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Science Policies for the Next Scottish Parliament
Agenda for the Next Four Years

INTRODUCTION

Science touches every aspect of modern life. In various forms, including technology, medicine and engineering, scientific progress is a part of everyday life and it is the fundamental basis of a modern economy.

Because of its all-pervading influence on society, science now hits the headlines more often than ever before. At the same time, the rapidly-moving world of scientific discovery and technological change can alarm sections of the population, who feel that they need more information or better expert guidance if they are to make sensible and positive choices about science in a democratic society.

Because of this, the majority of non-scientific politicians can no longer afford to leave scientific and technological issues to a small group of experts.

Political debate must encompass discussions about how science and engineering advice can feed into effective policy-making, and how scientific innovation can stimulate the economy. Public policy must also understand how to fund and organise scientific research, and how to structure a scientific education.

This document is a contribution to such a debate from Save British Science (SBS), a voluntary organisation that campaigns for better funding of scientific research, and stronger policies relating to science.[1] SBS focuses its efforts both on the UK government in London, and also on the devolved administrations in Edinburgh, Cardiff and Belfast.

In this document, we set out our thoughts about the state of Scotland's scientific past and present, and list those policies we believe are necessary if Scotland's scientific future is to be strong and productive over the next four years, during which the next Scottish Parliament and Scottish Executive will govern Scotland.

One of the driving beliefs of SBS is that, in the UK's scientific culture and history, together with its current potential, there is something worth saving. Pages 3 to 4 therefore set out a brief summary of Scotland's Scientific Past, showing how every part of Scotland is represented in an illustrious scientific heritage.

Pages 5 to 21 describe some of the more important aspects of Scottish science as they are at the moment, and as they have been in the past few years. This section on Scotland's Scientific Present is divided into the four main interlinked themes:

- The science research base
- Science education
- Science and the economy
- Science in society

In these headings, the word 'science' is used as a shorthand to include the social and natural sciences, engineering, technology, medicine and mathematics.

Pages 22 to 25 set out some specific policies that SBS believes create an agenda for Scotland's Scientific Future up to 2007.

Page 26 describes how Westminster policies impact on Scottish science, because of the way in which the devolution settlement divided power and authority between London and Edinburgh.

This document is a companion to SBS's *Science Policies for the Next Parliament*[2], published before the UK General Election in 2001. That document sets out in more detail some science policies that are relevant across the UK, as well as others that relate to devolved matters.

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1 For more information see our website <www.savebritishscience.org.uk>

2 *Science Policies for the Next Parliament: Agenda for the Next Five Years*, SBS 2001

SCOTLAND'S SCIENTIFIC PAST

Scotland's strong tradition of achievement in science and engineering is the foundation on which future success can be built.

A diverse history

Scottish contributions to science have come in a wide diversity of fields. The table below gives an indication of this breadth of achievement.

Geology: Highland geologist Hugh Falconer was born in 1808. He corresponded with Darwin and founded a museum in his home town, Forres.
Physics: Charles Thomson Rees Williamson was born in Glencorse in 1869. He won the 1927 Physics Nobel Prize, for the invention of the cloud chamber, inspired by the mist around Ben Nevis.
Botany and Cell Biology: Botanist Robert Brown was born in Montrose in 1773. He was the first to recognise the significance of the nucleus in living cells, and described Brownian Motion, a phenomenon also of interest in chemistry and physics.
Medicine: Born in Glasgow in 1921, Alick Isaacs jointly discovered interferon, a protein used in flu vaccines.
Engineering: James Watt, born in Greenock in 1736, played a highly significant role in the development of the steam engine, completing his version in 1769. The metric unit of power is named after him.
Embryology and Evolution: Francis Maitland Balfour was born in Edinburgh in 1851. He studied evolution and embryology. In 1881 he set up a biology laboratory in Cambridge to provide access for women.
Chemistry: James Dewar was born in 1842 in Kincardine-on-Firth. He was the first to note the effects of temperature on chemical reactions. He also discovered superconductivity.
Public Engagement with Science: Baron Lyon Playfair, from Benvie, was among the first scientists to hold important public positions. He organised some of the first public science exhibitions and museums.

Table 1: Examples of Scotland's scientific heritage, demonstrating the diversity of disciplines in which Scots have contributed.[1]

Women in Scottish science

Throughout the world, science has traditionally been dominated by men, but Scotland has also had some important women scientists, engineers, mathematicians and medics. Box 1 outlines some of their contributions.

Geographic spread

The map on page 4 demonstrates that Scotland's scientific heritage is not confined to any one part of the country, but spread across all regions.[2]

BOX 1: WOMEN IN SCOTTISH SCIENCE & ENGINEERING

Early women scientists include **Mary Sommerville**, who was born in Jedburgh in 1780. She learnt mathematics in secret, and went on to popularise the work of Laplace. She also worked in astronomy and physics, and was one of the first honorary women Fellows of the Royal Society. **Shelia Scott** received a first class degree in mathematics from Edinburgh University in 1932, before teaching at several Scottish schools and at Aberdeen University.

There are now approximately 20% more women studying in Scotland's universities than there are men. Women outnumber men in the study of medicine and allied subjects, biology, veterinary medicine, mathematics and information technology.

5.8% of the Fellows of the Royal Society of Edinburgh are women, and this figure compares favourably with that of 3.4% at the Royal Society of London. Although this figure is low, partly because of historical inequality, an indication of an improving situation is that 7 of the 19 members of the Scottish Science Advisory Committee are women.

Sources: Futureskills Scotland: The Scottish Labour Market 2002, Scottish Enterprise, 2002; *Standard Tables on Higher Education and Further Education in Scotland, 2000-2001*, Scottish Executive, 2002; information from the Royal Society and Royal Society of Edinburgh

1 *Chambers Biographical Dictionary*, Chambers Harrop, 2002
2 as above

Scotland’s Scientific Past

<u>Highlands and Islands</u>

Roderick Murchison was born in 1792 in Tarradale. He named the Devonian and Permian geological periods, and pioneered the use of fossils in dating strata of rocks.

Born in Inverness in 1858, Sir **James Swinburne** worked on the first light bulb, helped to develop dynamos, and invented a transformer for long-distance power transmission. He is also known as 'The Father of British Plastics', for bringing Bakelite to the UK.

<u>West of Scotland</u>

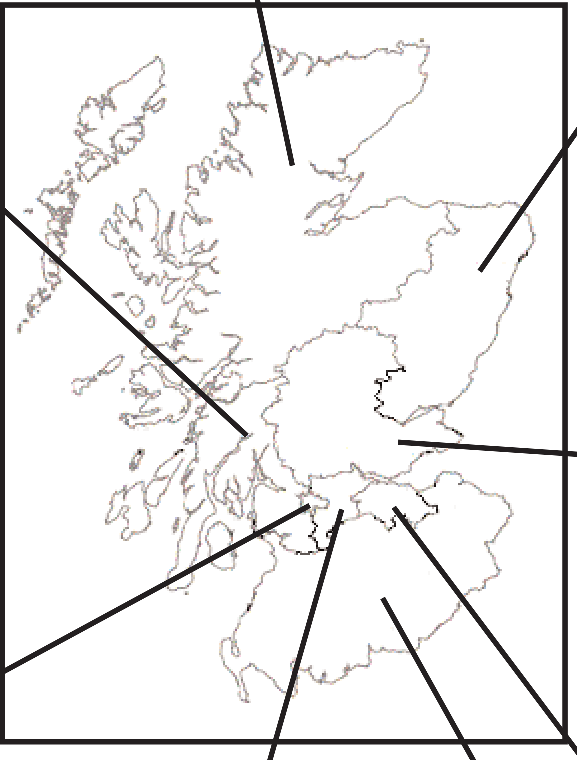
William McNaught, from Paisley, born in 1813, developed the first ever compound engine, which recycles wasted heat to improve efficiency.

