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Science and Technology Committee

Strategic Science Provision in English Universities

Eighth Report

Volume II

Oral and written evidence

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The Science and Technology Committee

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Oral evidence

Taken before the Science and Technology Committee

on Monday 7 February 2005

Members present:

Dr Ian Gibson, in the Chair

Mr Robert Key
Dr Brian Iddon
Dr Desmond Turner

Witnesses: **Danielle Miles,** Exeter University, **Ian Hutton,** University of East Anglia, **Amy Huntington,** Newcastle University and **Stephen Rowley,** Aston University, examined.

Q1 Chairman: Thank you for coming to help us at the start of this inquiry into universities. Some of us are too long in the tooth to remember what it is like to study at a university, so we are very grateful to you for finding the time to come away from your precious studies. I am sure you are missing important lectures or something, and you are going to be contributing hopefully to higher education in this country. Please do not treat this as *viva*; we are not awarding any degrees, we are trying to get to your feelings and any information that you have to reflect some of the issues, as you see them, so that we can maybe do something about them because we are not happy with everything that is going on. So, I do not know how you are going to answer all this, but I will keep you down to a few sentences so that we get through it all. Firstly, can you tell me what was your reason for studying science? Amy?
Ms Huntington: Interest really; interest at school.

Q2 Chairman: Ian?
Mr Hutton: Just the same, interest at school; I have always been interested in biology.

Q3 Chairman: Danielle?
Ms Miles: Very much the same. Every career aspirations I had I wanted to do something sort of science based.

Q4 Chairman: It was not the least of all the bad things you could have done, then? You could have done the arts or something. Stephen?
Mr Rowley: It is more something I have fallen towards during my school career. With civil engineering it is nice to have a definite goal at the end.

Q5 Chairman: So you enjoyed the subject at school, that is basically what you are saying. Were you interested in the career end of it, the great sums of money that would come your way? Was that part of your decision making?
Mr Hutton: Not really.

Q6 Chairman: Because you knew you were going to be poor and would never have to pay your loans back!
Ms Miles: Mine was more to do with the fact of just finding it interesting and being able to answer questions and find out facts and new things all the time, and just being updated with things rather than the money side of it.

Q7 Chairman: Let me get right into it. What is your assessment, when you look back at science teaching in the school you were at? Was there an inspirational teacher? What about the practicals that went on? Tell me something about your experience from your generation, please. Amy, could you say something about that? What did school did you go to?
Ms Huntington: For my secondary school years I was actually home educated. I did my A Levels at a college. My physic teacher at college was fantastic, she was just brilliant, and obviously she was a woman, which helped at the time.

Q8 Chairman: Which makes her brilliant than a man!
Ms Huntington: Yes! Wow! a woman physics teacher. She was an inspiration.

Q9 Chairman: In what way was she inspirational to you?
Ms Huntington: She was just so enthusiastic about the subject and her teaching. You could not help but enjoy lessons.

Q10 Chairman: Ian?
Mr Hutton: I found more or less the same, but I found that when I was going through GCSEs and A Level, at each level as the subject progressed more areas of the subject opened up and you were taught more information, and as that kept going I kept on wanting to find out more at each stage, I guess. So it kind of progressed up, and also I had very enthusiastic teachers, both at GCSE and at A Level.

Q11 Chairman: Danielle?
Ms Miles: After GCSE it was fine; I got to A Levels and had a bit of a nightmare. My AS Levels, I was taught my chemistry by a biologist, and obviously she had some knowledge of it but I did not feel that she was that enthusiastic about it.

Q12 Chairman: Which school were you at, Danielle?
Ms Miles: The John Collet School, in Buckinghamshire. I got to my A2s and my chemistry teacher—I actually had a chemistry teacher—left six months towards the end of the course, so I then had to teach myself. Everyone else that was on the course gave up and I tried to stick it out and got information from other people that I knew, and things like that, and had to basically teach myself.

Q13 Chairman: You were pretty determined to go ahead with it?
Ms Miles: Yes. Stupidly! And now I am in this situation.

Q14 Chairman: Stephen?
Mr Rowley: Throughout school most of my teachers were good, up to GCSEs, which were really good. I think A Levels, it was more that was not really following it very well and I lost interest in it a bit.

Q15 Chairman: What about the courses you did at school? Did they influence what university science course you went for? From your situation, Amy, I know it is slightly different, but from what you learnt, did that make you decide and make you look through before you filled in the UCAS forms and so on?
Ms Huntington: It made me decide that I wanted to go into physics rather than any other science.

Q16 Chairman: So you were pretty clear what you wanted to do?
Ms Huntington: Yes.

Q17 Chairman: How did you choose the university?
Ms Huntington: I am not actually sure, to be fair.

Q18 Chairman: How many interviews did you go for?
Ms Huntington: Two.

Q19 Chairman: And you got an offer at both?
Ms Huntington: Yes, and I decided on Newcastle.

Q20 Chairman: But you could have gone to five or six?
Ms Huntington: I presume, so but I liked the idea of Newcastle, the university and the city and it felt it the right decision to make.

Q21 Chairman: Ian, how did you choose?
Mr Hutton: I guess when I was looking at courses I picked a generalist course because, as I said, I felt that at each level I kept going up and new areas of the subject kept opening up and I did not want to get to university and find out that I would rather be doing something else at that sort of level. Then university-wise, I guess I picked UEA because they always described themselves as a research-led teaching school and the idea of having *the* people doing the research—

Q22 Chairman: So it was the research that stimulated you?
Mr Hutton: Yes, making the publications—

Q23 Chairman: Why do you think research makes a difference? I mean, you just read it by rote and you pass exams, do you not?
Mr Hutton: No, not really because the people who are doing the research, they are the people who are actually progressing the field of biology and they are the people who are finding out new things and making the publications. They are writing what goes into the journals, and it is very nice to be able to go to a lecture and to be told, "Actually this paper came out last year but since then our group has discovered that this in fact is what is going on." That was one of the things that I wanted, to be taught by the people doing the research at the forefront of the subject.

Q24 Chairman: Did you care about whether the department had a grade four, grade five, five stars or whatever? Did that affect you at all?
Mr Hutton: I had heard about the ratings but that was not what I based my decision on; I based my decision on when I went round and when I talked to people and when I was shown round the school at the Open Days. That was what gave me a real feel for the school. You can put numbers on a lot of things but until you actually see them you cannot always relate them.

Q25 Chairman: Danielle, how did you choose?
Ms Miles: I chose university pretty much on the feel of the place again. I applied to a couple of universities with similar courses. I chose Exeter in particular because they did forensic modules and I was interested in forensic science, but I did not want to do a forensic degree, I wanted to get a chemistry one so that I could still do other science careers if I changed my mind later on. And they did the forensic module which would help me.

Q26 Chairman: Forensics?
Ms Miles: Yes.

