



Citizen Science

A Study of People ,
Expertise and
Sustainable Development

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ENVIRONMENT AND SOCIETY

SCIENCE AND CITIZENSHIP

Now, what I want is, Facts . . . Facts alone are wanted in life. Plant nothing else, and root out everything else. You can only form the minds of reasoning animals upon Facts: nothing else will ever be of any service to them.

(Thomas Gradgrind, Esq.)¹

I wish I could collect all the Facts we hear so much about . . . and all the Figures, and all the people who found them out; and I wish I could put a thousand barrels of gunpowder under them, and blow them all up together!

(Thomas Gradgrind, Jun.)²

Concern over the relationship between citizens, science and technology seems to be characteristic of contemporary society. Right now, for example, various political and social groups (industry, government, environmentalists, scientific organizations, campaigning bodies) are attempting to educate, propagandize or cajole the general public into accepting their own evaluation of a series of technical – or at least technically-related – questions (over the best means of tackling environmental issues, the desirability of new consumer products, the dangers of AIDS, the merits of various energy policies and an endless array of social questions such as genetic screening, transport safety and the implementation of new technology). In that sense, we are all barraged with new ‘information’ about developments in science and technology which might affect our lives and also, of course, with exhortations about what different social groups would like us to do about those developments.

In such a situation, it is unsurprising that many accounts have been put forward by scientists and others which describe (or, more usually, lament) the linkage between science, technical knowledge

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and the wider population. At present, the topic of 'public understanding of science' – as defined by, for example, the British Royal Society – has once again focused attention on these issues.

As the first section of this chapter will discuss, there have been certain recurrent elements within these more general accounts – a concern at the 'scientific ignorance' of the populace, a consequent desire to create a 'better-informed' citizenry, an enthusiasm for making science 'more accessible' (but with strict limitations on the extent of this accessibility). Notably also, and as we will discuss, these accounts have represented a commitment to 'science as progress' and offer a decidedly 'science-centred' (or 'enlightenment') view of society. Frequently, the accounts offered by scientists and others reveal an anxiety lest public ignorance should get in the way of scientific/technological progress. Thus, one senior British scientist entitles his book on this subject *Is Science Necessary?* but provides the answer – before the text even begins – by citing Nehru's exhortation that the 'future belongs to science and those who make friends with science'.³

As this chapter will outline, the notion that the 'future belongs to science' has underpinned most accounts of the relationship between citizens and science. However, there have also been a number of more critical accounts which draw upon the 'tragedy of technology' theme (as discussed in the previous chapter) and on a notion of 'science as ideology' in order to ask starker questions about the impact of scientific dissemination on everyday life. It is also possible to portray concerns over the public understanding of science as an indicator of anxiety amongst the scientific community lest it should become marginalized in the post-Enlightenment era. This chapter will begin with a brief historical excursion into these differing accounts of the 'public understanding of science' before presenting three case-studies of the contemporary interaction between citizens, science and technology.

Discussion of the role of 'ordinary citizens' in 'technical progress' extends back to the beginnings of the Industrial Revolution. In nineteenth-century Britain, for example, there was a lively debate about the general level of science education – which was seen by many as holding back industrial and technical development.⁴ Just as in the late twentieth century, public indifference was viewed as an obstacle to scientific progress. Of special relevance to the themes of this book was the establishment of institutions such as the Mechanics Institutes which represented one attempt to build a

bridge between formalized scientific knowledge and working-class people (although, as we shall see, there are differing interpretations of whether the Mechanics Institutes were an attempt to enlighten – or to indoctrinate – the working classes). The Mechanics Institute movement spread across Britain in the 1820s and 1830s and offered a training in science and technology to the skilled working classes.