Archibald Barr was born in Paisley in 1855. He was an engineer who established a pioneering scientific instrument-making business, and used his profit to set up new research laboratories at Glasgow University.

<u>Glasgow</u>

John Scott Russell, well known to mathematicians for the discovery of the standing wave, was born in Parkhead in 1808. Since computer modelling of the wave in the later 20th century, his work has been used to understand tornados, plasmas, shock waves, optics, and Jupiter's red spot.

Sir **William Ramsay**, who won the 1904 Nobel Prize for chemistry, discovered the elements argon, helium, neon, krypton, and xenon.



<u>North East Scotland</u>

Sir **Patrick Manson** was born in Olmeldrum in 1844. He was knighted for his work establishing that diseases such as malaria are carried by insects.

Sir **Robert Alexander Watson Watt** was born in Brechin in 1892. He was the physicist who developed RADAR.

<u>Mid Scotland and Fife</u>

John Goodsir, born in Anstruther in 1814, studied anatomy, dentistry and agriculture. He highlighted the importance of the cell in tissues.

Nobel Prize winner **John James Rickard Macleod** was born in Cluny in 1876. In 1922 he discovered the existence of insulin. All proceeds from patenting its production were donated to medical research.

<u>Central Scotland</u>

William Cullen was born in Hamilton in 1710. He was the first to use the term neurosis, and suggest that this was a disorder of the nervous system. He promoted the new discipline of chemistry, founding laboratories in Glasgow Medical School.

John Boyd Orr was a biologist born in Kilmaurs who won the 1949 Nobel Peace Prize for work on global food shortages carried out through the UN. He served as a medic during World War I, and his work on nutrition later became the basis for British food policy.

<u>Lothians</u>

Born in 1550, **John Napier** was the inventor of logarithms, and the first ever mechanical computing devices.

Kenneth Craik was born in Leith in 1914. Moving from philosophy to experimental psychology, he pioneered the development of cognitive science.

<u>South of Scotland</u>

David Brewster was born in Jedburgh in 1781. He established laws for the polarisation of light and used spectroscopy to analyse chemicals.

Arthur Lapworth was born in Galashiels in 1872. He founded the discipline of organic physical chemistry. He showed that organic compounds can ionize, and act as if they bear an electric charge.

SCOTLAND'S SCIENTIFIC PRESENT: THE SCIENCE & ENGINEERING RESEARCH BASE

The science and engineering research base is the foundation on which to build all the other scientific aspects of national life. In its strategy for science, the Scottish Executive named its first objective as the need "to maintain a strong science base".[1]

Among the 14 universities in Scotland, practically every scientific and engineering discipline is represented. The equivalent of more than 3,000 full-time researchers are active, and they publish around 9,000 technical articles each year.

The Research Assessment Exercise
Table 2 shows the results of science departments in Scottish universities in the 2001 Research Assessment Exercise. Out of 29 science and engineering subjects, there were 11 in which Scottish institutions performed better than those in the rest of the UK (these are shaded in the table). Scotland was rated less highly than the rest of the UK in 15 subjects, and equally in two.

The overall picture is that Scottish science is relatively strong. Although Scotland has just 12% of the UK's universities[2], using the RAE as a measure, Scottish researchers outperform their counterparts across the rest of the UK in 38% of science subjects.

The total number of research active staff in 5-Star rated departments in Scottish universities was 588, 15.5 % of the total. 1534 (40.4 % of the total) were members of departments rated 5. These figures are marginally lower than the corresponding percentages in the rest of the UK, which are 17.5% and 42.0%.

Subject	Scottish universities	Universities in the rest of the UK
Mining & Mineral Engineering	6.00	5.00
Clinical Laboratory Sciences	5.00	4.81
Hospital-Based Clinical Subjects	5.00	4.48
Pharmacy	5.00	4.63
Biological Sciences	5.00	4.31
Veterinary Science	5.00	5.00
Pure Mathematics	4.80	4.21
Mechanical, Aeronautical & Manufacturing Engineering	4.75	4.15
Electrical & Electronic Engineering	4.60	4.20
Physiology	4.50	4.13
Psychology	4.50	4.15
Agriculture	4.33	3.69
Physics	4.33	4.55
Earth Sciences	4.33	4.36
Applied Mathematics	4.33	4.33
Statistics & Operational Research	4.29	4.33
Community-Based Clinical Subjects	4.25	4.30
Chemistry	4.17	4.97
Civil Engineering	4.14	4.52
Clinical Dentistry	4.00	4.58
Pharmacology	4.00	4.75
Chemical Engineering	3.67	4.57
Computer Science	3.46	3.97
General Engineering	3.37	3.67
Food Science & Technology	3.33	3.87
Other Studies & Professions Allied to Medicine	3.14	3.49
Environmental Sciences	3.00	3.32
Metallurgy & Metals	3.00	4.39
Nursing	2.80	3.19

Table 2: Average scores in the 2001 Research Assessment Exercise.[3] Shaded subjects are those for which Scottish researchers obtained higher average scores than their counterparts. 3a and 3b ratings were both given 3 points, 5-Star ratings were given 6 points.

[1] *A science strategy for Scotland,* Scottish Executive, 2001
[2] According the website of UniversitiesUK, it has 121 member institutions, of which 14 have addresses in Scotland
[3] *2001 Research Assessment Exercise: The Outcome,* HEFCE, 2001

Figure 1 suggests that Scotland's scientific performance relative to the rest of the UK has improved dramatically over the past 20 years, to a position where Scottish scientists are publishing papers that are, on average, cited at least as often as papers published from English addresses.

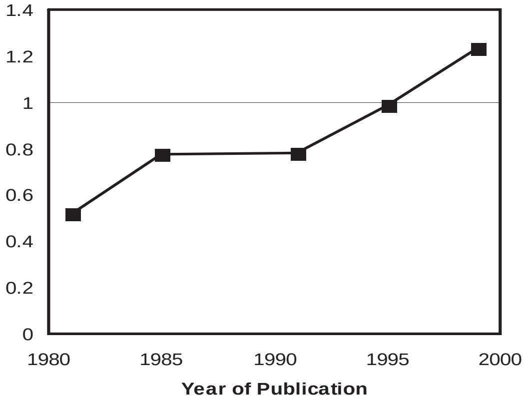


Figure 1: Average number of citations per paper for Scottish research papers published in particular years, relative to the number for English papers, scaled so that the English average=1 for all years. Insofar as citations are a measure of quality, Scottish research has improved over the past twenty years.[1]

International comparisons suggest that Scotland's research is particularly strong in Pharmacology, Ecology, and Agricultural Sciences, but is especially weak in Economics and Immunology.[2]

Investment in research

Table 3 shows that at least 40% more money is invested in Scotland's science base, per head of the population, than is invested in any other part of the UK.

The level of investment via the Funding Council is under Scottish control, whereas the Research Councils are not devolved, and their level of investment represents the sum of many individual decisions by grant-awarding committees.

Scotland's success in winning Research Council grants is clearly based partly on the fact that the Scottish Higher Education Funding Council provides a better-funded base from which universities can make stronger bids.

	via Higher Education Funding Councils	via Research Councils
Scotland	39	41
England	23	33
Wales	24	15
N Ireland	20	6

Table 3: Annual investment, £ per capita, in the Science & Engineering Research Base in the constituent parts of the UK in 2003.[3]

Internationally, however, although Scotland's investment in university research is relatively high, it is by no means the highest among comparable countries. Table 4 sets out the figures for a selection of industrialised nations.

