How Scientists View Their Public Communication

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Public communication of science has conventionally been represented as an activity dependent on, but quite different from, communication between scientists. The 'scientific literacy' and 'public understanding of science' movements were seeking to correct a perceived lack of information or knowledge in the wider society. The corrective was to be found, according to the promoters of such initiatives, in providing to the public scientific information that had been tested and proven in the professional domain. Communication beyond the boundaries of the scientific system was governed by implicit or explicit rules of professional conduct on speaking only about a recognised specialism and only after formal scientific publication. But the decision whether or not to engage in public communication and the manner and content of such communication were matters for the individual scientist, and thus wholly distinct from professional communication.

This orthodoxy within science about the rules for public engagement was reflected in much of the earlier work done in the name of science communication. It was argued or implied that the credibility of scientists in the public space was directly tied up with the reliability of their procedures for verifying and controlling publication of scientific findings. It followed, both as norm and as practice, that scientists said in public only what had been tested in the closed scientific community, albeit in reduced form.

The representation of scientists' public communication or popularising activities as a distinct, discrete field of communication, thoroughly separated from internal scientific communication has been challenged by a number of important studies in recent years. The "canonical" model of the levels and types of science communication has been critique (Bucchi, 1998). A case study of scientists' public work was used to demonstrate the complex webs of internal and external communication (Lewenstein, 1998). An analysis and programme for science communication argued that popularisation was an integral part of scientific communication (Gregory and Miller, 1998).

Increasingly, public dimensions explicitly enter intra- and inter-scientific communication, as, for example, in discussions on science policy, on the possible practical applications and ethical implications of certain scientific developments and on the public and political impact of releasing certain findings. The growing evidence of a crisis of confidence in the public credibility of science appears to be provoking anxiety among scientists about their public role.

In this context, it is important to know how scientists discuss and reflect on public communication and science-and-society relations. They might be inclined to be more

defensive, retreating into the certainties of their professional codes, or they might be inclined to be more open to the inquiries and challenges from those outside science seeking to understand its social significance and intellectual authority.

Our study represents a departure from the more usual focus on the methods and content of scientists' contributions to "public understanding of science", or similar public communications. We turned our attention to the communication between scientists *about* their relations with the public, thus to the backstage communication rather than frontstage communication, as they have been called (Goffman, 1963). According to this distinction, groups use social backstages for planning, managing or responding to their collective public life on the frontstage. We set out to track the trend of these internal discussions and to establish the assumptions scientists make about their public communication. We wanted to find out what the "insiders" thought was at stake in their communications with "outsiders" – funding, employment and authority only, or also the status of scientific values, beliefs and knowledge.

In the central part of our work to date, we surveyed several professional magazines, including their opinion columns and correspondence, for items concerning public communication and promotion of science, relations between experts and lay public, and the standing of science (or the particular scientific discipline) within the broader intellectual culture. In another version of this paper being prepared for print publication, we also analyse statements from professional and science-promotion societies as well as additional publications.

The publications surveyed here are magazines published by and for members of professional scientific bodies, in physics, chemistry and biology. The views expressed in articles published in their magazines may not – indeed, frequently do not – represent the formally held opinions of the organisations that publish them. However, we may reasonably infer from the fact that certain positions are published at least an openness to that point of view. A higher incidence of any given position may, we believe, be taken as indicating greater openness to that position.

We have found significant differences between publications and between scientific disciplines, but it is clear that there is, in general, substantial discussion within most scientific communities on public aspects of science. The larger part of that discussion has to do – as it has for some decades - with the responsibilities and challenges of presenting scientific information to non-expert publics. But some of that discussion relates to the possible contribution of arts, humanities, and social sciences to the better understanding of science's place within contemporary culture and to the constitution of better relations with the publics.

