PUBLIC ATTITUDES TO SCIENCE

- *Public perceptions of science and scientists.*
- *Does an "anti-science" culture exist?*
- *Students' perceptions of science as a career.*
- *The role of public understanding of science.*

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POSTnotes are intended to give Members an overview of issues arising from science and technology. Members can obtain further details from the PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY (extension 2840).

UK policy emphasises the importance of the science base to wealth creation and the quality of life, and Government policy seeks to raise public awareness of science, engineering and technology (SET) and their role in the economy. Yet, there are recurring fears of a decline in science's status, concern that science is undervalued by the public, careers in science appearing less attractive, and moves towards an "anti-science" culture.

This note reviews evidence on the perception of science in the UK and related issues.

NATIONAL DIFFERENCES

The European Community-wide 'Eurobarometer' surveys of over 11,500 Europeans in the Member States allow national attitudes to SET to be compared. The first study was in 1989 and some of the most recent (1992) results are summarised in **Table 1**. These results do not support the notion that the UK public has an especially "anti-science" attitude compared with other European countries. Indeed, UK respondents are slightly more positive than the EC-wide average citizen on the benefits of science and technology. Moreover, other survey results show that UK respondents exhibit relatively high levels of knowledge, interest, and support for science in general.

When attitudes in Europe are compared with those in the USA, differences do emerge, and Americans have both a stronger support for science than the average for Europe and a greater faith in the positive impacts of SET: - in 1989, 76% of Americans thought that science benefits more than it harms, compared with 46% for Europeans and 42% for the UK. Indeed, 63% of Britons and 62% of Europeans believe scientific researchers can be dangerous because of their knowledge.

One reason why support of science in Britain appears highly qualified may be an effect common to many societies with high levels of industrialisation, whereby the benefits of SET are increasingly taken for granted and the negative aspects illuminated and nurtured in public debates (on nuclear power, genetic engineering etc.) leading to a more critical attitude to the role of SET in daily life. In this context, the environment can be a key source of negative attitudes. As Table 1 shows, while 61.2% in the UK agree that scientific research can help protect and repair the environment, over 28% think otherwise - a higher proportion than in other EU states. DoE-supported surveys (**Box 1**) show that 85% of UK respondents remain concerned about the environment and that the public can distrust official sources of information in this field. The Eurobarometer surveys found similar scepticism on biotechnology, although general attitudes to science appear to have become more positive between the '89 and '92 surveys.

TABLE 1 SOME RESULTS OF THE 1992 EUROBAROMETER SURVEY

		Strongly disagree	Dis-agree	Neutral	Agree	Strongly agree
Science and technology make our lives healthier, easier and more comfortable	**UK**	2.1	8.6	6.3	63.7	19.3
	EC	3	8	10.5	50.9	27.6
	G	1	8.2	10.9	49.5	30.4
	F	2.9	8.6	8.1	54.2	26.2
S & T research cannot play an important role in protecting the environment and repairing it.	**UK**	26.7	34.5	10.6	20.8	7.3
	EC	35	25.3	15.3	16.8	7.5
	G	33	30.5	14.1	14.9	7.2
	F	40.1	28.7	11.8	12.6	6.8
S & T research do not play an important role in industrial development	**UK**	34.1	41.7	11.5	10.3	2.3
	EC	42.6	27.8	14.1	10.5	4.9
	G	37.3	35.1	13.2	9.0	5.1
	F	41.0	30.7	12.0	12.8	3.6
Most scientists want to work on things that will make life better for the average person	**UK**	4	11.9	8.8	55.1	20.2
	EC	5.4	13.7	16.5	42.2	22.1
	G	6.8	17.9	18.1	41.3	15.7
	F	5	16.1	13.9	46.3	18.8

Source: INRA et al (1993)

SCIENTIFIC LITERACY

Attitudes to science and technology are not the same as scientific literacy, and other studies have compared levels in different countries, based on a definition of a 'scientifically literate' adult as someone who:

a) has a basic vocabulary of scientific terms and concepts adequate to read reports of scientific disputes;