Country	Annual investment in university research,US$ per capita
Netherlands	157
Finland	153
Norway	153
USA	134
Scotland	133
Japan	112
England	93
Ireland	68

Table 4: Annual investment in research and development in the higher education sector for a selection of industrialised countries.[4]

Recruitment of research staff

The major problem for the whole of the UK science base is the recruitment and retention of high calibre staff.

A recent international review of chemistry research in the UK found that although scholarship remained high, the ability to perform the most innovative, cutting edge

1 Data from the ISI Web of Science, using random samples of 200 research papers (excluding book reviews, letters etc.) with English and Scottish addresses for each year.

2 *Science in Scotland 1996-2000, What's New in Research 2002, Sci-Bytes*, Institute of Scientific Information (2002)

3 Calculated from *The Forward Look 2001: Government-funded science, engineering & technology, Office of Science & Technology*, 2001; Hansard [House of Commons] 12 June 2000, column 465W; figures assume that the distribution of Research Council investment is the same as it was in 1999, although the total has risen.

4 *Main Science and Technology Indicators*, OECD, 2002

science was being lost, specifically because "the academic community appears not to recruit globally for talented faculty and graduate students as effectively as its competitors".[1]

Detailed information was collected from nine universities, including two in Scotland, and the international panel reported no difference between what they found in Scotland and what they experienced elsewhere. Nobody believes that the problems highlighted in the review are unique to chemistry.

Among the Deans of Science at Scottish universities responding to a survey in 2000, 75% claimed that it was harder to find high quality research students and staff than it used to be. 50% admitted that their institutions had been forced to appoint researchers who were not really good enough, while 75% said that they had left jobs unfilled because it had not been possible to attract candidates of sufficiently high calibre.[2] Although based on small sample sizes, these results are cause for serious concern.

The salaries of research staff

Researchers in the UK science base, including those in Scotland, are badly paid, both by comparison with their counterparts in other countries, and by comparison with other jobs that well-qualified scientists might do in the UK.

For example, university professors have salaries that are, on average, only 65% - 75% of what they could earn elsewhere in the UK job market, while the average lecturer in Britain would need a pay rise of almost 30% to reach the income of an equivalent in the USA.[3]

An independent review of salaries in higher education institutes found that, before devolution, Scotland's problems in this area were essentially the same as those in the rest of the UK.[4]

Although following devolution, Scottish universities are marginally better funded than those in England (see page 10), there has been no significant change in the remuneration of Scottish university academics in the past few years.

BOX 2: THE WORK OF RESEARCH INSTITUTES AND UNITS

Scotland has a substantial number and variety of Institutes and Units funded by the Research Councils, as well as a number of Public Sector Research Institutes, which carry out curiosity-driven investigations as well as performing research aimed at informing Government policy.

Research Council units and institutes include the Centre for Ecology & Hydrology at Banchory, the Institute for Animal Health in Edinburgh, the Social and Public Health Sciences Unit in Glasgow and the Protein Phosphorylation Unit in Dundee.

Government laboratories make particular use of Scotland's natural resources and environment. They include the Macauley Land Use Research Institute in Aberdeen, the Hannah Research Institute in Ayrshire, Moredun Research Institute at Pentlands, and the Scottish Agricultural Science Agency in Edinburgh.

Some of Scotland's most significant research achievements in recent years have come from these Units and Institutes. For example, Dolly the Sheep, the first mammal to be successfully cloned, was the result of a research programme at the Roslin Institute in Edinburgh.

Over the last three years, research scientists at Banchory's Centre for Ecology & Hydrology have produced an average of 1.45 published research articles per researcher each year. This compares with estimates made during the 1990s for the number of papers produced per researcher per year of 1.0 for the whole of the UK, 0.97 for Denmark and 0.5 for Norway.

Sources: Institute of Scientific Information Web of Science; website of the Centre for Ecology & Hydrology <www.ceh.ac.uk>; *The Quality of the UK Science Base*, Office of Science & Technology, 1997

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1 *Chemistry at the Centre: An international assessment of university research in the UK*, Engineering & Physical Sciences Research Council/Royal Society of Chemistry, 2002

2 *The recruitment and retention of researchers in UK universities*, SBS, 2000 [SBS 00/20]

3 *Science policies for the next Parliament: Agenda for the Net Five Years*, SBS, 2001 [SBS 01/03]

4 *The Independent Review of Higher Education Pay and Conditions,* The Stationery Office, 1999

The Science and Engineering Research Base: Summary of the Current Situation

- The Scottish science and engineering research base is relatively strong, particularly in some subjects.

- Scottish research has improved substantially over the past two decades.

- This strength is based in part on better levels of funding than are present in other parts of the UK.

- A crucial element in this funding is a high level of success in winning Research Council grants.

- Part of this success can be attributed to relatively high levels of investment via the Scottish Higher Education Funding Council, which form a base from which grant applications can be made.

- Although funding levels are higher than in other parts of the UK, they are lower than in many competitor countries.

- Difficulties in the recruitment and retention of high quality research staff could jeopardise the future success of Scotland's science base.

- The salaries of researchers in Scottish universities are much too low.

SCOTLAND'S SCIENTIFIC PRESENT: SCIENCE EDUCATION

Scotland's distinct education system, coupled with the fact that education is now a wholly devolved issue, means that science education is an area where the policies of the Scottish Parliament can make a real and distinct difference.

Primary school maths and science
Figure 2 shows the results of an international study of 9-year old children, which found that Scottish children were approximately average in their abilities at mathematics, compared with other industrialised nations.

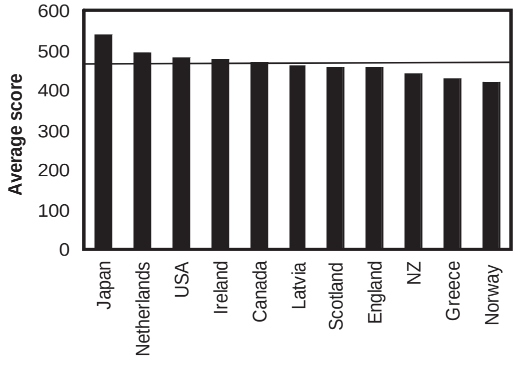

Figure 2: Average scores of 9-year olds in mathematics assessments for various countries. Also shown is the overall average score at 470.[1]

In science, children in Scotland have comparable achievement to the children of England, Ireland, Canada and Singapore, but are not as accomplished as 9-year olds in Japan, the USA or Australia. Scottish children scored more highly than children in Norway, Portugal and Greece.

Secondary school maths and science
Figure 3 shows the number of hours that 13-year old pupils spend, during compulsory education, studying mathematics and sciences each year in different European countries.

Scottish pupils spend more time studying both mathematics and science than most of their European counterparts.

