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Socially distributed knowledge: five spaces for science to meet the public

Helga Nowotny

By definition, science meets the public in a space which is public. This paper rests upon the assumption that this space has been considerably extended, and continues to differentiate. Imparting scientific knowledge is highly dynamic, and has led to a process of socially distributed knowledge through which an increasing number of heterogeneous sites in society are being created where knowledge is produced. Five public spaces are presented, ranging from the space of individual scientific creativity drawing upon cultural representations available in society, to a space in which ethno-scientific knowledge and practices encounter scientific ones, followed by the space in which the process of professionalization of expert knowledge and standards interlinks with protoprofessional knowledge and standards. The last two public spaces of encounter, the market and the hybrid space of public forums, are perhaps the most familiar. While the concrete patterns of interaction take very different forms, ranging from cooperative or reinforcing to confrontational, it is claimed that the boundaries separating the public from science are becoming more fluid. As a result, not only the public's knowledge of science, but also scientific and technological knowledge, are transformed through these structures.

Introduction

Writing on science and the public, Steven Shapin recently remarked that even historians and sociologists of science, on the occasions when they do consider the categories of science and the public, tend to assume that they know with self-evident certainty who is a scientist and who is a layperson—where science ends and where other forms of culture begin. Shapin's observations find ample confirmation in the literature on the public understanding of science. There, much emphasis is placed upon the nature and structure of specialized contexts in which transmission of scientific knowledge and its reception occur, and how they impinge upon, shape or distort the knowledge transmitted. Whether these contexts are schools, museums, television and other media or the more diffuse context of societal discourse about science and technology, the underlying image is invariably one of a knowledge transmission line, in which a sender—a scientist—tries to address a receiver—the public. Emphasis centres either upon the structuration of the institutional context in which transmission occurs, with its resulting biases, contingencies and distortions; or upon those who, as a loosely structured public, receive, use and integrate scientific and technological knowledge in specific and highly selective ways, fitting it into their everyday world of understanding and daily concerns. Rarely, however, are questions asked about the points of departure in this transmission chain, the contexts in which scientific knowledge itself is constituted before its diffusion, and whether and how interaction with the public occurs at this stage.
This is all the more surprising, since social studies of science assume that societal influences impinge upon the social construction of scientific knowledge. Hence, one would expect that science meets the public not only at the receiving end or in the course of a diffusion and transmission process, but even prior to diffusion, namely in the process of scientific knowledge becoming constituted. Science, as Marta Fehér has pointed out, needs no cognitive support from the public: but it does need, and to an increasing degree, their moral, political and financial support. More precisely, though science needs no external cognitive support, it needs cognitive approval and acceptance of its knowledge claims. To this end, science has to exercise its cognitive authority on and impart knowledge to the public, in order to get the approval, and with it the political and financial support, of those laypeople who are otherwise denied cognitive access to science—a situation which needs very careful balancing.

In this paper I will take this argument one step further. The process of imparting knowledge to the public has to be seen as a highly dynamic one. Rather than forming two fixed and immutable points on an imaginary linear transmission line, science and the public are instead linked by a complex web of interactions which take place in what constitutes a manifold public space in which scientific and technological knowledge becomes increasingly distributed throughout society. It is the extremely powerful and efficient process of social distribution of knowledge into ever wider segments of society which creates the increasing number of sites in society where new knowledge continues to be produced in different contexts of application. It is this space which creates the context in which scientific knowledge transmission to the public is being redefined. The process of the social distribution of scientific knowledge itself is based on a general rise in educational standards and, more generally, on the success of the cultural, as well as the technological, message of science to society. It has led to a rising number of knowledge experts and protoexperts distributed throughout society, men and women who possess scientific and technological knowledge of different kinds and degrees and know how to apply them in different contexts, thus contributing to the production of novel configurations of knowledge and knowledge claims. In the traditional view scientific expertise becomes reduced to the epistemological status of lay knowledge outside a relatively narrow field. What actually happens, however, is a highly differentiated and context-dependent spread of expert knowledge distributed through society which is called upon and activated in very different contexts of use. The result of these processes is a much closer interaction of expert and lay knowledge—or, as I prefer to say, expert and protoexpert knowledge—which cannot fail to influence scientific and technological knowledge in the making. Unless these patterns of interaction with a protoexpert or lay public, and their impact upon the form and content of the constitution of scientific expert knowledge, are taken into account, we are in danger of clinging to an outdated model of scientific knowledge in which it is immune to societal influences.

