Science, Culture and Museums

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We live in a world in which the benefits of science and technology are all about us. Never before have we been so dependent upon the fruits that they offer. Indeed, it is reasonable to propose that it is science and technology that for the last two hundred years have provided the distinguishing characteristics of western society. They are at the root of our success, our prosperity, our quality of life, and, I suggest, increasingly our political stability, security and confidence.

But we also live in a world of paradox. Never before in human history has anxiety about and antipathy towards science and technology been greater. The position of science and technology in contemporary culture is ambiguous. Never before have the achievements of scientists, engineers and of manufacturing industry been viewed with such suspicion. This is especially the case in the western industrial democracies, most notably I believe in Germany, the United Kingdom and the United States. There seems to be almost a causal relationship between the success of science and technology, the benefits that they bring, and the misgivings and anxieties that they create amongst the public at large. The wealthier the society, the greater its anxiety about science, technology and industry.

This ambivalence raises profound issues about the way in which we consider science and technology, how we embrace it as part of our culture, ensure that we continue to derive real benefits from all it has to offer us, but, at the same time, view its evolution in a manner that is both critical and rational.

Throughout the western world we now talk about the *public understanding of science*, recognising that for many people - a substantial and possibly increasing proportion of our populations - science is an unfamiliar discourse. There is now a widespread consensus that ignorance about science and technology lies at the root of much of society's antipathy towards it. For those nations where science and technology are deeply embedded in their historical as well as their contemporary cultures, and provide the mainspring of their economies, a population hostile towards science and technology increasingly represents cause for concern.

Today I wish to examine these issues about public perceptions of science, to determine how they influence the agendas for the public understanding of science and then to look at the implications in practical terms, for those people and organisations who are dedicated to providing some insight into the history and contemporary practice of science and technology. For museums and science centres and increasingly for educational establishments - be they schools, colleges or universities or perhaps more importantly still, for widespread programmes of public science education - these issues will I believe become progressively more important.

Let me begin by making some observations on public attitudes towards science, technology, and manufacturing industry. I shall draw many of my examples from the United Kingdom but these are, I believe, representative of views more widely held in, for example, Germany and also the United States. In Britain, the first industrial nation, the country that became the workshop of the world in the middle years of the nineteenth century, we enjoyed the material benefits and suffered the social consequences of what we have come to call the Industrial Revolution. The Industrial Revolution was the British revolution and many nineteenth century observers saw it as having an impact upon British thinking and the British way of life comparable to the great political upheavals that took place in continental Europe and in North America, as the War of Independence that took thirteen dependent colonies forward into nationhood. But whereas political revolution often created intellectual and cultural stimulus it is arguable that the British Industrial Revolution generated a counter-reaction, leading ultimately to strong anti-industrial attitudes which were well established before the end of the nineteenth century.

Some historians have suggested that there was almost a moral crusade against industry in Britain, beginning in the second half of the nineteenth century, and that this has done more to set the scene for our contemporary attitudes to science and technology than almost any other influence on our lives today. On the one hand the Industrial Revolution created images of social division, of factory chimneys, gritty northern industrial towns, of pollution and decay. On the other it created enormous wealth, individual, civic and national, an almost universal growth in disposable income and undreamt-of prosperity for a growing population of skilled workers, tradesmen, and a new and increasingly influential professional class. The growth of what we might today call the middle classes became the most visible, successful and enduring symbol of Britain's rise as an industrial power. This intelligent, articulate group, increasingly anti-capitalist in belief and sentiment, provided the cultural base for anti-industrial attitudes in the nineteenth century. They also, I believe, provided the historical foundation for those who two or three generations later now view science and technology with such antipathy. As the British commentator Noel Annan has observed of the nation's values in the early part of this century, and in particular of the middle class cultural elite: "the propaganda of the intelligentsia has become the gospel of the nation". That propaganda was urban in origin, powerfully anti-capitalist and anti-industrial.

