



The Save British Science Society

29-30 Tavistock Square, London, WC1H 9QU

Tel: 020 7679 4995 Fax: 020 7916 8528

SBS 05/04

The future of science in Northern Ireland

Invited Lecture given at the University of Ulster
on 24 November 2004

It is a real pleasure to be here again a couple of years after I came for the unveiling of the Foundation Stone of your fantastic Centre for Molecular Biosciences. One of the things that is extremely enjoyable about going around universities these days is to see the many new buildings and refurbishments that are being undertaken. There is no doubt that the money that the Government has released for university infrastructure is making a real difference to the science and engineering research base, and the University of Ulster is playing its part in the renaissance of research infrastructure.

It is within that context of sharply rising investment that we are now able to talk more positively about the future of science than we were just a few years ago.

In this talk, I want to concentrate on things that are different in Northern Ireland from in the rest of the UK. There are many policy issues that are common to various parts of the UK, and many of them are very interesting, but here in Ulster, I shall emphasise the things that I think pertain specifically to Northern Ireland. So I will not touch particularly on the Research Assessment Exercise or the prospects for postdoctoral researcher on short-term contracts, or the underfunding of university teaching. These are important issues, and Save British Science deals with them regularly, but they are problems throughout the UK, and are not in any way special to Ulster.

I must begin by pointing out that although I used to be a scientist myself, I now work full time for Save British Science, which as you know is a pressure group. As our logo demonstrates, we use the word “science” inclusively to encompass “engineering,” “medicine” and “technology” and if there were room, we would probably have included the word “mathematics” as well. I know that each of these activities has a different complexion and that there are good reasons to treat engineering or medicine as special kinds of research, but most of our audience of politicians do not make these distinctions.

Of course, I am a complete fraud in giving this talk, because everyone else in this room knows more about science in Northern Ireland than I do. You are, after all, involved in Ulster's scientific life on a daily basis. But by choosing as my title *The Future of Science in Northern Ireland*, I need not expose my ignorance too much. I can speculate wildly about the future without anyone being to prove me wrong.

History

In fact, I want to start by touching on the history of science in Northern Ireland. I do not want to dwell on it, but I want to view science in Ulster as a trajectory, which has a history, a present and a future. I will briefly mention the past, analyse something of what is happening in the present, and then try to predict what might happen in the future.

Like all parts of the UK, Northern Ireland can name some interesting examples of its scientific work that either took place here or were conducted by Northern Irish researchers. For example, Charles Wye Williams brought modern technology to Northern Ireland at the same time as others were bringing it to Manchester and other parts of the north of England. He came from Dublin as it happens, but he worked a good deal in the north. Lord Kelvin is probably Northern Ireland's most famous scientific son. He is always referred to as a *Scottish* physicist, but he was born and spent his early years in Belfast. His brother, James Thompson, was a distinguished scientist in his own right, and worked at Queen's University. More recently, Denis Burkitt worked on cancer and other diseases, especially in Africa, but he never forgot that he was from Northern Ireland¹.

But as we look at the present, science in Northern Ireland has gone through a huge change in recent years. I am standing in an institution, the University of Ulster, that did not exist 25 years ago, and as I have already mentioned, new buildings are going up all over the place, and exciting new science is being undertaken in them.

The Science Base

The sense of optimism engendered by this new work is reflected in the quality of the scientific results delivered by the science base in Northern Ireland. During the last Research Assessment Exercise in 2001, Northern Ireland beat the rest of the UK in nine science subjects.

I am not a fan of the RAE, but its results at least give a way of making comparisons. We at SBS calculated the average scores across the rest of the UK for each subject, and compared them to the average scores in Northern Ireland. Of course, in Northern Ireland, the average in each subject is of just one or two scores, depending on whether one or both of the two universities here carry out research in the field.

Of the 20 science and engineering subjects that Northern Ireland entered in the RAE, Northern Ireland achieved a higher average score than the rest of the UK in the following nine disciplines:

- Mechanical engineering
- Subjects allied to medicine
- Electronic and Electrical engineering
- Community clinical subjects
- Civil engineering
- Nursing
- Food science
- Agriculture
- Computer science

Put another way, Northern Ireland has 2% of the UK's population, but outperforms the UK in 41% of the science subjects that are represented here². Of course, with just two universities, it is not possible for you to enter research in all subjects, but by any standards, the results of the RAE demonstrate that the quality of what is being done here is at least as high as it is in the rest of the UK.

And this is reflected in groups you are now building. Just a few weeks ago, this university advertised for a whole host of Directors, Professors, Readers, and Lecturers to expand your scientific research³. I have had the pleasure of speaking to some of you this afternoon, and I know that you are attracting the highest quality applicants from around the world.