Q27 Chairman: Is that because you watch telly a lot, or what?
Ms Miles: Not really! I am not one of the CSI fans, no, I do not watch that! I have always been interested in it, as well as the police and things like that. I chose the university in the end—I just went and had a look at it—just the friendliness of it and the way they taught and the contact hours and everything like that, I thought it would suit myself.

Q28 Chairman: Stephen?
Mr Rowley: I actually chose Aston because it had a good foundation course that I needed to get for my degree.

Q29 Chairman: For really different reasons, I suppose. So what use was the science at school to you? Did you get it knocked out of your head in the first week, second week, or was it helpful, do you think, having a background in the science you got at school or was it irrelevant to what went on and has gone on later?

Mr Hutton: It was helpful but the actual direction of the course takes you in another direction in your second and third years. The first year, some of it you have already done at A Level and other bits you have not and they bring you up to speed on that. Then the second and third years they specialise you in the true nature of what biology is.

Q30 Chairman: Does anybody want to add to that?
Ms Miles: I feel with the chemistry—it is slightly different for me because I did not have the teachers teaching me and I am not really sure if I got as much out of my A Levels as I could have done if I had a teacher—you are not really told the whole truth; they give you an easier version of it to digest. And sometimes I feel in my course now it would have been more helpful if they had us the truth in A Levels and GCSEs rather than skimming around the outside of it.

Q31 Chairman: You mean they lied to you, did they, Danielle? Who lied to you, Danielle?
Ms Miles: Only white lies!

Q32 Chairman: Write it down on a piece of paper! Stephen?
Mr Rowley: I agree with Danielle.

Q33 Chairman: You know why we are having this inquiry, presumably, that we are very concerned with what is happening to science in universities and the fact that many people in schools like yourselves are not going on to do these courses because they may not be there, or they do not see any future in it, or whatever. How do you explain what is happening, the number of students going into science? You were obviously fired up, enthusiastic, determined, under pressure and so on, but a lot of people are not risking that any more. Why do you think that is?
Ms Miles: I think it is because it is being made increasingly harder, the fact that less people are going there and less courses, and there are so many things that are easier to get on to.

Q34 Chairman: You mean science courses?
Ms Miles: Yes, there are less science courses but there are a lot of different degrees in different areas that have less qualifications that you need to get on to them.

Q35 Chairman: Do you still think that there are soft art courses that you can do, like media studies, shall we say, and end up on Radio 4 or something? Is there a lot of that still around?
Ms Miles: Yes, an awful lot of that, and I think there is a lot of pressure to go to university now. I have been talking to my mum, and from her generation they never even considered university at her school, but at my school it was just the next step. Pretty much everyone in the sixth form went on to university. And because there is so much pressure you think you have to go to university, even if you have not got the grades to do what you want, so you go on and do a degree that might not be what you want to do but it is just easy to get on to it, and you are at university. So people are going for the wrong reasons and not doing truly what they want to do, maybe.

Q36 Chairman: My daughter tells me that the scientists she knew at school—she was on the sociology side and so on—that the scientists at school were always thought of as "geeks", that they were a bit strange. Is that still there in school?
Ms Miles: It is at university still as well. I remember my first week at Freshers' Week, when everyone was asking what you are studying, and the facial expressions of people when you say, "I do chemistry," is an "Ooh" kind of look on their faces. They say, "Why are you doing that?"—"It is because it is what I want to do, it is a good subject to do," and there is a whole image of it as not being very cool, as you say, and looking like "geeks".
Mr Hutton: It is almost as though there are these two cultures that go with university; there are the people who go to study and the people who go to university because they feel that they should, and they get on an easy course and they spend a lot of time lazing around and relaxing, and often you are stigmatised if you do a science course, purely because of the number of hours, and people see that in fact you want to do that.

Q37 Chairman: That is not just at UAE, is it?
Mr Hutton: No.

Q38 Chairman: You have to watch because the Press are here, you know! So you think that is general in schools and the thinking?
Mr Hutton: Yes.
Ms Miles: Yes.

Q39 Chairman: What do you think, Amy?
Ms Huntington: I think it is a little bit that people at school are not sure. Maybe the careers advice is not as good as it could be? They do not have the information that, "If you want to go into *this* you will need a science degree" or "A science degree will help you do *this* career or *that* career."
Chairman: Go on, Brian, pitch in.

Q40 Dr Iddon: If when you were applying to go to university, because it is more expensive to teach science subjects and engineering subjects, if the universities charged more to teach those subjects would you have been put off or would you have just pursued what you were interested in?
Ms Miles: I think personally it might have slightly deterred me, just the fact I might have thought, "I am not sure," but if Exeter University had said to me, "Unfortunately we have some financial problems, we need to charge a bit more this year, maybe we need to charge you for things like photocopying and things like that, do you mind, otherwise basically you are not going to be able to finish your degree here," I definitely would have done anything to pay that money and to stay there. Also, you have to think about the amount of money that you will earn at the end of it as an incentive, if you can get that degree.

Q41 Dr Iddon: Let us bring in Stephen?
Mr Rowley: Yes, I think I would have been influenced by that. I might have been less likely to do it.

Q42 Dr Iddon: It would have put you off studying—is it engineering?
Mr Rowley: Civil engineering, yes.

Q43 Dr Iddon: Amy, you were desperate to get to NUT?
Ms Huntington: It depends, if the universities are charging more, where are you going to get that money from? Would I have been put off? If I had the money, possibly no; but if there is no means of getting that money, if there are no loans or whatever, then maybe I would have thought twice. The debt coming out of my degree now is scary enough, never mind if it was three times as much.
Mr Hutton: I would have tried to have met the costs as best I could, I guess, but if I could not meet them then I would have to . . .

Q44 Chairman: Do you have to work now when you are at university? Which bar are you running?
Mr Hutton: I tend to work in the holidays so that I have free time when I am up at uni to concentrate on my studies really.

Q45 Dr Iddon: If somebody provided an incentive for you to study physics, chemistry, engineering subjects, would that appeal to people, do you think?
Ms Miles: I think it would appeal to people but I think you would get the wrong people on the courses. I think you would get more of the people that would be thinking, "I want to go to university", for the wrong reasons, to party, relax, whatever. If you were talking about money, if you were giving them money to do it, it is an incentive to think, "I will do chemistry," or whatever science, "I do not really want to go into a career of it but it is a good degree to have to do," whatever, "plus I will get money so I will get less in debt, I will just do it anyway," you might end up not having as many researchers and people going into the fields that they have studied in, and more people just going into IT with good degrees and things like that.

Q46 Dr Iddon: Stephen?
Mr Rowley: I agree with that, but I cannot really answer that because I did it anyway.

Q47 Dr Iddon: Ian and Amy, if somebody gave you incentives would that appeal? Would you have been switched off your subject if there had been more money available in another subject for you?
Mr Hutton: No, not really. I have always wanted to do biology; that is what I wanted to do so I would have done it anyway.