In the following I will outline five different contexts or public spaces in which science meets the public. The notion of the public is itself dynamic since the public continues to be constituted and reconstituted through the process of social distribution of scientific and technological knowledge. The public is therefore highly heterogeneous, well informed, and possesses expertise or protoexpertise; it also articulates its own interests and views which depend upon the context of the encounter and potential use. These contexts represent structured societal spaces of discourse and knowledge claims, through which a mixture of expert, protoexpert and lay interests become shaped and legitimated.
The five public spaces

1. The public space of individual scientific creativity and of socially determined knowledge structures

Scientists are embedded in social contexts: they are members of the society of their time and place. While it is undoubtedly individual scientific creativity which is at the root of productivity in science, this creativity needs to encounter, and become transformed by as well as transform, the public scientific knowledge shared by the scientific community. This process of interaction whereby the private scientific imagination meets with publicly validated and objectified scientific knowledge has been described many times. Gaston Bachelard resorts to the unconscious as a shared collective resource. Speaking about the poetic or scientific imagination, he insists that in the sudden, unexpected flash of thought or image, what arises is spontaneous and seemingly without antecedents. Surprise results from the fact that such creative images emerge from the unconscious and are hence free from causal links binding them to what has existed in the past. The creative image does not associate with, nor can it repeat, anything that already was, because it is new. The function of the real is necessary in order to communicate the new. The image must be capable of producing a resonance, a reverberation or excitement in others who have never seen nor heard of it before, and yet feel deeply touched by it since they are able to recognize it.

Although, and this is the function of the unreal, nobody has experienced nor lived the image before, it can take hold of a common, shared imagination. Through its communicability it touches something more profound than lived experience.4

In a sophisticated and detailed way based upon the work of Galileo and Einstein, Jürgen Renn has analysed the social and individual aspects of cognitive structures. They are not universal, but depend on the historically given material tools of how knowledge is represented, such as scripture, printing and other information processing technologies. Without these material representations, knowledge can be neither communicated between individuals nor transmitted in history. Cognitive structures are the results of the appropriation by individuals of the knowledge available in a given historical period. They appear in individual variants that are the result of modifications and extensions by individual experience. Renn proceeds with a detailed reconstruction of cognitive structures, illustrating the relationship between the social accessibility of knowledge and individual intellectual progress. Galileo, for instance, participated in the integration of the technological knowledge of his time, embodied in the artisan tradition, as well as in the philosophical and scientific knowledge, embodied in the intellectual tradition. In these interlinkages, as in other accounts of human creativity, a recurrent feature appears. Individual cognitive structures 'happen to be suited' because they emerge as individual variants of socially determined knowledge structures. This can be found even though the relevant intellectual context initially had little to do with the problems for which these structures eventually provided sometimes epoch-making solutions.5 It is therefore the access to the socially distributed knowledge of the time, and the individual's idiosyncratic and unique way of appropriating and modifying it, which marks scientific creativity.

Public scientific knowledge in these instances is embodied by a highly specialized group of practitioners and peers, whose expert knowledge, consensus and validation practices are indispensable in bringing about the agreed, and hence public, character
of the knowledge thus validated. And yet, as Shapin and Schaffer have shown in their
fine case study of the Hobbes–Boyle controversy and of the circumstances in which
experimental practices became institutionalized in the seventeenth century, it was
important that experiments were witnessed. Boyle insisted that witnessing be a
collective act. Virtual witnessing on the part of a selected lay audience served as a
practical option for the validation of experimental performances. Matters of fact were
to be produced in a public space: a particular physical space in which experiments
were collectively performed and directly witnessed and an abstract space constitu-
ted through virtual witnessing. The problem of producing this kind of knowledge
amounted to maintaining a certain form of discourse and a certain mode of social
solidarity.

