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19 Science and Public Participation

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Whatever happened to the heroes?[1]

A group of activists protest against GMOs outside a biotechnology research institute. The citizens of a region vote in a referendum on a new waste disposal facility. A patients' association compiles a large database of the symptoms and clinical evolution of a rare genetic disease. A group of citizens is invited to discuss the issue of embryo stem cell research and produce a final document to be submitted to policy makers.

What do these examples have in common? Are they all in their own way expressions of a profound change in the terms and conditions under which scientific knowledge is produced, discussed, and legitimated?

Public participation in science is an emerging phenomenon with uncertain boundaries, and the difficulties of defining it are compounded by the fact that it has simultaneously become a key focus of social mobilization, policy initiatives, and scholarly analysis. Moreover, a plurality of points of view and motives of interest for public participation can be identified within each of these areas.

However, for our purposes here, public participation may be broadly defined as the diversified set of situations and activities, more or less spontaneous, organized and structured, whereby nonexperts become involved, and provide their own input to, agenda setting, decision-making, policy forming, and knowledge production processes regarding science (Callon et al., 2001; Rowe & Frewer, 2005).

This chapter seeks to (1) provide an overview of the emergence of the phenomenon and theme of public participation in science, (2) define a general interpretative framework with which to map its various manifestations, and (3) outline the possible driving forces behind it as well as its potential impact in terms of changes in the production of scientific knowledge. Specific types of public participation are dealt with in the following chapters.

THE "DEFICIT MODEL OF PUBLIC UNDERSTANDING OF SCIENCE" AND ITS DISCONTENTS

Although antecedents can be traced back to long-standing debates on participatory democracy that have touched science and technology issues since the 1970s (see, e.g., Dickson, 1984), the theme of public participation with regard to science has come with new force to attention in conjunction with the crisis of the so-called deficit model of public understanding of science (Wynne, 1991, 1995). This model has emphasized the public's inability to understand and appreciate the achievements of science—owing to prejudicial public hostility as well as to misrepresentation by the mass media—and adopted a linear, pedagogical and paternalistic view of communication to argue that the quantity and quality of the public communication of science should be improved. To recover this deficit, public and private bodies—especially since the mid-1980s—have launched schemes aimed at promoting public interest in and awareness of science. These initiatives have ranged from "open days," which have become a routine feature at most laboratories and research institutions, to science festivals or training courses in science journalism.[2]

Despite their variety, these activities, as well as the studies conceived within the framework of the deficit model, share certain assumptions and features, namely,

1. the assumption that *public understanding of science* largely coincides with *scientific literacy*, i.e., with the ability to understand science "correctly" as it is communicated by the experts, which is measured by appropriate questions on scientific methods and contents;
2. the assumption that this understanding, once achieved, guarantees favorable attitudes toward science and technological innovation;
3. the tendency to problematize the relationship between science and the public only as regards the latter term of the relationship, i.e., the public.

Especially since the early 1990s, however, these assumptions have been strongly criticized on several grounds. For example, it has been pointed out that the equation between public understanding and the ability to answer questions about science has long restricted the discussion to the somewhat tautological observation that members of the public do not reason in the same way as professional scientists. This has prompted the question about whether surveys of scientific literacy are actually measuring "the degree of the public's social conformity to a stereotype held by scientists of a 'scientifically literate public'" (Layton et al., 1986: 38).

Also disputed is the linkage among exposure to science in the media, level of knowledge, and a favorable attitude toward research and its applications. As regards biotechnologies, for example, recent research has shown a substantial degree of skepticism and suspicion even among the sections of the population most exposed to scientific communication and best informed about biotechnological topics (Bucchi & Neresini, 2002). In general, therefore, it does not seem that the opposition of certain sectors of the general public to particular technical-scientific innovations is due solely to the presence of an information deficit. Rather, the phenomenon requires more systematic and detailed analysis.

More in general, the disjunction between expert and lay knowledge cannot be reduced to a mere information gap between experts and the general public as envisaged by the deficit model. Lay knowledge is not an impoverished or quantitatively inferior version of expert knowledge; it is qualitatively different. Factual information is only one ingredient of lay knowledge, in which it interweaves with other elements (value judgments, trust in the scientific institutions, the person's perception of his or her ability to put scientific knowledge to practical use) to form a corpus no less sophisticated than specialist expertise.[3]

Critics of the deficit model have also pointed out that these are complex matters difficult to grasp with large-scale surveys. This criticism has prompted the use of ethnographic methods and discourse analysis tools to produce a series of in-depth studies of specific cases of (mis)understanding of scientific questions by nonspecialists. The use of ethnographic rather than quantitative survey methods, a definition of the relationship between science and the public that is not abstract but locally situated, and a conception of both expert and lay knowledge as socially and culturally contingent are some of the key features of the approach known as "critical/interpretative public understanding of science" (Wynne, 1995; Michael, 2002).

One of the studies based on this approach has detected, for instance, a difference between a conception of "science in general"—used by nonspecialists as a distancing device whereby science is defined as "other" from oneself—and a conception of "science in particular" used in practical settings. From this perspective, the notion itself of public "ignorance" is difficult to define. A group of electricians working at the Sellafield nuclear reprocessing plant in the United Kingdom gave the researchers various reasons for their lack of interest—contrary to expected—in acquiring scientific information about the risks of irradiation. First, the electricians believed that interesting themselves in the scientific aspects of irradiation would have caught them in a chain of pointless argument and discussion. Secondly, they feared that being confronted by uncertainties and probabilistic estimates of risks would cause them alarm, or even panic, and would therefore be dangerous. Thirdly, the electricians said that there were other workers at the plant who possessed the information; any active effort on their part to acquire it would have undermined the trust and authority relations established in the workplace (Michael, 1992). In other cases, scientific information may be ignored by the public as irrelevant to their needs, or simply because they distrust the source, believing it to represent interests other than their own. Thus, "technical ignorance becomes a function of social *intelligence,* indeed of an *understanding* of science in the sense of its institutional dimensions" (Wynne, 1995: 380).

