

Science Education and the Needs of Society

A Conference held at Cumberland Lodge

Friday September 12th to Sunday September 14th

An Interim Report

The Conference Background and Theme:

Public debate about the future of science education at all levels is intensifying. The Twenty First Century Science pilot course was launched in 2003. Subsequent changes in the Key Stage 4 Science Curriculum resulted in new specifications for GCSE Science from 2006 onwards. A revised version of this pilot provided one of these post 2006 options, but the changes in the curriculum have only served to intensify the debate at national level. The House of Lords Science and Technology Committee on Science Teaching in Schools produced a Report in November 2006, resulting in a response from the Government in January 2007 and subsequent comments on this by the Royal Society's Science Community Partnership (SCORE). Other reports relate to science education and research at university level.

This Conference, a joint initiative of St. George's House and Cumberland Lodge, provides an opportunity to address a range of questions about the role of Science Education in Society. Is the job of the science educator to teach an understanding of the fundamental principles of science or to provide a general scientific literacy? There has been much talk of the 'dumbing down' of science education, but must the aim of instilling a responsible concern for the environment or an awareness of the potential of modern weaponry inevitably come at the expense of a less solid understanding of the underlying principles? If so, is this a price worth paying to achieve an education which is allegedly more relevant to the needs of the vast majority of students who will not go on to become professional scientists? And how can we ensure the British scientific talent is identified, nurtured and given the means to flourish?

The conference will examine whether the vocational aspirations of society today, led by market forces, is creating a generation of inadequately informed scientists. It will examine the performance of this country against international comparators. It will also raise the question of whether moral dilemmas resulting from scientific advances should be a part of the teaching of science. In a curriculum packed with facts and applications is there still room to share that sense of wonder that younger children and professional scientists alike feel when they uncover the mysteries of nature?

The Conference Itself:

In brief, six key points which emerged from the Conference:

Those responsible for teaching School Science might need to consider how best to create and use resources beyond the classroom in order to give students an added dimension to their studies.

Science in the UK, at both school and university level, is not in the state of crisis that popular belief often claims. At the same time there is an urgent need to enable better science education to the age of 14 so as to encourage better participation from GCSE onwards.

A “one size fits all” curriculum no longer does the job. There are a variety of ways into science for all children. At the same time, more might be done to encourage those capable of it that a traditional programme based on studying all three disciplines in the Curriculum is perfectly legitimate and still has a place.

Long live STEM! It has much to contribute to the development of business and the economy. At the same time, science education must never be shaped by the perceived needs of society. Science education is always for its own sake, and it best serves wider interests when it retains its enviable base in the finest research environment and is committed to rigorous procedures.

Good science is disinterested science, but it can never be truly amoral, in the sense that no form of education is amoral if part of its aim is to shape human character and societal flourishing. Considerations of ethics and impact on society of certain science related questions may also provide a way into the study of science for those who find the more academic approach too daunting at first.

Science must never make the mistake that it has all the answers that society might ever require. The very fact of its own methodology, where experiment confirms or denies theory and further experiment refines, is proof of its own inbuilt disposition to humility. Good science pays attention to what is going on in other disciplines and intellectual pursuits.

At the end of a week that had witnessed two very different events in the world of Science (being the launch of the Large Hadron Collider at CERN and the minor furore created by some remarks of the then Royal Society's Director of Education concerning exactly how the subject of creationism be treated in the context of school science lessons should it ever arise) some 75 people gathered at Cumberland Lodge in order to discuss the role and responsibility of science education within the society that provides its context, working environment and (perhaps) *raison d'être*.

The gathering contained a mixture of senior academics, school teachers and university and college lecturers, as well as school science advisers, freelance advisers and senior figures from various agencies connected with the world of science. The very full and wide ranging programme that had been organised was reflected in the good number of feedback forms that were received at its end, indicating a high level of appreciation for that programme, as well as the intellectual and practical commitment of the audience. This was one of the Conference's strengths; the fact that it drew not only on significant figures within science to address it but also that its participants were highly informed and willing to engage ever further with what was on offer.