Q48 Dr Iddon: So if there are shortage subjects, as there are at the moment—languages is going the same way, quite frankly, as some of the hard sciences are going, but industry keeps telling us that there are shortages of certainly good quality people from the hard sciences—do you think the government should intervene in any way to attract people into shortage subjects?
Ms Miles: Yes, personally.

Q49 Dr Iddon: How should they intervene, do you think?
Ms Miles: I think there should be more control over closures. Maybe, say, if a school were to decide it was going to shut down its chemistry or biology department I am pretty sure that maybe the government could step in and say, "You cannot do that," because of the National Curriculum and everything. As far as I can see there is not really much point in having chemistry in schools if you cannot go on to do a degree at it because the less departments there are the less chance there is of getting anyone to do it and there are less people that are going to do it. So it is a vicious circle.

Q50 Dr Iddon: The university Vice-Chancellors are saying to us and their staff are saying to us as well, "You cannot touch us, we are independent."
Ms Miles: But they cannot be really because they have to look at the fact that the people paying for it are taxpayers and the like, and also we are all customers of the university; we pay to be there and we pay quite a lot to be there and they should respect what we want. I am not sure about everyone else's departments, but our department was up by 27% on admissions this year and they are saying they are not getting enough people in, but that is quite a large increase in this year. They just do not seem to be listening to what people want.

Q51 Dr Iddon: Do the other three have a view on whether the government should intervene, perhaps by providing incentives to study shortage subjects? Stephen?
Mr Rowley: I think perhaps, but I would not know exactly how.
Mr Hutton: I think you would have to be very careful about what incentives you offered because it is not just taking the places as a blank spot and trying to put people in them, you need the right kind of people to fill those places and careful consideration would need to be given as to why those places are not being filled by the people you want them to be filled by and to try to get an incentive towards filling them with the right kind of person. I think that is the issue more than just incentives to fill the places.

Q52 Dr Iddon: What role do you think industry and commerce has in all this? Any?
Mr Hutton: Yes, I do to a certain extent. You can change obviously what you want to do but I guess when I was thinking about going to university I was thinking that I am going to get a job or a career within the field of biology somewhere along the line, and I guess if there was more of a drive to make it known what you could do with a degree in biology and the careers that those places could take you, all

those qualifications could take you, then younger people might be more enthused to go into those subjects if they were made aware at a younger age.

Q53 Dr Iddon: Amy?
Ms Huntington: I think industry does have kind of a say in this. I presume they accept that it is going to be losing out on graduates filling roles, so certain companies are going to find that they do not have people to employ.

Q54 Dr Iddon: They are recruiting in France, you see; why should they care about the British university system? My daughter is recruiting abroad for a big company—she is in human Resources.
Ms Miles: That is where the government should get involved and that is why they should be worried that even the people that are still getting through with their degrees might not be getting recruited, and they should be worried about the fact that people like us should be able to get what we want and the jobs that we want if we are prepared to put in the time and the effort and get the education. By stopping us from doing that it is causing more problems for themselves.

Q55 Chairman: When you are talking about incentives and you are talking to your mates at university and all that sort of thing, what do they say about bursaries and remission of fees and bigger maintenance grants? When you are having a serious conversation about it how do you think it could work, for incentives?
Ms Miles: I think maybe if there were more sponsorship type things, so if people were getting the grades and you had to get to a certain level and you would get more money, that might put the right people in the right place and it would give them more of an incentive to be there, because you would have to be of a certain mind to be working hard to get those grades, and then if you were to get the money as a reward it would push us to it a bit more and might help more people who cannot afford to do it.

Q56 Chairman: Ian, what do you think, and Stephen and Amy?
Mr Hutton: That sounds like a reasonable idea.
Mr Rowley: I agree.

Q57 Chairman: So do you worry about the next generation of students coming through? Do you think they are going to be put off or be put on subjects? How do you feel about it? Have you escaped the atrocity of top-up fees?
Mr Hutton: It almost seems to me like it is going to go over towards the American system, where parents will have to start saving from a child's early age if they are thinking of them going to university.

Q58 Chairman: You mean at the zygote stage!
Mr Hutton: Just put money aside from earlier on. I think that is the way that it appears to be moving but the public perception has not completely caught on with that yet. But I think that is how it will be in future generations.

Q59 Chairman: Has anybody else got a view about this, the next generation? I know you are caught up in getting through yourselves and you do not look over your shoulder much at your age, but you must sometimes think about it? You must have younger brothers, sisters, or whatever, who want to do similar kinds of science subjects.
Ms Miles: I think it is worrying because I am having to look at another university to transfer to now and to finish my degree, and not only am I myself worried about finding a good university with a good chemistry course, where I would fit in, where I could do the work and where I have got the qualifications to get on, I have also got the added worry of is it going to close down now? If people are worrying about that as well they are going to be looking at universities in a different light and be worrying about them closing down, and if you are slightly concerned that it might get closed down that will deter people even more. They need to be assured that their universities are going to be safe. When I started I had no idea that this sort of thing happens, that degrees just got cut off and that was it; I was not even concerned about it. I think now it is starting to hit the papers a bit more and it is making a bit more of an impact people are going to be worried about doing science degrees because in fact they might close down.

Q60 Chairman: How much are you being offered to move?
Ms Miles: We are being offered up to £2000 relocation—but that is *up to* and I cannot really see getting very much of that. At the moment they are pressurising us to go to Bristol or Bath for the regional aspect of it. I am not sure how that works and what sort of funding it is, but they are pressuring us to go there, and from my personal point of view I do not really want to go. I did not go to Exeter because of where it was, it was because of the university, and I am looking at going to Leeds and I have not really had that much help in getting there, I have had to go off and do it all myself.

Q61 Chairman: Are you having a choice of courses thrust at you?
Ms Miles: They have said to us that we can transfer on to any other course in the university, but from a personal point of view again chemistry is all I want to do. A few of my friends are doing chemistry and law and they have decided to go on to law, but that is just because they do not really know what to do and they are panicking about being lost and not knowing.

Q62 Chairman: Why are Bath and Bristol being chosen and not Cambridge and Oxford?
Ms Miles: Bath and Bristol are being chosen because they are the local universities.

Q63 Chairman: Local universities?
Ms Miles: To Exeter, yes; they are playing a regional card and trying to keep us as we were.

Q64 Chairman: But you do not pick the university because it is local, do you?
Ms Miles: No. I am originally from Buckinghamshire and I want to go to Leeds. So it is about the same distance to Leeds as it is to Exeter, so it makes no difference to me whereabouts it is.

Q65 Chairman: Do you think you will manage that, going to Leeds?
Ms Miles: I went up and saw them on Friday and they seemed very happy.

Q66 Chairman: There is a chance?
Ms Miles: Yes.