A classic example of the gap between expert and lay knowledge is provided by Brian Wynne's study of the "radioactive sheep" crisis that erupted in certain areas of Britain in 1986, following the Chernobyl nuclear plant accident in Russia. British government experts long minimized the risk that sheep flocks in Cumberland had been contaminated by irradiation. However, their assessments proved to be wrong and had to be drastically revised, with the result that the slaughter and sale of sheep was banned in the area for two years. The farmers for their part had been worried from the outset, because they had direct knowledge based on everyday experience (which the scientific experts dispatched to the area by the government obviously did not possess) of the terrain, of water run-off, and of how the ground could have absorbed the radioactivity and transferred it to plant roots. This clash between the abstract and formalized estimates of the experts and the perception of risk by the farmers caused a loss of confidence by the latter in the government experts and their conviction that official assessments were vitiated by the government's desire to "hush up" the affair (Wynne, 1989).

According to some scholars, experts themselves may reinforce the representation of the public as "ignorant." During a study on communication between doctors and patients in a large Canadian hospital, a questionnaire was administered to patients to assess their level of medical knowledge. At the same time, the doctors were asked to estimate the same knowledge for each patient. The three main findings were decidedly surprising. While the patients proved to be reasonably well informed (providing an average of 75.8 percent of correct answers to the questions asked of them), less than half the doctors were able to estimate their patients' knowledge accurately. Thirdly, this estimate was in any case not utilized by the doctors to adjust their communication style to the information level that they attributed to the patients. In other words, the fact that a doctor realized that a patient found it difficult to understand medical questions or terms did not induce him or her to modify his or her explanatory manner to any significant extent. The patients' lack of knowledge—the authors of the study somewhat drastically conclude—appeared in many cases to be a self-fulfilling prophecy, for it was the doctors who, by considering the patients to be ignorant and making no attempt to make themselves understood, rendered them effectively ignorant (Segall & Roberts, 1980).

HYBRID FORUMS AND THE CO-PRODUCTION OF SCIENTIFIC KNOWLEDGE

More recently, various studies have reported the advent of a new form of interaction between nonexperts and scientific knowledge. Levels of communication and social actors external to the research sphere may, in certain circumstances, play a significant role in the definition and accreditation of scientific knowledge (Irwin & Wynne, 1996, Bucchi, 1998). These forms have been interpreted as representing a major change not only with regard to the deficit model but also with regard to its critical or interpretative version. According to Callon, for instance, the critical/interpretative version of public understanding of science shifts the priority from "the education of a scientifically illiterate public" to the need and right of the public to participate in the discussion, on the assumption that "lay people have knowledge and competencies which enhance and complete those of scientists and specialists"; however, both models are seen as sharing "a common obsession: that of demarcation. [The first model], in a forceful way, and [the second model], in a gentler, more pragmatic way, deny lay people any competence for participating in the production of the only knowledge of any value: that which warrants the term 'scientific.'" (Callon, 1999: 89). On this basis, Callon invokes the need for another, more substantial shift to a model of knowledge co-production in which the role of nonexperts and their local knowledge can be conceived as neither an obstacle to be overcome by virtue of appropriate education initiatives (as in the deficit model) nor as an additional element that simply enriches professionals' expertise (as in the critical-interpretative model) but rather as essential for the production of knowledge itself. Expert and lay knowledge are not produced independently in separate contexts to later encounter each other; rather, they result from common processes carried forward in "hybrid forums" in which both specialists and nonspecialists can actively interact (Callon et al., 2001).

Medical Research and the Active Role of Patient Organizations

One area in which this co-production has been particularly visible is the area of medical research, where patient organizations have become increasingly active in shaping the agenda of research in fields of their concern.

Particularly well known and carefully studied is the case of AIDS research, where methods to test the effectiveness of drugs, and the term itself chosen to denote the disease (which was changed from the initial Gay-related immunodeficiency disease [GRID] under pressure from American homosexual associations) were negotiated with activists and patients' associations (Grmek, 1989; Epstein, 1996). In the mid-1980s, AIDS patients participating in clinical trials of the AZT drug (then considered a likely cure for the disease) developed a marked ability to contribute to and influence the experimental procedure—for example, by learning to recognize placebos and refusing to take them—thereby accelerating approval of the drug by the U.S. Food and Drug Administration (FDA). Human trials of another drug, aerosol pentamidine, used to treat an AIDS-related disease, *Pneumocystis carinii* pneumonia, were conducted by groups of activists after scientists had refused to do so. In 1989 the use of aerosol pentamidine was approved by the FDA, which for the first time in its history authorized marketing of a drug solely on the basis of data collected by means of community-based experimentation (Epstein, 1995).

Another configuration of knowledge co-production in the biomedical field is offered by the case of the French Muscular Dystrophy Association (AFM). AFM was founded in 1958, at a time when muscular dystrophies were "orphan diseases," rare genetic pathologies largely neglected by specialists who considered putting effort into their study and care unrewarding and too much at risk of failure. By actively promoting and performing the collection of clinical data, conducting surveys among patients, and establishing a genetic bank, AFM managed to create the body of knowledge lacking on these diseases, establishing muscular dystrophies as a fully legitimate object of scientific inquiry as well as of public concern. AFM advocacy has had profound consequences on research in this field, redefining the professional trajectories of specialists themselves—so that researchers working for AFM are at the same time geneticists and pediatricians and thus combine research with daily therapeutic experience—or launching new research lines or structures, for example, Genethon, which was founded by AFM in 1990 to identify the genes responsible for diseases like MD, an inquiry that neither the public nor the private research sector had been able or willing to pursue (Callon & Rabeharisoa, 1999; see also Bourret, 2005).

