CaSE News

Campaign for Science & Engineering in the UK

The Quarterly Update for CaSE Members

Number 55 May 2008

The Haldane Principle

Contents

The Science Minister, Ian Pearson MP, has recently invoked the Haldane principle that the Government should not interfere in the way in which Research Councils spend their money. It provides a convenient justification for the lack of intervention to resolve the funding crisis in physics and astronomy research. However, the same principle is apparently ignored as the Government seeks more and more control over the way in which the science budget is spent. The Government is apparently able to have its cake and eat it, picking and choosing when to apply it. Here we revisit the principle and consider how it is applied to today's science policy decisions, balancing scientific freedom with government accountability.

The Haldane principle has been a much debated part of the UK's research policy for 90 years. It arises out of the Haldane Report, published in 1918, that examined the structure and function of the UK government. The central thrust is that general research should be administered at arm's length from Government departments. The creation of the UK's Research Councils was the embodiment of the Haldane principle.

As with most principles there is inevitably scope for re-interpretation over time. Until the 1970s there was a general consensus between the scientific and policy communities that scientists were best placed to set research priorities. However, recent definitions have limited its scope to "day-to-day" decisions, allowing the Government to set general policies and direction of research councils.

Research Councils should starting using the Haldane principle to maintain or regain their independence in setting research priorities. The last science budget allocation targeted funding at thematic research priorities, which responded to the government grand challenges, such as climate change. Ian Pearson has said that "there is a debate that we will continue to have about to what extent we want to focus research spending on some of the big challenges facing society and our economy today." Research Councils need to balance the need to respond to government priorities in order to increase their funding with their ability to maintain their independence. The Government believes that it is right for it to set the broad areas where they want to see research done (like nanotechnology) and leave what projects to be funded to peer review by scientist and engineers. Pearson thinks "we have got the right sort of balance but we need to continually review this." CaSE believes that it needs to be urgently reviewed in advance of the next comprehensive spending review.

There is a real danger that the Haldane principle is now being used not to maintain scientific independence but to reduce government accountability. Research Councils have to submit delivery plans and funding requests to the Department for Innovation, Universities and Skills (DIUS) and the Treasury for approval. Approval is not a mere formality. Ian Pearson said before a parliamentary select committee that he would not have approved the Science and Technology Facilities Council's (STFC) delivery plan unless it contained support for certain projects. However, when questioned about the ramifications of the STFC's delivery plan he said, "It is not the responsibility of government, respecting the Haldane principles, to make detailed decisions in terms of how a research council should allocate its budget. That is up to the STFC and its decision-making processes which involve the scientific community."

The interaction between the Research Councils and DIUS needs to be much more transparent so that it is clearer about the degree to which DIUS is directing Research Council decisions, especially with regards to their delivery strategies. It would be desirable for any guidance from DIUS to Research Councils to be documented and made a public record. If the Haldane principle is going to remain limited to "day-to-day" decisions then the Government needs to become more accountable for the decisions it helped to create.

Nick Dusic, CaSE's New Director

When I applied for the position of Director, I knew the importance of CaSE as I had been the British Ecological Society (BES) contact for three years. I was the Science Policy Manager at the BES and prior to that I worked in parliament on science and environmental policy. In all of my various positions, I have worked to ensure that science usefully informed parliamentary debates and government policies.

I am originally from the USA, which is helpful in thinking about how another country invests and supports science and engineering. The UK and the USA have a strong record of scientific and engineering achievement. However, there is no room for complacency if both countries are going to remain competitive in terms of producing highly skilled graduates, innovative companies and cutting-edge research.

Over the last ten years the UK Government has begun to rectify the under-investment in science and engineering that prompted Save British Science into existence. Going forward, CaSE needs to hone its arguments for why the Government needs to redouble its efforts to make the UK a world leader in science and engineering. This will help our campaigns on funding and policy issues, from improving the education system through to public and private sector investment in research. In order to do this, CaSE will be consulting our members to get input on a new strategy and science and engineering policies for the next government.

Susan O'Dwyer

Susan O'Dwyer, CaSE's Administrator, will be leaving at the end of April to work for Brent Music Services. Susan has been with CaSE since 2000 starting off as the Director's personal assistant. She has been the first port of call for members, journalists, the Advisory Council and the Executive Committee. Susan is instrumental in ensuring the smooth running of the CaSE office, which has been particularly important during the transition period between Directors. CaSE thanks Susan for her hard work over eight years and wishes her every success in her new job.

Commenting on her departure, Susan said, "The best thing about working for SBS/CaSE has been the people I have met. I am delighted to have made friends with people I have worked with and had the privilege of meeting some eminent people at CaSE meetings. I have stayed so long because it has been enjoyable and I want to thank the staff, past and present, for making it such a pleasant place to work and such fun too. But after almost eight years it is time to move on and I am excited about the prospect of working for an organisation that brings music to the lives of school children.

"SBS/CaSE has taught me that with the right mix of people and their individual talents, plenty of energy, enthusiasm and a belief in what you are doing, you can make a difference. CaSE has reached so many people and I am sure will continue to do so, I will watch with interest to see it grow and am sure I won't be disappointed."

CaSE has advertised for a research and administrative assistant to take over Susan's administrative duties and provide more research capacity within the organisation.

New Organisational Members

We are pleased to welcome the following organisations that have recently joined CaSE:

- Unilever
- Norwich Research Park
- Breast Cancer Campaign
- Association of Medical Research Charities
- London School of Hygiene and Tropical Medicine

New Advisory Council

The Advisory Council is a group of eminent scientists and engineers who provide CaSE with input and advice on our policy activities. CaSE is pleased to welcome the following individuals to our Advisory Council.