We can identify a number of communicative stances adopted by scientists and their professional organisations to underpin various modes or registers of public communication. These range from imperatives about educating various publics about sciences and persuading them about its benefits, through statements about a moral responsibility to engage with the public, to propositions about possibly learning about science itself through the insights of others. We present these positions as a spectrum ranging from more authoritarian to more participatory positions, or from more monologic (communicating *to the public*) to more dialogic (communicating *with publics*). We suggest that scientists constructing their public role tend to do so on the basis of one, or more, of the following propositions:

> We need to educate the public in science as the leading source of knowledge
> We need to persuade the public about the benefits of science
> We need to persuade students and parents about the value of careers in science
> We need to ensure the public can handle scientific topics more rationally
> We can have social rewards communicating with various publics
> We can learn from the questions and contributions of various publics
> We have a responsibility as generators and guardians of knowledge to be more accessible to various publics
> We have a responsibility to consider with various publics the ethical and social implications of our work
> We have a responsibility as recipients of public funds to be more accountable to various publics
> We want to participate with various publics in the policy process
> We want to participate with other interests in the cultural process
> We want to participate with other interests in placing our work

We group these positions in three bands of unequal width. These correspond to three models of communication – the Deficit, Dialogue and Deference models. The first two have been much commented in recent times. The third refers to a model of communication according to which scientists acknowledge the value of, or "defer" to, the insights of other intellectual disciplines and cultural activities on their own.

Within any band of the spectrum there may be significant variations. For example, the need to persuade the public about the benefits of science may be expressed in terms of a confrontation with scepticism about science, or in more neutral form. Any individual's or organisation's communicative stance may include within its range several points of the scale. A publication's editorial policy or practice may spread over a large part, or even all, of the spectrum.

Paleontologist Stephen Jay Gould, in the preface to his ninth and penultimate volume of collected essays, describes his own movement over the decades from one end of the spectrum towards the other:

> I began the series with quite conventional notions about writing science for general consumption. I believed, as almost all scientists do (by passively imbibing a professional ethos, not by active thought or decision), that nature speaks directly to unprejudiced observers, and that accessible writing for nonscientists therefore required clarity, suppression of professional jargon, and an ability to convey the excitement of fascinating facts and interesting theories (Gould, 2000).

Gould explains that he set out to use humanistic and historical references as a means to faciliate access, but be came to see that the humanistic and scientific components belonged together:

> I experimented with many styles for adding this humanistic component about how we learned (or erred) to standard tales about what, in our best judgement, exists "out there" in the natural world – often only to demonstrate the indivisibility of these two accounts, and the necessary embeddedness of "objective" knowledge within worldviews shaped by social norms and psychological hopes.

In a brief exchange in the columns of Nature, these differences were also demonstrated. Biologist Lewis Wolpert contributed a Commentary under the title, Is Science Dangerous? (Wolpert, 1999) His answer was in the negative, as he drew the line firmly between science and technology. Scientific knowledge has "no moral or ethical value", he wrote. "Science tells us how the world is." In relation to technology, scientists should not be required "to make moral or ethical decisions about its use". Wolpert did consider, however, that scientists had an obligation "to make public any social implications of their work and its technological applications" and he wondered how the public might become involved in decision-making, in order that scientists and other experts "do not appropriate decision-making for themselves".

Two critical responses to this essay were published, both disputing Wolpert's neat divisions of the fields of knowledge and of public discourse. Plant scientist Nick Battey argued that science is dangerous "because it is out of contact with much of its user base", and because "scientists have patronised the non-scientific majority" (Battey, 1999):

> Scientists are boxing themselves into a corner by their inability to see that other people have a legitimate right not to see the world scientifically, and by their poor social skills.

Pablo Jensen contested Wolpert's view of scientific knowledge as neutral, arguing that "all knowledge has been acquired and is therefore a mix of 'reality' and our own way of understanding" (Jensen, 1999). Science's way of understanding is to reduce things.

> Science summarizes reality as much as a football score sums up two hours of emotions, missed opportunities and referees' mistakes.

Nature has for some time published occasional contributions on issues in public communication, and a regular column, Science in Culture. Previously, it hosted a column by art historian Martin Kemp on science and art. The journal, Science, also carries occasional items on public communication and cultural issues in science. So too does the medical journal, Lancet, which ran a series of articles in 1994 under the thematic heading, Medicine and the Media. The mere presence of these articles, columns and correspondence may indicate something about assumed or known attitudes among the scientist readers.

In the next three sections, we review explicit statements of purpose about public communication practices and implicit communicative stances underlying contributions to three magazines published for scientists in three distinct disciplinary areas.