ut there were other reflections of antipathy towards industrialisation. Today many people in Britain value the rural at the expense of the urban. It is rural landscapes in which we seek solace. A majority of the British population who live in cities (some 63 per cent) wish that they lived in the country. And it is what was perceived to be the horrors of industrialisation that led at the end of the nineteenth century to the setting up of our National Trust, an organisation dedicated to the preservation of areas of outstanding beauty, of the countryside, of great houses and beautiful architecture. Today the National Trust for England and Wales (Scotland has its own) is the largest

conservation organisation in the world with 2.2 million members, more than the membership of all our political parties put together. In other words, one in every twenty people is a subscribing member of an organisation created just over a century ago to protect us from the ravages of industrialisation. Paradoxically, the National Trust itself now recognises that the age of industry, as it developed in the eighteenth and nineteenth centuries, is now a part of our past and so it is beginning to take seriously the conservation of Britain's industrial heritage.

The declinist view of history, with its concentration upon the development of anti-industrial and anti-capitalist attitudes, may or may not be valid. But if we lay them aside and make some observations on contemporary attitudes towards science, technology and industry we can see what appears to be a similar phenomenon alive and perhaps growing in modern industrial societies. How does this manifest itself? From the 1960s onwards we have seen the rise of single issue pressure groups, many of which now enjoy widespread membership and even wider spread, if unstated, public support. Their concerns stem from what they see to be threats to the environment, characterised by such phrases as global warming, greenhouse gases, pollution, the ozone hole, and so on. For some people these anxieties are clear and focused but for the majority they represent a generalised and non-specific worry that the world is changing, profoundly for the worse, that they have little control over it, and that in some unspecified way scientists, engineers, and industrialists are to blame. In terms of world headlines, Three Mile Island, Bhopal, genetically modified organisms, BSE, form the prompts, the common currency not only of those who campaign for the environment but for the public at large.

There are I believe other manifestations of this same phenomenon. If I am right, that significant sectors of the population in developed nations are in retreat from the threat of modernity, it is important that we understand where they seek safe havens. Is it more than coincidental that, in parallel with these feelings of antipathy towards science and industry, we see a rise of interest in fundamentalist religions, in the paranormal and the occult; a withdrawal from a world where for two hundred years scientific rationality has provided one of the unspoken assumptions upon which civilised attitudes have been founded? In Britain and North America for example an increasing proportion of the population believes in astrology and a significant number of them believe that astrology is a science - that its foundations lie in scientific rationality.

If these are the cultural parameters within which contemporary society will be developing, then how do we ensure that science and technology, and by inference manufacturing industry, are viewed with some degree of rationality by the public at large? Even those people committed to promoting the public understanding of science are, I believe, less than clear about the motives that lie behind their endeavours. They recognise, and have an increasing body of evidence to demonstrate, that modern populations are, relatively speaking, less than scientifically literate. I use the words "relatively speaking" with some care. For one of the issues that is undoubtedly of great consequence for us is the speed of scientific advance and, perhaps more importantly, the extent to which the cutting edge of science is now well beyond the levels of understanding of many even well educated people. At the Science Museum in London, where for the last seven years we have been engaged in a major initiative in the public understanding of science, we have developed a large body of research information about the attitudes of the British public towards science and technology. We have also comparative evidence from other countries. We know quite a lot about levels of scientific literacy, we know something about which fields of

science create most anxiety and we know a little about those areas in which public interest - if only expressed through simple curiosity - is greatest. Much of this has been published in the journal, *Public Understanding of Science*, launched and produced jointly by the Science Museum, London and the Institute of Physics.

In carrying out research on the future direction of the Science Museum in London we have sought to examine the attitudes of our audiences, actual and potential. We know that a high proportion of our visitors, and of the public at large who do not at present visit, expect the Museum to provide them with an authoritative insight into contemporary science. Audience research and focus groups involving the use of normal random sampling techniques have produced remarkably consistent results. The areas in which the public are most interested, in priority order, are, the new genetically-based sciences, cosmology, and information technology. It has been information of this type that has led us to new policies for the Museum; I shall return to these later.

