

The role of science teachers in the drive for scientific literacy

The Rt Hon the Lord Jenkin of Roding

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My first duty is to acknowledge the high honour the Association has conferred on me by admitting me as an Honorary Member. I join a long list of people who have given signal service to the Association over the years, and hope that I will be worthy of it. I was surprised, though delighted, when I received the invitation to become the ASE President for 2002–2003. The very distinguished list of those who have recently held this high office includes scientists of renown, captains of industry, academics of distinction – all of them with particular skills and experience germane to the work of the Association. I am none of these things, but a career politician who never even served as an Under-Secretary for Education!

So what can I offer the ASE? My interest in science education and the work of the ASE was aroused by my experience as Chair of the House of Lords Select Committee's inquiry 'Science and Society', which addressed many of the issues now at the forefront of debate on the future of science education. I will draw on the report of that inquiry for at least part of my talk today. In particular, I would like to direct attention to what we identified as the need for a higher level of 'scientific literacy' in our society – what is sometimes called 'science for citizenship' – and to the crucial role of science teachers in helping to achieve this.

Julius Caesar described Gaul as being divided into three parts; my address will likewise have three parts. The first part is a very brief *apologia pro sua vita* – a confessional describing my own pilgrimage towards an awareness of the need for scientific literacy. This leads into the second part which will be about the House of Lords' 'Science and Society' report itself. In the third part I will explore the relevance of all this to your work as teachers of science.



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My journey to awareness

For most of my life, I was under the impression that I did no science at school beyond 13. I was a classicist, and most of my education was about Latin and Greek history, language and literature. I learned how to compose Latin verses in elegiac couplets; I read, in the original Greek, the histories of Herodotus and Thucydides; I learned long passages of Homer and Virgil by heart; and I studied the ancient Greek dramatists. I was not, but might well have been, the schoolboy who, when asked in an examination paper to describe the principles of the Archimedes' pump, answered: *'I know nothing about the Archimedes' pump, but here is a list of the Kings of Israel and Judah'*. I did know that Archimedes ran naked from his bath into the street shouting *'Eureka!'*, but I never really understood what it was that he had discovered, other than that when he got into the bath he slopped a lot of water all over the floor which must have made Mrs Archimedes very cross!

So I was startled to come across among my papers a school report of 1944 (I was 17) which contained the, to me, astonishing verdict: *'Science – Jenkin takes a keen and intelligent interest in the subject and I feel that he is profiting by the course'*. The sad fact is that I have almost no recollection of that 'course', but as the rest of that report was universally critical of my efforts, I can only imagine that the science teacher was more gullible than the rest! (To be fair to him, he was quite a good violinist – he and I sat at the same desk in the school orchestra!)

I wish I had learnt more basic science at school, for throughout almost the whole of my career I have found myself regularly confronted with science and felt singularly ill-equipped to cope with it. In the army, it was signals, and electricity and magnetism; in the chemical industry, it was organic chemistry; at the Treasury, digital telephone exchanges and offshore oil and gas; at the Department of Energy, it was nuclear reactors; at Health, the pharmaceutical industry; at Industry, information technology, and at Environment, it was climate change, pollution and biodiversity. So, in talking about 'scientific literacy', it is clear that, for most of my life, I have been part of the problem. My only saving grace, if such it is, is that I have always insisted on trying to understand what the scientists and engineers were talking about. If you cannot make me understand it, I would say, how am I going to convince Margaret Thatcher, who is a scientist, that we are right and should be supported?

Appointment to the House of Lords gave me the chance to take this further; I was invited to join the Select Committee on Science and Technology and I accepted with alacrity. I already regularly attended the seminars run by the Foundation for Science and Technology (where I first made contact with the ASE), and was becoming disturbed by the apparent loss of public confidence in scientists in general, and in Government scientists in particular. So at my first Select Committee meeting, I was rash enough to suggest that the Committee should study public attitudes to science. Now, as you probably know, that Select Committee has always had some of the most distinguished scientists in the land among its members, and I was soon put in my place! *'We are already dealing with this,'* they said, *'it is called "the public understanding of science", and all the scientific bodies – the Royal Society, the Royal Institution, the British Association, and so on – are all involved. We do not need another study!'* So I subsided, suitably chastened, but, I have to add, quite unconvinced!

The first inquiry in which I took part was about antibiotic resistance. At once we were confronted with the phenomenon of the patient who always expects an antibiotic prescription for whatever ill he or she presents with. Not much public understanding there!

Then it was an inquiry into the management of nuclear waste. For me this was a real eye-opener. Not, I must make clear, the technology. Though we learned a lot from our witnesses, it soon became evident that the overwhelming consensus of world scientists was and remains that the right long-term solution is to dispose of the radioactive waste in deep underground repositories. As Environment Secretary, I had tried to implement this solution but failed. What was new, at any rate to me, was the evidence about how to gain public acceptability for this recommended policy. This came from a number of social scientists who, for the last two decades, have been studying public attitudes towards science and technology. Time forbids a detailed account of what they told us, but, in essence, they said that today's public expects to be consulted; that people will not now accept scientific advice as a given; if policy-makers want to gain public acceptance for a preferred course of action, it is no longer enough to 'decide–announce–defend' (the so-called D–A–D process); instead, there must be clear, long-term programmes of public consultation, with as much listening as talking. This compelling evidence led to some of the main recommendations of our report.