Some authors maintain that the public culture of science which started, albeit in
a highly restricted and selective manner, with the seventeenth-century witnessing
practices, is today in decline. While science was once thought of as demonstrating the
possibility of cementing many individual and independent sense experiences of the
world into a public sense experience, which then could function as an authoritative
constraint on the validity of claims made by actors in the social sphere, the belief that
science confirms the world as an observable object and that seeing is a public act of
knowing no longer commands wide consensus. The discontinuities between the scien-
tific notion of public knowledge as knowledge resting upon intellectually detached
applications of rigorous intellectual norms of describing experience and reasoning,
and the more ordinary popular notion of public knowledge as widely shared infor-
mation, have become blurred, undermining thereby the authority of science in the
larger social context.7

The public space of individual scientific creativity is therefore embedded in a wider
manifold space. It maps the process of transformation from the individual scientific
imagination to its recognition and validation through others. What has never been
seen, experienced nor thought before, becomes—as Bachelard describes it—com-
unicable. The innovative image and creative thought can produce resonance in
others, setting into motion the process of the collective production of knowledge. The
private version of science in the making meets the public version, and only when the
public version recognizes the private one can the former transform and contribute to
the latter.

There is yet another space where science encounters and is embedded in a public
culture of science. Beginning with the institutionalization of experimental performance
and the public being admitted as witnesses, science as cultural practice and as authori-
tative pronouncement on the natural world and its functioning was carving out its
space in the wider societal order. But the public did not remain present solely in its
role as passive spectator. Developments internal to the culture and practice of science
and developments in the wider societal sphere became increasingly intermingled.
Public witnessing has become a much more complex task. It no longer can rest upon a
naive notion of seeing and believing, but has come to include notions of an active
construction of the world, of making it. The public culture of science demands novel
forms of involvement of the public, if the authority of science as cultural practice is
to be reconstituted in accordance with more widely diffused and less centralized
standards of public discourse and action. As Shapin and Schaffer have already noted
for the seventeenth century, solutions to the problem of knowledge are solutions to the
problem of social order. And an altered social order, we might add, comes with altered
solutions to the problem of knowledge.
2. The 'great divide' reconsidered: the public space where science meets ethno-sciences

Ethno-sciences, the belief of systems and practices of groups and societies outside the boundaries of modern science, as well as folk knowledge in Western societies, continue to be a fascinating labyrinth of knowledge in their own right. Mythologies and the history of ideas, in both European and other cultures, are full of powerful images and narratives inviting us to consider tantalizing similarities or differences on a meta-level. The question of whether differences exist in modes of thought between Western and non-Western societies, between traditional and modern, pre-scientific and scientific, literate and non-literate or industrial and non-industrial, has occupied generations of anthropologists, historians of science, sociologists and philosophers. The answers have differed, depending on time and place and on their closeness to or rejection of an implicit Eurocentric point of view. The answers given can not be separated from the more fundamental relationship existing between Western societies and the others, nor from the assumption or rejection of a 'great divide' separating scientific and Western thought from all other. Today, with a greater openness towards cultural relativism and a willingness to perceive continua in place of sharp dichotomies, interest has shifted more towards the discovery of commonalities than differences. The specific ways in which conflicts between modern and pre-modern, Western and Vedic, scientific and indigenous systems of beliefs and practices are articulated, accommodated or resolved, are of far greater interest than the search for answers grounded in principles of dubious ancestry and often based upon notions of Western superiority or exclusive rationality. In a period of global awareness, other cultures and their scientific practices and styles, including ways of doing science, have moved to the centre of attention in their own right. They provide an intriguing point of entry into exploring cultural diversity and analysing the impact of modern science and technology upon other cultures.

In many developing countries, ethno-scientific and indigenous cultural practices often have entered complex configurations of alliances or opposition which are at the same time scientific and highly political. Modern science is often perceived as being linked with prestigious 'big science' projects, espoused by a political leadership that is more intent on immortalizing themselves and upgrading their military strength than on utilizing science and technology to improve the lives of their people. International development agencies have learned that they ought to seek ways and means of building upon indigenous knowledge and practice, rather than forcing Western modernization models upon people. Some are looking for innovative ways to combine a 'high tech' and 'high science' approach with resources readily available in the country and with local cultural practices with which people are familiar. The encounter of science with a public rooted in non-Western traditions and belief systems is then shifted to a ground which is both intensely political and global, containing a heterogenous mixture of unequal access to resources, levels of education and the like, and vigorously local, for it is here that solutions will have to be worked out. A sense of urgency with regard to the necessity of combining the local and the global has recently appeared, as has the pressure towards halting the degradation of the environment. This has opened up a new scientific and geo-political space in which science encounters the actions of millions of people yet to be brought under its spell.