The Biochemist

In 1994, The Biochemist, a bi-monthly magazine, described itself as "The Bulletin of the Biochemical Society". In the late 1990s, it was still published by the Biochemistry Society, but now styles itself "*the* magazine for life scientists". Indeed, a correspondent to the magazine, remarking on the broad interest in the topics covered a special issue on sports and science, lamented that the magazine evoked a "glazed" reaction at his local running club (Twite, 1998). "I know The Biochemist is a specialist journal for life scientists, but we could try a bit harder to bridge the gap between science and the public."

Up to the mid-1990s, however, the magazine was clearly defined as a professional and technical journal. From the opening pages, it was devoted to scientific articles. The only exception made was for news from the Biochemical Society, which, very occasionally and briefly, touched on public education or public communication activities. A correspondent from the University of Pittsburgh drew attention to the use of an image derived from biochemistry in a story published in the New Yorker, and suggested, only half-seriously, it seemed, that "courses on the role of biochemistry in modern fiction … be initiated" (Bentley, 1994).

The magazine's editor, appointed in 1995, is a life scientist, Frank Burnet, an advocate and practitioner of 'public understanding of science' activities. Professional scientists work with the small full-time editorial staff in commissioning, contributing and editing material for the magazine.

The Biochemical Society's policy officer, Mike Withnall, contributes a Policy Matters feature to The Biochemist which frequently addresses issues of science education, both in schools and third-level institutions, and reports on public communication issues or public attitudes surveys. Withnall offered his own response to the "media frenzy" on GM foods in a series of questions, including some that challenged the scientists involved. Noting a commentator's remark that laboratories were "crammed with idiot savants … with a

profound understanding of their own subject, but who know nothing about the political and economic realities which govern its deployment", Withnall meekly asks: "Is this fair?" (Withnall, 1999)

A correspondent in Lewis Wolpert's department appeared to think it was, indeed, fair. She referred to "the often-heard accusation that the genetically modified organisms debate is based more on emotion than scientific knowledge" (Junemann, 1999). The correspondent suggested that this view "gives scientific knowledge a significance which it does not possess … It is important that we can place our work in a wider context where ethics are not dictated by the quality of scientific argument or, for that matter, by purely economic considerations".

Jeff Thomas, a biologist by training but now head of the Centre for Science Education at the Open University observed that "views that link the words 'social' and 'science' within the same dimension are far from popular" in the scientific community (Thomas, 1999). The traditional reliance on science as objective was, he argued, problematic in educational terms. Yet it was still evidenced in the statement of the Biochemical Society's newly appointed Professional and Education Projects Manager that she hoped to "[encourage] more scientists to go into schools to talk about their work", remarking that "students benefit from seeing a new face at the front of the class" (Loosley, 2000).

A signed editorial on the Lords Report, Science and Society, noted the recommendations about encouraging scientists' dialogue with the public but claimed that "the big issue around the quality of science education at all levels has been ducked" (Burnet, 2000a). Another editorial identified "one of the biggest pressures now bearing on science" as being that to remain "accountable to society" (Burnet, 2000b).

Chemistry in Britain

A survey of editions of the monthly magazine, Chemistry in Britain, published in association with the Royal Society of Chemistry, for the years 1994, 1998, 1999, and 2000 showed a notable increase in the space devoted to items on public dimensions of science in the latter two years. The level of interest in these topics was seen to be similarly low (two-three items in a whole year's editions) in 1994 and 1998.

The range of relevant articles published in 1999-2000 included opinion pieces on public policy issues, news items on public controversies and science policy initiatives, readers' correspondence on public attitudes, and notes on Royal Society of Chemistry education support activities. A couple of features explored relations between chemistry and other sciences, and between chemistry and humanistic and artistic endeavours.

Comment pieces and other items on public communication activities tended to emphasise the task of persuading school students to pursue studies and careers in chemistry through

promotion of a more attractive image of the discipline. They also dwelt on the need to improve reporting procedures within the chemical industry as a means to improve public confidence.

A reflection by the secretary-general of the Royal Society of Chemistry, Tom Inch, on the society's public understanding of science activities restated these tasks, but noted that these activities were not necessarily delivering the hoped-for results (Inch, 1999). "New approaches must be found to counter the negative perceptions that many people have about the method of science and its potential social implications," he wrote. In an interview, Sir Robert May, the chief scientific adviser to the UK government, suggested that public cynicism about science may be due to experience of science in school – the "new approaches" this critique suggests are not explored (Evans, 2000). .