But when it comes to an agenda for the public understanding of science it is, I believe, important that we are clear about what it is we wish to say and why we wish to say it. Let me begin by stating what I think it is not. The public understanding of science is not, nor should it be, yet another lobby for the scientific or industrial community, nor for the science education community, to promote their own internalist interests. It must not be a propaganda tool for those whose business is science or for science-based industry.

If there is an intellectually defensible justification for the public understanding of science then it has still to be articulated in a logical and compelling way. For most people, I suggest, it is at face value a weak and non-specific umbrella term for unfocussed good intentions. For those without direct involvement in the public understanding of science or who are not yet already committed to it, it is easy for it to be perceived either as an empty concept or one with an undeclared agenda not made explicit by its supposed aims.

Others see the cosmology of the public understanding of science as simply political: *the scientific community feels threatened and regards itself as underfunded in a political climate in which science and research are subordinated to application, industry and technology*; that is, it increasingly requires a utilitarian justification. Thus, the only political leverage to be had for science is perceived public benefit, so the public understanding of science is needed to mediate between the scientific community and the public in order to publicise the benefits of science - a new utilitarian lobby the unspoken text of which is that science is a good thing. This is perhaps reinforced by the word "public" in the public understanding of science which gives it the appeal of egalitarian and altruistic worthiness.

One argument then in support of the public understanding of science seems to run something like this: *the distinguishing feature of western industrial democracies is science and technology. An understanding of science and technology is therefore necessary for "informed citizenship" which might be interpreted narrowly as the responsible exercise of individual democratic right*. The argument is doubtless worthy and is likely to be listened to with politeness but with little passion by anyone without a vested interest of some sort. However worthy the argument, it lacks both logical and psychological appeal. In the first instance appeal to "responsible citizenship" leaves most people cold. "Citizenship" in our culture is an ambiguous concept linked

with politics - something to do with unwelcome burdens and responsibilities transferred from the state to the individual. Politics, by and large, is something remote and science policy is an even more obscure footnote that is difficult to find in any party political agenda. Except for politicians, the centre of most people's lives is not politics but context and community. So, because of its political connotations, appeal to the concept of citizenship is, I suggest of little relevance.

A revised argument which I can see being attractive to a member of the interested general public might run as follows: *The distinguishing feature of modern western societies is science and technology. Science and technology are the most significant determinants in our culture. In order to decode our culture and enrich our participation - this includes protest and rejection - an appreciation or understanding of science is desirable*. In short, any appeal to politics - something to do with votes - is an anonymous one that disempowers individuals, whereas to appeal to culture - context, implicit and explicit symbols in daily life, social expectations, physical environment and so on - is one that is readily personalised. An argument for the public understanding of science should therefore be culture based if it is to have appeal outside its protagonists. Needless to say we shall have to take the public understanding of science into the political arena but, I suggest, it should be taken forward as a broad cultural issue which society as a whole has to address.

The "responsible citizenship" argument is only one part of the picture. Its weakness is that it is not specific to science. The need for "responsible citizenship" can be used in support of the public understanding of almost anything. Why not the public understanding of accountancy? Accountants are at least as numerous as scientists and are arguably closer to being the shamans of modern life. It would undoubtedly be a good thing for us all if the population at large had a better knowledge of accountancy. So, in considering the public understanding of science, are there any grounds why it should have special treatment?

I believe that there are. I would argue that the discourse of science is distinct and possibly unique and it is upon the special features of the discourse and conduct of science that any argument for the public understanding of science should be based. The explanatory paradigms, the traditions and methodologies of science, derive from the exact or hard sciences - physics, chemistry and mathematics. The domain or universe of attention of the hard sciences is the material world - inanimate matter. I am not the partial subject of such deliberations. A physicist or applied mathematician interested in ballistics or kinetics is interested in my terminal velocity when falling from an aircraft, in my density or volume. He is interested in a stone for the same reason. He is interested in me in so far as I am a material thing.