In the twentieth century, the need for a greater awareness of science became a major theme of the ‘visible college’ of scientists and writers who adopted a socialist perspective on scientific progress.⁵ As J.B.S. Haldane put it in the Preface to his 1939 book, *Science and Everyday Life*:

I am convinced that it is the duty of those scientists who have a gift for writing to make their subject intelligible to the ordinary man and woman. Without a much broader knowledge of science, democracy cannot be effective in an age when science affects all our lives continually.⁶

Writing immediately after the Second World War, the Association of Scientific Workers expressed similar sentiments. In so doing, they outlined the three most regular justifications – both of that time and since – for an enhanced ‘public understanding’:

- that a technically-literate population is essential for future workforce requirements (‘the present inadequate standards of the available labour’).⁷ This argument had also been important within nineteenth-century debates over working-class technical education;
- that science is now an essential part of our cultural understanding (‘In this age no man can be considered to be cultured who makes no serious attempt to understand and appreciate the broad principles of science’);⁸
- that, as Haldane argued above, greater public understanding of science is essential for democratic reasons.

The Association of Scientific Workers made various recommendations for improving public understanding through further education classes and also such media as exhibitions and museums, film, the press and the radio. They also stressed the need for working scientists to become more involved in public activities and in the dissemination of science – a challenge to which scientists such as Haldane and Hogben had already responded through popular publications on science and mathematics.⁹

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The Association of Scientific Workers thus offered a model of 'progress through science' which resonates strongly with many contemporary statements of the need for both greater public understanding and public acceptance of science: 'Science offers means to use unprecedented powers with which a finer, more beautiful and happier world than ever before can be built. With mankind using a vigorously developing science for social ends, the future can be bright and inspiring'.¹⁰

However, unusually for a group of scientists, the Association recognized that this new world would require scientists to adopt an explicitly *political* role in society. The Association was highly critical of those who simply stood on the sidelines of social change. Important decisions needed to be made about the social control of science and industry – it was the responsibility of every citizen to get involved. Meanwhile, science itself is: 'neither good nor bad; it is organized knowledge and a method, a tool or weapon, which society can use for good or evil. It can confer the highest benefits and it can be used to destroy'.¹¹ Again, this notion of science as value-free has been a regular feature of scientific statements concerning the relationship between citizens and technical change.

Some forty years later, the prestigious Royal Society was to revive these debates in its 1985 report on the 'public understanding of science' – suggesting the durability of these concerns but also a perceived absence of real progress. The Royal Society took a distinctly less 'political' perspective than the Association of Scientific Workers – its recommendations emanate from a more liberal concern with the well-being of both science and society (and perhaps also from a concern that the value of scientific understanding might be neglected by society – the mid-1980s were a time of great anxiety about the future of public support for science).

Despite this difference in political perspective, the 1985 report of the Royal Society presents an argument which many members of the Association of Scientific Workers would readily have endorsed:

better public understanding of science can be a major element in promoting national prosperity, in raising the quality of public and private decision making and in enriching the life of the individual. . . . Improving the public understanding of science is an investment in the future, not a luxury to be indulged in if and when resources allow.¹²

The report goes on to cite a number of specific areas where an 'improved understanding' would be of personal and national value:

- in terms of *national prosperity*, a better informed citizenry could appreciate the opportunities offered by new technologies and could provide a better trained workforce;
- in terms of *economic performance*, wider scientific awareness would reduce 'hostility, or even indifference' to science and technology and so aid in the rapid innovation of such product and process changes. There would also be a 'considerable competitive advantage' if those in 'positions of responsibility' were better informed;
- in terms of *public policy*, science and technology should be major considerations – for the Royal Society there is a strong case that these decisions would be improved by 'better understanding' (we will examine this assumption very closely in Chapters 2 and 3);
- in terms of *personal decisions*, for example regarding diet, smoking, vaccination safety – 'an uninformed public is very vulnerable to misleading ideas';
- in terms of *everyday life*, a basic scientific literacy is needed just to understand what goes on around us (e.g., how a ball point pen or a television functions);
- in terms of *risk and uncertainty* (e.g., concerning nuclear power or seat-belt wear), it is important that the public have a better appreciation of the nature of risks and of how to interpret and balance them: 'Once again it must be argued that better understanding fosters better public and personal decisions'.¹³
- in terms of *contemporary thought and culture*, any citizen without an understanding of science is cut off from the richness of this important area of human enquiry and discovery.

So far, we have briefly examined two major arguments – from the Association of Scientific Workers and from the Royal Society – for greater efforts to be made by scientists and citizens in the dissemination of technical information and understanding. A typical justification for such efforts has also emerged – generally based on a mixture of economic, political, personal and cultural arguments.