Public Mobilization on Technoscience Issues

Public participation is also manifest in the increasingly frequent cases of public mobilization on technoscience issues. Especially since the second half of the 1990s, in more or less organized forms, citizens have demanded closer involvement in decisions concerning the development of research and technical-scientific innovation. Most active in this field have been the "new social movements" and NGOs. These two phenomena are in fact closely interconnected: NGOs have provided crucial organizational support for new social movements and have been their main channel of recruitment (Della Porta et al., 1999; Diani, 1995), while the latter have given the former visibility and enabled them to intervene more effectively in decision-making (Della Porta & Tarrow, 2004). Nor should we overlook the local forms of protest usually centered on protecting health and the environment and opposed to the siting of installations that they deem dangerous in their area (waste disposal facilities, electricity power lines and booster stations, power plants). Although it is not yet certain whether these forms of mobilization pertain to the new social movements, they express a clear public demand for involvement in issues with high technical-scientific content.

Relations between new social movements and science have always been characterized by a marked ambivalence. According to social movement theorists (Touraine, 1978, 1985; Melucci at al., 1989; Melucci, 1996; Castells, 1997), the distinctive features of such movements are the ways in which they construct an individual and collective identity, define the adversary, and structure a vision of the world put forward as an alternative to the dominant one. It is evident that science and technology are bound up with each of these three features.

On the one hand, science and technology are often an integral part of the "enemy" against which the new social movements mobilize. They are viewed as instruments of the dominant power and as responsible for the perverse effects of globalization, especially so now that the connection between scientific research and economic interests is increasingly apparent. This is a connection that STS has repeatedly analyzed, and from various standpoints (Etzkowitz, 1990; Funtowicz & Ravetz, 1993; Ziman, 2000). Once again the case of biotechnologies is paradigmatic: the science sustained by—and therefore subservient to—the multinationals is seen as threatening the future of the environment (destruction of biodiversity), jeopardizing human health (harmful emissions), and increasing the third world's dependence on the industrialized countries (it erodes the social bases of small-scale farming in the developing countries [Shiva, 1993]). For these reasons, it is an enemy to be fought against.

Yet science and technology are also resources for the identity, organization, and action of the new movements themselves. In fact, criticisms of the present model of development and the dominant economic paradigm base themselves on data concerning the depletion of environmental and social resources furnished by scientific analyses and forecasts (Moore, 1995; Yearley 1995: 458, 461). Moreover, not only do the new movements rely heavily on the latest communication technologies (e.g., Internet and mobile phones) to organize their activities (Castells, 1997: 117, 142) but they also exploit more traditional media to gain access to the public arena and to exert political pressure (Castells, 1997: 86–89, 116, 129–30, 141).

This "ambiguous, deep connection with science and technology" (Castells, 1997: 123; Yearley, 1992) enables the new social movements, especially the environmentalist ones, to play a significant part in the production of scientific knowledge itself. As Yearley has pointed out, this participation may take place at various levels. First, a number of NGOs have set up laboratories and research facilities in order to have their own scientists produce independent scientific research (Yearley, 1995: 462). Also to be mentioned are the "science shops" set up by universities or networks of NGOs so that research projects can be commissioned from those universities, or from other research bodies, on the basis of recommendations by civil society. Launched by Dutch universities during the 1970s, the science shop system has been introduced in various other European countries, as well as in Eastern Europe, the United States, Canada, Israel, Malaysia, and South Korea, where the initial intent to "reorient science toward social needs" has been declined in various ways. In the case of the more mature Dutch experience, "science shops started out as a counterculture phenomenon in the 1970s, but by the end of 1980s, most had become regular elements of university organization" (Wachelder 2003: 253–54). In certain respects, science shops can be viewed as a "bottom up" interpretation of what is termed community-based research, especially when they are intended to promote public participation not only in specific research projects but also more generally in research policies (Sclove, 1998). But the new social movements and NGOs participate directly in the production of scientific knowledge also by orienting research work in accordance with their beliefs (regarding experiments on animals, for example). They do so by seeking to disseminate certain theories (certainly the best-known of which is the Gaia theory) and to condition decisions on research policy (Yearley, 1995: 469–77). Finally, the new social movements have on occasion put themselves forward as the champions of a "true science," urging what they regard as a scientific community in league with political and economic power to regain its neutrality and independence—"the science of life versus life under science" (Castells, 1997: 127)—or promoting alternative paradigms, such as those proposed by Capra (1975), Morin (1977), or Prigogine and Stengers (1979).

Making Science in the Court

A third important interaction between expert and lay knowledge lies in the area of law. Over the past decade, a technicist view of the application of scientific knowledge in legal practice has been replaced by one where the law not only utilizes the tools of scientific research but actively participates in it, for example, by defining what can be patented as a scientific discovery, who can be considered a scientific expert, or even what counts as "scientific proof" (Mackenzie, 1993; Jasanoff, 1995). Scholars who have analyzed this process describe the settings where laws are devised, and especially where they find interpretation by the courts, as ones of co-production between science and law in a context characterized by an "erosion of faith in legal processes and institutions" and by "the public's often expressed distrust of technical experts and their undemocratic authority" (Jasanoff, 1995: 4).

Although science and law have numerous important features in common, they also differ considerably, especially in the methods used to verify facts. However, these differences do not prevent them from collaborating in designing frameworks and definitions that shape society and transform it, especially in relation to scientific and technological developments that impact on well-established social relations. Thus, courtrooms are used for experiments to solve the problem of arriving at socially endorsed decisions without delegating to experts—whether judicial or scientific—the task of unequivocally establishing what is to be taken as fact, on what bases, and by what procedures. For example, the Daubert decision by the U.S. Supreme Court, while acknowledging the importance of peer review by the expert community, reaffirmed the central role of judges in evaluating a certain piece of information as "scientific evidence" in a trial (Solomon & Hackett, 1996). Legislation is currently being enacted that enables citizens to object to the standard neurological criteria used to establish death—cerebral in the New Jersey Health Statute—in case it conflicts with individual religious beliefs, thus making room for a sort of "pluralist" definition of it (New Jersey Statutes, 1991; Tallacchini, 2002). The concept of democracy here acquires a meaning quite different from the traditional one: no longer a majoritarian decision-making process driven by hegemonic expert knowledge but rather the scrutiny of a range of options using a procedure that gives a decision greater transparency without hampering its effectiveness. Hence, the law as practiced in the U.S. courts has contributed significantly to the construction of a civic culture of science, both by revealing how the opinions of experts differ and by evincing "their underlying normative and social commitments in ways that permit intelligent evaluation by lay persons" (Jasanoff, 1995: 215).