Box 1 THE ENVIRONMENT AND ATTITUDES TO SCIENCE

- 39% of the public believes they do not fully understand environmental issues; 37% believe scientists do not know what they are talking about in environmental issues
- 82% of the public trusted scientists working for environmental groups in contrast with 47% for industry and 48% for government scientists.
- Environmentalist "rationalists" derive their concern from science and the excesses of materialism and economic progress, whereas "romantics" are concerned for emotional reasons and are generally pessimistic about the relationship between humans and the environment.
- Scientific knowledge is positively associated with environmental concern.

Sources: Witherspoon (1994), MORI (1992)

b) distinguishes between science and pseudo-science;
c) knows how science affects our daily lives.
When Europe and the USA results were compared in 1989, the results on the three measures were (a) E 37%; US 28%; (b) E 9%; US 12%; (c) E 40%; US 40%. Combining these leads to only 4.4% of Europeans and 6.3% of Americans being literate on all three counts.

These low figures may reflect the demanding nature of the definition, and more recent insights come from the Daily Telegraph annual surveys on science, now in their eighth year, where correct responses to simple measures of scientific knowledge range from 30 to over 90%. However, over the years 1990 to '94, the Telegraph surveys suggest that the public felt **less** well equipped to make sense of the latest scientific developments.

ATTITUDES & EDUCATION CHOICES

Today's adolescents must provide tomorrow's scientists, and thus the attitudes and education choices of adolescents are important; here, surveys show many influential factors (see **Table 2**). In terms of image, scientists may well be seen as dedicated, productive and creative, but are also seen as anti-social and socially isolated. Schoolchildren interested in issues such as the environment may 'blame' science for the perceived problems and not appreciate its positive role in wealth creation, health, quality of life, pollution control etc. In particular, adolescent attitudes to animals can cause hostility to science since most pupils do not recognise the role animals play in developing and ensuring the safety of medicines and other medical procedures on which their own health may depend. Animal use is thus one of several areas where education has an important role to enable students to develop an informed view rather than one based on hearsay.

Table 2 FACTORS DETERRING SIXTH FORMERS FROM PURSUING SCIENTIFIC SUBJECTS

- Subject too impersonal/ abstract,
- content too heavy and sterile,
- seen as for only the most able,
- media parodies of scientists,
- perceived poor pay and status,
- science perceived as cause of problems (e.g. environment, misuse of animals),
- unenthusiastic/ poorly qualified teachers,
- poor labs/equipment,
- government perceived as unsympathetic.

Source: Making Choices, B. Woolnough (Ed.), Univ.Oxford, DeptEduc.Stud.

Other factors in Table 2 discouraging students from pursuing science include media caricatures of 'mad' or eccentric (mostly male) scientists and the tendency for 'experts' to only be wheeled out to explain disasters or accidents. A perceived lack of sympathy in Government also features, despite Ministers' emphasis on the need to increase the numbers with SET qualifications. Sixth-formers may be put off science by the comparable benefits of other professions, the difficulty of obtaining a degree in science or engineering and the perceived relatively low pay, job prospects and status in science.

Perceptions still exists among students and teachers that scientific aptitude is innate, so that students who potentially could find satisfying careers in science and engineering are discouraged from doing so. Gender and home background are also important. Almost as many girls as boys now get at least one GCSE / O-level pass in a scientific subject, but the percentage of girls receiving at least one science A-level pass (11.8% in 1993 / 4) remains behind that of boys (14.8%)[1]. At first degrees, this male / female spilt continues and women only make up 27% of postgraduates in science. Girls are more likely to see science taught in school as impersonal, male dominated, abstract, and irrelevant to their daily lives (just as women are more likely to view science more negatively than men). The prevalence of these attitudes is less in single-sex than co-ed schools.