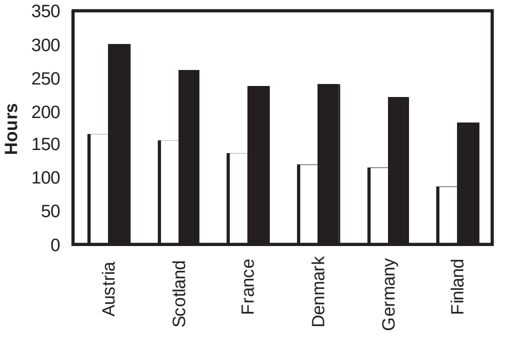

Figure 3: Number of hours the average 13-year old pupil spends each year studying mathematics (white bars) and sciences (black bars) in different European countries.[2]

When the Organisation of Economic Co-operation and Development surveyed the "scientific literacy" of 15-year old students, the results showed that Scottish pupils came eighth out of a group of 32 countries. They scored considerably better than their counterparts in France, Germany and the USA, but performed less well than youngsters in the rest of the UK, Canada and Japan.[3]

However, the mathematical ability of Scottish schoolchildren was substantially better than that of their counterparts in the rest of the UK and Canada. Among the G7 nations, only Japan had schoolchildren with better mathematical literacy than those in Scotland.

Figure 4 compares entries in science subjects for Scottish Highers with those for A-levels in England and Wales. This gives some indication of the choices that

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1 *Achievements of Primary 4 and Primary 5 Pupils in Mathematics and Science*, Scottish Office, 1997
2 *Key Data on Education in Europe 1999/2000*, Eurydice (European Commission), 2000
3 *Knowledge and Skills for Life - First Results of the PISA Study*, OECD, 2002

youngsters make about science once it is no longer a compulsory subject. A greater proportion of Highers than A-levels are in science and mathematics (although this may be partly explained by the fact that each individual Scottish student studies a larger number of subjects than those in England). Over the past few years, there was a very modest fall in the percentage of all Highers entries that were in science subjects.

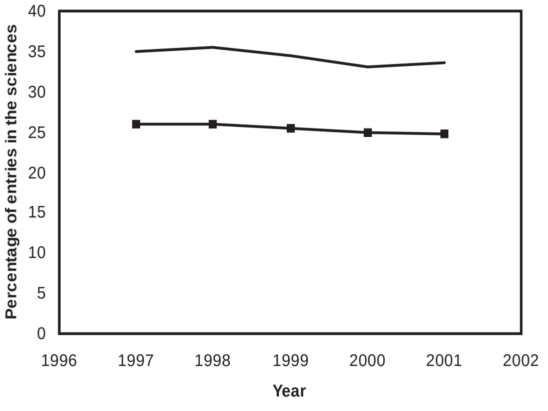

Figure 4: The percentage of entries for Highers (top line) and A-levels (bottom line) that were in science subjects.

The supply of science teachers

Table 5 shows the decline in the number of qualified secondary school science teachers in Scotland.[1] While the overall number of qualified teachers across all subjects has stayed roughly constant, the number of qualified science teachers has fallen by almost 10%. The number of physics teachers has fallen by almost 20%, although the number of qualified biology teachers has risen by about 6%.

These figures mirror the situation across England, where a shortage of physics teachers means that 66% of those teaching physics to 16-year-olds do not have a degree in the subject, and 29% do not have the equivalent of an A-level or Higher in physics. However, although a far greater proportion of biology teachers are properly qualified, the pace of change in modern science is such that only 52% have 'a lot of confidence' in their ability to teach modern life sciences.[2]

	Number of Teachers Holding Qualification in Subject	
	1990	1998
All Subjects	38,997	38,823
General Science	2,831	2,363
Biology	1,710	1,810
Chemistry	2,474	2,214
Physics	2,088	1,675
Mathematics	4,488	4,186
All Sciences and Mathematics	13,591	12,248

Table 5: Change in the numbers of qualified secondary school teachers in Scotland during the period 1990-1998.

Further Education

Box 2 outlines how Further Education colleges contribute to the science and engineering landscape in Scotland.

The Scottish Parliament has recently proposed significant changes in the way that Further Education is integrated as part of lifelong learning.[3] The Scottish Executive has accepted the broad thrust of the proposals, which include the merger of the Further and Higher Education Funding Councils.[4]

Funding of Higher Education

Scottish universities are generally thought to be better funded than those in the rest of the UK.

Although this is true, the composition of the student population is different in Scotland from elsewhere - for example, there is a relatively high number of medical students, whose courses are among the most expensive to run.

Taking such factors into account, Scottish universities have about 4% more money per student than those in England.[5]

1 *Teachers in Scotland: 1998*, Scottish Executive, 2000 [Edn/G5/2000/1]

2 *Science Teachers: A report on supporting and developing the profession of science teaching in primary and secondary schools*, Council for Science & Technology, 2000

3 *9th Report of the Enterprise & Lifelong Learning Committee*, Session 1 (2002) [SP Paper 679]

4 *Final Report on Lifelong Learning: Interim Response of the Scottish Executive*, 2002

5 Reported in the *Times Higher Education Supplement*, 24 January 2003

BOX: 3 SCIENCE AND ENGINEERING IN FURTHER EDUCATION

There are 46 Further Education Colleges in Scotland, catering for over 430,000 students. Most of the science-related courses they offer fall into one of five general types:

- Various engineering specialisms
- Health, medicine and sports-science
- Environmental science
- Numeracy and mathematics
- Highers and GCSEs in the sciences

Further Education science and engineering benefiting the workforce and economy:
Six workshops organized by Ayr College Engineering Department yielded hundreds of thousands of pounds worth of savings at three companies in Girvan. Over 200 employees from BDF, ISP Alginates and Nestlé participated in a programme funded by the European Science Foundation. Teams studied continuous improvement at the college, and then returned to their factories to undertake various projects, which ranged from reducing the amount of time that machinery was out of action, through to increasing production throughput. Many colleges also provide business advice alongside other kinds of training.

Further Education improving the relationship between 'science' and 'society':
Moray College has recently developed a Centre for the Communication of Science, which aims to promote wider understanding, and to rethink interactions between science and the rest of society. It will be holding five science festivals, developing links with many organizations and individuals involved in science, and fostering an online dialogue between 'science' and 'society'.

Access to Higher Education
Nearly 60% of Scots entering Higher Education for the first time do so in a college of Further Education. Providing students with links to Higher Education is one of the key aims of the University of the Highlands and Islands Millennium Institute:
"Wider access means working towards having a curriculum that offers progression routes and is available throughout the network, including the many learning centres associated with UHI. Under the themes of Access and Participation, some of the areas we would like to highlight are: Success stories of students who have come into higher education through non-traditional routes, the challenges faced both by the individual and the staff providing support."

Sources: <www.ascol.org.uk>; <www.ayrcoll.ac.uk/latest_news/latest_news/ ln_helping_companies.asp>; <http://www.moray.uhi.ac.uk/ ccs/index.htm>; <www.access.uhi.ac.uk>

Student Finance
Attitudes towards student finance formed one of the most significant divergences between education policy in Scotland and England following devolution.

While English students currently pay slightly more than £1,000 per year in up-front tuition fees, Scottish students pay the same amount into a higher education fund after they graduate.

The reasons for the change in Scotland were varied, but focused mostly on what was considered fair for the students.[1] Insufficient time has yet elapsed to be certain of the effects on young people of differences in student finance between Scotland and England. From figure 5, it appears that applications to study biological and physical sciences have seen a greater fall in Scotland than in England, and while the total number of applications to study mathematics, engineering and information technology has risen in England, it has fallen marginally in Scotland.

Future changes in England
The higher education system in England is set to change dramatically. A new White Paper on the subject has specified changes to funding mechanisms, including the possibility (from 2006) of students paying fees of up to £3,000 per year, after graduation rather than in advance[2].