The small amount of readers' correspondence addressing public aspects of chemistry is balanced between appreciation of the demands of two-way communication and definition of communication tasks and responsibilities in terms of the public's ignorance and gullibility.

The single largest bloc of relevant items appeared in the Comment section, to which industrialists, journalists and politicians, as well as scientists, are invited to contribute. One scientist-contributor Colin Pulham, winner of an award for his public communication activities, wrote of his disappointment that some scientists still see no point in explaining science to the public. This attitude, he said, "plays a major part in damaging the image of science, and chemistry in particular" (Pulham, 2000). Pulham declared that "every one of us has a moral obligation to promote public understanding of science". Among the reasons for doing so was "the issue of accountability … a significant proportion of public money is spent on science and people have a right to know how and why it is being spent".

In another Comment, the head of science policy at the Royal Society of Chemistry, Rodney Townsend argued that to change the public perception of chemistry, chemists needed to be "more assertive, even aggressive", as "chemistry is more exciting, more intriguing and more relevant than it has ever been" (Townsend, 2000). This appeared as an apparently unconscious endorsement of the description of British academic chemistry as having a "siege mentality", though the author of that description was urging a closer engagement with the life sciences, in place of the more common defensiveness (Naismith, 2000). Bob Jones, an industrial chemist, was earlier critical of colleagues in insisting on the break between science and technology. Separating them, he said, was "a defence strategy, designed to protect science in the court of public affairs" (Jones, 1998).

The "conservatism and self-satisfaction of most chemists" were targeted by Dennis Rouvray, professor of chemistry at the University of Georgia, in a provocative exploration of the discipline's evolution over 300 years (Rouvray, 1999). Rouvray reflected critically on the attachment of chemistry to positivistic modes of thought, but also drew attention to the growing literature from American chemists on chemistry as a human science, linking it with rhetoric, philosophy and literature. In a radical reversal of

the more usual modes of argument, Rouvray described chemistry as lagging behind other sciences in terms of the space it leaves for practitioners to express themselves creatively.

Physics World

This monthly magazine is published in association with the Institute of Physics, but even more than either Chemistry in Britain or The Biochemist, it presents itself as a publication for the interested public. Regular reviews of general-science books and correspondence and comment pieces on the nature and standing of science in general and physics in particular create the space for discussion of sociological analysis of science. This appears alongside material more obviously based on professional self-interest, that has to do with the image problems of physical sciences, the need to make school science more attractive, and the priorities of science policy.

The range of this coverage was narrower, and the level lower, in 1994 than in any of the years, 1998, 1999, or 2000. However, a 1994 editorial commended signs of "willingness on the part of some scientists to talk about their work with (rather than at) non-scientists" (Physics World, 1994a). Another editorial in the same year remarked on the difficulty scientists have in "communicating what be almost spiritual instincts bound up with discovery" (Physics World, 1994b).

John Ziman, a physicist and prolific writer on the nature of science, became a regular contributor to Physics World in the late 1990s. His presence ensures that readers of the magazine are frequently reminded of philosophical and historical perspectives on science, even if Ziman is himself taking issue with them. A survey of the magazine's readers showed that many wanted more articles of this type. "This came as a big surprise to us," was the editor's comment (Physics World, 1999).

Sociologists of science Steve Fuller and Harry Collins have joined the discussion, both as letter-writers and as invited contributors. Collins was given space to defend his method, revisiting his examples of science-gone-wrong in the field of gravitational physics, and insisting that sociology of scientific knowledge (SSK) is not an attack on science or "on the way honour is distributed within professional history" (Collins, 1998). Three long and considered letters were published in reply, and Collins had a further reply to them.

Elsewhere, teachers and students of physics reflected on ways to make the subject more appealing, for example by making some popular-science texts required reading in first-year university courses. The case was also made for ethics to be included in university courses (Thomsen, 1999). Issues of social responsibility in science were extensively aired in coverage of the 1999 World Congress of Science, with Nobel Physics Prize-winner Leon Lederman quoted in support of calls for an ethical code of conduct for

scientists. French physicist Gerard Toulouse called for protection of those who blow the whistle on scientific mosconduct (Toulouse, 1999).