- Professor Julia Goodfellow (University of Kent)
- Professor Diana Green
- Professor Dame Julia Higgins (Imperial College London)
- Sir Tim Hunt (Cancer Research UK)
- Professor Sir Aaron Klug (MRC Laboratory of Molecular Biology)
- Professor Lord May of Oxford (University of Oxford)
- Professor Sir John Walker (MRC Dunn Human Nutrition Unit)

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Encouraging Creativity and Innovation in UK Science

As a number of commentators have pointed out, the UK is not winning Nobel prizes at anything like the rate we used to. Between 1947 and 1966, there were 20 British Nobel laureates; between 1987 and 2006, only 9. The comparable figures for the USA are 50 and 126, so it is not simply that there are more countries competing for the prizes than there used to be.

Now no single metric can adequately describe the state of science in an institution or even a country. All the same, data like the numbers of Nobel prizes – or indeed citation indices – are useful indicators that we should take seriously, especially when we have other evidence that confirms what they are telling us.

For example, in 2002, the Engineering and Physical Sciences Research Council (EPSRC) commissioned an international review of chemistry in the UK. The panel reported that the general level was comparable with the world's best but that the UK was no longer at the forefront of innovation. They suggested that a major reason for this was that academic chemistry in the UK is highly dependent on industrial support. This, they said, has some clear advantages, but it is not conducive to innovation and discovery.

Should we be worried if we are falling behind in the sort of science that opens up new fields and wins Nobel prizes? We think we should, for a number of reasons, not least because if we discourage the very best scientists from realising their potential, the whole of the science base will suffer. It cannot be good for UK science and engineering as a whole if the people who might make major discoveries either set their sights lower or move somewhere else to do their work.

It's harder to decide what to do about it. Those who fund science are naturally going to insist on some form of accountability and this is much easier to achieve with clearly defined projects that are very likely not only to succeed but to do so soon enough to be listed on an annual report. We need somehow to direct funding to people and groups that will make good use of it, but the methods we use can put very strong pressure on scientists to concentrate on conventional research. Governments and charities are bound to have their own priorities for areas in which they want research carried out; this is hardly unreasonable but it can leave very little scope for researchers to follow their own intuition about where the breakthroughs are likely to come. In a reversal of the old saying, the good can be the enemy of the best.

We will be addressing this issue over the next year, and we'd be interested in hearing your views both on how serious the problems are and on possible solutions. In the meantime, government and other funders should start at least to take it into account when they are deciding policy. Perhaps if the Research Councils had done this, they would not have been so keen to transfer money from responsive mode to specified areas.

Anxiety over the Science Budget Allocation

The particle physics and astronomy communities have been thrown into disarray after the Science and Technology Facilities Council's (STFC) budget allocation and delivery plan were announced in December. There has been considerable confusion about how and why the situation arose in the first place. Both the Department for Innovation, Universities and Skills (DIUS) and the STFC have been blamed for putting the UK's scientific standing in these areas in jeopardy. CaSE worked with the Today Programme to bring the £80 million shortfall in the STFC's budget to light when the Science Budget Allocation was announced.

DIUS responded by announcing a review to look into the state of physics in the UK. Bill Wakeham (Vice Chancellor of the University of Southampton) is leading the review, but it is unclear how or whether it will actually affect the funding of physics and astronomy. There needs to be a moratorium on implementing the STFC delivery plan until the review has been published in September.

The STFC delivery plan currently includes a reduction in responsive mode grants by roughly 25% and the cancellation of a number of international collaboration projects. The STFC has since consulted the scientific community to get their input in re-prioritising research projects. The physics and astronomy communities have been vocal in their opposition to the STFC budget allocation and delivery plan. 17,528 people signed an online Downing Street petition calling for the Prime Minister to find a solution to the crisis. MPs have tabled Early Day Motions, asked questions and held debates on the issue.

The Innovation, Universities, Science and Skills Committee is investigating the situation and will be producing its report shortly. CaSE has liaised with the Committee over certain issues, including the Haldane principle. Phil Willis MP, Chair of the Committee, has said that they will find out where the fault lies and what can be done to save physics in the UK.

CaSE wants to see a solution to the funding crisis. It is critical that the Government takes the findings of the Wakeham review seriously and does not allow the health of the UK's physics and astronomy community to be undermined.

Research Excellence Framework

Higher Education Funding Council for England (HEFCE) is in the process of developing the Research Excellence Framework (REF), which is a metrics based approach to replacing the Research Assessment Exercise (RAE). For science-based subjects, the proposal was to have a bibliometric indicator to assess research quality. For non-science subjects, the proposal was for "light touch" peer review.

CaSE raised a number of issues and objections in its response to HEFCE's consultation on the REF. The response raised concerns about the ramifications of a bibliometric indicator. Specifically, how it could change researchers' behavior, affect researchers' career prospects, and the health of certain disciplines. CaSE recommended that all subjects should be allowed to have "light touch" peer review.

Scotland's Universities

Scottish Universities are concerned about the impact of the Budget recently passed by the Scottish Parliament. Students, on the other hand, are welcoming the scrapping of the £2300 graduate endowment charge (at a total cost of £17 million).