One of the attractions of science is the supposed privileged access to certainty that it offers through its method. The culture of science requires the elimination of everything personal in the conduct of science from the practitioners of science. Objectivity is the altar of scientific method. So the practice of science - what it is that scientists do - does not relate as immediately to me as does that of medicine, accountancy or for that matter art or music. This is not to say that exchanges between doctors or medical scientists are any less "scientific", esoteric or unintelligible than exchanges between pure scientists. It is just that the particular dialect - the language - that scientists talk does not have me as its partial subject.

The culture of art on the other hand - humanity, the human condition - does have me

as its partial subject and the culture of the practice of art involves the cultivation of personal sensitivity and the validation and endorsement of the uniqueness of individual perception. Indeed, so successful have been those who promote the interests of art that they have persuaded me and many others not only to believe in what we do not understand but to pay good money for it too. As Aldous Huxley said: *...if it were not for the intellectual snobs who pay the tribute that philistinism owes to culture the arts would perish with their starving practitioners. Let us thank heaven for hypocrisy*.

So, the culture of personalisation in art contrasts absolutely with the objectivisation in science. The content of science is alien to ordinary experience and the culture of science is alien to the values endorsed by the arts. It is pointless for scientists and engineers in their grey suits to mumble resentfully into their beer about being third class citizens and look on enviously as elegantly clad arts folk sweep by to sip martinis with the Bellinis in sumptuous galleries.

Art, with mankind as its partial subject, is seen to elevate humanity, a machine to degrade it. Objectivity disempowers because it depersonalises. So, I suggest, the translation of objective science into the culture of the subjective world is essential if science is to have any popular appeal, to be accessible to a mass audience, and to command any widespread level of understanding and support. This can only be done, if it can be done at all, by personalising the activity; shifting the fixation from the content of science to the activity, experience and presuppositions of science.

My argument therefore is this. *Science is a uniquely inaccessible discourse. If science and technology are the features that distinguish western industrial culture then the discourse and the conduct of science requires, as none other does, a process of decoding or interpretation*. The role then of the public understanding of science movement is to decode the culture of science.

Philosophers of science have set out the nature of scientific explanation, methodologies of science, logic of discovery, status of theories, the direction of time, objectivity, certainty, consistency, the universality of physical law, features of scientific knowledge, mechanism, determinism, causality and so on *ad infinitum*. Social historians however have concerned themselves with the effects, with industrialisation - including its material evidence and its archaeology, the mythology and doctrine of science, scientific images of man and the history and culture of science and science in society.

We need to be explicit about what it is that is special about the conduct of science, what is it that scientists do when they do science, what characterises explanations in science, what is special about the knowledge to which science gives access. Moreover, how would we be different people if the level of our scientific understanding was enhanced or for that matter reduced?

So I see the purpose of a public understanding of science programme being to explain what it is that science is about - its presuppositions, and where relevant its content, its tenets, its traditions, it organisation, its failures and successes. It would certainly explain its history and its culture. The influence of a public understanding of science programme may not accord with public relations stereotypes - the possibility that the supposed certainties of science have limited validity outside science itself; that the "objectivity of science" is in some sense specious; that the acceptance of theories rests on belief as well as "evidence", tribal loyalties and political factors; and that scientists are as individually passionate, and therefore illogical, as are the rest of us; that the authority of science has a strong cultural component; that science is individually creative not simply technically competent.

Before I move on to the implications that such a public understanding of science programme has for museums and science centres, let me briefly summarise. I believe the discourse of science is unique. Much of its process is alien to the human condition, if only because science values objectivity and we live in an increasingly subjective world. Moreover, modern science is actually difficult to understand for most people who have no serious background in it. Most of us live within the logic of the Newtonian world. Post-Newtonian science is alien to the popular experience. But for those of us in the modern industrial democracies science and technology are the key determinants of our daily lives. We live in what is in effect a science and technology based culture. The purpose therefore of the public understanding of science is not a utilitarian one but a cultural one. It is to help us decode the culture within which we live.