But some of these people possess ethno-scientific knowledge which is of interest also to twentieth century science. The concern about biodiversity, for instance, has led Western pharmaceutical companies to set up projects with the aim of exploiting more...
fully such indigenous knowledge. The commercial apparatus attached to such scientific pursuits adds a new twist to an already complicated relationship.

A global economy and a world-wide network of information and communication technologies have practically obliterated the notion of a 'great divide'. With it, assumptions about the nature of different modes of thought and of different kinds of knowledge and rationality have also shifted and assumed a more relativistic stance. As in other public spaces, politics has entered together with science. From constituting a somewhat esoteric field of scholarship with a romantic-nostalgic touch for 'otherness' in the aftermath of colonialism, the pre-scientific space of indigenous knowledge and different cultural practices around the globe has become politicized where global environmental issues are concerned. The globality of their challenge negates any complacency with regard to science possessing all the answers. Yet, whatever new solutions are found, they are unlikely to work without accommodating the different cultural practices, knowledge and belief systems of people growing up in a space where ethno-science and science still have to work out a functioning partnership.

3. The public space of professional and lay knowledge: the case of health and illness

One persistent body of folk knowledge deals with notions of the body, health and illness. Ranking highest in public interest in science as evidenced by public opinion polls, the lay representation of health and illness reveal the social patterning of such representations. They are grounded in a structural-economic and cultural context. But they also form part of belief systems, which in themselves are systems of interpretation. Typically for this space, the distinctions between what constitutes medical or professional knowledge, with its scientific basis and validation, and the struggle for social control and market shares are not easy to draw and shift through historical time and space. Important discrepancies persist, for instance between lay notions and representations of what constitutes a common cold or how to take prescribed medicine and the corresponding notions and interpretations of the medical profession. Since the individual patient is faced with the authority of the medical profession in a highly unbalanced power situation, lay beliefs are likely to be acted out only in secret—while still having an effect upon the efficiency with which a health system functions. It is only under the condition that lay representations can organize themselves collectively and in public, that they may acquire more weight. This is partly what self-help movements set out to achieve. But it was the more substantial pressure of rising costs of health care and delivery systems that eventually led to a partial shift towards demedicalization, i.e. the de-emphasizing of 'purely medical' factors and the inclusion of non-medical, especially behavioural dimensions, such as a healthy life-style. The AIDS epidemic, while it urges us to search for a vaccine and for an effective treatment, has also revealed the importance of social behaviour in preventing or slowing the spread of the disease. Socio-somatic illnesses have also laid bare a range of factors which are not medical in the strict sense.

Thus, the public discourse on health and illness, and the medically controlled space in which it occurs, has been gradually invaded by non-medical, especially social factors, and by protoprofessional knowledge claims about their links. Abram de Swaan has described how the processes of professionalization and protoprofessionalization were initiated in the nineteenth century. Doctors, but also social workers, lawyers, psychologists and their like, were engaged in a continuous formative and

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informative practice, providing their patients and clients with facts, explanations and advice. In these ways, by first absorbing professional notions and attitudes and then passing them on to others, a simplified and censored version of professional knowledge was gradually transmitted throughout society. The citizens of the welfare state were taught the essentials of hygiene and a limited repertory of diseases, their symptomatology and cure. In the process, people were transformed into more or less competent members of society. The medical profession in particular rose in esteem and the supply of medical services has ever since continued to increase the demand for them. In the course of this process, people increasingly orient themselves in everyday life to the fundamental notions and stances of the professions, and they adopt corresponding standards of behaviour. They do not become professionals themselves, but rather protoprofessionals, i.e. professionals in embryo. It is the external effect of the process of professionalization that extends to ever-widening circles of laypeople. But there is a reverse side to it. Well-informed laypeople will increasingly articulate their troubles as problems for professional treatment and seek corresponding professional services for the problems so defined. Professional helpers, in turn, will be more inclined to accept the clients who in their perception clearly present problems with which they feel competent to deal. Today, one can observe the extent to which protoprofessionalization in turn makes its impact felt upon the process of professionalization. While still redefining their own troubles in terms borrowed or learned from the professional vocabulary, patients have elaborated and extended such knowledge. They have become competent protoprofessionals, and in this capacity confront the professionals with their own version while seeking a better fit between more overtly competing versions.