Before I go on, I just want to point out something about the subjects in the list of those where Northern Ireland outcompetes the other parts of the UK. On a crude classification, all nine disciplines might be called "applied" rather than "blue skies": various kinds of engineering, nursing, food science, computer science and medical disciplines.

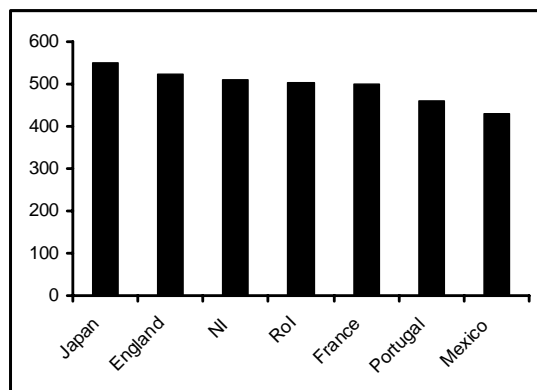
I do want to give the impression that I am saying that there is no good blue-skies research in Northern Ireland because that would obviously be rubbish. But it is clear that your particular strength is in research that falls broadly within the applied end of the spectrum.

Applied and *blue-skies* are of course just one set of terms you might use. Another way of looking at it might be to classify research as *useful* and *useless*, and to say that Northern Ireland is good at useful subjects. I do not entirely mean this, because applied research relies on blue-skies research for its raw materials, but I want to stress that I am not intending to be critical in pointing out that the bulk of your strengths are in research at the applied end of spectrum. I will return to that point a little later.

Education

I want to turn briefly to educational matters.

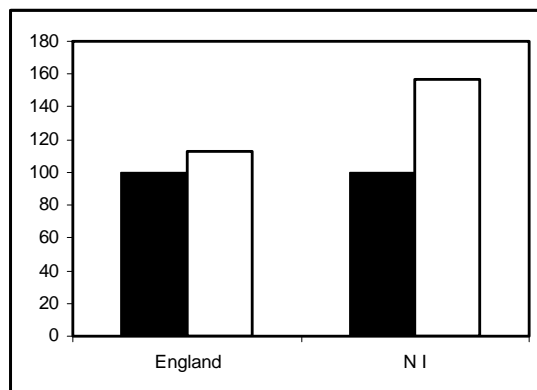
The OECD carries out a series of studies of educational achievement, and the graph below shows their measure of the 'scientific literacy' of 15-year olds in each of seven different parts of the world.



'Scientific Literacy' of 15-year olds, as measured by the OECD; the higher the score, the more 'scientifically literate' the pupils were judged to be [Source: OECD PISA study].

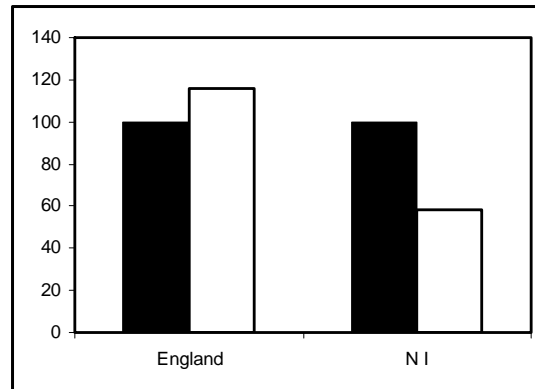
You can see that Japanese children lead the world, but that Northern Ireland's children do very well. Their 'scientific literacy' is roughly the same as that of children in England, and marginally ahead of those in the Republic of Ireland. As examples of the other countries in the study, France, Mexico and Portugal all perform worse than Northern Ireland in terms of their systems of science education.

This strong system of science education is reflected at least in part in the strength of interest in science among young people. The bar chart below shows the change in the popularity of biology as a university subject in recent years. The number of students wanting to read biology in England rose by between 10% and 20%. But in Northern Ireland, the popularity of biology as a university subject rose by a much bigger factor; the number of applications to study biological sciences increased by more than 50%.



Change in applications to study biological sciences at university between 1997 (black bars) and 2000 (white bars) in England and Northern Ireland, with the 1997 figure scaled to 100 in each case [Source: Higher Education Statistics Agency].

But the picture is not universally rosy, as the graph below shows. Although in England there was a modest increase in the number of students choosing to study physical sciences, in Northern Ireland physical sciences have in fact become less popular.



Change in applications to study physical sciences at university between 1997 (black bars) and 2000 (white bars) in England and Northern Ireland, with the 1997 figure scaled to 100 in each case [Source: Higher Education Statistics Agency].

Investment in science in Northern Ireland

Scientific endeavour requires investment, and the total amount of money going into research and development in Ulster is considerable. The biggest single tranche of money comes from the private sector, which invests about £157 million each year in Northern Ireland's research. Government investment via the universities runs at £106 million each year and all other forms of Government investment is £11 million annually⁴.