The Conference was fortunate in its panel of speakers. That good fortune began with its choice of Dame Bridget Ogilvie as its Chairman. An influential scientist in her own right (both as a medical researcher in early career and then as Director for seven years of the Wellcome Trust) her concern for the state of science in schools was demonstrated by her chairmanship of the AstraZeneca Science Teacher's Trust. It was, however, her chairmanship of all three days of the Conference that enabled the highest possible levels of discussion and questioning at its heart. The kind of rhythm that is established by the virtue of having a single chairman enables so much more "added value" to be generated. It is to Bridget Ogilvie's credit that this is precisely what happened.

The keynote address, given by Laura Grant (Honorary Research Fellow at the Science Communication Unit at the University of Liverpool, as well as being a freelance researcher) promised an "explosive approach" to how science might be taught to children at Key Stage Three and GCSE. Her presentation delivered precisely this. Much of it centred on her involvement with the making of a *Discovery Channel* series entitled **The Big Experiment**, working with a group of underachieving and scientifically disengaged children from a London school. The aim of the series was to see if there were ways of introducing these children to science that enabled them to move beyond a perception of it as boring and irrelevant. The fact that most of this group then went on to pass the equivalent of half a Science GCSE after a mere six weeks of exposure to such intense and "big experiment" type science speaks for itself. It is the case, of course, that school science is in no position to reproduce the level of presentation and resources open to a television programme, but the nature of the discussion that followed upon Laura Grant's session demonstrated that much could be learned about methodology in the classroom from the kinds of reactions to the science being presented on the part of the group of pupils, and the way in which their own development in understanding took place.

In the session that followed John Holman, Director of the National Science Learning Centre, was in conversation with David Perks, Head of Physics at Graveney School, a mixed Comprehensive in Tooting, London. Described as old sparring partners, both (addressing the title of the session **A Science Curriculum fit for All?**) gave impassioned accounts for their view of how science education might develop for all pupils until the age of 16, with Holman a clear and unequivocal proponent of the 21st Century Science approach to things (with the opportunity for pupils to choose from a range of options after Key Stage 3, depending on ability and interest) and Perks equally uncompromising in his advocacy of three separate Science GCSEs for all, regardless of individual ability, and based upon his own School's successful practice in this regard. Needless to say, there was little in the way of rapprochement on this set of issues, and the Conference seemed equally divided as to the merits or otherwise of either approach.

The final session of this first day brought together Richard Greenhaigh (Chair of the QCA, Fellow of Templeton College Oxford and, most significantly, a former Chairman of Unilever UK) with Rodney Eastwood (Secretary and Clerk to the Council of Imperial College, London) to discuss the inevitable question of how science skills can best benefit the economy. Greenhaigh, although a social scientist by training, was obviously in favour of all that STEM (Science, Technology, Engineering and Mathematics) has to offer big business. For his part, Eastwood very clearly outlined the factors that tend both to attract and repel students about the study of science, and what therefore school science might do in order to ensure that more pupils are encouraged to study it beyond its compulsory years. At the same time he was also clear that, in seeking an answer to how science best contributes to the economy, no one should suppose that there is a clear and definite relationship which holds true in all times and places. No one can tell exactly what science might contribute to an economy, and neither should this kind of concern dictate what kind of science is done, and by whom. At the same time, science should continue to offer to its practitioners what only it can; a rigorous intellectual base, a proper research environment and the opportunity for good practice. As long as these are ensured, then benefits to the economy will follow.