But there are also trends pointing in opposite directions. The level and extent of the spread of protoprofessionalization in society remains highly unequal. Demedicalization is accompanied by the trend towards a new medicalization, i.e. attempts to ground health and illness more firmly on a strictly medical-biological basis again. This is particularly the case with the new possibilities offered by genetic diagnostics and gene therapy. While research on the human genome has been accompanied by a certain amount of overselling, a clear tendency for redefining health and illness in the language of genetics cannot be overlooked. In a recent commentary, Benno Müller-Hill spells out some of the likely disastrous consequences for the life and employment chances of those who have been diagnosed with a genetic disability. But he refuses to let the responsibility for this lie with science for putting such diagnostic possibilities at the disposal of society. He foresees—and hopes for—the advent of public protest movements among those who have decided not to reveal their genetic identity and others likely to suffer social disadvantages. A turning point will come when genetic injustice has become so immense that the law will have to protect genetically disadvantaged groups. What is of interest in this scenario is the interactive link foreseen with a strong public reaction based upon pressure to make science more responsive to social demands that is likely to follow the ‘genetic closure’ in the definition and handling of genetic diseases. By calling for future genetic minority rights, the public discourse about inequality and genetic injustice is expected to lead to new societal measures protecting against the intolerable social consequences of what scientific knowledge will be able to reveal. Competent citizens, conscious of their rights or demanding new ones to protect them, are expected to grow up alongside with the new possibilities that genetics will put at the disposal of society.

The public space in which health and illness are continuously defined and redefined...
thus constitutes another, partly controversial space in which science meets the public. On an individual level, the protoprofessionalization of citizens remains highly uneven. Laypeople retain private notions about their state of health and illness together with beliefs about their causes. They resort to a variety of coping strategies, including many other concepts, vocabularies and practices current in society. But the spread of education and socially distributed knowledge, and a demand for participation in matters concerning them as patients with rights, if necessary against professional experts, has led to new levels in the process of protoprofessionalization. They manifest themselves in self-help movements and in the insistence on including non-medical factors and interpretations in the professional repertoire of expert knowledge. At the same time, especially through the newly opened possibilities of genetic diagnostics and gene therapy, a trend towards remedicalization has set in. To counter it, citizens probably will have to resort to the public articulation of their griefs and to finding ways of redressing or preventing them. The process of protoprofessionalization through which laypeople increasingly orient themselves in their everyday life to the fundamental concepts of the profession and adopt corresponding standards of behaviour has been widened by a greater willingness to contest professional dominance when necessary and to insist on the value of taking protoprofessional expertise into account. It is highly probable that this tendency will continue to spread.

4. The public space of the market

This is probably the most familiar and seemingly the most accessible public space in which science and technology encounters the public. Although it is now recognized to be a naive and obsolete view to think of basic science proceeding through applications to technology and finally to marketable products, the market remains primarily interested in products which, whether they have a science-based origin or not, will sell. What has changed is the role played by science and technology in the process of innovation. They have opened up a previously unimaginable field of discoveries, a flow of constant innovations consisting of novel products and processes, and of instruments and new uses leading to further innovations. Single inventions or innovations have been supplanted by methods of how to invent and innovate.

As a public space where science and especially technology meet the public, the market has also undergone an evolution. It is no longer served on the supply side by independent and lone inventors, who make their discoveries and inventions to be taken up, or not, by an anonymous and unstructured mass of potential buyers and users. As Thomas Hughes has masterfully shown, the rise of the market open to the products of science and technology went hand in hand with the creation of the large technological systems of the modern world, replacing a natural environment with a human-made one. Modern technological systems are extensions of the inventions made by independent inventors before and around the turn of the century. They were incorporated and extended by so-called system builders, people who succeeded in building technological systems of immense size that embodied not only technical components, but also mines, factories and organizations such as business corporations, banks and brokerage houses. Especially in the United States, they encountered a nation committed to mass consumption, freedom of enterprise and capitalism particularly suited to their goal of technological system building.14 The market came in the form of a labour market and a consumer market, as a market for mass production and
for mass consumption. It is only if we remind ourselves of these complex interactions that we can fully appreciate the present situation.