Certain assumptions about the relationship between citizens, science and technology have also started to become clear – assumptions which are implicit in the very concept of the 'public understanding of science'. Such assumptions include:

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- the notion of contemporary 'public ignorance' in matters of science and technology;
- the notion that a better understanding of science will lead to better 'public and personal decisions';
- the notion that science is a force for human improvement;
- an explicit or implicit notion that science is itself value-free – although there are moral and political choices to be made about its *direction*;
- the notion that the life of citizens is somehow impoverished by an exclusion from scientific thought;
- the notion that wider exposure to scientific thinking will lead to greater acceptance and support for science and technology.

Of course, there are differences between the accounts offered by these two groups of concerned scientists – with the Association of Scientific Workers offering, for example, a more 'political' programme (linked to the aspirations of the postwar Labour Government). However, what the two accounts share is a fundamental belief in the centrality of scientific development to the future of society – and a belief (whether as part of a social democratic or more vaguely liberal ideology) that a better informed citizenry can play a crucial (but essentially reactive) role in this development. The future should indeed belong to science.

There is no suggestion in the Royal Society report that the organization of science is open to change or that it should incorporate citizen views within research policy. The goal is to make the public better informed about science but not to encourage a critical evaluation of scientific institutions. For the Royal Society and most of the contemporary apologists of science, *science* itself is not the problem – the problem is gaining public understanding and hence *acceptance* of science.

This worldview can be characterized as 'science-centred' or (perhaps more accurately) 'enlightenment' in its assumptions about science, technology and the wider public. This is not to suggest that all working scientists hold this worldview. However, it does provide a powerful and frequently reiterated case for the centrality of scientific reasoning to social development. Within such a worldview, any problematic relationship between science and citizens must be a consequence of either public ignorance or public irrationality.

This book will argue that a critical perspective on these issues is

required and that there are new developments and ways of thinking which suggest that *change* is indeed occurring. We can begin by contrasting the notions expressed so far of 'science as progress' with one account of a nineteenth-century experiment in the 'public understanding of science' – the Mechanics Institute movement as discussed by Maxine Berg and others.¹⁴ Berg's more critical analysis of this movement sets the debates so far concerning citizens and science into a much-needed social and political context.

As already suggested, the Mechanics Institutes appear to offer an excellent example of a highly localized and responsive 'continuing education' (to use the modern jargon) for one section of the working-class community. Institutes were established across Britain and offered technical training at a time when demand seemed to be high – this demand linked, of course, to the rapid progress of industrialization. Berg's account suggests, however, a less attractive ideological purpose to this movement – essentially the Institutes were not philanthropic in orientation but were instead one part of the legitimation of the emerging capitalist order. The underlying philosophy of 'self improvement' was designed to divide working-class communities by creating a 'labour aristocracy'. The basis of the movement was to evangelize the harmony between science and industry. The Institutes were largely dominated by the middle classes whose main purpose was to create a more ordered society and to prevent social unrest. Science was, therefore, an important legitimation of the social order rather than a force for liberation or active citizenship.

The discussion of Mechanics Institutes is important here not for its specific conclusions but for the wider questions which it raises about the relationship between science and citizens. The 'enlightenment' approach – as exemplified by the Royal Society – would argue that the provision of scientific information to public groups will in itself be beneficial – if only in allowing a better appreciation of the scientific changes which are influencing society and in clarifying citizen choices. The analysis provided by Berg suggests that science can present an ideological face to citizens – so that it can be used to obstruct rather than assist understanding. In particular, the control of Mechanics Institutes by middle-class forces meant that training in science was also a propagandizing of a particular political ideology (in this case that known as 'political economy'). At this point, we could add to our discussion a number of Marxist accounts of science which generalize this point about

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capitalist ideology and its relationship to contemporary science.¹⁵ Thus, for example, Marcuse has argued that: 'The industrial society which makes technology and science its own is organised for the ever more effective domination of man and nature, for the ever more effective utilization of its resources'.¹⁶

Marx himself expressed such notions of 'technology as domination' with particular clarity:

