THE FOUNDATION FOR SCIENCE AND TECHNOLOGY

The Royal Society of Edinburgh

DINNER/DISCUSSION SUMMARY

Science education - are we losing the plot?

Held at The Royal Society of Edinburgh on 2nd November, 2006

We are grateful to the Gatsby Educational Foundation and the Institute of Physics for supporting this meeting.

Welcome: **Sir Michael Atiyah OM FRS PRSE**
President, The Royal Society of Edinburgh

Chair: **The Earl of Selborne KBE FRS**
Chairman, The Foundation for Science and Technology

Speakers: **Professor Anne Glover FRSE**
Chief Scientific Adviser, Scottish Executive

Professor John Holman
Director, National Science Learning Centre, York and National STEM Director, DFES

Bob Kibble
Senior Lecturer, The Moray House School of Education, University of Edinburgh

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PROFESSOR GLOVER outlined her objectives in her post as Chief Scientific Adviser for Scotland. They were: to raise the profile of science in government; ensure that the best scientific evidence was deployed in policy formation; to give independent advice to Ministers; to strengthen the science base; promote science careers and develop the engagement of the public with science. The last three objectives required a focus on science education in schools, building on the Science Strategy of 2001, the network of Science Centres, and Scotland's high scientific standing. They would feed into the review of the science curriculum now in progress.

Education was using knowledge developed through the learning process, which should be enjoyable and enlightening, leading to creative manipulation and use of facts. Why did children lose their natural interest in science at nine years of age and perceive science as dogmatic and authoritarian? Why did first year science students seem to constrict their vision to the facts they needed to learn without looking more widely? The answers might well lie in the focus in schools on learning facts without doing sufficient practical work, so that there was a failure to understand their use. Effective science education was crucial; it depended on the supply of scientists the economy needed, and the active participation of the public in debate on future technologies.

PROFESSOR HOLMAN said that there was concern about the supply of students doing science subjects. A-level numbers for biology were constant, chemistry had shown a decline, although recently there had been an increase, but in physics and maths the decline continued. His spot survey of why his chemistry students did chemistry indicated the influence of enthusiastic teachers and good job prospects - the latter reflecting, perhaps, the introduction of fees.

Science education was not now just for the elite: it must cater for all. It had a "dual mandate" - to ensure that everyone had a 'basic' science literacy, and that those who were to become professional scientists had adequate training. This was the basis of the new curriculum "Science for the 21st century". Ten per cent of curriculum time should be given to science for citizenship - covering contemporary science issues, explanation of the nature of science, and ideas underlying it. Another ten per cent would be for additional science, either general or applied, for those going further. Assessment was important, but he was concerned that an undue amount of time was spent "teaching to the test". There was also a severe shortage of physics teachers. But the policy drive was to increase student numbers (although physics targets would be difficult to reach), recruit more teachers, get more schools to offer 3 science subjects, raise attainments at 14 and 16, and to rationalize STEM support.

MR. KIBBLE said that Scotland had the advantage of having trained physics and chemistry teachers in every school; good recruitment; small class sizes (20 against 30 in England) and one, instead of five Examination Boards. The single examination board meant it was easier to maintain standards, but inhibited change and could breed complacency. Perhaps, in Scotland there was a greater value attached to science, which was, after all, the cultural legacy of mankind. Scientific education should foster competence, understanding, creativity, sensitivity and curiosity. You should not do science or learn facts simply because you were told to do so; it was important to differentiate explicitly between education to enhance science literacy, and that designed to train future sci-

entists. The 2006 curriculum review should ask why students do science, consider the problems of assessment, look at different curriculum models and understand that results would not come through until 2010/12. He was concerned that the proposals for "Curriculum for Excellence" would draw focus away from the science curriculum; the two were not the same.

A major theme in the following discussion was the nature and dangers of assessment. Testing should be a tool, not a means to an end. A number of speakers thought that there was too much assessment, it dampened creativity, lead to a too prescriptive curriculum, hindered teachers from being creative in dealing with the particular corpus of pupils they had, and - echoing Professor Glover's comment - meant that students left school unwilling to look beyond the boundaries of what they had to learn to pass a test or exam. It could also mean that really able pupils were not sufficiently challenged. On the other hand schools did need to learn where they stood in relation to other schools; parents demanded an assessment of how their children were doing, and there was some advantage in teachers knowing that certain things were required to be learnt. It might well be that parents - and indeed society - did not fully understand what education was, in the terms that the speakers had spelt out, and were looking for reassurance about their children which failed to take account of the crucial end result of stimulating curiosity.

There was also some doubt about the sharp distinction being drawn between science for citizenship and training for scientific careers. First, it overlooked the need for a third objective in scientific education - the development of a cadre of outstanding scientists who would be capable of world class research; they needed training and resources well beyond that adequate for those pursuing normal science degrees. Second, it was somewhat dismissive to assume that those who had received science for citizenship would not have an ongoing interest in science, even although they might have decided to pursue their major studies in other areas. There should be an opportunity for those with such interests to participate in some further science courses if they wished. Of particular importance was to provide an opportunity for those who had a life long interest in science, but were not able to pursue it in their normal university career, to pick it up in later life. Also, it was not clear that the training for university studies was what the universities actually wanted; it was suggested that there was a considerable gap between the perceptions of what was required in skills by the schools and the universities.

Participants shared the speakers' concern that children were put off science because they saw it as something handed down from above, with little relation to their own interests, and with no opportunity to argue or challenge. This was partly due to the problems about assessment, which crowded out the time and opportunity for wider discussion, but also it was due to the reluctance - or perhaps inability - of many scientists to communicate their enthusiasms and interests (or, as one speaker caustically remarked, to show that they were human). Was sufficient importance being given to the different perceptions and interests of children at different ages? Was science for citizenship - which would be addressed to younger secondary school pupils - basically concerned too much with concepts and not enough with hands on experiments which would lead to outputs which the pupil himself could judge? There was also the perception that the curriculum was owned by the teachers, and not sufficiently responsive to wider interests, including that of pupils themselves. But this was disputed by speakers, who cited a number of stakeholders who were concerned in its production - the science community, and charitable and other bodies. The curriculum proposals were now much more identified with children's interests - because it was recognized that failure to respond to their interests led to refusal to pursue science.

Speakers cautiously welcomed "Science for the 21st Century", although the remarks of Sir Richard Sykes and Baroness Warnock were noted. There was a danger in not ensuring that the boundaries of individual disciplines were maintained. It was difficult to discuss science (or the latest fashionable term "evidence") in the abstract. On the other hand, there were elements of each discipline in all others - e.g. there was much chemistry in biology; anything which promoted interdisciplinary working - and the solution to any significant problem did involve such working - must be encouraged.

Sir Geoffrey Chipperfield KCB

[Note: The House of Lords Select Committee on Science and Technology published a report on Science Teaching in Schools shortly after this meeting – see below.]

The presentations are on the Foundation website at www.foundation.org.uk.

Useful web links:
Department for Education and Skills:
www.dfes.gov.uk
The Foundation for Science and Technology:
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The Gatsby Educational Foundation:
www.gatsby.org.uk
Higher Education Funding Council for England:
www.hefce.ac.uk
House of Lords Select Committee on Science and Technology - Science Teaching in Schools:
www.parliament.uk/parliamentary_committee/lords_s_t_select/teaching.cfm
Institute of Physics:
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