In the following edition, physicist Joseph Rotblat, founder of the Nobel Peace prize-winning Pugwash Conferences on Science and World Affairs, argued for an ethical code of conduct for scientists, along the lines of the Hippocratic oath taken by doctors.

Coverage of ethical issues in science continued in 2000, as Physics World also responded to its readers' stated interests with a series of article by US science historian, Robert Crease. In the first of these he argued that scientists had no reason to fear a science criticism that would "evaluate the presence of society in science" (Crease, 2000a). But, in a parallel discourse, other contributors continued to promote a more limited mode of public communication. "We need to improve public understanding and approval of physics dramatically," argued Irish physicist, John McInerney. "We must reinvent physics to remain the basis for all science" (McInerney, 2000).

Discussion

Our analysis of the three professional magazines, The Biochemist, Chemistry in Britain, and Physics World, shows significant differences between the three when we assess their positions on the Deficit-Dialogue-Deference spectrum introduced above. The range of The Biochemist only just reaches out of the Deficit band of the spectrum, by virtue of individual contributions. Taking account of the editorials, the magazine's centre of gravity is decidedly within the Deficit band. Chemistry in Britain covers a wider range, and maintains a higher level of coverage of public communication / participation issues, largely through its Comment feature. However, it is only through a single contribution in the sample period that its coverage stretches into the Deference band.

Physics World has both a higher level and a wider range of coverage of public issues than the two other publications. Its editorial centre of gravity is in the Dialogue band, but its invited coverage, and readers' correspondence gives extensive exposure to social, philosophical, historical and other critical perspectives on science. Whether these differences are to be interpreted as quirks of editorial recruitment, manifestations of specific editorial policy, or as reflections of cultural differences within the respective disciplines, may only become apparent when wider samples – including publications from other countries – are studied.

It comes as something of a surprise that The Biochemist, "the magazine for life scientists", is less active than its counterparts in critical consideration of the place of science. For it is from the controversies surrounding applications of biotechnology and genetics that some of the strongest stimuli to the public discussion of confidence in science have come.

One common aspect of the three magazines' output should be underlined: all of them maintain reportage and advocacy of public communication based on a largely unreconstructed deficit model alongside their explorations of alternative perspectives.

We began looking at scientists' communication with other scientists in order to answer some questions. We asked whether these inside communications could make more plain the motivations of scientists. Do scientists communicate with various publics simply as a reflex action to an unhappy consumer? What do the scientists believe is at stake in their communications with the publics? Is it money and jobs only? Or are more fundamental scientific values, beliefs, and knowledge at issue?

Our research would suggest that while the forces of money and jobs clearly are (to varying degrees) at work, there is also significant evidence to suggest a demonstrable excitement and interest in work that merits sharing. More than that, there are some indications of a growing conviction that the experience and exploration of that sharing may offer new insights into the scientific enterprise itself. There is, in general, a strongly held belief that scientific work will somehow make the world a better place - not just a wealthier or militarily superior place - for all concerned, scientists and publics. Of course we can analyse these beliefs as ideologies, conscious or unconscious, but that is beyond our current project. We are more concerned with the pronouncements regarding motivation that scientists are willing to put to one another. Not only did we find these motivations expressed, but we found that the responses to these calls to communicate changed their character even over the relatively brief time that we sampled.

In this research, we have looked at scientists' communications with each other. We did so because we were interested in seeing what the scientists were saying about communicating with the public when they spoke to each other. But the publication of these comments and articles, even in professional magazines, opened up the potential audiences to include more than just other scientists. We need to keep in mind that open correspondence, even of the sort found in editorials and comments in professional publications, is written with the knowledge that people outside of the scientific community can, and do, read them. Thus, the boundaries between ‘backstage’ and ‘frontstage’ communication become blurred.

By taking account of types of public-ness among audiences even when scientists write to one another, we would further a shift that has already begun to recognise the proper role of the public audience in nearly all of science communication. This audience-focussed shift will help to bring to science communication insights that are already firmly established in the field of communication generally.

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