Users and the Shaping of Technology

As described in detail in chapter 22 of this Handbook, technology is yet another terrain where the involvement of different actors in knowledge creation is of increasing importance. Numerous studies have shown the various ways in which users are involved not only in the implementation of technologies but also in their design, and in developing the knowledge that makes them possible. In fact, artifacts can be reinterpreted, adapted, and in certain cases actually reinvented by users; their needs and point of views can be incorporated in the design process itself (Pinch & Oudshoorn, 2003; Kent, 2003; Eglash et al., 2004). Especially in cases in which user-innovation communities come into being—for example, the free and open source software movement—participation by users in innovation processes goes well beyond the adaptation of initial projects to the needs of the final users, giving rise to the co-production of new knowledge embodied in technological artifacts (von Hippel, 2005). Also of increasing importance are organizations set up both to protect consumers and to influence innovation processes so that they more closely reflect their needs. Technology deserves attention also insofar as it frequently represents a background for the other forms of interaction described here—think, for instance, to the importance that recent media technologies have acquired in collective mobilization processes, or to the role of the Internet in facilitating the gathering and circulation of information among patients and families affected by rare genetic diseases.

FORMAL INITIATIVES PROMOTING PUBLIC PARTICIPATION IN SCIENCE

Additionally as a result of these and other cases, the attention of scholars and practitioners has concentrated on a variety of schemes to promote public involvement in issues concerning science and technology. Particularly since the mid-1990s, local, national, and international public institutions as well as NGOs in many countries have devoted significant effort to creating opportunities for citizen participation with regard to potentially controversial science and technology issues such as genetically modified (GM) food, genetic testing, transport technology, and ozone depletion. Political institutions have also started to consider "citizen participation" a necessary policy provision in the field of research and innovation, with special regard to highly sensitive fields like biotechnologies, the siting of radioactive waste disposal facilities, or more in general sustainable development.[4] Indeed, we can trace, for instance, the history of the policy framing of such relationships by analyzing the linguistic shifts in documents and funding schemes of national and international institutions: from "public awareness of science" to "citizen involvement," from "communication" to "dialogue," from "science and society" to "science in society."[5] In some countries, Switzerland for example, specific agencies have been established to undertake "participatory technology assessment" of upcoming innovations on behalf of parliaments or governments (Joss & Bellucci, 2002).

The promotion of public participation in the area of science and technology is often justified by the sponsoring institutions in terms of enhanced citizenship and democratic participation. This rationale is sometimes expressed in the more sophisticated argument that advances in research and innovation are challenging the standard forms and procedures of democracy, requiring new forums and opportunities in which complex technoscience issues can be addressed without sacrificing the needs of contemporary democracy. However, not infrequently present is a more or less implicit expectation by those same sponsors that opportunities for participation will prevent heated public controversies on sensitive issues related to science and technology and restore otherwise declining public trust in science. Indeed, a number of initiatives in the area of science and public participation, like the wide-ranging "GM nation" debate conducted in the United Kingdom in 2003, have been launched after significant public mobilization on a particular issue (Jasanoff, 2004a). This expectation—in this or its even more cynical version where participation is seen simply as providing stronger public legitimation for decisions already taken (Callon et al., 2001)—may in some cases be expressed so explicitly that participants and commentators begin to suspect that the institutions promoting public participation initiatives see them, to some extent, as the "prosecution of the deficit model by other means," a more subtle way of disciplining—in a Foucaultian sense—citizenship to make it more suitable to comply with technoscience advancements (Foucault, 1975).[6]

Sponsored initiatives for public participation in science have taken a variety of forms in terms of

1. the nature and number of participants, how they are selected, the time frame, and the geographic scale;
2. the method by which the public input is gathered;
3. the extent to which this input may be binding for policy decisions;
4. the type of issue at stake (Rowe & Frewer, 2000).

Participants may, for instance, be stakeholder representatives, as in the case of the "negotiated rule making" exercise, or ordinary citizens selected—according to certain criteria—to represent the public, as in the "consensus conference" (a model first experimented with in Denmark in the late 1980s) (Joss, 1999; Joss & Bellucci, 2002). The number of participants may be fairly small—as in the case of citizens' juries—or quite large (public opinion surveys). Events may last a few minutes (public opinion surveys) or several months (public hearings, negotiated rule-making); geographical scale may range from the very local to national and (more rarely) transnational. The methods used to obtain public input may be multiple choice questions, moderated or free discussion by participants, the questioning of expert witnesses, or presentations by agency representatives, expert witnesses, or stakeholders. Participant input may be strictly binding (as in the case of referenda) or simply offered to policy makers as additional support for their decisions (consensus conferences, citizens' juries) or even no more than opinions that may well not be included in the final recommendations (public hearings). The themes addressed may be very general topics (in 1996 a consensus conference was organized in Denmark on "The Consumption and Environment of the Future") or single issues (genetic testing, GM food, cloning) (Joss, 1999; Joss & Bellucci, 2002). The questions asked of participants may concern the implementing of specific decisions at the local level (e.g., choosing the most appropriate site for a new waste disposal facility) or the devising of broad, long-term scenarios (e.g., the future of transportation). Table 19.1 sets out some of the most widespread forms of public participation elicited by a sponsor.