Labour [is] . . . subsumed under the total process of the machinery itself, as itself only a link of the system, whose unity exists not in the living workforce, but rather in the living (active) machinery, which confronts his individual, insignificant doings as a mighty organism.¹⁷

Hill has developed such themes (particularly with reference to the work of Foucault) in *The Tragedy of Technology*:

Employees generally see technology . . . as an alienated force that stands somewhere behind their left shoulder, and which, with one new breath of change, may extinguish their means of livelihood. The aesthetic is one of externally imposed order rather than human harmony; the words of knowledge are opaque, controlled by the masters of the technological system and the variety of specialists who inform them. The technological aesthetic is unreadable to the layman, but is embodied in words of knowledge that say 'you shall adjust'.¹⁸

Of course, the argument here is that this relationship to technology is found also *outside* the workplace – so that people's general experience of technology fits this pattern of 'unreadability' and 'adjustment'.

It would appear, therefore, that we have reached the point of incommensurability between those accounts of science which stress its empowering and enabling role and those – drawing broadly on a notion of science as a source of legitimation (Habermas), alienation (Marx) or disenchantment (Weber) – which stress its role as a form of social control and dehumanization. One should nevertheless be wary of splitting debate in a conventionally-political fashion (the 'establishment view' versus the 'radical opposition'). Certainly, left-wing and environmental groups have been as eager to adopt a scientific mantle ('if only people knew the facts of ozone depletion, acid deposition or factory farming then they'd support us') as have the political establishment – although such groups have

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On the one hand, forms of knowledge developed by citizens do not typically make such a claim. Their very strength is in the observation of specific areas of everyday reality. On the other hand, the claims for the superiority of scientific knowledge rest especially on notions of universalism. Scientific knowledge claims to be replicable (or falsifiable) in any location and not just in the place of its original development.

However, the specific contexts offered by our 'three stories' seem remote from the world of scientific experimentation. They are inherently messy and uncontrollable since so many variables are at flux. From a scientific perspective, they seem unlikely to generate or falsify universalistic claims. Accordingly, they are frequently reduced to the status of 'sites of implementation' where science is *applied* but not developed. Meanwhile, citizen understandings – which typically see the local environment not as a 'special' case but as *the* case – fail to engage with wider scientific debate. In that sense, scientists are denied access to what might represent a substantial body of socio-technical data.

At one level, this lack of engagement may be inevitable – the farmers were not, for example, concerned to attend scientific conferences nor to publish in journals. The *difficulty* in such cases, however, is that scientific accounts can come to be seen not just as remote but as an obstacle to citizen concerns. At the same time, the legitimate questions and knowledges of citizens fail to be granted the significance they may deserve. Once again, this is not to suggest that such knowledges are inevitably superior to those of science but rather to advocate a more symmetrical form of analysis and policy debate.

Lay understandings and contextual knowledges

The production and dumping of toxic waste

Further evidence of 'citizen science' in action can be taken from various community campaigns around local exposure to toxic chemicals. Typically, such campaigns have involved opposition either to waste disposal sites (typically, incinerators or landfill) or to toxic pollution from the chemical industry. Very often, the beginnings of such campaigns have been informal public knowledges of health effects. Thus, for example, in Robert Allen's account of local community campaigns against waste disposal¹⁸

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there are numerous examples of local knowledges stimulating oppositional activity. Such knowledges take many forms:

- direct observation of working practice, e.g., of smoke plumes emanating from disposal sites, of smells and vapours, of the condition of emission stacks. Local knowledge can also be built upon crucial information concerning, for example, the kinds of delivery made to disposal sites. In one case, the claims of a company were directly countered by the itemizing of the trucks which arrived at the site displaying certain HazChem signs. It is also commonly observed that emissions are more severe at night when formal inspection tends to be limited – the local community is well-placed to make such observations;
- evidence that health has been directly affected – as when workers at a neighbouring site claimed they were suffering from incinerator emissions or members of a community noted unusual patterns of illness (typically, problems relating to the eyes, nose and throat, respiratory system or to nausea, headaches, birth deformity or miscarriage);
- observations of animal health disorders – either involving family pets or farm animals;
- understandings of the relative efficiency and management competence of key organizations – these can be important in suggesting bad safety or pollution practice (e.g., with regard to the average temperature of waste incineration);
- comparisons with other sites – generally, those run by the same company or where similar industrial processes are in operation. This can involve the establishment of community networks where groups build upon the experience of others elsewhere;
- the testimony of workers (or former workers) about conditions of operation and associated hazard. Workers may also be local citizens and, as such, become an important source of information about a site's operation and management;
- systematic data collection – in one case, through a round the clock 'toxic watch' recording activities and pollution levels. This could also involve the study of published accounts of hazard.