What does all this mean for science museums and science centres? One of the difficulties that I have in talking about purpose and process with professional colleagues in my field is getting them to focus upon what it is that they are there for. This is inevitable and I should not, I suppose, be critical of them for evading the issue. Museums, in particular, derive their purpose and their wisdom from their collections and the purpose of holding collections - whether it be collections of art, archaeology, science or industry - is extraordinarily difficult to articulate. But if we consider the great historical collections of scientific instruments, of ingenious mechanisms, of industrial equipment, I see an immediate validation and justification for their existence in museums such as this - as the material evidence of the origins of our scientific culture. Not only do collections provide us with a scholarly route to greater understanding, a means of widening horizons of knowledge through research, but, their presentation to the public offers insights unattainable elsewhere.

That we need to have something of the past around us is in itself another distinguishing characteristic of contemporary societies. What was once the quixotic desire of an esoteric minority now has massive and widespread support across the population. There is plenty of evidence to suggest that in the context of rapid cultural

and technological change, we value the presence of the past all the more. We are, I believe, the first generation that has elevated the value of the past above the present, such is our demand for certainty, our need for comfort in a hostile world, our desire for security. This places all the more pressure upon those for whom the mainspring of their existence is modernity - scientists, engineers, technologists. They are the agents of change and if change is seen as hostile, then it is easy to blame them for it.

But a further requirement of our wishing to have the past around us is the need for familiarity. Museums offer us not only an intimacy with the material of our past, but with things that are familiar and, by and large, comprehensible. But, here again, in establishing an intimacy through contact with objects, the museum of science and industry has something of a difficulty. The rise of what has come to be called heritage, with its strong emphasis upon populist values and social insights, has resulted in the successful and I believe highly beneficial uncoupling of preservation from the desire for aesthetic satisfaction. We can now contemplate the perpetuation of the ugly as well as the beautiful in the interests of historical or social record. But familiarity, in the sense of being comprehensible, is still essential. Whereas a museum of social history, of furniture, even of old motor cars, offers us contact with something that we can understand and with which we are familiar, a museum of nineteenth century chemical industry equipment, to cite a perhaps extreme example, holds things, again from the past, but with which we are profoundly unfamiliar. If the purpose of a museum is to promote understanding through contact with its collections, then those collections - if they are unfamiliar to their audiences - need to be placed in some sort of context.

for many museums, especially those of industry, the social context provides the obvious point of contact. For example : *these objects are relevant to you and me because they are symbols of work and the concept of work is familiar to us*. Here in Mannheim we have a museum of technology and work, illustrating, among other things, that technology and industry have provided us with work and that work provides us with wealth. So in one sense this museum is a museum of wealth generation and for most of us wealth generation - at least at the personal level - is seen to be rather a good thing.

But here in this outstanding and innovative museum in Mannheim cultural context is also provided by the use of a powerful structural thread - time. Time offers the contextual medium within which objects and the processes they represent can be set in a broader cultural setting and their effects contested. Social benefit and disbenefit, the concept of winners and losers, can be debated against this broader cultural timescale in a manner that allows intellectual integrity and affords balance. Moreover it avoids - I believe with great success - the accusation that is levelled at so many museums of industry and technology, that they are simplistic celebrations of progress, as defined by increased technical competence and greater efficiency and thus provide a propagandist endorsement of science itself. Mannheim is a museum of the culture of technology, neither triumphalist nor declinist, celebratory or pessimistic.

But when we consider the purpose of a museum of science or industry as being to explain the methodologies and processes of science and technology in the past or the present through the exhibition of instruments and machines then again, difficulties arise. A machine, as an unfamiliar object, may be incomprehensible to most observers. Its purpose - that is what it does, may be explained but the process by which it achieves its purpose - how it works, may well be incomprehensible without

some form of animation, either by operating the machine itself or by some form of simulation, using for example, models or screen-based reconstructions.

So museums of science and industry face a dilemma. Their objects are, like all museum objects, inalienable. By their nature they are precious and we want to keep them in perpetuity. But their cultural value, in terms of their perceived importance to society, may often be low. Their purpose may be understood, at least intellectually, but if in order to make them more widely comprehensible we require to operate them, then we are in effect wearing them out. Some are incomplete, others too fragile, still others too obscure, to make their operation a realistic or even worthwhile proposition. In museums of science and industry the object may have iconic value but often it stands in the way its own explanation. Museums offer what are primarily visual experiences for their majority audiences. To see is to understand; but not in the case of modern machines. In order to explain them and the principles that lie behind them we need another medium.

