

Within this phase too I have also identified the boundary work which occurred within social science. This was a debate about competing methodologies, and about how the public is constructed by quantitative and qualitative methods. We can also view it as a rhetorical fight amongst social scientists for legitimacy and expertise over whose definition of the public, science and society was right, and over the allocation of funds in what was still a relatively young and expanding field. Wynne and his colleagues in particular attempted to draw a distinction between themselves and a deficit model, which, they argued, both scientists and quantitative social scientists were operating under.

Phase III

Phase III is characterised by the uptake and use of social scientific expertise and language, first by science policy-makers, and then very quickly by many scientific organisations in the wake of the influential House of Lords Report in 2000. The widespread uptake of the language of 'dialogue', 'engagement', and 'public values', and a widespread acknowledgement that scientists' understanding of the public was of importance, suggest that the social scientists (in particular the qualitative researchers) were the rhetorical victors of the previous phase. Under the new banner of 'science and society' many scientific institutions attempted to rhetorically redraw the boundaries of PUS to include much of this language, and a different, less separate conceptualisation of the public. However, I have argued that much of the meaning gets 'lost in translation' from the social scientific to the scientific or policy arenas.

Whereas certain social scientists were mobilising a particular normative idea of society with their use of such terms, the scientists and policy-makers deployed the same terms, in line with their own interests, to construct a new problem of 'science and society' which identified attitudinal deficiencies in the public, and dialogue and engagement were conceptualised as the means to restore, or manufacture, trust and confidence in science or scientists, (the loss of which was almost universally blamed on controversies over BSE and GM crops, hence also the heightened focus on science policy-making). Thus I have identified that the boundary work performed by many scientists and many within the UK Government - though it used similar language and terms to those being used by the social scientists - rhetorically draws the boundaries in a manner similar to previous episodes, and certainly differently from those mobilised by many qualitative social scientists. The public is problematised as attitudinally deficient by scientific organisations and government officials, and scientists, it is decreed, need to attempt a dialogue with this public to manufacture a change that would restore social relationships to how they were perceived to have been previously: that is, with science as a separate cultural domain, but in a dominant position over the public.

I have therefore identified in this phase a variety of representations being mobilised by different individuals and organisations, of 'publics', 'science', of engagement and communication, and thus ideas about society and the manner in which science and the public relate, or should relate. I want to avoid characterising a 'dominant discourse' in this phase too closely as there is no clear dominant formulation of either 'PUS' or 'Science in Society'. Indeed the phase is dominated by the variety of uses and meanings of these terms by individuals, organisations and, indeed, within organisations. The *GM Nation?* exercise exemplifies the complexity within this phase, with many different actors working on this project, each holding many different ideas about what it was for, who it should engage, and the proper relationship of scientific knowledge and politics to the public. Equally we can see that not all scientists and scientific organisations were attempting to correct a perceived public trust deficit, and the conflict within the science communication community reflects the diversity of agendas, interests and definitions of the problem and the action to be taken.

Phase IV

The uptake of the term 'upstream engagement' in Phase IV highlights again the different approaches to the public and its relationship with science. I have highlighted the different constructs of this idea, as well as the way in which the uses of this term rhetorically draw the boundaries of science and society in different ways in line with the interests of those deploying the term. I have argued that upstream engagement was promoted by policy-makers to manufacture early consent for the products of innovation. Others, such as Demos, promoted upstream engagement as a means of redrawing the boundaries between science and the public, to shift the focus away from what they argued was a narrow scientific and risk-based framing of issues that needed public discussion, and to open up innovation to a wider range of social perspectives, which would potentially influence technological innovation in other directions, though with collective social consent. I have identified, therefore, that within the mobilisation of the term 'upstream engagement' we can identify that the public is both problematised and assigned an almost equal status as experts in decision-making about science and society. We can also identify the term being used to rhetorically construct the relationship between science and society in different, and often opposing ways. Many scientific and government actors conceptualise upstream engagement as a means of manufacturing public consent, or legitimacy, for their expertise or scientific products. Many social scientists, on the other hand, continue to deploy their own conceptualisations in which such boundaries are dissolved and public values and knowledges become part of a more egalitarian process of discussing and influencing the impact of science on society.

I have also identified in this phase the beginnings of a new critical turn within social science. Many social scientists, though initially enthusiastic about the change in rhetoric by scientific and governmental organisations, begin to criticise them for misunderstanding, or misusing their research or claims, and not changing their practices in the manner in which these social scientists had been advocating. This does suggest that these social scientific constructions of the science and society relationship, and the ideologies inherent within them, get 'lost in translation' as they are taken up by other professional groups and rhetorically deployed in line with other interests. This critical turn continues to the present day.[606] This phase does not end in 2005, where my research and analysis stopped, but I have included it to indicate another shift in the dominant discourse of public and science, with a focus on 'upstream engagement'.

A richer historical perspective would be gained by identifying how discourses of PUS articulate with other expert discourses of risk and uncertainty, and citizenship more widely. The recent shift towards explaining public opposition to science in terms of 'distrust' instead of 'ignorance' is in line with more general observations about a decline of public deference with respect to governments, courts of law, and other cultural sources of authority in Western countries. Further research will be necessary to locate PUS history within the context of these wider social and political discourses over the same period. Equally, one might wish to view this history as part of, or indicative of, a wider intellectual phenomenon whereby enlightenment discourses, such as scientific notions of progress and rationality, have been subject to attack by post-modernist and post-structuralist critiques. In particular, many sociologists have undergone a post-modernist turn, claiming to be attempting to recover the 'public voice' suppressed by a rationalist modernist enlightenment discourse. These two competing discourses could also be interpreted as further boundary work between, and within, different 'expert' professions.

[606] See for example, Wynne (2006), op. cit.; Irwin (2006), op. cit.

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Appendix: List of Interviewees

Name and Job Title (at time of interview)	Date of Interview
Mr Gary Kass Head, Public Engagement of Science and Technology, Office of Science and Technology	21 May 2004
Dr Martin Bauer Lecturer in Social Psychology, LSE	26 May 2004
Professor John Durant Director of @Bristol, Science Centre	28 June 2004
Professor Alan Irwin Pro-Vice Chancellor, Brunel University	29 June 2004
Dr Jeff Thomas Lecturer in Science Communication, Open University	14 July 2004
Professor Robin Millar Professor of Science Education, University of York	20 July 2004
Professor Harry Collins Director of the Centre for the Study of Knowledge, Expertise and Science, Cardiff University	3 August 2004
Dr Barbara Knowles Head of Science and Society, Office of Science and Technology	9 August 2004

Mr Mark Dyball and Dr Suzanne King (joint interview) Directors of People, Science and Policy	19 August 2004
Dr Jon Turney Lecturer in Science and Technology Studies, UCL	11 August 2004
Dr Jane Gregory Lecturer in Science and Technology Studies, UCL	20 September 2004
Professor Sir Walter Bodmer Principal of Hertford College and Chancellor of the University of Salford	5 October 2004

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