The Science and Society report

It was already apparent that nuclear waste was not alone in arousing public mistrust: Britain was already deep into the BSE fiasco; GMOs were becoming very controversial; mobile telephones created anxieties about possible brain damage; and advances in genetic research, such as Dolly the sheep, aroused profound fears. So, when it was again suggested that the Select Committee should study public attitudes to science and technology, this time, it was swiftly agreed. I was invited to chair the inquiry and we decided to call it 'Science and Society'. It took us eight months to hear a mass of evidence and to write our report. We made 26 detailed recommendations, and these can be accessed on the Web (see Websites). They can, however, at the risk of oversimplification, be condensed into five main messages:

- It is no exaggeration to say that there is a 'crisis of trust', with a real risk that the tacit assent by society for ground-breaking research may be threatened. At the same time, there is a strange paradox: people are aware of the benefits of technology; they are intrigued by scientific discoveries; the sales of popular books on science have never been higher; viewing figures for TV science programmes run into millions. Yet, there is this undercurrent of mistrust which, if not dealt with, can threaten our future.
- In an age when all authority is questioned, science is not alone in facing public scepticism. Yet we identified one distinctive feature of the controversies over science: confusion between attitudes to the science itself, and attitudes to the ethics, values and morals that lie behind the science and its applications. I will quote just one sentence from the report:

A negative public response to expert assertions on issues involving science may be mistaken as negative to science, when in reality people are responding negatively to the way in which this reduction to a 'scientific issue' alone distorts or excludes other legitimate concerns.

So the question becomes, what to do about it?

- 'Public understanding of science' is not enough: scientists need to understand the public. Communication must become two-way, using, as an American witness put it, 'ears as well as voices'. In place of the condescending 'public

understanding of science', we need a new culture of dialogue – dialogue *with* the public, not just giving information *to* the public.

- Dialogue with the public requires that the cult of secrecy must give way to a new culture of transparency and openness. We call this 'engaging the public' and it is the heart of the report. This engagement is beginning to happen but it needs to be pressed forward vigorously.
- However much 'dialogue' takes place, however pervasive the new culture of openness becomes, most people will still have their views on science formed by two sets of influences: the media, and lingering attitudes dating from people's schooldays. Many in science blame the media for their woes. Our conclusion on this was unequivocal: in a free society and with a free press, science can look for no special protection. Scientists must simply get better at dealing with the media. Yes, the media are one of the main means of information and ideas about science reaching the public, but the right reaction to this is not to attempt to censor what goes out, but to equip people better to judge the merits of what they read or watch. What we need, the report argued, is, in short, more 'scientific literacy'.

This brings me to the third and last part of what I have to say to you this afternoon – the relevance of all this to this audience.

Relevance to science teaching

Chapter 6 of our report is headed 'Science education in schools'. Originally, we had not intended to cover education in our inquiry, mainly because others, notably the Council for Science and Technology, were already engaged on major studies into how to raise the general level of science education up to the levels of the best that exist in Britain. We did not, therefore, try to deal either with the education and training of specialist scientists, or with ways of encouraging more young people to follow science careers: we were happy to leave that to others better qualified than ourselves. However, so many witnesses told us that school education is crucial to restoring the relationship between science and the public, that we could not ignore it. Lingering attitudes from a person's schooldays are a major influence on his or her adult views of science. We found ourselves concerned, not so much with the 10 per cent of pupils who aim at

science A-levels followed by a degree in science, but with the 90 per cent who have other ambitions and goals. It is among that 90 per cent that are mainly found those who, in later life, most mistrust – and even despise – science and scientists.

As you all know, science became a core subject of the National Curriculum for all children aged 5–16 as long ago as 1989, but the syllabus has not changed fundamentally since the days when it was designed primarily for the 10 per cent going on to A-levels. Some of the most compelling evidence we received argued that this needs to change if what is taught and learnt up to 16 is to equip *all* students for ‘scientific literacy’. Witnesses called for less emphasis on imparting facts, and more on the nature and processes of science. People need to know more of the history of science so that they can begin to understand that a scientific theory is valid only until it is displaced by later work leading to a new theory. One distinguished scientist told us that the present way of presenting science as facts ‘leaves people unprepared to encounter as adults the uncertainties of much current science’. Others blamed the emphasis on facts for ‘a profound misunderstanding of the whole scientific process amongst the general public’. The Head of Science Exhibitions at the Science Museum called this misunderstanding ‘quite a hurdle’ for the Museum’s efforts to engage with the public.