When science is taught by enthusiastic teachers in well-equipped laboratories, it is attractive for youngsters. Yet, as emphasised by the Education Committee, primary teachers' lack of subject knowledge may lead to a lack of confidence in scientific subjects. Other educational barriers identified by the Committee included:

- the discontinuity in style and content between primary and secondary school science which leads to a 'falling off' in motivation;
- the difficulty of balancing the conflicting needs of preparing future specialists and providing the remainder with a basic level of understanding;
- placing scientific knowledge in its social content;
- training shortcomings.

In addition, science teachers had a below-average status and salary for surveyed sixths formers. This situation gives rise to concern about attracting high quality people to teaching in the future.

The overall effect of such influences has been that the number of students passing GCSE and A-level in science and maths has **fallen** since 1980, because the slight increase in the proportion of students passing a maths / science subject has not compensated for a declining school population. Within this trend, there are also subject shifts with maths and physics entries declining most, chemistry changing only little and biology increasing slightly. Maths underpins so many other subjects, the declines here are of particular concern. At first degree level, all scientific fields beside maths and computing have seen a decrease in the proportion of all graduates, while business and financial subjects have had the fastest growth.

Despite this, however, the UK ranks 4th out of the 24 OECD member nations in the proportion of university degrees which are in the natural and physical sciences. Thus 17.1% (19.4% male, 14.4% female) of university degrees in the UK are in the natural and physical

1. Boys also make up the majority of those in the physical sciences, engineering, and mathematics while girls are the majority in biology and some related fields.

sciences compared with an OECD mean of 12.7% (15.5% male, 9.8% female). In terms of engineering graduates, however, the UK performs less well and rates just below average (13 vs. 13.2%). When it comes to overall numbers, the UK has the highest number (989) of science graduates aged 25-34 per 100,000 people of all OECD countries. Such numbers should be taken with caution, however, given the difficulties of making international comparisons of educational qualifications and the subjects involved.

CAREER PROSPECTS

Despite the relatively high production of SET graduates by international standards, the UK employs fewer than many of its industrial competitors (**Figure 1**). This relatively low ranking is also against the backdrop of falling numbers of R&D personnel - down from 134,000 in 1987 to 123,000 in 1992 - the UK is the only OECD country to show such a decline. Unemployment rates for science graduates are comparable to average rates but, as **Table 3** indicates, pay can be much lower than that of some other professions requiring a comparable education. By international standards, SET positions are poorly rewarded in the UK relative to other professions - for instance Sweden and the UK were the only industrial countries in a recent ILO survey where accountants earned more than chemical engineers.

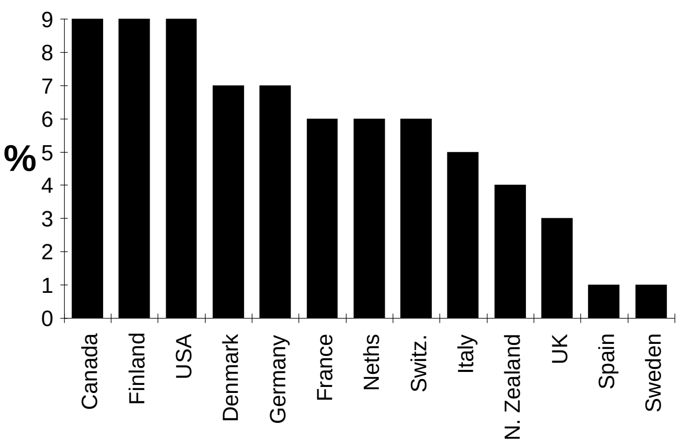
Career potentials for those trained in science differ markedly between public and private sectors. In the **public sector,** the career prospects of scientists are seen as affected by the decline in government funding of R&D in real terms - from £6.18 billion in 1984/5 to £5.62 billion in 1994-95 (both in 1992-93 prices). Universities have also seen a substantial rise in short and fixed-term contracts in many fields. Between 1977/78 and 1993/94 the number of scientists and engineers on short-term contracts rose from 5,886 to 18,627 - an increase of 216%. While the rise in contract work has some advantages of flexibility for employers and employees, it means that there is no longer a clear career progression for scientists in university-based research. The low proportion of scientists and engineers in senior levels of the civil service is also well known (34 out of 668 in Grades 1 to 3 in civil departments). Moreoever an unintended, but potentially significant side-effect of the move to Next Steps Agencies and privatisation has been to separate further the administrative and decision-making grades from scientific and engineering staff's expertise. This has also in many cases been associated with shifts from grant-in-aid funding to short-term contracts.