Q67 Chairman: What do you others think about this kind of situation? Do you fear it might happen? Are students talking about it?
Mr Hutton: They are not talking about it at my university. I do not know. I guess, what are the reasons for the closures? Is it because science is unfashionable, or is it because science departments are expensive to run in the university? Then that brings into question all the pros and cons about having research-based science faculties or science faculties which literally just teach, and how that impinges on costs.

Q68 Chairman: There have been threats of closures at UEA.
Mr Hutton: What, for biology?

Q69 Chairman: Not in biology but in other departments. If you think not just about yourself perhaps, but other students and what they think potentially closing and having to move? Because you guys have been through it, Amy and Stephen, at your universities?
Mr Rowley: Yes, but I did not have to move it, they just ran the course out until everyone was through. So it was different in that sense.
Ms Miles: It is huge at our university, we are all talking about it at the moment because our Vice-Chancellor has made the point in the Senate meeting about the fact that if chemistry is not closed other subjects would have to be closed. So a lot of other subjects are now panicking and a lot of people are worrying about their degrees and there are lots of rumours going around and lots of panic, and they were talking about closing the Italian and music, and it was sort of across the board, and there is quite a lot of widespread panic actually at the moment about degrees being cut off and no one really knows what is going on.

Q70 Chairman: There is a court case pending, is there not?
Ms Miles: Yes.

Q71 Dr Turner: So you will not be able to have an Italian with a chemistry degree in Exeter!
Ms Miles: No!

Q72 Dr Turner: Not many people obviously go into science related careers without having an undergraduate science degree, although the relationship is not absolutely absolute. How much did your career aspirations and interests affect your choice of undergraduate course? Danielle, you have done chemistry, you are interested in forensic science. Did you take career advice about that, for instance?
Ms Miles: I did because I was looking into doing forensics and I was told that if I do chemistry it is probably a better degree to have because I can still get into forensics, but it does not narrow down my options too early, and also I get a more wide ranged and in depth chemistry than I would have with forensics because you would be looking at other aspects and not just chemistry with it.

Q73 Dr Turner: You had some sound career advice because we have been looking at forensic science in another inquiry, but what was the experience of the rest of you with the quality of the career advice you got into the relevance of the subjects that you were proposing to study? Amy?
Ms Huntington: I knew I wanted to study physics. It was not because I wanted to do X as a career. What my career advice was, basically, if that is what you want to do it is not going to harm you in most career choices.

Q74 Dr Turner: Yes, you could end up making a fortune in the City with a physics degree, I can assure you. Ian, you want a biological career presumably?
Mr Hutton: Yes, but I was given similar advice as well, that a biology degree is a very good degree to have because of the transferable skills and if I wanted to do something else then it would not really be a problem to transfer at a later stage, and I had the time of my degree to make up my mind.

Q75 Dr Turner: Stephen, did you get good career advice from the point of view of engineering?
Mr Rowley: I think so, yes. I was aware I wanted to do something that got me out and about; I did not want to be stuck behind a desk and things like that. They made me aware that there was going to be a shortage of good engineers, so it might be a good way to go.

Q76 Dr Turner: This makes you all fairly unusual, although you are clearly not sure, Amy, because you are all obviously envisaging careers which are directly going to use some of the content of your undergraduate degrees. Do you feel that this makes you very unusual in your student body? Do other students feel the same?
Ms Miles: I have been asking a couple of my friends about that and a lot of my friends are actually thinking about going into teaching. Some of them are looking to go into chemistry teaching, sort of lecturing. I have one friend who is looking to doing special needs teaching, but she wanted to get a good degree behind her—not just any degree—to get into it. She wanted a good one, that if she came out of university and she had been inspired by lecturers and

research that had been going on, that she could then carry on with the degree that she had done and it was something that interested her, rather than just doing any old degree and to get into a teaching college.

Q77 Dr Turner: Most scientific careers also involve some postgraduate education. Are any of you thinking of following your undergraduate degree with a postgraduate course?
Mr Hutton: I am currently toying with whether to or not really, I guess.

Q78 Chairman: Why are you toying with it and not being determined with it at this stage? Are you not good enough, do you think? Or bad enough!
Mr Hutton: I think it is that I have spoken to a lot of my lecturers and being in the third year you come into a lot more contact with contract research staff, and I have considered the career prospects and the job prospects after having done, say, a PhD and then several post-docs, a lot of them seem to bounce around from contract to contract with no real security, and if I had worked that hard to get that qualified and have a PhD then I would want to find myself in a more stable environment than that. Whereas if I went, say, into industry and got recruited by a company now then I would have a set career path and a clear-ish future.
Dr Turner: So have any of you been deterred in your future choices—
Chairman: Amy is doing a PhD.

Q79 Dr Turner: . . . by the very problem that you have just raised, of the insecurity of post-docs—and I know all about that, I have been there and it is very uncomfortable. It has worried you, Ian, has it worried the rest of you?
Ms Miles: To be honest with you, I have only just started and so I have not really thought that much into it, so I would not be able to say on that.

Q80 Dr Turner: Do you think many of your peers will want to pursue a career in science?
Mr Hutton: Yes, but I do not necessarily think that a lot of people will want to go down the PhD route now that way, but I can see a lot of other people on my course staying within the field of biology, but not necessarily through the PhD route.

Q81 Dr Turner: What do you feel about the obvious prospect that you can have a situation whereby people who reach the highest levels in a subject are actually going to be disadvantaged in their careers. Do you think it is a disincentive and a damaging thing to the whole subject?
Mr Hutton: That is one of the things that is seriously making me evaluate whether or not I want to go into postgraduate education.

Q82 Dr Turner: Uncertainty is a big thing.
Mr Hutton: Yes.

Q83 Chairman: What about you, Amy? There you are, you are doing it.
Ms Huntington: I am halfway through my PhD and, no, I have not seen it as anything other than a plus point, to be honest.
Dr Turner: Physicists are fairly scarce animals, so maybe you will be all right.

Q84 Dr Iddon: Danielle, you have given us an indication that you are going to Leeds, but could you give us a feel for what is going to happen to the rest of your people on your subject at Exeter? Is there a general feeling or is it all over the place? Can you tell us the mood of the students?
Ms Miles: I think it is pretty much all over the place. A lot of people I think have just given up hope. There are a lot of people now left thinking, "What am I going to do?" We put in an awful lot of effort—and I am sure everyone else did as well—thinking about where you wanted to go with your life, choosing a university, deciding what degree to do—it was a big decision—and when you finally reach it and you get there and you are happy and you feel relaxed about it, and then to suddenly have it all ripped apart underneath you and to say, "No, you cannot do that," and you then have to look again and then got to make new decisions, I have taken that as maybe this is a good opportunity, maybe I can go somewhere that I will enjoy more, or whatever.

Q85 Chairman: How did you hear about it, Danielle?
Ms Miles: We heard about it through the Press.