Evidence of this active knowledge generation fits well with the patterns of local knowledge discussed in this and the previous chapter. In a case-study of one other planned waste disposal site in North-East England, Hooper observed how the local community in

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question was particularly successful in generating two main forms of evidence.¹⁹

First, direct contact was made between groups living in the area of the proposed Sunderland site and those living in the area of an existing facility run in the Midlands by the same company. Residents in the Midlands gave evidence of smells, noise and disruption, an explosion at the site and a tanker leak. This severely dented the company's claim to pollution-free operation. Second, since the planned site had been a coal mine, it was possible to draw on local practical expertise of the rock formation and its characteristics. Thus, a former mine worker gave evidence that there had been a history of flooding within the mine – suggesting the strong possibility of toxic leakage and contamination. Prior to this intervention, the technical assurance had been that the site was secure.

In all these cases, locally generated testimonies have suffered from the accusation of being 'anecdotal'. However, it is also clear that they have offered well-grounded accounts of hazard which standardized scientific evaluations have generally failed to draw upon or even acknowledge. Thus, outside scientists have found it impossible to offer a historical perspective on previous experience of hazard, to consider local variations or to deal with failures of operation and safety organization. Instead, such 'decontextualized' accounts are generally built on the idealized social models and sets of assumptions which were seen to operate in cases such as the 2,4,5-T controversy. This gives rise to two particular points.

First, there is, as noted at the end of the previous section, a general reluctance from official bodies to accommodate citizen knowledges within decision-making processes. The common experience of citizen groups is that their testimony is disregarded despite what has been suggested here about its possible significance. As Allen quotes one campaigner:

It has been suggested that ordinary mortals keep out of this debate – let's leave it to the experts to make the right decision. This underestimates our intelligence and the ability of people to research into a subject that affects them deeply. Moreover, 'experts' can sometimes have vested interests! Our vested interests are our own health and that of the natural environment.²⁰

Second, and linked to this, there is the problematic relationship between 'local' and 'scientific' knowledge. Whilst local knowledge

may form the heart of any campaign, protesters are often wary of presenting evidence which may be seen as circumstantial and unconvincing (once again, as suggested in the previous chapter, the dominant form of discourse can serve to stifle other knowledge and concerns). However, the inevitable resource imbalance leaves them weakly placed to offer 'expert' testimony – there is also a distinct shortage of scientists willing to go to the assistance of campaign groups without payment or technical resources.

Furthermore, for a scientist to 'mediate' between oppositional groups and policy-makers can create real difficulties – the risk is that the scientist will then be seen to have lost 'neutrality'. The institutional and professional pressure is for the scientist not to 'get involved'. In this situation, local groups are effectively disenfranchised from the 'science-centred' decision-making process.

Down's syndrome, domestic energy, methane and Sellafield

We can turn now to an academic account – presented by Layton, Jenkins, Macgill and Davey – which has compiled further evidence of the complex relationship between science and its publics and, in particular, of positive citizen responses in this domain. These authors put their general case in terms broadly sympathetic to the argument in this book:

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

As an immediate example of this, Layton *et al.* offer the Himalayan 'Chipko Audolan' movement dedicated to a holistic analysis of deforestation. Whilst 'scientific' forestry tends to advocate the replacement of traditional forests by commercially valuable teak and pine, this movement stresses the importance of self-reliance (and hence 'sustainability') in 'food, fodder, fuel, fertilizer and fibre'.

In this specific case, we see the tension between 'scientific' and 'citizen' perspectives – but also the manner in which citizen know-