That sounds like a lot of money, indeed it is a lot of money, but we live in a modern economy, and large sums of money are routine. What matters is not the absolute quantum of money involved, but what is done with it, compared to what the competition is doing.

Unfortunately, Northern Ireland is not doing as well as it could in terms of investment in research. Public sector investment in the science base works out at £29 per head, which compares unfavourably with the £37 per head that is invested in Wales, and very unfavourably indeed with the £75 per head in England or £88 per head in Scotland⁵.

The science base has a technical definition, and relates exclusively to public sector funding for science in universities and institutes, via the Research Councils and Funding Councils. One reason that investment is relatively low in Northern Ireland is that there are no Research Council Institutes here.

The other element of public funding for science is investment in policy-driven research. Individual Government departments perform and commission scientific studies to inform ministers and advisers when they are developing their policies. This is a crucial part of the way the public sector uses science, and on issues such as genetically-modified foods and nuclear power, we have seen that officials and politicians need first-class information on which to build their decisions.

In Whitehall, this kind of Government research and development has risen by 3% since the current UK Government came to power in 1997⁶. In Scotland, the amount of money going into policy research has risen by 60% and in Wales it has more than doubled. It appears that devolution has delivered a sense that Wales and Scotland need additional scientific capacity, but Northern Ireland, where devolution is going less smoothly, has yet to share in that improvement.

In fact, Northern Ireland is the only place in the UK in which policy-driven research has fallen since 1997. Nor is that fall a modest blip. Investment in policy-oriented research in Ulster is 24% lower now than it was in 1997.

In other words, by any measure, public investment in Ulster's science is not healthy when compared to the rest of the UK, which as a whole does not invest as high a proportion of its national wealth in research as many of its industrial competitors do.

Of course, the other parts of the UK are not the only neighbours with which Ulster might find it useful and interesting to make comparisons. Public investment in the Republic of Ireland is also of great interest.

As it happens, such a comparison is no more heartening than the contrast with England, Scotland or Wales. According to the OECD, investment in university research in the Republic of Ireland is about £44 per head per year, compared with £23 in Ulster⁷.

Government sector investment in policy-driven research is also healthier in the Republic of Ireland than it is here in the north. South of the border it runs at around £28 per head annually, but here in Ulster the comparable figure is only £16.

One of the main reasons why taxpayers invest in science is because of the technological benefits that research can deliver. Private sector investment in research and development is the catalyst that allows the results of the science base to be developed into useful products and processes that generate wealth for the economy.

In some ways, it is more difficult to gather such precise figures about the private sector's investment in research, but that is not as important as it may seem, because a few headline facts allow us to draw the main lessons.

Of the Northern Irish companies that are listed on the London Stock Exchange, only one of them – Galen – performs enough research and development to be listed in the Government's *R&D Scoreboard*, which gives details of the 700 UK-based companies that invest most heavily in research. So, with 2% of the population of the UK, Northern Ireland has just 0.3% of the nation's most research-intensive companies.

Without the big scientific companies that play such an important part in other modern economies, Northern Ireland inevitably has fewer scientific jobs. Roughly 2.5% of the workforce is employed in science here in Ulster, compared with roughly 3.5% in Wales and more than 4.5% in Scotland and Wales⁸.

Put another way, this means that if Northern Ireland were to match England in terms of the number of scientific jobs it could create, roughly 15,000 extra people would have jobs working for scientific enterprises here in Ulster than are doing so at the moment.

The overall nature of the private sector science taking place in Ulster is not very different from that in the rest of the UK. For example, in the UK as a whole, 77% of industrial research and development is in manufacturing, and the remainder in services. In Northern Ireland, the comparable figure is virtually indistinguishable, at 76%. The big difference is in the sizes of the companies in which that science is taking place.

The graph below shows the approximate percentage of research and development that takes place in companies of different sizes in Northern Ireland and in the UK as a whole.



Percentage of industrial research and development carried out in companies of different size in Northern Ireland (black) and the UK as a whole (white) [Source: Office for National Statistics].

One of the obvious features of the graph is that there is relatively little research occurring in large companies in Northern Ireland – that is the same phenomenon that we observed when we noted that Galen is the only Ulster company in the *R&D Scoreboard*.

However, there is another important phenomenon displayed in the graph. Three times as much of Northern Ireland's research is carried out in smaller companies as it is in the other parts of the UK. There is clearly a very vibrant SME sector in Ulster that bodes well for the future.

This is reflected in the figures for university spin out companies. In 2001, the two universities in Northern Ireland spun out a total of 19 companies, an average of 9.5 companies per university. That was more than three times as many as Scotland, where each university generated an average of 2.6 companies. England and Wales produced fewer than two companies per university⁹.