This can be characterized by considering science and technology as the core of incessant innovation, the driving engine for economic growth and international competitiveness. Today, technological innovation takes place in many different and heterogeneous contexts of application. Innovation is most intense wherever the producers and users or potential clients have succeeded in establishing close interactive ties and in cultivating reiterative feedback links. The lines separating producers from users are becoming increasingly blurred. A famous example is the case of scientific instrumentation. Originally produced in scientific laboratories for specific purposes, it undergoes various transformations and partly unpredictable developments when moving into other contexts, such as other laboratories, business and finally the market. It has been shown that great improvements may occur through commercialization, by making instrumentation accessible to a much larger industrial and research population. Incentives operating in businesses mean that they will find new uses, thus expanding the total population of users and hence increasing the market. It has also been shown that while initial performance levels are generally poor and/or unpredictable, requiring materials or components not yet available or with potential bottlenecks, the return to further basic research during which the new questions were raised has led to these questions moving the products in new directions.15

The public present in the high tech market are likely to be users with a scientific and technological background. While this is typical for innovation taking place in specific contexts of application, analogies can be drawn with the process of protoprofessionalization described above. The close interaction of producers and users of technological innovation also takes place in a space where a heterogeneous mixture of skills and experience are exchanged and brought to bear interactively. But protoprofessionals and professionals in these instances are more likely to be engaged in a collaborative venture in the so-called pre-competitive phase of innovation, with competition being reserved for a later phase.

Ultimately however, the market is destined to sell products to customers. The influence the general public can make felt is through market mechanisms. With regard to innovations, the market is far from being an omnivorous black hole. It is highly selective in taking up only a small percentage of all innovations made. It provides a filter for different performance criteria that are in demand, with technological criteria constituting often only a relatively minor part when compared to economic and other criteria. The larger the technological system which is already in place, the more difficult it is for a newly arrived scientific or technological innovation either to find its place or to replace a more established technology. Technological systems therefore exhibit a degree of inertia or robustness that makes them difficult to change by other means—including by means of public policy.

Another noteworthy tendency here is that purely technological factors cannot be easily distinguished from and need to accommodate the others, notably financial, economic, judicial and organizational factors, thus making more room for them. The public participates through the way in which these differentiated institutional spheres function, rather than being involved directly. Due to the increasing demand for financial support for research, however, the public is increasingly called upon to lend legitimacy to the allocation of resources and the priorities set. In our study of high-temperature superconductivity research, for example, we saw how science, in this case basic science, met the public through the shared expectations of the potential
technological applications that research might yield, even though these were still in a
distant and uncertain future. The public space of the market operates in this and in
an increasing number of similar cases as a space for public legitimation of resources
for science and technology.

5. The hybrid space of public discourse

The last interactive setting to be considered here is the more recently evolved public
space in which science- and technology-related controversies have gained ground and
political visibility. Because scientific and technological knowledge constitutes an
important input, the role and function of scientific expertise has emerged as an issue
and the authority of science has become publicly contested. The contestants in a
controversy are able to organize themselves by having access to resources such as
scientific expertise, often in the form of scientific counter-expertise. The stakes include
not only the controversy itself, but also issues such as the right to democratic decision-
making and participation, and of discussing which direction future scientific and
technological developments should take. Science meeting the public assumes here its
most direct, confrontational and political form of expression.

The hybrid space of public discourse is not inhabited by all sciences. Public
concern is particularly acute about environmental issues and issues related to potential
technological risks. Since it is a non-market space, utilitarian or economic arguments
that dominate in the market are superseded by political, social or moral ones. These
so-called 'non-scientific' criteria are pressed upon science in public: there is open
advocacy to take them into account. Indeed, as the controversies over technological
risks show, eventually a lay notion of risk had to be accommodated. Michiel Schwartz
and Michael Thompson argue on the basis of cultural theory that in a democratic,
albeit conflictual forum, all the different standpoints which are rooted in different
organizational and social structures will have to be taken into account, for only
'divided we stand'.

It is a hybrid space both because experts from science and technology mingle with
administrators, politicians, the media and the public, the latter often being represented
through environmental and other interest groups, and because expertise is confronted
in an open, adversarial procedure with counter-expertise, leading to the creation of a
new kind of knowledge. Protoprofessionalization, in this case of environmental groups
and non-governmental organizations sufficiently capable of organizing expert advice
and utilizing expert knowledge as a resource, has exerted a strong influence upon the
professionals. The once strongly defended line of a separation between 'scientific facts'
and 'values', for example, has had to be given up, and it is generally acknowledged
now that socio-political factors in the widest sense have to be taken into consideration
alongside, and intermingling with, scientific and technical ones. The societal space
of protoprotention has invaded the space of scientific and technical expertise in what
appears to be an irreversible process. The result is an on-going process of knowledge
generated in the hybrid space of public discourse becoming transformed.