Evaluation of these initiatives has not yet provided clear indications, for several reasons. One is the lack of unambiguous definitions of key concepts like "effectiveness," which can be articulated on several dimensions, as well as from the different perspectives of the actors directly involved, of those who are in some way affected, or even of those excluded from the initiative. The criteria employed to assess participatory initiatives have referred both to their public "acceptability" (e.g., representativeness, independence, early involvement of the public, influence on policy,

Table 19.1
Some of the Most Widespread Forms of Public Participation in Science Elicited by a Sponsor

Participation Method	Nature of Participants	Time Scale/Duration	Characteristics/Mechanism
Referenda	A significant proportion of national or local population	Vote cast at single point in time	Vote is usually choice of one of two options. All participants have equal influence. Final outcome is binding.
Public hearings or inquiries	Interested citizens, limited in number	May last many weeks or months or even years	Presentations by agencies regarding plans in open forum. Public may voice opinions but have no direct impact on recommendation.
Public opinion surveys	Large sample of population	Single event, lasting a few minutes	Input gathered through a questionnaire administered face-to-face, by telephone, via post, or e-mail.
Negotiated rule-making	Small number of representatives of stakeholders groups	Uncertain; usually lasting days to months	Working committee of stakeholder representatives (and from sponsor). Consensus required on specific question.
Consensus conference	Generally, 10–16 members of the public, selected as representative	Preparatory demonstrations and lectures to inform panelists about topic, then 3-day conference	Lay panel with independent facilitator questions expert witnesses chosen by stakeholder panel. Meetings open to wider public. Conclusions on key questions made via report or press conference.
Citizen's jury/panel	Generally, 12–20 members of the public selected as representative	Generally involve meetings over a few days	Lay panel with independent facilitator questions expert witnesses chosen by stakeholder panel. Meetings not generally open. Conclusions on key questions made via report or press conference.

Source: Rowe and Frewer 2000, pp. 8–9.

transparency) and to "process" considerations relative to their design and implementation (e.g., the availability to participants of the resources necessary for their task, clear definition of the task, structured decision-making, cost-effectiveness).[7]

SCIENCE AND PUBLIC PARTICIPATION: A PROPOSED INTERPRETATIVE FRAMEWORK

The proliferation and variety of participatory mechanisms and the problem of finding common definitions has been seen as reflecting the *statu nascenti* instability of the field and as being at least partially responsible for the difficulty of deciding "what works best and when," that is, of assessing the effectiveness of each specific technique (Rowe & Frewer, 2004, 2005). Nevertheless, since participatory initiatives first made their appearance, attempts have been made to categorize them on the basis of such dimensions as objectives, type of participants, and the extent to which the procedure is structured. In a recent study, Rowe & Frewer (2005) draw up a typology of participatory mechanisms with a view to evaluating their effectiveness. The authors consider a general aim of "public engagement" to be "maximizing the relevant information flow (knowledge and/or opinions) from the maximum number of relevant sources and transferring this efficiently to the appropriate receivers" (Rowe & Frewer, 2005: 263). Depending on where the emphasis in the process is placed, three broad categories of public engagement can be thus identified:

- *public communication*, "maximizing the relevant information flow from the sponsor . . . to the maximum number of relevant population";
- *public consultation*, "maximizing the relevant information flow from the maximum number of the relevant population and . . . transferring it to the sponsor";
- truly *public participation*, "maximizing the relevant information from the maximum number of all relevant sources and transferring it . . . to the other parties" (Rowe & Frewer, 2005: 254–55).

Differences between specific participatory procedures can then be related to a series of variables associated with the above objectives (e.g., maximization of relevant participants, maximization of relevant information from participants). This typology has several advantages: most notably, it highlights similarities and differences between mechanisms and thereby paves the way for conceptual clarification and thorough impact evaluation. For instance, consensus conferences, citizens' juries, and action planning workshops can be treated as a homogeneous cluster of participatory forms, since they all involve a controlled selection of participants, facilitated elicitation, an open response mode, and unstructured group output (Rowe & Frewer, 2005: 281). Nonetheless, the typology may not fully respond to our purposes here, for a series of reasons.

First, it anchors public engagement to a notion of information flow—described as a rather mechanical process of "transfer"—which seems largely to reprise the limits of the deficit model and traditional communication paradigms, the main difference being that it envisages the possibility of two-way transfer (i.e., not only from the sponsor/experts to the participants but also from participants to the sponsor/experts).[8] However, hybrid forums often involve not only the exchange of information among the actors concerned but also the negotiation and production of new identities (Callon, 1999).

Second, defining relevance as a key concept for the typology is only unproblematic if a specific point of view is adopted. Who defines which information is relevant? Who defines which population is relevant? Is it the sponsor promoting the specific participatory initiative? The potential participants? In the case of muscular dystrophy patient associations, the relevant groups did not exist until thorough interaction between them and the experts became possible; just like the disease, they became visible and relevant only through this interactive process (Callon, 1999).

This brings to the fore a third, and probably more substantial, shortcoming of the typology: the fact that it is limited only to mechanisms actively promoted by a sponsor.

In that we have instead adopted a broader definition of participation, we propose an interpretative framework able to account also for "spontaneous" participatory forms, i.e., those not deliberately elicited by a sponsor in all the varieties that were briefly outlined above: public mobilization and protests, patient associations shaping the research and care agenda, community-based research.

This framework is partly based on the one used by Callon and colleagues (2001) to classify hybrid forums and adopts one of its key dimensions: the *intensity* of cooperation among different actors in knowledge production processes (Callon et al., 2001: 175). While intensity should, of course, be understood as a continuum, some key gradations can be identified, what in Callon et al. correspond to "access points" where nonexperts can intervene. One such point is the moment when laboratory results are "translated" to real-life situations, which is a crucial stage in the stabilization of scientific knowledge (Callon et al., 2001: 89ff.). At that point, contradictions and conflicts may emerge between specialist and lay knowledge, with nonexperts questioning the extent to which laboratory data can be applied to their own specific situation. This was, for example, the case of people living close to the Sellafield nuclear reprocessing site, who used data collected by themselves to contradict the reassuring statistics of experts on the number of leukemia cases in their area and eventually obtained an official enquiry (Wynne, 1996), and the case of the Cumbria sheep farmers whose concrete experience of the peculiarity of Cumbrian soil gainsaid predictions based on expert models that the contamination would soon disappear (Wynne, 1989).

A second and more substantial degree of participation corresponds to the access point offered by what Callon and colleagues (2001) call "the definition of the research collective," for instance, when members of AIDS patient associations managed to gain involvement in the design of experiments and drug trial tests, thereby broadening the research collective to include nonresearchers.