Strategies for developing economic gains from university research are becoming more sophisticated, with licensing and other activities now seen as being just as important as spin-out companies. But the overall picture remains strong; Queen's University Belfast and the University of Ulster are doing well at feeding the economy with small companies.

The Future

This talk is supposed to be about the future of science in Northern Ireland, and I have spent the bulk of the time analysing the present.

But that analysis suggests some strong potential trends for the future, and identifies some pitfalls that must be avoided if science and technology in Ulster are to thrive.

First, public investment must rise, because Northern Ireland currently has an uphill struggle. Without a more level playing field, Ulster cannot really hope to compete with the rest of the UK.

To raise Higher Education investment in research to the same *per capita* level as Wales would cost £300,000 annually, but if Ulster wants to be more ambitious and aim for Scottish levels, it needs to find an extra £15 million per year. This last figure would mean that each of the two universities here would get an extra £7.5 million each year. It may not be realistic at the moment, but just imagine what you in this institution could deliver if politicians and civil servants would show that level of confidence in your abilities.

In terms of Government sector research, it would take between £4 million and £20 million annually to take Northern Ireland to the levels of funding in other parts of the UK. £4 million would enable you to catch up with Wales, the nearest competition, while £20 million would overtake Scotland, currently the strongest part of the UK.

In terms of Research Council funding, I think we have to accept that none of the Councils is about to announce the founding of a new Institute in Northern Ireland. To win a bigger slice of the Research Council's funding cake, you need to win more grants in open competition. That will not be a trivial exercise, but if serious new investment comes in from the Higher Education side, from DELNI, then Ulster's universities will be in a stronger position to bid for grants, and will almost certainly be awarded more.

If this happens, and if more investment delivers more of what you are already doing, then Northern Ireland will command a position at the top of the league in some subjects.

Long-term success will depend on developing a broader range of strengths. As we observed earlier, Northern Ireland's strengths lie in more applied subjects, and although there are areas of strength elsewhere, there is not the same broad base of strength in research at the more fundamental, blue-skies end of research. This needs to be built, perhaps in collaboration with researchers in the Republic of Ireland, or with other partners elsewhere in Europe.

And if more investment delivers more of that you are already doing, then there does not seem to be any doubt that Ulster will have a more vibrant sector of small and medium sized companies than other parts of the UK, and that could be a significant strength.

The trick will be in turning this strength into long-term prosperity and jobs, and one element in doing this will be to increase the large company sector of the economy.

To do this, there could be three possible strategies, which are not mutually exclusive, and could potentially all be adopted simultaneously. First, Ulster could try to attract more existing large science-based companies to come here. Fighting for inward investment is hard, and every part of the world is competing for the same investment. But the strength of the scientific work here should be a significant factor in advertising the attractiveness of Northern Ireland as a place to do technological business.

The second element of an overall strategy will be growing existing small and medium sized companies. You have an advantage here because you already have a

strong SME sector. It is crucial that Ulster capitalises on that advantage so that in ten year's time, some of those small companies have become larger firms, continuing to do high quality science, but doing a much higher volume of research, and employing many more people.

The final set of activities needed to grow the large company sector will be convincing existing Ulster-based companies to do more research. It is the only way they will keep ahead of the game, but the UK's firms in general are not as receptive to this fact as their counterparts elsewhere. If Northern Ireland can do even moderately well in this area, it will pay dividends.

Conclusion

In summary, all that I have said can be expressed in two simple sentences:

Northern Ireland already has an excellent research base, and a strong base of innovative small firms.

What it needs is a fairer amount of public investment and more science-based large firms.

Good luck!

March 2005

Notes and References

¹ *Oxford Dictionary of National Biography*

² *Science Policies for the Legislative Assembly of Northern Ireland: Agenda for the Next Four Years*, SBS, 2003.

³ *Times Higher Education Supplement*, 29 October 2004.

⁴ *Northern Ireland Research and Development Statistics*, Office for National Statistics, 2003.

⁵ *Forward Look: Government Funded Science, Engineering and Technology*, OST, 2003 and *Hansard* [House of Commons] 12 June 2000.

⁶ Figures for all parts of the UK are official Government statistics from *Forward Look: Government Funded Science, Engineering and Technology*, OST, 2003.

⁷ This figure is lower than the £29 cited above because the figures cannot be calculated in precisely the same way; the OECD does not report the same level of detail that can be gleaned from the UK figures. The numbers here refer to the OECD's category of "General University Funds for research".

⁸ Figures from the decennial Census.

⁹ *Science Policies for the Legislative Assembly of Northern Ireland: Agenda for the Next Four Years*, SBS, 2003.