The effects this will have on Scotland are unclear, although there are already fears that 'refugees' from England will boost the number of applications to study in Scotland to such an extent that Scottish

1 *Student Finance: Fairness of the Future*, The Independent Committee of Inquiry into Student Finance, 1999
2 *The Future of Higher Education*, Department for Education & Skills, 2003

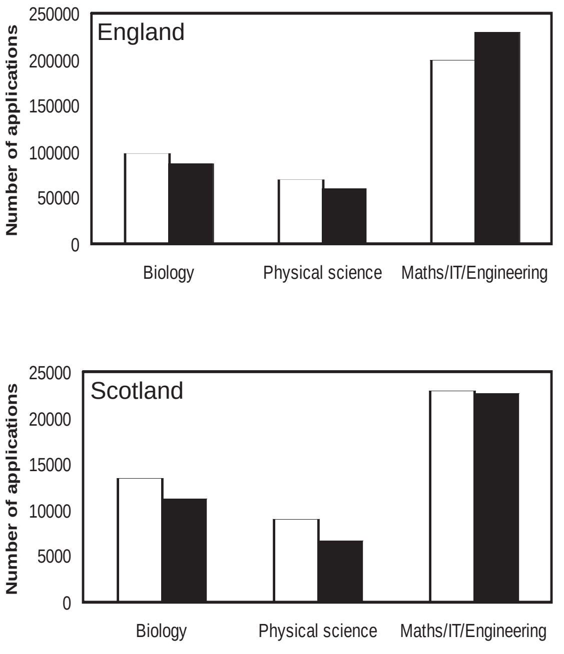

Figure 5: Numbers of applications to study first degrees in science subjects at universities in Scotland and England in 1997 (white bars) and 2000 (black bars).[1]

universities will have to introduce quotas for English students to prevent them from 'being flooded'.[2]

Whatever the effects of the new system in England, Scottish higher education policies will need to take full account of the changing situation in Westminster.

One of the main reasons for the changes in England is that ministers have been forced to admit that funding of English universities is in 'crisis'.[3]

With Scottish institutions only marginally better funded than those in the rest of the UK, it is plain that there is no room for complacency. Overall investment per student is lower in Scotland than it is in Denmark, Switzerland, the USA, Norway, Sweden, Australia, the Netherlands or Canada.[4]

1 *UCAS Annual Statistical Tables*, Universities and Colleges Admissions Service
2 *The Herald (Glasgow)*, 18 January 2003
3 *The Guardian*, 15 November 2002
4 *Education at a Glance: OECD Indicators 2002*, OECD, 2002

Science Education: Summary of the Current Situation

- Primary school children in Scotland have levels of attainment in science and mathematics that are slightly higher the average for comparable industrialised nations.

- Secondary school children in Scotland spend more time studying mathematics and science than their counterparts elsewhere in Europe.

- This increased emphasis on science is reflected in the fact that children in Scottish secondary schools show higher than average performance in international comparisons of scientific and mathematical achievement.

- The single greatest threat to science in schools is the difficulty of recruiting and retaining well-qualified, enthusiastic, confident teachers.

- Teaching in Scottish universities is marginally better-funded than it is in the rest of the UK.

- However, the number of applications to study science at Scottish universities is falling slightly faster than they are in England.

- By international standards, investment in university education in Scotland is not high.

SCOTLAND'S SCIENTIFIC PRESENT
SCIENCE IN THE ECONOMY

In the twenty-first century, the "knowledge economy" has become a reality. Successful nations in the coming decades will be those that invest heavily in scientific and engineering research, and those which put in place effective mechanisms for capitalizing on new knowledge.

Private sector investment in Research & Development

Scottish business invests about 0.5% of Gross National Product in research and development. Although this is comparable with Wales and Northern Ireland, it is lower than the rate of investment in the Republic of Ireland, Norway and Denmark, and very much lower than that in parts of England, Sweden, and France.[1]

As the Scottish Executive has observed, a single company in Finland (Nokia) invests more in research than the entire Scottish economy.[2]

This low private-sector investment in research is reflected in the density of science-based jobs, which is lower in Scotland than in Iceland, Ireland, Denmark, Finland or Norway.[3]

Patentable research

Of the three large regions in which the European Union reports Scottish data, none produces as many as 400 European patent applications per year for every million members of the workforce, a level achieved by parts of Sweden, France and Finland.

However, the North East of Scotland produces in excess of 200 European patent applications per million members of the labour force each year, an intensity similar to that of the South East of England, and which is not surpassed in any part of Denmark or Italy.[4]

The performance of the science-based economy

Figure 6 shows the average share price of Scottish companies between January 1999 and January 2003. It compares those companies included in the R&D Scoreboard (the ones that carry out a significant amount of research and development) with those that either make no investment in research, or invest too little to be included in the Scoreboard. The figure also tracks changes in the Financial Times 100-Share Index of leading companies (FTSE), as an indication of the fortunes of the wider UK economy.

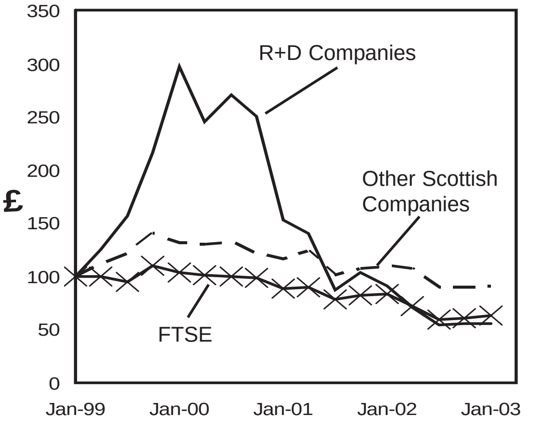

Figure 6. Stock market value of a £100 investment made on 1 Jan 1999, invested in the FTSE100 companies, Scottish companies included in the R&D Scoreboard, and quoted Scottish companies not included in the R&D Scoreboard.[5]

1 *Business Enterprise Research and Development in Scotland 2000*, Scottish Executive, 2002

2 *Business a.m.* 11 December 2002

3 *Statistics on Science & Technology in Europe*, European Commission, 2000

4 as above

5 Data taken from the Financial Times website <www.ft.com> and averages calculated assuming an equal monetary holding in each company at the start of the period. Non-R&D companies based on a random sample of 30 companies.

One of the most obvious trends revealed by the figure is that research-intensive companies were significantly overvalued in 2000 and 2001 before the market corrected (possibly overcorrected) itself.

£100 invested in the FTSE on 1 January 1999 would have been worth approximately £63.50 on 1 January 2003, indicating that the economy was not performing well. But if a similar amount had been invested in the general Scottish economy, although it would not have grown (because of a poor global economic climate), it would at least not have been so greatly devalued, having an estimated value of £90.97 by 2003.

However, investing in the research-intensive sector in Scotland would have seen the greatest loss in share price, with an investment of £100 falling in value to £55.22 over the four-year period.

This poor performance by science-based industry is somewhat unusual, and was not found across the UK economy as a whole. Indeed, a £100 holding of shares in English companies included in the R&D Scoreboard would have increased in value to approximately £125 by 2002, bucking the downward trend in the wider economy.[1]

It is unclear why the high-technology sector of Scotland's economy is not performing well, but it is important to put in place policies that facilitate the transfer of knowledge and skills between universities and private industry.

Knowledge transfer
Scotland has a good record of producing spin-out companies from its university research base.

In 2001, Scottish universities produced an average of 2.6 spin-out companies, compared with 1.8 for universities in England and 1.7 for those in Wales.[2]

Box 3 outlines one example of a Scottish research group whose work has been translated into economically useful products.

The centrepiece of attempts to improve Scotland's knowledge transfer is a £450 million investment in three flagship Intermediate Technology Institutes, announced at the end of 2002.