Q86 Chairman: Really? Nobody talked to you at all?
Ms Miles: Nobody talked to us at all.

Q87 Chairman: Which Press did you read it in—the local Exeter Gazette, whatever?
Ms Miles: A lot of rumours were going around and it was all flying around and one of the biggest problems was the lack of communication. We were not told we were going on. In fact I was there for six weeks when we finally got told what had happened, and as far as I am concerned I am pretty sure that they must have had thoughts about this happening before I had even started in my first year, and I would have appreciated it if I had been told when I got my A Levels what was going to happen. They must have had some sort of information that they had problems. We all got settled in, we were all happy, doing well in our course and then suddenly for them to turn round and say, "No." Some people are thinking of transferring, some people are going to stay on because they do not know what else to do, they are just lost, but for me, staying on—

Q88 Dr Iddon: When you say stay on, do you mean stay on in another subject area?
Ms Miles: No. Our university is saying that although they are closing the department and they are making pretty much all of the lecturers redundant by 31 July, we can finish our degrees in Exeter. I have turned round personally and said, "How are you going to do that without lecturers, without a department, without labs?" and they have said, "We are not really sure at the moment, but it will be okay, we will sort it for you." I said, "You need to put a plan into place

because that is going to be next September," and they are thinking of maybe bringing in temps, maybe buying back people they have made redundant, which I cannot see happening; maybe getting in retired staff or sending us to different universities at different times of the week to do different modules.

Q89 Dr Iddon: How many people are just going to say, "I have had enough, I am leaving university, I am going to get a job"?
Ms Miles: I am not sure how many will do that. I know that there are quite a few people who really like Exeter and have decided to do law courses, or a few people have decided to go on to geography or ancient history, which is not their choice but it is the only other thing that they could maybe see themselves doing, and they like Exeter, so that is why they are staying, which has put them off doing science.

Q90 Dr Iddon: I just want to pursue that hint that you have just put there that it is the university perhaps that attracts more even than the subject. Stephen, if your subject had not been available at your university would you still have gone to the university and studied something else, or would you have gone to another university to study what you have chosen to study?
Mr Rowley: No, I would have gone to another university to study civil engineering.

Q91 Dr Iddon: So civil engineering or bust. What about Amy?
Ms Huntington: I think I would have gone elsewhere as well.

Q92 Dr Iddon: Ian?
Mr Hutton: I would have gone elsewhere as well.

Q93 Dr Iddon: You have made a great play about Exeter, and it is a lovely city, I know Exeter well, but if your subject had not been available there you would have gone to Leeds or somewhere else?
Ms Miles: Yes, and I am pretty sure a lot of my friends as well who started in the chemistry course, if it was not available they would not have gone to that university. But now because of what has happened and they are unsure about their future, and whether it will happen elsewhere and all the hassles, I think they just seem to think that it is an easier option just to do something else.

Q94 Dr Iddon: Obviously the physics undergraduate course at Newcastle is being run down. How is that going to impact on your PhD, Amy?
Ms Huntington: We have not had an actual physics department for a couple of years due to restructure when it was put into a bigger school, so the department has not been in place for about two years. There is no intake of undergraduates on to a plain physics degree come September, that is true, but the year after that I am led to believe that they are going to start a natural sciences degree, obviously in all three sciences, and I am led to believe you will be able to specialise in physics. So in that sense physics is still going to be taught at Newcastle.

Q95 Dr Iddon: So your PhD is really unharmed, that is what you are saying?
Ms Huntington: As far as I am aware it should not really make a difference.

Q96 Chairman: Does it matter to you that departments are closing? You are going to get smaller numbers but they are going to be there, they are going to be bigger, better, we hope, and so on. What do you feel about that? How do you look at that, think about it? Say six chemistry departments closed and the six that were left were wonderful, you would get in, would you not?
Ms Huntington: There is no guarantee of that, I suppose, is there? That is the thing. I understand why departments are closing and I understand there are problems, but . . .

Q97 Dr Iddon: What do you think the main problems are? What do you think is causing these departments to close? We are told a number of things, like there is a shortage of people wanting to do chemistry or physics or engineering. What do you think are they reasons they are closing?
Ms Huntington: Basically I believe it is financial, fundamentally.
Dr Iddon: Whose fault is that? Is it the universities, whose fault is it?

Q98 Chairman: Who do you blame?
Ms Huntington: Who do I blame?

Q99 Chairman: Nobody, everybody.
Ms Huntington: Everybody, yes. I think that is the question, is it not?

Q100 Dr Iddon: Do you understand the financial arguments or are they a bit too complicated for students to get their heads around, do you think?
Ms Huntington: I understand some of it, or I think I understand some of it; obviously I do not understand the whole thing.

Q101 Chairman: You are in good company, the lecturers do not either, so do not worry about that!
Ms Huntington: I understand that the funding situation from HEFCE is not as ideal as it could be, and certainly they are creating different bands that are not being favourable towards the sciences.

Q102 Dr Iddon: What about the other three students, do you have a view as to what is causing these closures and whose fault is it? Who do you blame?
Ms Miles: I think it is financial, as was said. Money needs to be put in to make money and they need to put it into the right places and invest in the right places. But I think money also needs to be invested in lower levels. I know you all had good science teachers, but I obviously did not. I mean, 12 of us started out on a chemistry course, which is quite a

small sixth form, and I was the only one who actually sat my A Levels, and I feel that if we had teachers there, if we had people who were enthusiastic about it more people would have wanted to do it. I was thinking the other day, the whole Army recruitment drive that has been going on with all the things on the television, about how many different careers you can get in the Army, I feel if something like that was done for the sciences, like if you had TV adverts, with really random jobs that people would not necessarily associate with having a chemistry degree, that would give people the incentive to think, "Maybe I should do something like that." I think it is where the money is placed is the problem.

Dr Iddon: No risk to your life in the Army, you just get a job!

Q103 Dr Turner: A lot of other degree subjects actually depend on the basic sciences to underpin them. For instance, Ian, you are doing a biology degree, but unless biology at undergraduate level has changed since my day you have to do a certain amount of chemistry, so you presumably spent some time working in the chemistry department at UEA?

Mr Hutton: Not really; I did no chemistry at university at all.

Q104 Dr Turner: It has changed then.

Mr Hutton: I think I did a ten-credit unit in it in the first year as a top-up from A Level chemistry for biologists; but there is no teaching within chemistry.

Q105 Dr Turner: So you would not have felt that if your chemistry department was go to it would affect you?

Mr Hutton: It would not affect me, but it would affect people on other degree courses which were related to biology, such as biochemistry, but because I am doing straight biology everything I do is within the School for Biological Sciences.

Q106 Dr Turner: Physics again is one of the great enablers. Do you have to do a physics module in your engineering course?

Mr Rowley: I did in the first foundation years, yes.