The public may even participate in the initial recognition of research problems, for example, by making a particular event or series of events leave the limbo of happenstance and enter the realm of problems warranting expert interest and attention. The public may also accumulate the initial stock of knowledge required to make professional research possible and worthwhile. For instance, in the 1980s it was the action by Woburn, Massachusetts, residents in gathering by themselves epidemiological data and information on a suspiciously high number of childhood leukemia cases in their area that eventually persuaded MIT to initiate a research program that uncovered genetic mutations caused by trichloroethylene (Brown & Mikkelsen, 1990). Similarly, the mobilization of patient associations like the French AFM has been crucial in prompting fruitful research on genetic diseases.

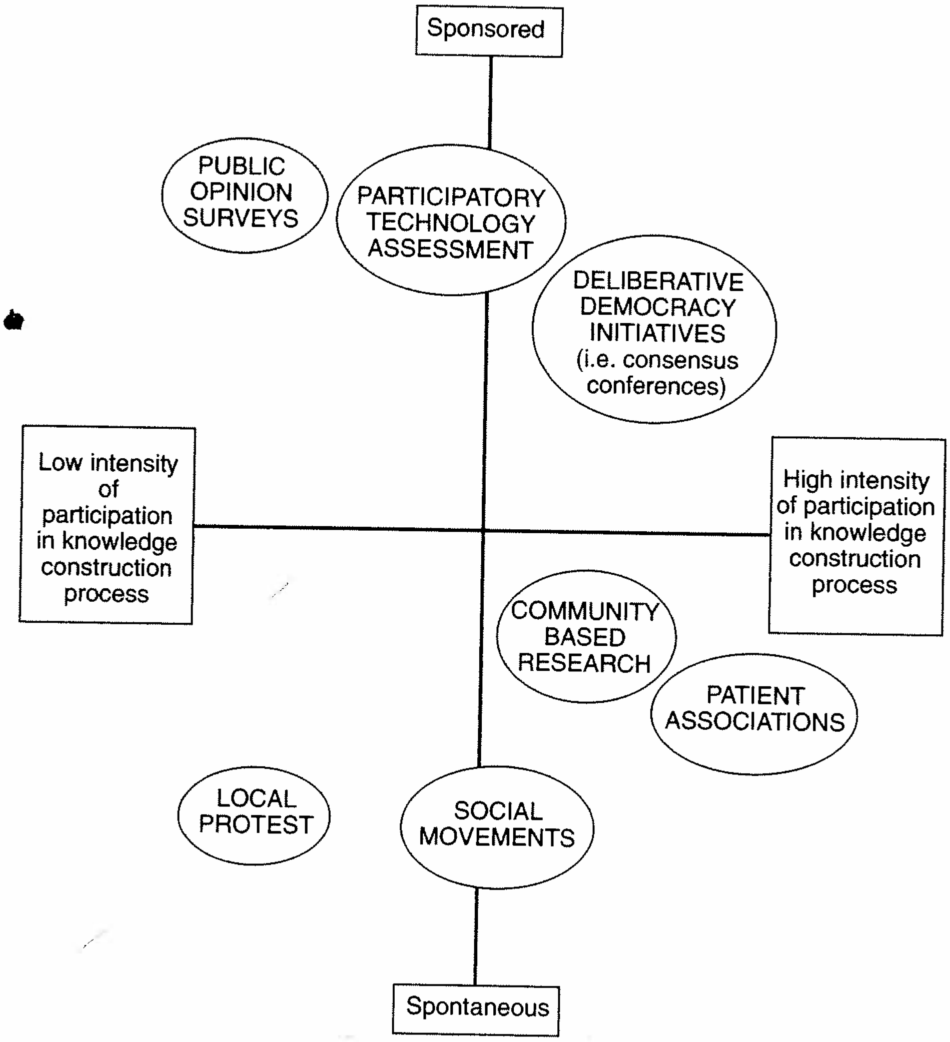

Figure 19.1
A map of public participation in science and technology.

The second axis of our diagram plots the extent to which public participation is elicited by a sponsor: what could be defined, with a certain amount of simplification, as the degree of *spontaneity* of public participation. Here again, the variable should be viewed as a continuum, with the participatory initiatives described by Rowe and Frewer at the upper end of the axis and protest movements and research activities of patient and resident organizations at the lower end. Figure 19.1 gives a graphical representation of the space defined by these two dimensions, together with some illustrative examples.

A wide variety of forms and cases of public participation can be mapped in this space. The upper left quadrant comprises forms typically elicited by a sponsor and characterized by low-intensity participation by nonexperts in knowledge production, e.g., a public opinion survey. The lower left quadrant contains spontaneous mobilizations that do not significantly impact the dynamics of research, e.g., residents' protests against the decision to locate a radioactive waste site in their area. The lower right quadrant includes "spontaneous" forms of knowledge co-production, such as those exemplified by the Woburn residents or by the AFM. Finally, a participatory initiative like a consensus conference on a science issue organized by a sponsoring institution can be placed in the upper right quadrant (high degree of elicitation, high degree of intensity).

Over time, public participation with regard to a certain issue may move along one or both dimensions: for instance, when a public protest induces an institutional sponsor to organize a consensus conference or a citizen panel, or when patient families initially get together to lobby research institutions or drug companies and in the long run decide to establish their own research facilities.

The "open-endedness" of public participation is also emphasized in this interpretative framework. By open-endedness is meant that the output of public participation is rarely entirely predictable on the basis of its structural features or on the basis of the sponsor's objectives; a public protest, for instance, may lead to renegotiation of a consensual decision, just as a participatory initiative originally designed to produce a consensus document may bring to light and radicalize conflicting positions, both among actual participants and—especially when the conflicts are reported by the media—in the broader public arena. Some degree of apprehension for this open-endedness may be regarded as a key factor accounting for the sometimes resurgent temptation, on the part of research bodies and other institutions, to tame unruly public participation through formal initiatives.

The interpretative framework outlined above could be integrated by at least two sets of considerations.