In the hybrid space where the public plays an articulate part and where different
sets of actors are legitimately admitted as knowledge co-producers, the production of
new kinds of knowledge can be observed with the traditional demarcation lines
between scientific and technical knowledge and social and political concerns breaking
down. The public's role is no longer confined to the provision of a handful of well-
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selected, gentlemanly witnesses, as was the case in the seventeenth century, nor are they the grateful but passive receivers of utilitarian benefits that science and technology bestow upon them. Rather, the public has become an uneasily admitted partner, inching its way through an ongoing process of protoprofessionalization even into the cognitive domain formerly exclusively reserved for members of the scientific community. The inevitable tensions and conflicts entailed in such controversies are not over.

There is as yet no clear-cut institutionalization of a more public, and hence more responsive and more accountable, science, nor does there exist a truly vernacular version of the environmental sciences. There are also dangers of letting the public go too far, as the invasion of US courts by junk science shows. The two dangers inherent in transgressing the actual demarcation lines between science and its public—between experts and laypeople—pointed out by Harry Collins are those of over-restriction and of over-extension of core-sets of experts. In the first case, too many rigorous criteria are set up for expertise, while in the second, inexperienced and untrained outsiders assume and are granted the right to communicate authoritatively on scientific matters. The question remains of how to find a new balance between these two extremes.

Conclusions

By examining five different contexts in which science meets the public I have tried to show that the boundaries that maintain and the discourses that structure these public spaces are highly fluid and contingent. The production of scientific knowledge itself is embedded in the wider societal context that surrounds it. This holds for individual scientific creativity and the emergence of cognitive representational structures since they are built upon wider cultural and material sources of representation. It holds for the constant interaction between the individual and the collectivity of science in the generation of new scientific knowledge and insights, both of which are linked to and guided by the entire spectrum of cultural representations available in wider society.

The boundaries separating ethno-science and prescientific thought from scientific thought has also become blurred. They represent a continuum rather than a sharp dichotomy, a continuum punctuated and restructured forcefully by political and economic factors of inequalities of access and means, especially in developing countries. In the third space, exemplified by notions about health and illness, the process of professionalization and protoprofessionalization were introduced, although they are not specific to this domain only. Professionalization occurs with expert knowledge gaining scientific authority and social status, while in the wake of rising educational, civilizing and living standards in the population such expert knowledge is diffused and leads to protoprofessionalization. In the domain of health and illness, but also in the market space of scientific and technological innovations, a closer interaction has come about with the lay public, in the form of patients, users and consumers of professional or technical services and products. Depending upon the form this interaction takes, whether it is seen as a challenge that essentially contests expert authority, or whether it appears more in the form of a collaborative venture or co-production, different configurations will emerge of how expert and protoexpert knowledge will meet.

Finally, in the hybrid space of public discourse, the public has had to be admitted as a legitimate partner exerting its democratic right of participation. In a mutual learning process, a new kind of public knowledge is being produced which combines
elements coming from professional and protoprofessional expertise, standpoints and systems of beliefs. What is common therefore to all these spaces is the ongoing blurring of the traditional boundaries separating expert from lay knowledge. This blurring is driven essentially by the twin movement of ongoing professionalization and protoprofessionalization, and their interaction. While invariably the social and cognitive authority of scientific expertise is challenged by the lay partners who gain in education and public participation, as well as in finding access to other professional expertise, initially often in the form of counter-expertise, a closer interaction may lead to mutually beneficial results. This is most readily acknowledged in the market space of technological innovation, although, as the controversies about technological risks remind us, the market space is not devoid of its contesting elements either. By admitting more and more lay notions, interests and concerns, the professional body of scientific and technological expertise is enriched, even though this is often resisted because of fear about losing scientific authority and professional status. But with the process of societal diffusion of scientific and technological knowledge continuing at an accelerated rate, the two processes of professionalization and protoprofessionalization will also be sustained interactively at a higher rate. The concrete patterns of interaction will take very different forms that depend upon the specific context in which either confrontation and search for professional control or cooperation and coproduction occur. There is one general conclusion, however. By making the boundaries more fluid and having to admit protoexpert notions, the very notions of what constitutes scientific and technological knowledge, as well as the expertise and social status derived from it, will continue to be transformed. It is the price to be paid for the successful distribution of scientific expert knowledge into the wider society.

References


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