The 19 Scottish universities had asked for an increase of £168 million, but got just £30 million, to reach a total of £1.1 billion for the Scottish Funding Council for 2008-09. While total funding was up 3.4% on the previous year, seven institutions were budgeted to receive an increase below the current 2.7% inflation rate. Unsurprisingly, cuts are not being felt in the area of knowledge transfer, which increases by 23%, along with a new £2 million knowledge transfer grant to fund strategic projects.

A universities taskforce has been set-up to report on the funding situation to the Scottish Parliament by this summer, in the meantime, an additional £20 million of funds have been made available. CaSE will monitor the situation and input as appropriate to make the case for investment in the Scottish science base.

Equivalent or Lower Qualifications (ELQs)

At the request of Government to find savings to expand access to higher education, HEFCE has proposed ceasing funding for students studying qualifications that are equivalent or lower than their highest qualification. There has been considerable concern about the effects of this proposal on improving the skills of the workforce and on certain educational institutions, particularly Birckbeck and the Open University.

The ELQ proposal exempts undergraduate medicine and veterinary science. It also includes targeted funding to protect Strategically Important and Vulnerable Subjects (SIVS), which include some, but not all, science, technology, engineering and mathematics (STEM) subjects. CaSE has come out in support for continued public funding for all students studying STEM subjects as an ELQ.

CaSE looks forward to seeing the final proposal on how HEFCE will protect non-exempt STEM subjects. The additional allocation needs to appropriately compensate institutions for increasing the uptake up of STEM subjects as ELQs. It should also include all STEM subjects in terms of allocating funding for ELQs. The proposal for protecting SIVS will be reviewed in 2010 – 2011.

PISA report

At the end of last year, the Programme for International Student Assessment released its detailed survey of the science and mathematics knowledge and skills of 15-year-olds in 2006. Of the 57 countries surveyed, 12 ranked higher than the UK in science, although the UK did score above average. The UK ranked lower than 15 other countries in mathematics and was comparable with the OECD average. There was some regional variation, with performance in Wales worryingly lower than England for both mathematics and science.

International comparisons identified the following factors as improving national ranking for science education: not grouping children by ability, not having a selective school system, public posting of performance, schools having budgetary autonomy, time spent learning science and additional science activities. Interestingly, the influence of shortages of teaching and materials fell out once a selective system was taken into account.

Overall countries, coming from a higher socio-economic background increased student's appreciation and enjoyment of science as well as their performance. These relationships were disappointingly strong in the UK, which had an unusually broad distribution of performance. Finland performed way above all other countries and also has one of the least divisive education systems, with little impact of social background. There is nothing special about Finland that means we cannot learn from its successes and achieve them here in the UK and this report provides a great opportunity to do just that. We hope that the Government utilises this detailed report to full effect in guiding education policy decisions.

Worrying trends in UCAS application figures

While the total number of university applications by March 24th this year was up 7.8% compared to the same point last year, we were alarmed by changes in the pattern of student preference. This year students could only choose a maximum of five courses, compared with six last year, and there was an overall fall of 9.8% across all subjects.

There were alarmingly high falls of 15.8% in pharmacology, toxicology and pharmacy and of 29.9% in anatomy, physiology and pathology. A recent SEMTA report found that the bioscience and pharmaceutical sector was experiencing severe skills shortages, with 39% of bioscience and pharmaceutical companies failing to fill key posts. We can only hope that these numbers do not convert to fewer students studying these critical subjects.

In other core science subjects, there was a fall of just 7.3% in mathematics, suggesting a shift of student preference towards this subject. Biology and chemistry fell about 11%, but the higher fall of 15.4% in physics is worrying and may reflect student concern about long term funding in this areas.

Update on Secondary Science and Mathematics

CaSE continues to campaign on key issues in secondary education, keeping pressure on the Government to achieve its targets for September this year: (1) that all children achieving above level 6 at key stage 3 can study separate science GCSEs and (2) that all science specialist schools should offer triple science GCSEs.

In January this year, the first school league tables were published that included the number of children achieving two A* to C grades in GCSE science. Although it was disappointing that only half of children attained this level of performance, the inclusion of these measures indicates to all the importance of a science education for all. We must be sure that any future increases are not driven by fewer children being entered into triple science. CaSE has also urged the Government to include whether a school has specialist science teachers in biology, physics, and chemistry in performance tables; this should be easier now that schools are required to report this information centrally to Ofsted.

The Government also needs to set targets for teacher recruitment that would actually reduce the shortage of specialists science teachers. A Royal Society 'state of the nation' report that came out in December detailed the Government's lack of knowledge of the current workforce on which it bases its targets. The Royal Society estimates that to reach the Government's own teaching targets for 2014, there would need to be 1000 new physics recruits into teacher training each year and 3000 in mathematics. Yet Government recruitment targets are for 2350 teachers overall the sciences rather than in specific subjects and 2000 in mathematics. Last year's recruitment figures were actually just 350 in physics and 2000 in mathematics. Furthermore, CaSE argues that a strategy needs to be developed to target these teachers to the (typically low-achieving) schools in which they are most needed.

The Royal Society report also notes an alarming trend for fewer science and mathematics graduates to train as primary school teachers, with numbers dropping from 428 to 227 in two years. Presumably, those with an urge to teach are being lured into secondary teaching where the financial incentives lie. We will be keeping an eye on this trend. One way to improve teaching numbers would be to improve teacher retention, which is only 50% after five years for science teachers. In January, the Department for Children, Schools and Families (DCSF) announced funding of £140 million to support Science, Technology, Engineering and Mathematics (STEM) subjects in schools, although it was not clear how much of this is new money. Some of the money is targeted at incentives to improve retention, but there are other issues at play, which include high workload and poor pupil behaviour. We look forward to clarification on how the DCSF will improve non-financial aspects to teacher retention. The money also included £9 million to increase the numbers of students studying three separate science GCSEs.

