

INTRODUCTION AND OVERVIEW

It is widely accepted that the importance of the communication of science to the public can be summarised under five headings. They are, not necessarily in the order of importance, economic, utilitarian, democratic, cultural and social.

The economic imperative, regrettably, is today the main driving force towards a better scientifically educated public. No better illustration of this is the joint statement of March 2000 that President Clinton and Prime Minister Blair saw fit to utter, that the human genome is the common property of humanity and not the intellectual property of a few entrepreneurial commercial companies. The concept of intellectual property, however, has fuelled many of the arguments in favour of public awareness of science. This is implicit in the Clinton statement that stresses the attainment of national goals.

The utilitarian argument is closely allied to the economic one. It is the view that the public should be scientifically aware because of the way the community uses science. It is often stated that science in everyday life is invisible, taken for granted. And so it is and—probably—so it should be. It is not necessary in everyday life to know how a magnetron works to run a microwave oven, nor much about electricity to be able to switch the light on and off. It is, however, desirable for the public to keep abreast of the general developments in science becoming aware of new applications, such as the use of DNA fingerprinting in identifying criminals, and feeling comfortable with them.

In a sense, the democratic argument is a subset of the utilitarian argument. The general public is often asked to make decisions about new technologies that could have far reaching effects, both on its own wellbeing and on the rest of the world. Trading in carbon futures in an attempt to halt global warming is an example.

Unfortunately, few politicians or financial experts have any scientific training at all. If the expertise is not present at the highest levels where does it reside? The answer is that it has to reside with the community that, through the exercise of democratic rights, appoints the politicians. It is not just wishful thinking to imagine that, eventually, political will, as expressed by scientifically aware politicians, will have an influence on multinational corporations.

Next, there is the cultural argument. Science is one of the things people do and, like all of the things that people do, it can be done at the highest or the lowest level. As Stephen J. Gould has remarked, the best science is like high art, worth appreciating for its own sake and not necessarily because it brings an immediate benefit in material terms to the beholder. The elegant simplicity of Nobel laureate Niko Tinbergen's studies of digger wasps and herring gulls had no immediate 'use',

but for the reader the sheer pleasure of comprehending something of the life of these common animals transcends the need for 'usefulness'. Although a lesser scientist might have achieved the same results, Tinbergen's insight, the creativity of his hypotheses, the elegance of his experiments and the simplicity of his writing combined to produce work that takes science to the highest levels of human endeavour. Mathematicians experience the same *frisson* of pleasure when contemplating an elegant solution to a problem even though a 'quick and dirty' answer might do the job.

Finally, there is the social argument. As science permeates all levels of human activity then an awareness of the basis of science and the issues surrounding it will serve to enhance social cohesion. Much of science has relevance for all cultures and becomes a shared tradition. Unfortunately, it cannot be denied that, as Gregory and Miller (1998) point out

There is no doubt that many in the scientific community who want to further the public understanding of science are really concerned with increasing the public's appreciation of science, with a view to enhancing the status of themselves and their colleagues. (p9)

Scientists are very likely to think in terms of the way they perceive that scientific communication might benefit their own work. A common feeling amongst scientists, as soon as they emerge from the self-delusion of believing that people will not understand what they do, is

if only people knew how exciting my science is they'd give us more money

In spite of much evidence to the contrary, they rarely think

if people knew what we are really up to, they might stop us

Scientists are no more nor no less altruistic than non-scientists. Even men like Humphrey Davy, Michael Faraday and Thomas Huxley, all of whom were outstanding science communicators, were driven by the twin imperatives of the science itself and the need to make a living. Good communication was therefore essential.

As far as the community is concerned, science is invisible until such time as it has a need for it. It is the task of the science communicator to demonstrate to the community that it has such a need. When the need is recognised the rate at which non-scientific members of the community are capable of assimilating scientific ideas is often astonishing.

There have been many surveys that claim that the public would prefer to read about science ahead of sport in the newspapers. They are often cited as a validation for the science communicator and one that should convince editors to include much more science in their papers. The editors, who presumably know what sells newspapers, remain unconvinced, and so does Professor Doherty (see Epilogue).

Yet it is an inescapable fact that several surveys have come up with the same conclusion. The reading public likes to read about science and places it high on their list of priorities. Editorial policy, however, is informed by circulation. It is

clear that editors are comfortable with the view that, while the reading population might like to read about science it doesn't want to read about it too much.

In understanding the community's attitudes to science, it is necessary to distinguish between 'knowledge' of science and 'affect' or mental disposition towards science. Herein lies the dichotomy between the public understanding of science (which rejoices in the revolting short form PUS; as someone remarked, only scientists would come up with an acronym like that) and public awareness of science.

It is good to be sceptical of studies that indicate that the public has a poor grasp of science. Many of these studies contain the seeds of self-fulfilling prophecy. For example, Durant Evans & Thomas (1989) describe work in which general scientific knowledge questions are asked of a randomly selected sample of people. This necessarily constructs an image of a public that is deficient in its understanding of science. Only if everyone answered all questions correctly could this deficit model be challenged. Other studies may have other flaws; if the public is asked what it wants to read about in newspapers, it may give 'science' as the socially desirable answer, or confuse science with medical breakthroughs. If the community is asked whether it is proud of the achievements of its scientists it might answer 'yes' without having a clear idea of exactly why. We can all be proud of the Dohertys and the Floreys without necessarily understanding what they did to win the Nobel Prize.