Based in Aberdeen, Dundee and Glasgow, they will focus on creating companies and jobs in the fields of energy, the life sciences and communications technology.

On average, each will receive investment of £15 million per year for ten years, and they were created partly as a recognition that "a lack of corporate research and development in Scotland is a major contributing factor to shortfalls in productivity and competitiveness".[3]

The Institutes will commission relevant research in universities, companies or other research facilities with the aim of creating a bank of ideas from which Scottish businesses can generate new products and processes that will generate new income for the Scottish economy.

The important feature of these Institutes is that they are funded with additional investment from the Scottish Executive, not money diverted from other research funds.

Links between universities and business
The Higher-Education Business interaction survey found some evidence that links between universities and the business community are at least as good in Scotland as they are elsewhere in the UK. For example, some (unnamed) Scottish higher education institutions are among the UK's best universities at earning money from providing education and training to business and industry, which in some cases generate over £1 million per year for the university.

1 *The 2002 R&D Scoreboard: Commentary & Analysis*, Department of Trade & Industry (2002)
2 *Higher Education - Business Interaction Survey 2000- 2001*, HEFCE, 2003 [HEFCE03/11]
3 *Launch of Intermediate Technology Institutes*, Scottish Executive Press Release, 10 December 2002

Scottish universities also have, on average, the same number of graduate studentships involving industrial sponsorship as their English counterparts.

In both England and Scotland, the average university has 16 Co-operative Awards in Science and Engineering (CASE), in which the cost of the studentship is shared between the public and private sector, and six Teaching Company Scheme Awards (TCS), where a graduate is employed to work in a company on a research or technology transfer project.

However, the figures show that some other parts of the UK have better records - on average, each university in Northern Ireland has five times as many students involved in the TCS scheme as each institution in Scotland.

BOX 3: FUNDAMENTAL RESEARCH AT DUNDEE LEADING TO WEALTH CREATION

Sir Philip Cohen and his team at the University of Dundee have been carrying out fundamental investigations into the chemistry of proteins for decades.

Funding from organizations like the Medical Research Council (MRC) and the Wellcome Trust comes on the basis of scientific excellence and, over the past 30 years, Philip Cohen and his colleagues have produced a string of publications in the world's leading scientific journals. Concentrating on enzymes known as kinases and phosphatases, the research work has discovered underlying biological mechanisms by which these chemicals operate in the human body.

When, in 1990, new funding was provided to set up an MRC Research Unit in Dundee, few people predicted that understanding kinase and phosphatase enzymes might lead to the development of new drugs. But abnormalities in the functioning of the enzymes are now known to be a cause of major diseases, such as cancer, diabetes, and arthritis. So this fundamental research is now delivering health benefits and generating wealth. Almost every pharmaceutical company now has a major programme in this area.

Cyclosporin is a drug originally found in fungi in the soil. It prevents tissue rejection in surgical transplant operations, and it works by acting on a phosphatase enzyme, which was identified and described by the team in Dundee. The first drug to be developed by investigating a specific kinase enzyme was the result of work initiated by Dr Nick Lydon, a student trained in Dundee. Called Gleevac, it was approved for use by the US Food and Drug Administration in 2001 and is used to treat leukemia and other cancers.

The economic impact of drugs like Cyclosporin and Gleevac is iincalculable. Novartis, the company that makes Gleevac, has annual sales of US$19 billion and, recognizing the importance of research, re-invests £2.5 billion annually in research and development. A group of similar companies is now involved in a £7.5 million collaboration with Philip Cohen's team, helping to develop new drugs based on the Dundee scientists' understanding of kinase and phosphatase enzymes. This collaboration has recently been renewed for a further five years at a greatly expanded level.

Over the past 30 years, the number of biomedical and life scientists in the Dundee area has increased from fewer than 100 to over 2000, and this sector now accounts for about 12% of the local economy. This has been possible only because Philip Cohen and his team have been able to carry out curiosity-driven research, guided by the most scientifically exciting opportunities, not constantly trying to predict precisely which research will pay economic dividends.

Sources: <www.dundee.ac.uk/lifesciences/mrcppu/pi/pc.htm>, <www.gleevac.com>, <www.novartis.com>; Financial Times 18

1 Higher Education-Business Interaction Survey, HEFCE, 2001 [HEFCE 01/68]

Science in the Economy: Summary of the Current Situation

- Scottish industry does not invest enough in research and development.

- As a result, Scotland produces only a moderate output of patents on which economic success could be built.

- Science-based industries in Scotland are not delivering the same economic returns as similar businesses elsewhere.

- Additional funding for three new Intermediate Technology Institutes will hopefully stimulate wealth creation in the fields of energy, life sciences and communications technology.

- Scottish universities, which have a track record of producing excellent research, also have a good record of forming links with industry.

- Therefore, the key to improving the contribution of science-based industry to Scotland's economy is to concentrate on encouraging more industry "pull" rather than forcing more university "push".

- Fundamental research, funded for scientific excellence rather than for obvious industrial relevance, is delivering real economic growth in Scotland.

SCOTLAND'S SCIENTIFIC PRESENT
SCIENCE IN SOCIETY

The place of science in a wider society involves two significant elements. First, it is important to understand what non-scientists think and feel about science and scientists. Second, it is crucial to put in place policies that facilitate the provision of high quality expert scientific advice to Government.

Scottish attitudes to science

Scottish people feel positive towards science and scientists. 85% of Scots think that scientists have a valuable contribution to make to society. 76% of Scots think that government should support research which advances the frontiers of knowledge but has no immediate benefits.

In some cases, Scottish attitudes are slightly more positive toward science than British attitudes as a whole: in Scotland, the belief that scientists want to make life better for the average person is 4% more prevalent than it is in the rest of the UK. There is a similar higher percentage of Scots subscribing to the belief that it is important to know about science in daily life, and to the belief that a career in science or engineering is a good choice.

77% of the residents of Scotland believe they ought to take an interest in science, compared with 73% in the UK as a whole.[1]

There is some evidence that the Scots actively pursue their interest in science. For example, 52.7% of items in Scottish museums are classified as 'Natural Science' or 'History of Science'. However, this large number of items is wholly not representative of the impact of science on visitors to Scottish museums. Science collections represent less than 8% of those surveyed. More significantly, of the 20 most visited museums, only 4 % even partially represent science.[2]

However, the survey of museum did not include Science Centres. Those six Centres in Scotland that are members of the science-based group known as Ecsite-UK attract over 800,000 visits each year.[3] The average of over 130,000 visits per centre each year compares favourably with the majority of Scottish museums, 88% of which have fewer than 50,000 visits per year.

In 2002, the Scottish Executive withdrew support from the Scottish Science Trust, even though it accepted that this would affect the Trust's efforts to "support the work of science centres in Scotland".[4]

Parliamentary Interest

High levels of public interest in science are reflected in Parliamentary activity. During 2002, each Member of the Scottish Parliament asked an average of 0.62 written or oral Parliamentary Questions about science policy. In Westminster, Members of Parliament asked an average of only 0.35 such questions.[5]

12.5% of Scotland's MPs are known to have a degree in science, medicine or engineering, compared with 9.7% in the rest of the UK.[6]

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1 *Science and the Public: Public attitudes to science in Britain: Data tables*, Office of Science and Technology/Wellcome Trust (2000)

2 *A Collective Insight: Scotland's National Audit, Scottish Museums Council*, 2002

3 Information from Ecsite-UK

4 *Scottish Parliament Official Report, Written Answers* 11 Nov 2002, S1W-31090

5 DeHavilland Information Systems, InfoPool; these figures refer to questions about science policy, and do not include all questions about scientific issues.