CaSE was pleased that the DCSF has accepted the recommendations of the School Teachers Review Board aimed at increasing the number of mathematics, physics and chemistry teachers. First, a strategy is being developed to encourage headteachers to use the pay flexibilities available to them to improve recruitment and retention of these teachers. Second, a pilot project will be implemented to offer teachers £5000 to retrain to develop a specialism in these critical subjects. CaSE has been campaigning for both of these proposals.

Science at the Foreign and Commonwealth Office

The Foreign and Commonwealth Office's (FCO) Science and Innovation Network was in jeopardy after the Foreign Secretary, David Miliband MP, announced his new priorities, which did not include science and innovation. CaSE wrote to the Foreign Secretary and engaged the media in this issue so that the FCO did not opt out of science. The Network is important as it works with a range of partners to foster scientific collaborations between the UK and other countries. The FCO had scientific attachés in 24 countries and territories gathering intelligence and acting as a point of contact for the UK's scientific community.

The Innovation White Paper, Innovation Nation, announced that the Department for Innovation, Universities and Skills would take over the running of the Science and Innovation Network, the FCO has said that it will remain a partner. CaSE was pleased that the Network would be maintained, but is still extremely concerned about the future of science at the FCO.

The FCO needs to keep science and innovation within it responsibilities as science underpins many diplomatic issues facing the UK today - be it understanding the technical options to monitor nuclear proliferation or supporting the deployment of low carbon technologies. The FCO should also consider options for improving international institutions' scientific and technical capabilities in order to improve their effectiveness.

Although the FCO does not procure research, like other government departments it should have mechanisms in place to ensure that science is fully utilised in diplomacy. This should be done through appointing a departmental Chief Scientific Adviser. The FCO is one of the few remaining Government Departments without one, although the Foreign Secretary has access to the Government Chief Scientific Adviser. The FCO also needs to take an active role in the Science and Innovation Network and maintain 'in-house' specialists.

New Chief Scientific Advisers

In January, Professor John Beddington started as the new Government Chief Scientific Adviser replacing Professor Sir David King. John Beddington is a professor of applied population biology at Imperial College. He has been the Chair of Defra's Scientific Advisory Council and an advisor to various other national and international bodies.

Professor Mark Welland FRS FREng has been appointed the new Chief Scientific Adviser at the Ministry of Defence. Professor Welland is Professor of Nanotechnology at the Department of Engineering at Cambridge University. He took up his new appointment as Chief Scientific Adviser in April, replacing Professor Sir Roy Anderson.

Professor Chris Pollock has been appointed the first Chief Scientific Adviser to the Welsh Assembly Government. Professor Pollock is the former Director of the Institute of Grassland and Environmental Research. Prior to being appointed, he led an inquiry into what the role and responsibilities should be for a Chief Scientific Adviser at the request of the First Minister, Rhodri Morgan.

CaSE looks forward to working with all of the new Chief Scientific Advisers in their new roles.

Innovation, Universities, *Science* and Skills Committee

The Government has recognised the importance of cross-departmental scrutiny of science by the House of Commons by agreeing to change the name of the Innovation, Universities and Skills Committee to include Science. The decision was made in response to the Science and Technology's Last Report, which recommended the word science be retained in the title of any subsequent select committee.

Chairman of the former Science and Technology Committee and Chairman of the IUS Committee, Phil Willis said: "The new Committee welcomes the opportunity to change its name to reflect the place of science within its work. It is an important signal to the science community that science will remain a high priority in terms of parliamentary scrutiny."

CaSE welcomed the addition of "science" to the Committee's title. CaSE had campaigned to keep the Science and Technology Committee, and has engaged with the new IUS Committee to ensure that Parliament effectively scrutinises the Government's science policies and budgets. CaSE will work with the Committee to ensure that this happens across government departments, not just within the Department for Innovation, Universities and Skills. If it doesn't, CaSE will lobby for the reinstatement of the Science and Technology Committee.

Innovation Nation - Where is the STEM?

The Government launched its science an innovation White Paper, *Innovation Nation*, following this year's Budget. The White Paper aims to make the UK the best country for innovative businesses and public services. The general thrust of the White Paper was to balance previous policy initiatives to improve the supply side (scientific and engineering capacity) with new demand side initiatives to promote innovation. The White Paper had little in the way of new initiatives to directly improve the UK's standing in science and engineering.

The White Paper made recommendations to improve public procurement so that it can better support research and innovation. The UK's two largest sectors for private sector investment in R&D are pharmaceuticals and aerospace, which do a lot of their business with the National Health Service and Ministry of Defence, respectively.

However, there was no mention on implementing the Sainsbury Review recommendation to increase government departments' R&D budgets and ring-fence them so that they do not get raided to relieve pressure on public finances.

The White Paper made reference to the fact that innovation is an internationally competitive and collaborative endeavour. To help position the UK internationally, it said that the UK Trade & Investment would be increasing its support for attracting high-tech foreign investment and that DIUS would take over the running of the Foreign and Commonwealth Office's Science and Innovation Network.

The strength of a country's research base is a key component for attracting and retaining multinational firms' research facilities. Competition for attracting private sector R&D is fierce, which means that the UK needs to quickly build upon its historic strengths of conducting cutting edge research and training highly skilled graduates.