First, the use of inevitably broad labels such as "nonexperts" or "lay public" should not lead us to flatten the intrinsic variety of citizens' involvement and their significantly differentiated capability and interest to shape knowledge production processes. Indeed, some of the most intense examples of participation actually involve highly motivated, highly informed groups—"quasi-experts" among nonexperts, so to speak—that leave large parts of the public potentially disenfranchised. Sponsored and institutionalized forms of participation are by definition selective, and even those aimed at the widest possible involvement—such as the voting referendum—entail a substantial degree of self-selection. In other words, the question of "who participates" remains open for future research not less than the question of "which forms of participation."

It might also be tempting to overemphasize the most intense forms of participation as well as to interpret the different analytical models of interactions among experts and the public as a chronological sequence of stages in which the emerging participatory form obscures the previous ones—e.g., with the critical version plainly obliterating the deficit one or the co-production version plainly substituting for the critical one. Such tendency might be related, among other factors, to how the theme of public participation has been framed at the same time as a policy issue and as a scholarly issue—something to encourage as well as something to study—in a way that may well go back to the long-standing debate on commitment versus neutrality within STS (Cozzens & Woodhouse, 1995; Ashmore & Richards, 1996; Woodhouse et al., 2002; Lengwiler, 2004).

However, it is clear that not only may different expert-public interaction patterns gradually shift one into another but that even at a given time, a certain technoscientific theme may witness different configurations of such interaction, involving different groups of experts and nonexperts. Accordingly, our proposed interpretative framework seeks to account for the simultaneous coexistence of different patterns of participation that may coalesce depending on specific conditions and on the issues at stake—from the "zero degree" of participation entailed by the deficit model to the most substantial forms of cooperation. In this light, rather than "which model of participation accounts best" for expert-public interactions, one of the key questions becomes "under what conditions do different forms of public participation emerge?"

CONCLUDING REMARKS: THE END OF EXPERTS?

Whence derives public participation in science, and where is it heading? In other words, is it possible to identify the factors responsible for its increasing salience—either in its more spontaneous, grass-roots version or as institutionally driven—and is it possible to determine its impact on the dynamics of knowledge production?

An argument frequently adduced to justify the relevance and promotion of forms of public participation in science is the growing frequency with which contemporary democracies must take decisions on issues imbued with science and technology elements: BSE ("mad cow disease"), radioactive waste, GM food, stem cells, nanotechnology. Contemporary democracies are considered ill equipped to deal with such issues, and their current institutional arrangements are seen as unable to withstand a powerful injection of technoscience. "Innovation in natural knowledge and in its technological applications demands a corresponding capacity for social innovation" (Jasanoff, 2004a: 91). However, complex science-related decisions were not uncommon in the past: take, for instance, the decision by the U.S. government to build the first nuclear weapon during World War II or the decision to allow the introduction of pesticides in agriculture—decisions potentially not less controversial than that of introducing GM organisms. Why was there no call for more public participation on those occasions? The answer may be that a number of conditions have changed in the meantime, so that by now largely implausible is the situation that Snow termed "closed politics" (Snow, 1961: 56), where policy makers consult their own trusted scientific experts away from public scrutiny.

One set of conditions may be the increasingly pervasive role of the mass media in questioning not only policy decisions in this area but more specifically the connection between expertise and policy making. They thus substantially shape—in accordance with their own rationales and production routines rather than with those of the scientific community—the selection and legitimation of scientific experts in the public arena (Peters, 2002). Seen in this light, the role of the media is part of the general process eroding the perceived neutrality and *super partes* status of scientific expertise also visible in the action of environmental movements and judicial forums over the past few decades (Jasanoff, 1995; Yearley, 1995; Lynch & Jasanoff, 1998; Jasanoff, 2003). The growing public perception of scientific expertise as interest-laden and unable to provide the scientific community with a consensual voice is damaging the credibility of traditional decision-making arrangements that involve only experts and policy makers (Bucchi & Neresini, 2004b).[9] This perception is accentuated by the mobilization of researchers in the public arena—when they protest against budget cuts or against state regulation of certain research fields, or simply advocate greater public concern with science—increasingly paralleled by the presence of citizens within research laboratories.[10] This suggests an ironical and somewhat paradoxical generalization of the above-mentioned open-endedness—the citizen pressures for more participation that have contributed to undermining the deficit approach may have been stimulated, among other things, by scientists' advocacy of that selfsame approach. Additionally, over the past decades, a series of issues and events—from nuclear accidents to BSE—have contributed to make not just public opinion but also sectors of the expert community particularly sensitive to the implications of technoscience.[11] Pressures for public participation in science can also be viewed as part of more general criticism of the capacity of traditional democracies to represent and include citizens' points of view when addressing global challenges, with crucial decisions being more and more taken at levels not directly subject to citizens' influence. This is the "democratic deficit" that is frequently a matter of concern with regard to, for instance, European or international institutions.[12] Science is obviously not extraneous to such challenges, for it highlights and fosters new processes of inclusion and exclusion that shape the meaning itself of citizenship (Jasanoff, 2004a, 2005).

Callon et al. (2001) account for both specific and general processes by interpreting the proliferation of "hybrid forums" as questioning the double delegation on which democracy used to be founded: to wit, the delegation of knowledge about the world to professional scientists and the delegation of knowledge about the sociopolitical collective to professional politicians. The fragility of this double delegation, originally intended to confine uncertainty within specific institutions where it could be appropriately dealt with (laboratories on the one hand, parliaments on the other), is revealed by the endemic uncertainty and innumerable controversies that arise in connection with science and technology. Whence derives the need to move from a democracy of delegation to a "technical democracy, or more exactly to make our democracies capable of absorbing the debates and controversies provoked by the rapid advances of science and technology" (Callon et al., 2001: 23–24).

In similar vein, Latour has called for the institution of a "Parliament of things"—where both nature and social collectives can be thoroughly explored—and for the design of new "rules of the method" to guide the sociotechnical experiments—like global warming, BSE, GM food—now blurring the boundaries between experts and nonexperts as well as the boundaries of laboratories, which expand to encompass houses, farms, and hospitals (Latour, 2004).