Many see these changes as having fundamentally changed perceptions of a scientific career, and the reduced security, poor prospects and relatively low pay are widely seen as deterring some able science graduates from postgraduate work or school leavers from enrolling in university science courses. Measures are

Table 3 SOME COMPARISON OF EARNINGS (MALE FULL-TIME)

(a) By Occupation (average in 1993)	£/week	(b) By Degree Subject (1987 earnings of those graduating in 1980)	£/year
Medical Practitioners	780	Computer science	16,140
Solicitors	621	Law	15,720
Marketing/sales manager	549	Economics	15,260
Electr. Engineering	514	Maths	14,480
Certified Accountants	489	Electr./Mech. Eng.	14,2-800
Professional Occupations(all)	476	Business	13,960
Scientists (all)	464	Physics	13,880
Engineers (all)	459	Chemistry	12,278
		All Subjects	12,345
Source: DFE (1994)		Biology	10,370

Figure 1
% OF WORKERS EMPLOYED AS SET PROFESSIONALS (OECD)

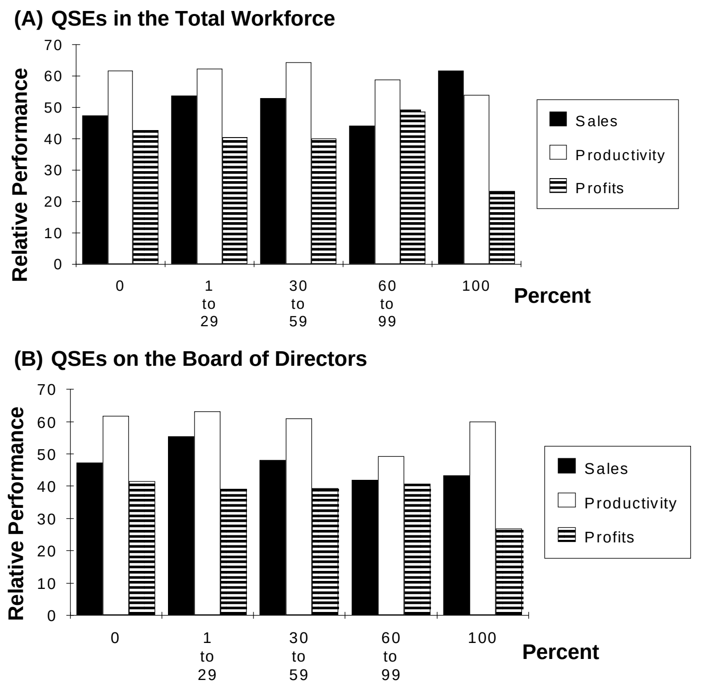


under consideration to address this - for instance the Scottish Office is suggesting a more pragmatic approach, to allow long term research to be supported by government within a competitive framework. This would provide core funding, medium term contracts awarded through competition for up to 12 years, as well as short-term competitive contracts. The subject of academic careers was recently reviewed by the Lords' Science and Technology Committee and new proposals on working conditions by the Committee of Vice Chancellors and Principals may help alleviate difficulties and help universities attract researchers.

A majority of SET graduates however, eventually find employment in **the private sector**. Once there, they can assume a variety of job types (management, marketing, financial services etc.) and their pay generally exceeds that in the public sector. Indeed, the shortage of able students heading for careers in SET is at least partly due to the decision of many of the more able graduates to head for alternative careers in business, commerce and the City. In contrast with popular concepts, engineering graduates are as likely as other graduates to reach the top levels of management.