Science and engineering alone do not equal innovation. There needs to be the right conditions and expertise to take research and turn it into a new product or process for the market. New "innovation vouchers" proposed in the White Paper may help SMEs to engage more effectively with local universities, which could lead to new partnerships between academia and industry. Other ways of doing this could be to provide additional training for STEM graduates so that they have the skills needed to bring innovations to the marketplace.

CaSE will continue its work to ensure that government policies support both science and engineering and the conditions necessary for innovation.

UK Civilian Space Strategy

The Civilian Space Strategy 2008 – 2012 aims to keep the UK "at the forefront of the evolving space scene." The UK has an impressive private sector space industry focused on satellite and robotic technologies and universities and institutes at the forefront of space science in many areas.

The UK's current spending on space programmes comes from a range of government departments, agencies and research councils. The Science and Technologies Facilities Council (STFC) is the largest funder of the British National Space Centre. Its current funding is in disarray due to an estimated £80 million shortfall in its budget (see article on page 3). If the UK wants to increase its commitment to space exploration it will need to invest a significant amount of new money into the system, it cannot come from the general science budget.

The British National Space Centre (BNSC) would need to be reformed for the UK to play a bigger role in space exploration. It would need to become a government agency with its own funding stream. This would help to ensure that the science budget does not get raided to fund space exploration. The Space Strategy did not have any firm plans for strengthening the BSNC. So there is considerable worry within the scientific community that ambitious plans for space exploration could come at the expense of space science, which is already in trouble.

Have GCSE and A Levels Really Become Easier?

I am sure that, like many other members of CaSE, I read each issue of CaSE News from cover to cover, intending to remember many of the detailed facts and arguments it presents. Later, of course, when intending to display my amazing command of the material it is frequently difficult to remember the details, so my contribution to a discussion is always less than I would wish. However, when the Editor asked me if I would write for this issues, I had instant recall of the article on evidence-based grading in CaSE News, June 2007. While commenting on the correlation of student rating of lecturers in the US and students' grades, the article touched upon two challenging aspects of UK education – the increasing proportion of students receiving first and upper second class honours degrees and the inflation observed in A level pass rates and grades.

The changes in A level (and GCSE) results have interested me for a long time. Anyone involved in science and engineering must have a desire to understand this phenomenon. In my case this was partially fulfilled when I was invited by the Qualifications and Curriculum Authority (QCA) to be the coordinator of a review of standards in GCSE and A level Chemistry over time. The outcomes of this study ("Review of standards in chemistry GCSE 1998 and 2003; A level 1999 and 2003") were published by the QCA in 2005.

The review covered the five main awarding bodies (representing ~80% of candidates for GCSE in 2003 and ~76% for A level) was carried out in several stages. First, a desk-based review of the syllabuses, question papers, coursework requirements, marking schemes and examiners' reports was undertaken by the Review Coordinator and six senior examiners. Second, the reviewers and15 experts were metaphorically locked in a hotel for a weekend where we were able to compare the work of candidates across the awarding bodies and between the two years. The comparisons were made at the grade boundaries of A, C and F for GCSE (for foundation and higher tiers) and at A and E for A level. The results were illuminating in view of the well publicised year by year increasing pass rate and higher grades – and the general perception that A levels were becoming easier.

At GCSE, the reviewers (including the highly sceptical Review Coordinator!) found relatively little difference in the overall demand in any aspect of the awards between 1998 and 2003, although some minor distinctions could be made between the awarding bodies. If one was searching for negatives the only points that could be made were:

- Performance at the Grade A boundary was slightly better in 1998
- One of the two optional routes in the OCR award was less challenging than the other option and other awarding bodies

Professor Ian Haines is a member of the CaSE Executive Committee and was at the London Metropolitan University

- Performance in mathematics as applied to Chemistry was lower in 2003 particularly at Grade A
- Coursework assessment had the potential to overcompensate for lower examination marks but only for the lower attaining candidates
- There was limited opportunity to display competence in mathematics (numeracy) or a grasp of real scientific concepts in foundation tier

Counterbalancing these were the observations that:

- Overall demand at each grade point was similar
- Standards at the Grade C and F boundaries were very similar in both years at both the foundation and higher tiers. These are the thresholds which dictate the total number (and proportion) of passes
- The expectations of mathematics in the assessment instruments had not changed over time
- Four of the five awarding bodies had reduced the weighting for coursework (which typically boosted the overall mark) from 25 to 20%
- Even the limited amount of choice in exam questions present in 1998 had been eliminated in 2003

These conclusions should dispel the myth that GCSE Chemistry has been getting easier, at least for the period covered by the review.

An important aspect of the review was assessing the extent to which GCSE was appropriate preparation for AS/A level. It concluded that the coursework was not helpful as a preparation for further "experiment and investigation" and there were major doubts as to whether a grade C reflected sufficient practical abilities. Adding to this concern, candidates at this level had limited mathematical and communication skills. Notwithstanding these points, almost all GCSE material was judged to be useful to progression.

Regarding A level Chemistry, the review somewhat surprisingly concluded that there was little discernable difference in the overall demand of the specifications between 1999 and 2003, or between the awarding bodies. It is important to realise that between 1999 and 2003 the curriculum had been revolutionised, moving from the traditional long syllabus to a modularized delivery/assessment involving AS and A2 section, each comprising three modules, separately assessed. The review concluded that performance had improved slightly at grade A, but declined a little at Grade E. If this is correct then it might explain a very small increase in overall pass rates but not the increase in A grades.