6 *Local science profiles for the United Kingdom*, SBS 2002 [SBS 02/16]

Knowledge and understanding
Unfortunately, a substantial 46% of the Scottish people think that they are 'not clever enough' to understand science and technology. This confidence is 8% lower than in the rest of the UK.[1]

This lack of confidence may be reflective of the fact Scottish people seem to show relatively poor knowledge of scientific information about some important issues.

For example a recent survey found that 'Scots have limited awareness of passive smoking risks, with a smoky atmosphere assessed in terms of comfort rather than health'. Only 74% of non-smokers and 42% of smokers felt that there was a health risk from inhaling other people's smoke.[2]

The average Scottish person says that, ideally, no more of their electricity should be sourced from nuclear power than from fossil fuels. This view may be based in part on widespread misconception: only 37% of Scottish people think that coal and oil power produce greenhouse gases, while 29% hold the mistaken belief that nuclear power does so.[3]

Scientific advice to Government
Although the Scottish Executive said in its science strategy that it intends to "ensure the effective use of scientific evidence in policy making", its investment in the relevant research has not kept pace with similar investment south of the border.

Figure 7 shows the trend over the past five years in government investment in policy-oriented scientific work, per head of the population, for English departments of the UK government in Westminster, and for the Scottish Executive. The figures exclude defence, which is not devolved, and are separate from the investment in the science base shown in Table 3, which is aimed at cutting edge scientific opportunities, not at answering policy questions.

At the point of devolution, it seems that equal investment was apportioned per head of the English and Scottish population. But the trend over the past five years has been for English investment to increase (by more than 20%), while Scottish expenditure has stayed roughly constant.

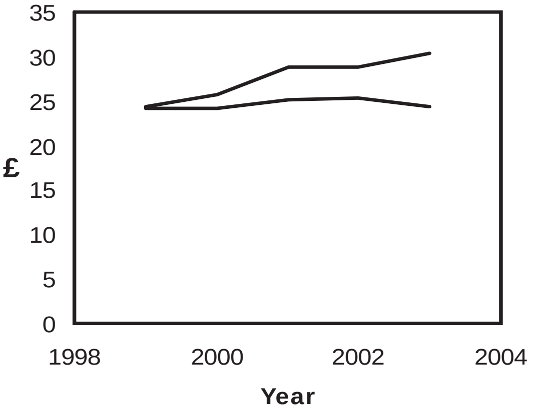

Figure 7. Government investment in policy-oriented research in the civil departments, per annum, in real terms [at 1999 prices] per capita, for England (via the UK government in Westminster) [top line] and for the Scottish Executive [bottom line].[4] The Westminster figures presumably include a tiny proportion of expenditure in Wales and Northern Ireland, where the devolution settlement reserved more powers than it did in Scotland.

If the Scottish Executive is to maintain a healthy base of its publicly-funded research aimed at informing public policy, it will need to increase its investment in this kind of research. To invest at the same level per head as England now does, the Executive would need to fund £30 million of extra research per year.

Expert advice
Box 4 shows that there remains a need for Scotland to strengthen its mechanisms for obtaining and interpreting scientific advice on contentious issues of policy.

1 *The Forward Look 2001: Government-funded science, engineering and technology*, OST/DTI (2001)

2 *Smoking Policies in Public Places - Survey of Public House and Restaurant Customers in Scotland*, MVA on behalf of ASH Scotland and the Health Education Board for Scotland, 2001

3 *Environmetal and Rural Affairs Research Programme- survey of public attitudes to the environment*, commissioned by the Scottish Executive

4 *The Forward Look 2001: Government-funded science, engineering and technology*, OST/DTI (2001)

The Scottish Executive has set up the Scottish Science Advisory Committee under the auspices of the Royal Society of Edinburgh, to provide independent advice to Scottish Executive Ministers. Still in its infancy, it is too early to judge the efficacy of the Committee, but since so many scientific issues are partially or wholly devolved, the Executive clearly needs its own independent source of advice.

Chaired by the distinguished physicist Professor Wilson Sibbert, the Committee intends to begin work on three broad themes: Science education; Science in Society; and Scientific Excellence.[1]

It is to be hoped that the new Committee will be fully resourced, unlike some other similar committees, notably the Council for Science & Technology in Westminster.

However, mechanisms for effective communication between Scotland and others parts of the UK are seriously hampered by existing rules.

At UK-wide level, the Chief Scientific Adviser's Committee is said to be "the principal committee at official level dealing with issues relating to science". The Scottish Executive is represented by the Head of the Lifelong Learning Group, but "when papers are considered on advice to [UK] Cabinet Committees, the officials of the devolved authorities will be asked to withdraw from the meeting for the duration of the discussion" and are prohibited from seeing relevant documents.[2]

Although officials of the Scotland Office may remain present for such discussions, the Executive, which actually runs Scottish affairs, could be denied access to vital information.

Sooner or later, Scotland's Government will be headed by a different political party from the Government in Westminster; ministers at the Scotland Office may then have little enthusiasm for ensuring that Scottish Executive ministers have full access to all the relevant details discussed by the Chief Scientific Adviser's Committee.

BOX 4: CO-ORDINATION AND COMMUNICATION OF SCIENTIFIC ADVICE ON DISEASES OF AGRICULTURAL LIVESTOCK

Among the most serious issues on which scientific advice has been required in recent years have been infectious diseases in agricultural livestock, most notable Bovine Spongiform Encephalopathy (BSE) and foot-and-mouth disease (FMD). The evidence suggests that methods of communicating appropriate scientific advice need to be significantly strengthened.

The BSE Inquiry made fifteen separate findings in relation to scientific advice in the devolved administrations. Most notably, the Inquiry found that the Scottish approach "appears to have been what was suggested in London" and that this "was not fruitful".

Moreover, it also criticised "poor liaison arrangements" both between London and Edinburgh, and between individual departments within the Scottish Executive.

At the time, the Scottish Executive and UK Government jointly said that most of the relevant policy development had occurred "pre-devolution" and that "formal arrangements have been put in place to promote a synchronised approach".

But when an epidemic of foot-and-mouth disease broke out in 2001, the "Lessons Learned" inquiry criticised the level of communication between the UK Government and the devolved administrations, and urged the Scottish Executive to review its relevant communications systems.

Sources: Report of the BSE Inquiry, Volume 9, 2000; *The Interim Response to the Report of the BSE Inquiry*, H M Government with the Devolved Administrations, 2001; *Foot and Mouth Disease: Lessons to be Learned Inquiry*, House of Commons, 2002 [HC888]

1 <www.scottishscience.org.uk>
2 *Terms of Reference of the Chief Scientific Adviser's Committee*, Office of Science & Technology, 2001

Science in Society: Summary of the Current Situation

- People in Scotland are interested in science and engineering, and believe that scientific developments are important.

- This interest is reflected in activities such as visiting Scotland's successful science centres and museums, and attending science fairs.

- However, Scottish people lack confidence in their own understanding of science, and appear not to have access to good scientific information about some important issues.

- Levels of public investment in policy-oriented research are low in Scotland.

- Scientific advice needs to be better co-ordinated, both among different parts of the Scottish Executive and between Scotland and Westminster.

- The Scottish Science Advisory Committee offers a new opportunity for the Scottish Executive to receive expert advice on scientific issues.

FUTURE POLICY: THE SCIENCE AND ENGINEERING RESEARCH BASE

Excellence should be at the heart of the ethos of Scotland's science and engineering research base. Risk-taking and high quality research should be promoted and rewarded. The science base should include curiosity-driven investigations across a broad range of disciplines, including both fundamental research and also research that is aimed at obvious applications.