It seems difficult to predict that the development of public participation in science will result in the outright disappearance of professional experts and their replacement by widespread socially diluted knowledge. One reason for this, besides those already mentioned, is that the model of knowledge co-production, undoubtedly commonplace in certain areas of biomedical and environmental research, does not seem equally applicable in other fields of scientific enquiry such as theoretical physics (Callon, 1999). Moreover, a significant number of the initiatives envisaged and the positions taken up by policy makers and representatives of the scientific community with regard to public participation reproduce an idea of a public that must be suitably "involved" to forestall uncontrolled mobilization.[13]

Public participation warrants attention not only because it may be a solution to a decisional impasse on technoscience issues or to a crisis of representativeness, but also because it exposes the inevitably political nature of current dilemmas. Both the technocratic option ("leave it to the experts") and the ethical option ("leave it to the conscience of individual users or producers") have for long been used to confine—respectively, in the domain of expertise and ethics—tensions that arise in areas typically pertaining to politics. Participatory experiences highlight, among other things, a growing endeavor to bring back into mainstream democratic politics those transformations driven by science and the economy that modernity sought to exclude from it (Beck, 1992). Defining which politics and which democracy, however, is far from straightforward.

On this view, public participation, with its variety of expressions, is not merely a *response*—albeit undoubtedly more sophisticated than that set forth by the deficit model—either to the need for democracy to keep pace with the headlong advance of science or to the need for science to adjust to public pressures and demands.[14] If the "anaesthetization" of politics by the massive injection of technoscientific expertise has been not sufficient to deal with crucial dilemmas, this is not a reason to expect that those same dilemmas will be solved simply by injecting democratic arrangements into science, especially if democracy is defined with its most simplistic meaning of "majority voting." Democracy, like science, cannot be taken as given; just as the latter is transformed by the entry of citizens into research laboratories, so the former is transformed when, for instance, scientists protest in public or propose a "compromise" on the public funding of stem cell research (Shaywitz & Mellon, 2004).). From a broader historical perspective, this role of science in the development of democracy has been significantly documented as regards not only the mere supplying of technical competences for policy deliberation but also the shaping of democracy's argumentative styles.[15]

Moreover, emerging forms of knowledge co-production challenge the conceptualization of expert and lay knowledge as discrete sites (in a unilinear or dialogic communicative relationship, respectively, according to the deficit model and the critical approach) as well as a model of interaction centered on the individual (as a cognizing individual in the deficit model, and as a socialized individual in the critical approach). On the one hand, those conceptualizations impede understanding of the variety of lay knowledge and the conflicts internal to it; on the other, they make such knowledge impervious to general cultural dynamics. As a matter of fact, the citizen's identity itself increasingly includes substantial elements coming from science, mediated, for example, by practices like consumption (Michael, 1998, 2002).

Straightforward confrontations between experts and the public are being replaced by unstable, hetereogeneous "ethno-epistemic assemblages" of experts, citizens, patients, stakeholders, and human and nonnonhuman actors (Irwin & Michael, 2003). Yet "participation" should not be reified as a circumscribed, static event—nor, in the perspective of certain institutions sponsoring participatory activities, as a prerogative that can be switched on and off at will. Rather, it should be viewed as a process that fluidly assumes different contingent configurations. A certain notion of the relationship between professional experts and the public—for example, as segregated categories in the deficit model or as inextricably intertwined as in the co-production model—is in itself a result of, and not a precondition for, the struggles, negotiations, and alliances taking place in those configurations. Nonexperts' interactions with technoscience are embedded in a wider "civic epistemology," which in turn includes participatory styles as one of its central elements (Jasanoff, 2005).

In broader terms, public participation is today one of the key dynamics at the core of the co-evolutionary, co-production processes (Nowotny et al., 2001; Jasanoff, 2004b, 2005) redefining the meanings of science and the public, knowledge and citizenship, expertise and democracy.

Notes

1. The Stranglers, "No More Heroes," UA records, 1977.

2. For an overview, see, for instance, OECD (1997), European Commission (2002).

3. See also Cooter and Pumfrey (1994).

4. See, for instance, the European Directive 2001/18/EC on the release of GMOs into the environment (European Commission, 2001b) or the UN document "Agenda 21" (available at: http://www.un.org/esa/sustdev/documents/agenda21/index.htm).

5. Possible examples include the European "Science and Society" action plan (2001a) and the U.K. House of Lords Science and Technology Committee *Science and Society Report* (2000).

6. See also Levidow and Marris (2001), Irwin (2004).

7. For an overview, see Rowe and Frewer (2000, 2004); for analyses of specific cases see also Guston (1999), Mayer and Guerts (1998), Marris and Joly (1999), Irwin (2001).

8. For a critique of the "transfer" communication paradigm with regard to science communication, see, for instance, Bucchi (2004).

9. Conflicts of interests and their public exposure have become a growing concern for the scientific communities. See, for instance, van Kolfschooten (2002).

10. See for example the case study of recent researchers' mobilization in Bucchi & Neresini (2004a).

11. With regard to the expert community, recall, for instance, the forming of groups like the Union of Concerned Scientists or the debate that in 1974 led molecular biologists to propose a moratorium on recombinant DNA experiments (cf. Berg et al., 1974).

12. For an overview of this theme with particular regard to EU institutions, see, for example, Burns and Andersen (1996). A more specific discussion concerning science and technology governance is in Levidow and Marris (2001).

13. A striking recent example is offered by the concluding report of the European Group of Life Sciences (2004): "One lesson to emerge after a decade of controversies (GM food, stem cells, reproductive technologies . . .) is that research, development and innovation can hardly prosper in the face of social opposition to science."

14. It has been argued, in fact, that enlarging the number of actors involved in knowledge production and negotiation reduces the efficiency of decisional processes, making them slower, more muddled, and ultimately fragile (Stehr, 2001).

15. This is, for example, the thesis of Ezrahi (1990), who considers the emergence itself of democracy as indebted to the "attestive" style of the experimental method, as opposed to the "celebratory" style of absolutist regimes.

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