Additional conclusions on A level Chemistry included:

- The reduction in the level of choice in examination papers across awarding bodies (with no choice available in 2003) resulted in very little variation in demand between awarding bodies by 2003
- The introduction of synoptic examinations slightly increased the demand in some awarding bodies, although the questions did not require candidates to synthesize knowledge and skills across the curriculum
- The mathematics and English requirements had not materially changed

- Although candidates with lower examination marks could compensate with higher coursework marks, some awarding bodies had significantly reduced the coursework weighting from the previous 20% (CCEA to 6.7%, AQA to 12.5%)

So why is there a perception that the apparently unending inflation of A level (and GCSE) grades means that the demand at all grade boundaries is reducing year by year? To answer this one needs to look beyond the above broad judgments.

First, examination papers had became increasingly clear and explicit over time, reducing misunderstandings. In 1999 some aspects of the syllabus could have been seen as somewhat open-ended. However, by 2003 the exceptionally detailed syllabi (and supporting CD Roms and other materials) and the transparency of examinations and their marking meant that teachers had the clearest indication of what they should teach down to the finest detail. So candidates could be better prepared for examinations (confirmed by the other reviewers who were nearly all still practicing teachers). Additionally the reviewers explained how teachers could maximize the marks obtained in coursework.

Such efforts by teachers to ensure the highest grades rather than extend the subject and attempt to engender a fascination for science is scarcely surprising. Teachers, pupils and schools will only be judged on league tables that count grades rather than real value added or enthusiasm for the subject. Of course, universities have taught to syllabi for years so the remarkable inflation in degree classification during a period of massive growth in student numbers is crying out for more attention.

On the day of publication of the QCA review I arrived at work extra early, prepared to respond to the many media enquiries I expected. The total number of enquiries was…..zero, and as far as I am aware no publication, including the Times Educational Supplement, covered it. Failing to disparage the standard of school exams was not considered newsworthy.

I am left with one final thought. By 2003 the breadth and depth of coverage of chemistry was similar across the awarding boards. In these circumstances one has to wonder why there is more than one awarding body for each GCSE and A level subject.

Bologna – 'A Bridge too Far'?

Steve Robinson is a member of the CaSE Executive Committee and was the Director of DERA

It is now two decades since three converging but conflicting trends led to four yearMEng and MSci degree courses being established in the UK. First, there was a need for remedial teaching in the initial year to close the gap opening up in content and level between A-levels and the entry standards required. This was particularly evident in mathematics, for example in calculus. Second, industry was crying out for experience in project work and more specialisation, so that graduate recruits could easily join their programmes at the sharp end of technology. This need was exemplified by the professional institutions moving from honours degree to master's degree as the academic prerequisite for registration as a chartered engineer. Finally, the government could be persuaded to fund undergraduates for a fourth year, but was adamant that it would not pay postgraduate fees.

Thus the four year masters first degree was born. It was possible to introduce more project work and specialised teaching options in the fourth year, and there was some slack to introduce, albeit with difficulty, remedial teaching in the first year. Furthermore, it was in the interests of both the universities and the professional institutions to agree that the standard academic basis for registration at chartered-level should be the new master's first degree.

There is no doubt that the MEng/MSci degrees have been a great success and have become the 'gold standard' in the UK. Moreover there is envy abroad that such standards can be achieved in four years, and often by the age of twenty two. However, the trends have not abated. The inherent conflicts are becoming starker, and there is trouble ahead.

The gap between A-levels and first degree input requirements continues to grow. The Treasury is bust, at least as far as university expansion is concerned. Student fees have been introduced. This is an enormous real and psychological change, which will impede the lengthening of courses and lead students to stay in education no longer than they deem necessary to meet their career aspirations. About half of science, engineering and maths students (and among these some of the best) do not go on to practise their specialist skills, and they will not want to run up debts to pay for fourth year and post graduate learning that they do not need. The others, however, require ever more specialisation, and the four year degree is proving to provide neither the time nor the flexibility to pick up important new areas in the detail required by the graduate market. A good example is systems engineering, where masters degrees in the USA are blazing the trail. Also, universities and technical schools in Europe, which do not in general terms have the academic standing of their UK counterparts, nevertheless generally produce technical staff better matched to industry's needs at the most advanced level, albeit at an older age.

The attempt to reach agreement on standards and equivalence across the EU in the debate on the Bologna agreement, has added another pressure on the four year degree; for it has led some to argue that the four year UK Masters is equivalent to a post graduate Masters based on a five year (3+2) programme. This is a challenge too far for the MEng/MSci degree, and the opportunity should be grasped to restructure UK courses so that all students have more options in the type of degree courses that they take. As the input standard falls, a strong case can be made for following the USA, where the Masters has a central role. That would imply a 3+2 arrangement, but it may prove that the flexibility provided by the option to complete a degree after two, three, four or five years is best. Such an arrangement would effectively comprise a foundation degree, an honours degree, a one year MSc and a two year MSc - all planned to match a broad national/international framework, and with the opportunity to transfer between departments (e.g., physics to engineering) or between universities where appropriate.

Above all, the 'one size fits all' fixed student fee and government capitation fee policy, is forcing the most able students into a four year straight-jacket which increasingly, will not always be in their best interests.

Creating markets for scientific enterprise and the role of UK Science Parks

Dr Robin Daniels, Chief Executive, Norwich Research Park

Over the last twenty years the number of UK science and research parks has increased to the point where, by 2004, there were over seventy established parks with a further eleven under development. These parks are now home to around 2,600 tenant companies, turning over £5.5 billion annually and employing almost 70,000 people (UKSPA, 2004).