- The salaries of researchers and public sector laboratories must rise substantially. An average increase of approximately 25% is needed to begin to make research careers competitive when judged against other options.

- The Scottish Higher Education Funding Council's budget for research should increase substantially. It must, at the very least, keep pace with the growing budgets of the Research Councils.

- The balance between funds provided for specific directed projects and following fresh ideas should be moved back towards giving academic researchers more freedom to follow the sort of research that offers potentially great advances, but where everyone accepts that it may fail.

FUTURE POLICY: SCIENCE EDUCATION

Scottish education policy in science should have three aims, namely:
1) to enthuse all young people about the wonders of science,
2) to prepare the majority for active participation in a society that is increasing driven by science and technology, and
3) to produce the next generation of world-class researchers.

- School teaching must be made a more attractive career.

- Funding arrangements for university undergraduates must do more to encourage the brightest people to study science and engineering.

- The Scottish Higher Education Funding Council must provide very substantial extra resources to increase the salaries of university lecturers.

FUTURE POLICY: SCIENCE IN THE ECONOMY

Scotland should aim to take full advantage of new technological opportunities. It should achieve this by promoting the exploitation of academic research, by having a scientifically-capable, well-trained workforce, and by making the Scottish economy an attractive place for innovators and entrepreneurs.

- The Scottish Executive should finance a detailed study of why research-based industry in Scotland is not currently producing the same kind of economic gain that is possible elsewhere.

- Funding mechanisms for the science base must not focus too closely on research that has obvious economic benefits, because 'blue-skies' research is at least as important in an overall portfolio.

- The Scottish Executive should do anything in its power to encourage Scottish business to perform more research and development, although one of the principal levers - the tax regime - is not within its power.

FUTURE POLICY : SCIENCE IN SOCIETY

Scottish society should promote an active dialogue between the scientific community and non-scientists, in a spirit of trust. This will allow research to progress with the democratic backing of a broad majority of the population. Also, the public will be able to confidence that policy-makers are making good decisions, based on interpreting the best advice and information available.

- The Scottish Executive should increase its funding for policy-driven civil research, aimed at generating evidence-based policy. Over the lifetime of the coming Parliament, such research should be boosted by at least £30 million per year.

- The Scottish Science Advisory Committee must be properly resourced.

- The Scottish Executive should consider how to support the Scottish science centres now that it has withdrawn financial support for the Scottish Science Trust.

- The Scottish Executive should insist to the Scottish Higher Education Funding Council that whatever replaces the Research Assessment Exercise, the rules are designed to reward rather than discourage researchers from interacting with a wider public.

THE RELATIONSHIP BETWEEN HOLYROOD AND WESTMINSTER

The devolution settlement for science in Scotland
The Scotland Act 1998 gave primary jurisdiction over science to the Scottish Parliament.[1] But it did not devolve all aspects of all scientific issues to the Scottish Executive and Parliament.

Because of this, the policies of the Scottish Parliament and Executive can deliver a world-class presence for science in Scotland only if UK policies are properly tuned to the needs of scientific research and education, and to society's demands of science and engineering.

The following paragraphs outline a few of the more important aspects of the current devolution settlement in relation to policies about science.

<u>The research base</u>
The Research Councils, which distribute over £2 billion each year for science and engineering research retain their UK-wide remit, and come under the control of the Secretary of State for Trade and Industry in London. They form the main source of funding for university research projects, and their policies and operation are crucial to a vibrant Scottish science base.

In addition, some nationally important scientific collections, such as the specimens in the Natural History Museum or the reference collection of the British Library, fall within the remit of the UK's Department of Culture, Media and Sport. Although Scotland has its many of its own similar resources, the need for realistic curation and acquisition policies for these collections, together with proper access for Scottish researchers, means that they are of interest to the Scottish scientific community.

<u>Science education</u>
The overwhelming majority of educational issues have been devolved, and Westminster policies have relatively little impact in this area.

However many young people cross the border (in both directions) to study at university. English and Scottish education policies must complement one another sufficiently that university entry requirements and standards remain comparable.

<u>Science in the economy</u>
The Scottish economy does not operate in isolation. The increasingly globalised nature of the world's economic systems means that health of Scotland's high-technology and science-based businesses relies in part on the functioning of the British, European and worldwide economies.

In particular, the tax regime covering industrial research and development is set by the Treasury in London.

<u>Science in society</u>
Problems with a scientific dimension, such as falling fish stocks, foot-and-mouth disease, global climate change and rail safety do not acknowledge national boundaries.

Policies designed to solve these problems in Scotland require strong mechanisms in London and elsewhere for delivering timely, authoritative and up-to-date advice, including assessments not just of what is known but also what is uncertain.

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1 Parliamentary authorities advised that a Private Member's Bill introduced in the House of Commons in 1999 to create a National Science Strategy could not extend to Scotland

SAVE BRITISH SCIENCE IN SCOTLAND

SBS is committed to campaigning for science and technology in a devolved Scotland.

In recent years, SBS and its representatives have:

- hosted a discussion dinner for an all-party group of MSPs
- organised regional science policy meetings with the Universities of Glasgow and Aberdeen, involving 200 local people, four MSPs, two MPs and one Parliamentary candidate
- met and consulted staff and students at the following universities: Aberdeen, Abertay Dundee, Dundee, Edinburgh, Glasgow, Glasgow Caledonian, Napier, and St Andrews
- chaired the first science briefing event for MSPs, on the subject of cloning
- held a meeting with the Scottish Executive Science Strategy Team
- visited the Glasgow Science Centre
- toured the University of Abertay Dundee and met with the Principal and senior staff
- published profiles of the scientific activity in the various parts of Scotland
- Published four policy documents relating specifically to science in Scotland since the start of 2001
- published responses of the Party Leaders in Scotland to a questionnaire about science policies in their General Election manifestos
- given a talks to students at the University of Edinburgh, to the Fisher Science World conference held in Glasgow, and to the Scottish section of the UK Shareholders Association
- consulted all of SBS's members in Scotland about the science policy issues that are most important to them
- attended the BA Festival of Science in Glasgow
- been interviewed by BBC Radio Scotland, and been quoted or had letters published in The Scotsman, The Herald, The Aberdeen Press & Journal, The Edinburgh Herald & Post, The Dundee Evening Telegraph, The Edinburgh Evening News, The Aberdeen Evening News and Business a.m.

Two members of SBS's Executive Committee are based in Scotland:
Professor Ursula Martin, Professor of Computer Science at St Andrews University
Dr Vicki Stone, Senior Lecturer in Biomedicine, Napier University

The membership of SBS's Advisory Council includes:
Professor Vicki Bruce, a psychologist from the University of Edinburgh
Professor Hugh Pennington, Aberdeen University
Professor Struther Arnott, former Vice Chancellor of St Andrews University

Save British Science is a voluntary organisation that campaigns for science and technology throughout UK society

We achieve this by:

• **meeting** with Ministers, advisers and officials

• regularly **submitting evidence** to Parliamentary and Government consultations

• having a reputation in the media as a **ready and reliable source of information and comment** on science policy

• **bringing together** leading figures in Government, Industry and the City to facilitate wealth creation from the science base

• hosting a series of **symposia and discussion meetings**

• keeping our members up-to-date with a quarterly **newsletter**

• publishing **reports and briefing documents** on all aspect of science policy

We focus on:
• the science and engineering research base
• science education
• science in the economy
• science in society

Our work is supported by
1,500 individuals
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