It is here that interactive science or technology exhibits can come into their own. Such has been the perceived success of interactive science - so-called hands-on science - that what once provided a supplementary experience to object-based exposition in traditional science and technology museums is now at the heart of a worldwide movement to establish free-standing institutions in which historical collections as such play no part. What initially developed in areas like the Children's Gallery at the Science Museum in London - opened in 1931 - as a means, but essentially a complementary means, of extending experience and understanding beyond objects now provides the inspiration for hundreds of new science and technology centres being set up around the world. Almost without exception these new centres are devised for the instruction and enlightenment of children. Their objectives, as I see them, are to stimulate, by providing contact with visitor-actuated experiments and mechanisms, some interest in and perhaps understanding of principles in science and technology. But, in the main, they lack cultural context. Science, as an enthralling process, is a message science centres can purvey to the age groups with whom they deal and achieve singular popularity and success. In one sense there is also perhaps a need for interactive science centres for whom adults are the primary audience. In my experience many of the exhibits contained in science centres and exploratoria provide revelations equally relevant to a large proportion of the adult population for whom scientific principle and process have remained obscure.

But there is I believe a danger in the widespread and uncritical development of interactive science centres aimed in the main at young people under the age of, say, thirteen. This is that science, especially in the de-contextualised form in which science centres present it, as a vivid experience that takes place in primary colours against a background of noise and excitement, will be seen as just that as their audiences grow older. Science is something we did when we were children; we are now past that stage. Science has no part of our adult life.

Some years ago the journalist Janet Daley, in commenting on the respective perceptions of science and the arts in British culture said "Science is something one grows out of with the coming of civilised tastes". She was contrasting the essentially populist rhetoric through which science museums promote themselves and the abhorrence by the arts community of a similar approach on the part of the Victoria & Albert Museum. But she was also noting what many of us who work in museums of science and technology have observed over many years, and that is the increasing

attractiveness of the subjective, aesthetic and essentially stylish world of the visual and performing arts to young people beyond the age of puberty. The increasing power of visual media, expressed in simplistic terms as style, the ability of the affluent young to determine for themselves the nature of the lives they wish to lead, their buying power and the scale of the cultural mechanisms that are there to serve them offer powerful cultural exclusivity. Science, as an enjoyable diversion for young children, has little to offer all but the most perceptive and questioning of young adult minds.

But, in the five years or so since Janet Daley's observations, there has been a visible cultural shift - and I believe an important one - in the view of science, if not technology, amongst intellectual commentators. No radio or television discussion show with any cultural pretensions is now complete without a scientist. Melvyn Bragg, perhaps Britain's leading arts presenter, who rather like a child with a new toy has in the last year or two embraced science and scientists, initially intrigued by what they had to offer, then enthralled by the power of their messages, now suggests without any obvious sense of irony, that the absence of real creativity in the contemporary arts leaves a debate that is essentially sterile and hollow. This may be more of a reflection on Melvyn Bragg and his new-found passion for scientific thinkers and their thoughts, but it reflects views that would themselves have been unthinkable only a few years ago.

Let me offer, in conclusion, one or two observations on the future direction of the public's view of science and technology. If science and the scientific discourse are increasingly seen as part of the wider cultural debate, as I believe is already beginning to be the case, then an important role for science museums must be to provide a forum for that debate - through their public galleries, their research, their programmes, educational activities and outreach. The science and technology museum as a place for objects and public discussion about their meanings occupies a unique position between the world of scientists and technologists and the public at large. The museum's perceived independence by both parties to the debate is therefore an attribute to be protected. As the scientific debate moves from the twilight to the spotlight of public interest and concern, its history, the nature of its discourse, its position within the wider public culture will command new attention. The understanding of science as an issue for all of us is essentially a cultural one. We need to decode the world in which we live; science and technology provide some of the cyphers.