Private sector expenditures on R&D in the UK have risen recently, and as a fraction of GDP (1.14% in 1993) rank about average for G7 countries, although they lag behind the United States (1.62%) Germany (1.49%) and Japan (2.06%). Such statistics also affect perceptions of career possibilities in R&D. Moreover, private funding

FIGURE 2 THE NUMBER OF QSEs AND COMPANY PERFORMANCE



Source: H.C. Tan and D. Bosworth, Scientists and Engineers, Dynamic Activities and Business Performance. Manchester School of Management

of R&D is highly concentrated in a few sectors (e.g. pharmaceuticals, chemicals, electronics) and a number of large firms within those sectors. The possibility of using the tax system to encourage industrial R&D was discussed in POSTnote 57.

Much discussion has also taken place on whether industry makes effective use of qualified scientists and engineers (QSEs) and the effects on performance when it does. ESRC-supported work has confirmed that there are greater shortages of QSEs than other graduates, and that it is more difficult to fill vacancies. Studies have also revealed considerable variations in the employment of QSEs, with foreign-owned companies tending to make more use of QSEs and graduates.

What is particularly interesting is the effect of such variations on company performance. One recent study (**Figure 2)** reveals that, across 350 different firms:

- Companies with graduates and QSEs in their workforce generally perform better.
- Companies whose MDs are QSEs or whose Boards of Directors include QSEs show better performance.
- There appears to be some optimal ratio of QSEs on the Board.
- Companies with QSEs tend to invest in projects which bring a longer term benefit rather than just immediate returns.

THE ROLE OF 'PUS' PROGRAMMES

The importance of public understanding of science (PUS) for a technologically advanced industrial nation has been recognised in many parliamentary inquiries (e.g. by the Education, Science and Technology and Trade and Industry Committees of the House of Commons and by the Science and Technology Committee of the House of Lords), and became a plank of government policy in the 1993 White Paper "Realising Our Potential". The OST now awards grants totalling £1.25M (1995/6) to organisations running 'PUS' activities (e.g. the Committee on the Public Understanding of Science (COPUS) run by Royal Society, the British Association and the Royal Institution), and to support the National Science Week (SET[7]).

When one explores the underlying reasons for public attitudes, a key finding is that public acceptance of science findings depends on trust in and identification with the institutions controlling it. If those institutions are seen as overly secretive or insufficiently policed, public confidence suffers (as suggested in Box 1 on environmental issues). A second important factor is that since scientific knowledge advances by gathering evidence, advancing hypotheses and exposing these to scrutiny and debate, science cannot always be portrayed as a certain and undisputed source of authoritative knowledge. This presents two potential difficulties for the interested public - firstly in recognising that uncertainty and debate are part of the discovery process. But secondly, that after a sufficient proving period, much scientific knowledge can be taken as proven fact. Appreciating such differences requires the public to have a firmer understanding of the processes of science. Without these, the public may lose trust in or respect for scientists and be unduly influenced by the media's tendency to focus on, exaggerate, or even invent disagreements particularly on 'headline' scientific issues such as AIDS, safety and the environment.

Such findings have bearings on the public understanding of science programmes, where at least some see attempts at promoting greater public scientific knowledge or literacy as inevitably leading to (and justified by) more positive public attitudes - the implicit assumption being that an educated public would realise the benefits of science when 'properly' informed. However, while studies show some general relationship between knowledge and positive attitudes for science, it is often those members of the public who are well informed who are most opposed to morally contentious research and even to basic research, and who support causes (e.g. environmentalism, animal rights) where science is often blamed for Society's ills. Fostering more positive attitudes towards science is thus not simply a matter of improving scientific literacy, but depends on addressing matters of trust (e.g. by improving institutional accountability and open-ness), clearer exposition of the role and benefits of science, better appreciation of the moral and ethical framework within which science is applied, etc. Novel means of furthering public involvement in scientific issues such as Consensus Conference (see POSTnote 56) may also have a role.