Q107 Dr Turner: So your course would have been undermined without a physics department?

Mr Rowley: Totally, yes.

Q108 Dr Turner: Does Aston still have a physics department?

Mr Rowley: It does not actually have a physics department itself, it is all part of the engineering part.

Q109 Dr Turner: Do you feel that that weakened the physics input into your degree?

Mr Rowley: I do not suppose so, not in any major sense because most of it was engineering related and so all the lecturers had a good knowledge of it, and I do not think it was a problem.

Q110 Dr Turner: Have you noticed ay impact on the other subjects in Newcastle with the impending closure of undergraduate figures?

Ms Huntington: The joint programmes, anything with maths and physics, chemistry and physics will have ceased as well, but as far as I am aware—

Q111 Dr Turner: So it is having quite an impact then. It is knocking out other subject choices on the way?

Ms Huntington: Indirectly, yes.

Q112 Chairman: Why do you think we need science graduates in this country at all, giving me a refreshing view on that, please? You are starting your careers, as it were, why do you think it is important to have science graduates? If you had the Prime Minister in front of you, what would you say to him, why you are important? Each of you come in at it, please.

Mr Hutton: At the commercial end science is an industry and if Britain is going to compete then Britain needs graduates and high profile scientists to be able to keep that industry going.

Q113 Chairman: Amy?

Ms Huntington: Yes, British industry, if you want to make your scientists and you want to make science feasible then you need science graduates.

Q114 Chairman: Danielle?

Ms Miles: I think it is the only way realistically to progress with the rest of the world into the future, into the new technologies and to find out the development, and without it you cannot carry on.

Q115 Chairman: Stephen?

Mr Rowley: There is no way it can progress without civil engineers.

Q116 Chairman: My last question to each of you again is: what do you enjoy most at university? Let us take it for granted that you like the science and the course that you are doing. You have told us that. But what is it that is so magic about university, if at all? I know you are going through hell at the moment, Danielle, but you must have had in that time a few moments of pleasure.

Ms Miles: It is chemistry related but it is to do with everyone at university; it is being able to share knowledge, and to be given knowledge from people that know more than you, and seeing their faces when they tell you something and you finally actually understand what they are talking about, and it all suddenly clicks into place. That is what it is all about, the sharing of knowledge and learning more.

Q117 Chairman: Do you feel that, Stephen?

Mr Rowley: Not to such a large degree, but there is a lot of good stuff.

Q118 Chairman: Not as passionate perhaps! Not as good teachers, perhaps! Ian?

Mr Hutton: Yes, I guess it is the fact that you still have a certain amount of freedom; it is not a nine to five job, and yet at the same time you are still learning things and you still have a certain amount of responsibility, and it is nice to have that mix really, and different aspects of things in your life at that time.

Q119 Chairman: Amy?
Ms Huntington: I like learning new things. I am nosy, I like finding things out, and I have to admit from a personal point of view I like our department, our staff, our academics, everything—it is just a really nice place to be most of the time.

Chairman: So no regrets, any of you. Can I say that you have been really very refreshing? You are a great advert for the British university system. Thank you very much, and stick with it. Danielle, I do hope it works out for you. Thank you very much. You are very welcome to stay. Thank you for taking time off. You may think you have contributed nothing, but you have stimulated and enthused us again who may be getting a bit old in the tooth and tired, but certainly it is nice to see that it still goes on to the level it does, and we are examining why things may be going a little wrong here and there. Thank you very much.

Witness: **Mr Bahram Bekhradnia,** Director, Higher Education Policy Institute, examined.

Q120 Chairman: Bahram, thank you very much for coming. I think you heard the last session and you heard the stimulation that young people get in our system and I know you have played a part in it. You know the nature of our inquiry; you have appeared before in front of us. Welcome. A number of reasons have been given for the closure of the university departments. What do you think is the root cause and why?
Mr Bekhradnia: Chairman, before I attempt to answer that difficult question—

Q121 Chairman: I do not want a long one-hour perambulation.
Mr Bekhradnia: You are simply going to get me saying, Chairman, how pleased I am to be here and how relieved and delighted I am to see you in such good health.

Q122 Chairman: Thank you very much; you have seen nothing yet!
Mr Bekhradnia: Many of your friends were shocked at the way you were treated—not surprised but shocked—and are delighted that you are back with us.

Q123 Chairman: Thank you very much.
Mr Bekhradnia: I think it would be wrong and possibly naïve to point to a single reason for closure of different departments. Universities have been closing departments for a very long time; it is a dynamic situation, departments close and departments open. There has been a lot of attention given to departmental closures recently and it is true, I suspect—although I have not looked at this and I think this is something that ought to be researched—that they have been rather more numerous recently and focused on some of the subjects that are of concern particularly to your Committee. I did not have time to look at this in detail but I believe that even the University of East Anglia, did it not lose its physics department?

Q124 Chairman: It closed its physics department and caused a shock.
Mr Bekhradnia: It was shocking at the time and life has gone on. Cambridge, I believe, did not close its architecture department, but I do not know whether, if it had done, that would have been a shocking thing to you and your Committee. So the first thing is to say that departments close, universities dynamically respond to the world outside.

Q125 Chairman: So it is just part and parcel?
Mr Bekhradnia: No, not just that; not just that, Chairman, this is the point I am trying to make. That these things happen and have always happened, but there probably is something going on at the moment that is different, and in my memorandum—and I must apologise that there was, as you will undoubtedly have noticed, a heading missing from table one of my memorandum—that table related to the number of A Level students, which would have been obvious from the text but of course not everybody reads the text, I know. One of the core issues that must be of concern to universities as they decide on what departments to maintain and which to build up and which to run down is the demand for those subjects, and, sadly—and this is an area that I do urge you to have some time spent by somebody, perhaps one of your researchers, to try to get to the bottom of it. The HESA data are very difficult because they keep changing the definitions, so it is actually difficult to work out what is going on there.

Q126 Chairman: Suppose suddenly there was a great influx of demand for science courses, would that result in failure to close departments?
Mr Bekhradnia: I suspect yes. Certainly one of the things that is driving universities to close their departments or to rationalise anyway the provision, is the demand for those. You have seen the A Level demand is going down and that must eventually, if it has not done already, lead to—

Q127 Chairman: Why is the demand going down? Why is the demand so low for university science courses?
Mr Bekhradnia: I was trying to tell you that. If you look at A Levels, if you look at GCSEs—

Q128 Chairman: Come on, you must have investigated it?
Mr Bekhradnia: No, no. No one knows, I suspect, Chairman. What is going on in the schools? Why are children deciding not to study science? I do not

know. But the table that I sent you on A Levels is quite shocking—13% reduction in A Levels in physics, 13% in mathematics and 7% in chemistry. A reduction at the time when the number of A Level entries has increased by 10% overall. That is bound to be reflected, if it has not already been reflected—and I suspect it must have been—in demand at university level. So then the university is left with issues about what to maintain in the face of reducing demand when demand elsewhere is increasing. The other interesting thing, which you, I am sure will already know about, which I had not known about until I studied the figures, is what has been happening to staff numbers over this period, when I would imagine that student numbers have been reducing sharply? They have been maintained or they have increased—in these subjects I am talking about, chemistry, physics and mathematics, and modern languages as well.