Only when the public have a specific interest will they turn to the science pages. When they are personally engaged, they will read voraciously and be capable of mastering difficult material with ease. It is the task of the science communicator to increase the 'need to know' and nurture it.

This seems so obvious that it is a surprise when scientists fail to grasp this very simple idea. In the face of declining enrolments in science at secondary and tertiary levels in the western world, and of the obvious disenchantment of young women with science, there is still great resistance amongst scientists to making their work accessible.

Research Councils now include the concept of 'duty' in their instructions to applicants. The Particle Physics and Astronomy Research Council in Britain, for example, states that

We believe that all those engaged in publicly funded research have a duty to explain their work to the general public.

This imperative generates both anger and anxiety among scientists when confronted with it. One of us (CB), in an earlier incarnation, recalls the intense irritation he felt when he had to spend valuable research time on both grant applications and communication with the public. These are feelings shared by many scientists today. We frequently run short, 3-day workshops on science communication for scientists. We have noticed marked variations in response to our opening question 'why bother with science communication?'

The more senior scientists tend to express resentment. They are in denial—their position is summarised by this statement:

people don't need to know about science. They should just let us get on with the job.

When we argue strongly that the community needs to become more scientifically there is a subtle shift of position:

I'm a scientist. It's what I do best. Let other people do the communicating.

Their point of view is easily understood. They grew up in a world of certainties, entrained into science at an early age, secure in the knowledge that there were facts somewhere 'out there' to be discovered and that, once discovered, these facts would immediately be accepted by an admiring public. They were never expected to communicate and may even have gone into science because they were poor communicators.

The ideas that science is culturally dependent, that knowledge is constructed, threaten their mastery of their discipline. They feel uncomfortable, unhappy and yearn for the certainties and security of their laboratories and their white coats. From this position it is a short step to agreement that while science communication might be a good thing it is not for them because

people wouldn't understand what I'm doing.

The sub-text is that their science is so complex and they have invested so many years in acquiring their expert status that they find it difficult to imagine that it can be understood by someone who has not put in the same effort. It threatens both their standing with their colleagues and their self-respect.

This idea that their science might be accessible to a lay public is abhorrent to many western scientists who seek certainty and absolute truth. Theirs is a view akin to those of the mediaeval guilds that protected their knowledge by allowing only initiates into full understanding of the one truth. Knowledge was power and was not to be let go; its communication was only permitted between initiates. It often required special language and signs; and it was not for the general public.

Graduate students and newly fledged scientists do not hold these views so rigidly. They are still only on the verge of disenchantment and have largely retained their enthusiasm for their subject and even some proselytising zeal. It is imperative that this be nurtured.

In summary, increasing the public understanding of science is a worthwhile endeavour that creates an intelligent, informed and skilled group within the community. Such a group is an extremely valuable resource for the community. Increasing public *awareness* of science, however, is a longer term project, but one that, if successful, can contribute enormously to social well-being as it creates a community that is confident in its possession of scientific ideas and is comfortable about raising children to have the same confidence.

It is the intent of *Science Communication in Theory and Practice* to range far across the whole field of science communication. It gives both a theoretical basis for the newly emerging discipline and a series of personal histories, the authors of which are effectively saying 'this is what *we* did' and in all cases, they did it very

successfully. They are offering their experience but none of them is prescriptively saying 'this is what you should do'. What they hope is that the prospective science communicator will shop amongst them and use whatever is fitting for his or her circumstances.

The structure of the book may need some explanation. It falls naturally into four parts, and an Epilogue. Part 1 consists of five chapters that are concerned with the disciplinary basis of science communication. Susan Stocklmayer explores images of science together with the implications they have for the effective communication of science. She dissects gender issues and draws attention to the 'masculinity' of science—the majority of practitioners are male, and thus are poor role models for girls. She points to the gender bias of texts, and dismisses biological factors as the prime determinant. She describes a constructivist model for learning and considers the consequences this has for communication. Glen Aikenhead sees science as culture, and the interaction of this culture with the 'culture of a public immersed in their everyday lives' is the essence of science communication. Science communication is 'crossing the border' and, when those borders are not crossed successfully confusion reigns. One of the editors still recalls with discomfort the debilitating gastric overload when the politeness, acquired as a child, of 'finishing everything on your plate' clashed with the politeness and generosity of his Indian hosts, to whom an empty plate meant 'please may I have some more'. Overloads are often experienced during the process of communicating science and, because most people are polite and have no wish to hurt feelings, the mores of the two cultures are not explored. Science communication permits an unthreatening exploration of the two cultures.

Jon Turney examines the depiction of science in literature, and science communication as a genre in its own right, and reflects on what qualities are present in good popular science writing. As the genre draws its inspiration from such a wide range of human endeavour he wonders whether it will ever be possible to categorise it. Lawrence Prelli sees science as discourse and discusses the implications of rhetorical understanding of argumentation in science, and the implications for scientific literacy. He has some trenchant comments on the science literacy movements –

if the public cannot grasp these essentials (a majority of Americans in one survey believe that Israel is an Arab nation) why should we expect that science literacy campaigns can elevate their comprehension of the complex principles of science?

These prophetic words have recently been echoed by an influential report of the House of Lords who wish to move the game from 'public understanding' to 'awareness' of science.

Richard Eckersley takes a *fin de siècle* look at science and sees harbingers for the loss of confidence in modern science at the beginning of the last century. He finds science at a threshold of opportunity provided by science communication. It remains to be seen whether the opportunity will be seized; already the first

Science Communication in Theory and Practice

Stocklmayer, S.M.; Goré, R.; Bryant, C.R. (Eds.)

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