While well run real estate is important to these science parks, creating a market for the commercial transfer and deployment of research outcomes is fundamental.

Creating a market for scientific enterprise

By linking supply and demand – and providing both with appropriate accommodation and connectivity – the science park provides the opportunity to create a micro-cluster which, with care, delivers real economic impact for the locality, the region and the country.

Defining the supply side

Successive government policies have too often been designed to support "Science and Technology", or "Research and Development", treating these as if they all mean the same thing; as if they are exclusive and automatic sources of innovation. The result is that "innovation support" usually consists of making substantial amounts of funding available for research and that, by comparison, very little is done to promote or facilitate the actual process of commercialising new ideas.

Building markets and bolstering market access

What makes innovation profitable is having customers who demand innovative products, services, processes.

What makes innovation possible is having access to innovative suppliers, staff, and universities. This is about making a market which supports the transfer of innovation between "players" - universities and businesses, SMEs and global companies, suppliers and clients.

Putting new technology to work

The establishment, development and growth of sustainable businesses that will provide increasing numbers of high value jobs, is the most robust measure of both research relevance and market effectiveness. Given the changing shape of manufacturing in the UK and the necessary shift up the value chain, it is crucial to our long term competitiveness that robust technology is pulled through into the market as effectively as possible.

Accelerated evolution

For science parks there is a real opportunity, taken up so far by only a handful, to become real hubs of innovation. To connect up the supply and demand sides of the market, to move beyond being exercises in real-estate and create hot-houses for technology entrepreneurship and corporate engagement. Those locations that include a good university, strong research institutes, business incubation facilities and links to established firms have all the component parts necessary to bring about a transformation in the UK's exploitation of science and technology.

The Norwich Research Park

The Norwich Research Park (NRP) is, with 9,500 people employed, the UK's largest science park and home to one of Europe's largest single-site life science clusters. The NRP is a collaboration between the University of East Anglia, the Norfolk & Norwich University Hospital and three independent research institutes; the John Innes Centre, the Institute of Food Research and the Sainsbury Laboratory and a growing community of technology-based companies. The Norwich Bio-incubator, opened in 2002 was, by 2005, 50% full. Just two years later the bio-incubator is running at full capacity and there are two new-build projects underway. This rapid acceleration has been driven, not just by sound real-estate management, but through the explicit and energetic support of collaboration between institutions and companies across the park – and between the park and the rest of the world. Over the last two years a branding and marketing strategy has been developed to capture the specific strengths of Norwich as a centre for both research excellence and commercial success. As the 'UK's Centre for Research in Health, Food & Environmental Sciences' the NRP has helped bring focus to a set of regional strengths and has led in introducing the trans-regional London Technology Network to East Anglia. What makes these achievements of particular note is that the company driving these developments, NRP Enterprise, has itself no assets, no land and just four employees. The NRP is a genuine collaboration between the five partners, funded by them, the local councils and the Regional Development Agency. Moreover, the NRP model includes the development of the partners' real-estate and land as simply a component part of a much broader remit, which includes knitting together their combined capabilities to create a coherent, thriving campus – the seed of a true cluster.

Education and social disadvantage

Joe Lamb

The government wants half the population of young people to go to university, although they do not say whether they consider this an intrinsic or a positional good. This target may be difficult to achieve and could even increase social disadvantage in that those children in the lower third of the social classes are 4.5 times less likely to reach university than those from the upper third (www.ces.ed.ac.uk, briefing 40 2006). This paper concludes that in both England and Scotland "social-class differences in entry to HE could largely be attributed to class differences in achieving the qualifications for entry to HE". So the differences are not simply due to the quality and training of teachers in state schools, but largely to the social background of the children and their families.

In the UK many, perhaps most, of the decision makers have a background of 'public school' and universities such as Oxbridge, St Andrews and a small number of others. As a result, they rarely meet those from a lower social class and find it difficult to understand their mind set. Partly through my large extended family and partly through medical practice, I have met many such people and have found that there is considerable ignorance about the function of universities and the advantages of a university education. I have often heard people say things like 'universities are not for the likes of us'; 'universities are a waste of our money' and latterly 'we do not want to get into debt' (living costs are not paid by the government). I once asked a Secretary of Education (Fettes & St Andrews) why the government did not advertise the function and advantages of Universities in the way they were advertising the sale of British Gas. He did not understand the question.

An anecdote might illustrate the problem. A close relative of mine and her husband had no idea what universities were for and did not see why they should be paid for by 'their' taxes. So they caused their three daughters and two sons to leave school as soon as they could even though some of them wanted to stay on. The sons followed a common Scottish route and joined the army as privates. During their army career in Northern Ireland they were taught a trade so that one of them joined a fire service training depot in England after demob. His two sons went to the local comprehensive school and turned out to be very bright at maths; this was picked up by their maths teacher, who entered them for Oxbridge. I became aware of this when my relative rang me up and said this grandson was going to a place called Oxford and had I heard of it! In fact he turned his place down and went to Nottingham because his girlfriend (now his wife) was going there. He got a good first and is now doing a PhD; his younger brother is in first year maths at Cambridge.

This anecdote illustrates that though good teachers are necessary they are not sufficient. The parents of children in the lower social classes need to understand what universities are for and the advantages that going to one may bring. This latter point is not simple because, on average, someone who goes to university and starts work at 22 will be 35 before he catches up with a contemporary who started work at 16. Over a lifetime graduates earn more than non-graduates; at least they did in the past. But it is difficult to make this point to a 20 year old who is in a job and enjoying his free time and relatively high spending power.