Against this background of criticism, we found ourselves much impressed with the thinking behind the series of seminars, supported by the Nuffield Foundation, which were written up by Professor Robin Millar and Dr Jonathan Osborne and published in 1998 under the title *Beyond 2000: science education for the future* (Millar and Osborne, 1998). I expect that many readers are very familiar with this seminal piece of work. It is not my purpose today to rehearse its recommendations, but rather to emphasise what we saw as its importance in bringing about that wider ‘scientific literacy’ that we seek.

Since we reported in March 2000, a great deal has happened. I do not think that I am exaggerating when I say that ‘Science and Society’ is turning out to be one of the most influential House of Lords’ reports in recent years. All the leading scientific bodies have embarked on new initiatives in response. The Royal Society has a new committee called ‘Science in Society’ funded by a £1 million grant from the Kohn Foundation; the press release was headed ‘Listening to the public’. The Royal Institution has set up a ‘Science Media Centre’ to build bridges between

scientists and journalists. The British Association’s new headquarters is to be in a new building – the Wolfson Wellcome Building – dedicated to conducting dialogue with the public. Copus – now a brand name, and no longer an acronym for the committee for the public understanding of science – has been reconstituted with the primary function of fostering communications between science and the public. The ESRC has launched a new £4 million programme of research under the banner of science and society, and has attracted Professor Steve Rayner, a very distinguished British academic, back from Columbia University, New York, to run it.

In the field of education, the Nuffield Curriculum Projects Centre has published a new post-16 course, ‘AS Science for Public Understanding’, edited by Andrew Hunt and Robin Millar (Millar and Hunt, 2002). I have also seen a draft syllabus produced for the Royal Society of Chemistry intended to reflect the thinking of *Beyond 2000* as applied to chemistry. I do not for a moment claim that our House of Lords’ report has been the only stimulus for all this activity; it did however articulate persuasively what many in science were already arguing. Still more needs to be done. We commended the Council for Science and Technology for their work on in-service support for teachers of science in primary schools and the early years of secondary schools. We made several recommendations ourselves about the importance of creative science teaching at primary schools, for instance, by using the new science centres, pairing scientists with teachers and schools – the Clifton Scientific Trust provides an excellent example of this [see Letters page this issue] – and building links with the research councils. Some of this is beginning to happen, but there is room for much more.

The Select Committee has also held separate hearings on ‘Science in Schools’, mainly devoted to Continuing Professional Development (CPD). I commend these reports to your attention – they, too, are available on the Web (see Websites). The main point that came through to me was that INSET is too often directed, not at improving skills or updating teachers on the subjects they teach, but on administrative and similar matters. In particular, we called for science-specific CPD to be available to primary school teachers, to encourage them to understand and promote science in the earliest years of a child’s education. It is not clear to me that much of this is yet happening.

The Select Committee was told of the plans for Science Year. In concept, this looked as if it might help to attract young people to stick with science, but the information I have is that generally, apart from the initial 'big jump', the profile has been very low. There are to be a lot of events but their impact is at the moment uncertain. I am considering tabling a Parliamentary Question on how it is intended to measure the effectiveness of Science Year [see Notes and News, this issue].

We are now told by the Government that they propose to set up what they call a National Centre for Excellence in Science Teaching. This is stated to be a response both to the Council for Science and Technology's report to which I referred above, and to the Select Committee's report on 'Science in Schools'. I hope that the DfES will consult fully with the ASE on all of this; I have no doubt that in this Association and amongst its members, you have a pretty comprehensive database of best practice, and you also have channels to spread the word to your thousands of members. Ministers would be wise to build on your

expertise before trying to duplicate at public expense what you are already doing well.

What I do not see yet is any recognition in high places of the strength of the case made so persuasively in *Beyond 2000*: that if the 90 per cent who are not going on to A-levels are to be helped to become science-literate, then a fresh approach to the syllabus will be essential, especially in the early years of secondary schooling. Of course, this cannot be done at a stroke – changes must come gradually – but I am sure that I am not alone in believing that the process must start now.

In this Presidential Address, I have sought to share with you some of the ideas and proposals we set out in our report 'Science and Society', and to point to some of the implications for you as teachers of science. I hope that my term as ASE President signals the ASE's support for the philosophy, and for many of the detailed proposals, in that report. I look forward to working with you to help to realise our shared ambitions for the future of science education in our country.

References

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Websites

- House of Lords Select Committee report 'Science and Society'.
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- House of Lords Select Committee reports on 'Science in Schools'.
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The Rt Hon The Lord Jenkin of Roding served, as Patrick Jenkin, as a Conservative MP from 1964 to 1987, holding a variety of offices, before being appointed a Life Peer and joining the House of Lords. Although not a scientist by training, throughout his career he has had to deal with a wide range of science and technology issues and has made it his business to develop his understanding. As Chair of the House of Lords Select Committee's inquiry into 'Science and Society' (1999–2000) he became interested in science education and in particular its part in achieving a higher level of scientific literacy amongst the general public.

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