The second day of the Conference began with a session dedicated to considering how well science education in the UK compares internationally. According to both speakers in this session (Jonathan Osborne, Professor of Science Education at King's College, London, and Lloyd Anderson, the Director of Science for the British Council) the answer is surprisingly well. The issues that make news headlines in this country with respect to our perceived educational failings are not dissimilar to perceptions of science education in western economies generally, and the data available tells a story that is at variance with the ways in which this account is often rendered publicly. Against a rather doom laden scenario that regards science education in the West as being on the back foot when compared to what is going on in Asia (China being one notable example) the reality is very different. At the same time, however, research does suggest that school children in this country have decided by the age of 14 (and the end of Key Stage Three) either to pursue or to abandon any interest in science academically. This alone suggests that more might be done to ensure that teaching at this important stage is improved so that more pupils will be encouraged to learn science after they are no longer strictly required to do so. Lloyd Anderson expanded upon these themes from the perspective of a career within an institution dedicated to promoting British culture to and within other countries. His presentation echoed many of the points made by Osborne, adding the extra point that this country is still one able to attract a significant international cohort to study science at university, and that the quality of our science education is much admired, even when there is increasing evidence of a serious lack of engagement amongst home students. The British Council has an enviable role to play in creating new international networks for science, creating ever greater possibilities for international co-operation and the chance for students to see that a career in science opens up all kinds of opportunities outside of this country.

The Conference then turned its attention to questions of ethics in considering the question "Is Science Education Amoral?". Peter Atkins, Emeritus Professor of Chemistry at Oxford, answered both yes and no to this, in his own description, strange question. In a wide ranging, and obviously thought provoking paper, he set out to address the question from all possible angles. His answer was an uncompromising "yes" if by amoral is understood the resistance of science to any methodology that demands preconceived opinion or moral obligation as part of its procedure. Good science is always disinterested science, and should proceed apart from the demand of particular moral frameworks. If one then wishes to ask further questions concerning the societal implications of scientific enterprise, these are not, and never should be, part of the Science Curriculum, belonging more properly to those academic disciplines that exist precisely for this purpose. In this sense all science is amoral. In reply to this, however, Michael Reiss (Director of Science Education for the Royal Society) argued that such education can never be amoral if by the latter term one understands it as being without value. Beginning by pointing out that the insistence of some scientists on experiment as the only basis for knowledge is simply not true (mathematical proofs are an obvious riposte to this position) he then developed a series of positions concerning education generally, and more specifically its aims. If it is the case that education aims to develop a sense of autonomy in the individual, alongside what might be termed a sense of well being and some understanding of justice in society, then it might also be the case that even science as a set of disciplines is open to different modes of teaching and understanding other than that advocated by "pure" science alone, as important as this is. A consideration of social and ethical issues raised by science could provide a different way into the discipline for those for whom pure science presents an initial barrier. It is in this sense that science education can never be amoral.

After a short set of discussion groups to consider questions of curriculum development, the Conference transferred to Windsor for a tour of the Castle and attendance at Choral Evensong in St George's Chapel for those who wished it. A short introduction to the history of the Chapel then followed, after which a Reception in the Dean's Cloister served as the prelude to a very enjoyable Conference Dinner in the Undercroft of the Castle, held by gracious permission of Her Majesty The Queen. Even here, however, the work of the Conference continued in the after-dinner address given by Kathy Sykes, Collier Professor in the Public Understanding of Science at Bristol University.

The final morning of the Conference witnessed the advent of Robert Winston, Labour Peer in the House of Lords and Professor of Science and Society at Imperial College, London. It was an address that drew upon a range of influences and insights from fields outside of the purely scientific, as one might expect of someone who has held such a wide brief in the world of science and whose own work, especially in the area of human fertility, has created new possibilities for so many. The Presentation used the best of the arts and philosophy to illustrate the thesis, as well as making the (perhaps surprising) call for science to recognise obligations beyond itself, of which religious sensibility is also part. What was certainly not present in Lord Winston's presentation was any sense that Science could ever claim the status of a modern Magisterium for itself; the world is far too ambiguous and paradoxical for that.

It would be misleading, however, to say that all was perfect. It was noted by more than one participant that there were no representatives from government present; neither, indeed, from business corporations which might be expected to have genuine interest in what science does, the more so when it is in the habit of commissioning original research. Also missing was significant representation from the state sector in education, the majority of the teaching profession present being from independent schools of one kind or another.

September 17th 2008.

Andrew Taylor (Acting Director of Conference Programme)

A Complete Report on this Conference will appear in due course