On the opening and closing of doors

Steve Robinson

Hamlet may have made the point most eloquently, but he was not the first to observe that in the conflict between hope and fear, there is no contest. Fear is the winner every time. Our lack of scientists at A-level and above is not so much because the doors of hope and expectation have not been opened by experienced and inspirational teachers in secondary schools, but that fear of failure at primary school has closed the numeracy door for ever.

General junior science can be maths free, but serious science cannot, and it is perceived or real inadequacy in maths, which stops students taking up subjects like the physical sciences and engineering, as often as it is lack of interest in the subject itself. Physics teachers in particular like to begin at the beginning, and a student with no school physics at all, but with an adequate grounding in mathematics would have no problem gaining a first class honours physics degree at any physics department in the country. The big battalions from the physics, chemistry and biology communities would serve their cause better by uniting in support of pure maths, applied maths and statistics in the core curriculum, instead of fighting their corner for an independent and rigorous presence in the GCSE syllabus. They could also unite in helping the mathematics community give primary school pupils confidence with numbers, which should not be an impossible task, given the current concern regarding the addiction of children for computer games.

The problem is that however badly expressed, a sentence means what the speaker wants it to mean, except when he says that two and two are three. Then he is just wrong. He probably never recovers his self esteem, for the public ridicule is absolute. The problem this presents to children should not be underestimated and is more severe for girls than for boys. Lack of ambiguity is the corner-stone of maths but also carries a virus which few have the anti-bodies to resist.

The game is given away by the classics professor who proudly puts down his completed 'fiendish' SU DU KU, with the smug remark that he only took the game up, when someone told him it was not about numbers but about logic. What one wonders does he think numbers are about? Anyone with firm grip on Aristotelian syllogisms should find the proof of Fermat's last theorem a 'walk in the park.'

International Opinion Forum

CaSE is organising its next Opinion Forum on *Attracting, Educating and Collaborating with International Scientists & Engineers* supported by sponsorship from the British Council.

An important and increasing proportion of the STEM workforce now comes from overseas and this raises a range of interesting issues for the sector. Fortunately, at the moment, overall outward flow is less than the flow in. At the student level, in the core sciences, about 8% of undergraduates are international, compared with up to 17% in some biological specialisms, 14% in mathematics and 20-30% in engineering. The rates of international post-graduate science, mathematics and engineering students typically range from 40-80%. Overall subjects, 27% of academic staff are from overseas.

In the meeting, we'll be considering how to attract scientists and engineers to the UK and what support structures would facilitate their recruitment. Recent reports (e.g., from SEMTA) suggest that some sectors are finding it harder to recruit from abroad. On the other hand, is there a risk that we are becoming over-reliant upon international scientists in some fields, especially given their increased mobility?

The benefits of *educating* international students include a multi-cultural environment, sharing skills with other nations, and economic gain. The fee income of all international students is estimated at £1.68 billion and the several thousand students who stay on in the UK after completing their studies generate an estimated £2 billion GDP. However, our market share is falling, from 16% in 1998 to 11% in 2004. We will consider the consequences of our growing dependence on international students to fill places in under-subscribed courses and to balance budgets and also how to maintain our competitiveness without compromising students' education and experience.

International and UK scientists and engineers who move abroad should be encouraged to maintain links with the UK to foster future *collaborations*, but are the right mechanisms in place to facilitate this? Multinationals are not investing in UK R&D at the same rate as UK-based industry, hopefully this does not reflect a decline in the attractiveness of the UK for international collaborations – we must work to understand this trend. We're also very concerned at new visa requirements that may eliminate the academic visitor category, reducing the length of stay from 12 to 6 or even 3 months.

Over the course of the day, a series of presentations will explore these issues and they will be further considered in breakout groups before a final discussion session. All organisational members will be invited to attend.

Delivering Diversity: Making Science and Engineering Accessible to All

Last year CaSE held an Opinion Forum on Under-Represented Groups in Science and Engineering, sponsored by the UK Resource Centre for Women in SET (see CaSE News, 54, November 2007). Although many of the issues raised affected a range of groups, we particularly considered the impact of disability, social-disadvantage, ethnicity and gender. CaSE has developed the ideas generated at the meeting into a policy document entitled: *Delivering Diversity – Making Science and Engineering Accessible to All*. We are currently scheduling the launch of the policy document so that it reaches various policy and parliamentary audiences. It will be available to download from our website once it has been launched.

CaSE Strategy

Over the coming months CaSE will be producing a five year strategy. The last strategy was published in 1996, ten years after Save British Science (SBS) was formed. It consolidated the work of the SBS over its first ten years and set the direction for the next. Since then a lot has changed both in terms of the conditions for science and engineering in the UK and for the organisation itself. Some of SBS's policy objectives, such as the doubling of the science budget, have happened under the Labour Government. However, there are still many issues to campaign for in order to improve the state of science and engineering in the UK.

The new strategy will enable us to redefine our mission and to consider how best we can achieve it. We will be engaging various parties, including our membership, in developing our new strategy. If you would like to provide input, please send an e-mail to nick@sciencecampaign.org.uk

Your Views

Contributions and letters from the membership are always welcome. If you want to have your say, please contact the Editor.

Website Latest

For the latest information on CaSE activities, please go to the website which is updated regularly www.sciencecampaign.org.uk