Q129 Chairman: We have just heard that there are going to be redundancies at Exeter of chemistry lecturers.
Mr Bekhradnia: Yes, I know. There could be more redundancies in the future. But over the last decade or so numbers have been more or less held at a time when numbers have been going down.

Q130 Chairman: In what subjects?
Mr Bekhradnia: I am talking about chemistry, physics, mathematics and modern languages.

Q131 Chairman: Across the country. Would you like to quote that, the numbers since 1997 and now?
Mr Bekhradnia: Yes, between 1998–99 to 2002–03, 3% reduction in chemistry, 9% increase in physics, mathematics more or less stable and modern languages up by 13%.

Q132 Chairman: But are these courses combined with other courses, like physics with music or something?
Mr Bekhradnia: These are not courses; these are staff that are attributed to a particular cost centre. So I do urge you—I have done the best I can for you, Chairman, in the very short time that I have—that this is something that does need to be looked at.

Q133 Chairman: Do not worry about the effectiveness of the time; what you say is very important.
Mr Bekhradnia: No, but if you are going to come to conclusions they will be incredibly influential, as they should be coming from this Committee, and there is a terrible danger of prescribing the wrong solutions if we misunderstand and misdiagnose the problem. I am very concerned about that all through.

Q134 Dr Iddon: Where are these extra staff, are they in the five star departments, which are able to expand?
Mr Bekhradnia: I do not know, but I would imagine they almost certainly are because what happens when you gain a high score under the RAE? You get more money. What do you do with more money? Universities generally recruit staff with more money, that is the sort of thing they do. So I would have thought that they are disproportionate.

Q135 Chairman: I am sure departments everywhere are listening to you and there will be letters in *The Times*, *The Guardian* and even *The Daily Mail* perhaps tomorrow about that.
Mr Bekhradnia: The figures may be wrong, but they are HESA figures and so they jolly well ought not to be wrong.

Q136 Chairman: Let me ask you about then about research and teaching funding formulae in universities, how much do you think that that has contributed to the problems we are discussing—numbers and so on and courses? Do you know their ratio generally?
Mr Bekhradnia: I think it probably has two effects and they are quite different. The effect that I think you are probably most concerned about is the financial effect. Obviously if you get a low score you get less money, if you get less money, that is one of the influences—

Q137 Chairman: Who sets the scores, Bahram?
Mr Bekhradnia: The Research Assessment Panel sets the score, but it is HEFCE that sets the value that is to be attached to those scores. So, yes, it leads to less money and that is one factor that universities must take into account—and when I say *must* I should say *should*—and I am sure that they do take into account in deciding what departments to maintain or what to run down. As I said in my memorandum, there are quite a few departments with zero income from the RAE, so it is not decisive; it does not have to be a decisive element. But it does reduce money and a university like Exeter will take that into account in deciding whether to keep its physics department open. The other thing, though, it does—and this is probably what is really driving a university like Exeter—it affects its profile, its prestige. If it wants to be a certain type of university it may feel that it cannot be that type of university if it is carrying departments that do not have a high score. So I would imagine—and I have not been privy to what went on in Exeter—that one of the things that they would be looking at—and I would probably be more comfortable if I got off individual examples—what a university would be looking at is the mission of that university, the sort of university that it wants to be and to concentrate on its strengths.

Q138 Chairman: Bahram, why do they make that decision after the students are in place rather than earlier in the year before they start recruiting students?
Mr Bekhradnia: If you have not already interviewed them, I am sure you will, and you must ask that question of them. I was listening to the previous session, and you may also want to ask them about the arrangements for the transfer of students, and if it really is true that they were offering them to carry

on with their degrees but without any staff and without any laboratories, I find that surprising, and those are things that you will want to ask the university concerned.

Q139 Chairman: They are sitting right behind you and they will talk to you later. Watch his back!
Mr Bekhradnia: I have not looked in detail at individual universities but I can talk about the system as a whole.

Q140 Dr Iddon: Can I ask about what your research has shown about the reduction of the factor 2 to 1.7 in the HEFCE funding formula? Do you think there is any rationale to that reduction?
Mr Bekhradnia: You are going to have the organ grinder right after me.

Q141 Dr Iddon: We shall be putting it to the organ grinder.
Mr Bekhradnia: I would be extremely surprised if there was not a rationale for that and I think I know what it is. If the funding formula is calculated as it was when I was at HEFCE, then that element of it is simply a reflection of actual relative costs as reported by universities as to what they are spending on different subjects. So that will be the reason for that. I suspect that Sir Howard will tell you that, but he must answer that question himself. But, yes, I am sure that there was a good reason for it. But you may well ask the question, should that be the only basis? Should what universities report as their relative expenditure be the only basis for setting the funding formula? That is a different question, whether you ought to use a degree of judgment in deciding how much money should attributed.

Q142 Dr Turner: Whatever the factors behind the problem that we have, I do not think anyone would disagree that there is a great deal of concern around Britain's future competitiveness if science faculties disappear and the supply of scientists dries up. I cannot imagine this much angst if sociology departments started to close, for instance, or law faculties. Given that, do you think it right for the government to actively intervene to try and maintain a sufficient core of university departments in the important subjects?
Mr Bekhradnia: The answer to that is I do not know and I do not think anybody else knows. The way you put it of course required the answer, yes, if they are important and they are at risk of drying up then necessarily some intervention is needed. And may I say that my instinct tells me that there is something important that is going on that needs intervention of some sort. The problem is, who knows what is important, how important it is, how much of it we need, where we need it? This is all stuff that you could make policy based on hunch and belief and it would probably be very bad policy, and I do hope that your Committee does not make recommendations based on what it believes to be true, and is able to underpin it recommendations with evidence abotu what it is that is important for the country.

Q143 Chairman: But you are saying that nobody knows, that nobody has done it.
Mr Bekhradnia: The trouble is that we are not going to get a quick fix. We need to have some good evidence. Remember that every pound we spend on supporting departments that are in declining demand is a pound that could have been spent somewhere else, and so there is a huge opportunity cost here. The cost of getting it wrong is very great, so it is important, clearly, that we have enough. What we do not know is how much is enough and how much the country will suffer.

Q144 Dr Turner: Let us assume that the Government should be doing something. What mechanisms of influencing this do you think the Government has open to it? What do you think would make the difference?
Mr Bekhradnia: As I said in my memorandum, the Government can take—and you can recommend, because it is the easiest thing to recommend, a supply-side action. It would be perfectly possible for HEFCE to say to universities, "you must keep open certain departments and perhaps "we are going to give you some money to do so—although the normal funding formula would not provide it." It does that already—or did it already—through its minority subjects programme. That mechanism already exists. There is a risk, and at the moment more than a risk, that you would be keeping open departments and providing places which would go empty. The key is to stimulate demand. I have no doubt that if the demand were, there, universities would react. They are very good at responding to student demand. How are you going to get young people to want to study these subjects? I do not know.

Q145 Dr Turner: I was about to ask you if you had any ideas about that. What do you think the Government can do to influence the demand?
Mr Bekhradnia: I think the one thing that would probably not do is to provide bursaries and scholarships at university level. It will be too late by then. The problem is quite apparent before they get to the position where they can even apply to university. Beyond that, notwithstanding the Chairman's views, and perhaps yours, about university fees, there is now conclusive evidence that at the levels at which we are talking student demand is not at all price elastic; it is not particularly sensitive to the cost of university education. For various reasons, taking action at undergraduate level with bursaries and so on, I suspect, would not be the right way to go about it.

Q146 Chairman: How can you say that, Bahram? You have not done any studies. You are a man who is always advocating studies.
Mr Bekhradnia: I have not done a study, Chairman, no, but my former employers at HEFCE have done a stunning piece of research that is about as good a piece of educational research that I have seen—and I wish I could take credit for it. One of the things it shows, amongst others, is that student demand for higher education—whether by social class, whether

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by subject, whether by region, ie, Scotland and England, which did things differently—was entirely unaffected by the changes that took place through the nineties in the cost of higher education. The cost of higher education varied according to social class because the poor lost their grants and had them replaced by fees, and it made not the slightest difference. I think we can be reasonably confident that at the levels we are talking—this is a different debate—student demand is not particularly price elastic. That is not to say that it is totally price inelastic and that you can carry on ramping up the cost, because you certainly cannot.

Q147 Dr Turner: Intervening in demand at university level may not be effective. What do you think would happen if you tried to intervene at the GCSE and A-Level point, and perhaps introduce financial rewards for students getting good GCSEs and so on in A-Levels, and help make it worthwhile—a sixth-form bursary?
Mr Bekhradnia: That sounds to me to be more promising, and there is some experience, is there not, of this with the Educational Maintenance Allowance? It suggests that financial intervention at that stage may have some effect. I am sure there has been some research done about the effectiveness of that, and I seem to remember seeing preliminary results of such research. It will be expensive, I suspect, but it may be more worthwhile intervening there than spending money on places that are unfilled at university or providing bursaries at university. I referred also in my memorandum to a government initiative in the 1980s. Somebody in the Department of Education can probably dig out the papers for you, but they called it the Science & Engineering Initiative. It poured millions of pounds into universities to provide additional science places, and of course it was completely money down the drain. They would have been much better off spending that on the sort of things you are talking about.

Q148 Dr Turner: I want to ask about government intervention in universities' decisions. Should the Government have intervened for instance in Exeter and said, "no, you do not close that; do something else"? Do you think it right that the Government should intervene in universities' affairs either by withdrawing cash if they do not like their decisions, or do you think it would be an undue interference in university autonomy?
Mr Bekhradnia: I think it would be a terribly slippery slope. I have no idea how you would decide what interventions were justified, the extent of the interventions and the subjects in which you have intervened. Should the Government have intervened to stop Cambridge closing its architecture department—of course it did not in the end, but would you do that? What would be legitimate for intervention, and what would not? I think my instinct is that rarely if ever is that kind of intervention justified. On the other hand, that is not to say the Government is not entitled to take a view and to find mechanisms of incentivising universities to behave in ways that it thinks are justified. As I said in my memorandum, I generally think it is unwise to try and substitute bureaucratic or political decisions for decisions of universities acting in the light of what they see locally . . .

Q149 Dr Turner: But you disapprove less of carrots than of sticks.
Mr Bekhradnia: Yes, but carrots can be enormously costly unless you really know that the intervention that you are pursuing is justified, and that the resources you are removing from other people in order to provide those carrots matter less. It is a zero sum gain we are playing all the way through. If you are going to provide incentives for some, you will be taking away resources from others.

Q150 Dr Iddon: Does anybody know what the demand is in the workforce for science graduates?
Mr Bekhradnia: No. I was hoping that was something that you had done some work on. We are assuming that there is demand that will not be met, and that the UK will suffer as a result of that, but I am not aware of any work on this. It is essential that it is done. We need to know the extent to which we have a problem or do not have a problem.

Q151 Chairman: Do we know how many graduates we need, not just science graduates? The Government has a position. Has there been an estimate of where those graduates will be employed?
Mr Bekhradnia: That sort of manpower planning is not likely to be very fruitful. We produced a report 18 months ago now—

Q152 Chairman: It would be fruitful for students who enter courses if they knew there was going to be a job, would it not—plus or minus a few?
Mr Bekhradnia: I was very interested by the answer to your question about whether students expected to be working in the field that they were studying. That is relatively rare, so that three out of four should have said "yes" was a matter of interest. By and large, there is not such a one-to-one relationship between the subjects.

Q153 Chairman: Expectation is different from what happens in the end, but people can have expectations of life and people can have dreams, can they not?
Mr Bekhradnia: Yes.

Q154 Dr Iddon: Does it matter if a single country out of 25 in the European Union is producing enough engineering and science graduates? Does it matter if those departments close? Surely, the companies can go abroad, as they are doing, and recruit within the other 25, or even outside the European Union, in China and India, where the labour is much cheaper, and people would rush to come over here!
Mr Bekhradnia: That question is not being asked only in this country. The same issues that we are facing in this country, with reductions in numbers of science and engineering graduates, are being felt elsewhere. I do not have figures for other countries in Europe, but I do have figures for the States, and I

can tell you that there were substantial reductions in numbers of engineering graduates, physics graduates, sciences graduates, maths and computing graduates, over two decades to 2001. We are not alone in this situation. I have not looked at this for this country—I could have done, and I apologise. The Americans also have been suffering from reductions in American students going on to do doctorates. They have made that good, exactly as you suggested, by bringing in overseas students to fill those places, and going on no doubt to become academics subsequently. We have been doing the same. We did a study on postgraduates recently. I do not have the figures, though, to give you the extent of that. The trouble is that if other countries are all suffering the same reductions, it will be a competition for a limited pool of people.

Q155 Dr Iddon: If university departments in hard sciences and engineering close, what impact will that have on the economy, either national or local?
Mr Bekhradnia: I do not know.

Q156 Chairman: Have you read the paper by Libby Ashton and yourself: *Demand for Graduates; a Review of the Economic Evidence* (September 2003)?
Mr Bekhradnia: Certainly! You are teasing me, Chairman, are you not?

Q157 Chairman: I am not teasing you.
Mr Bekhradnia: You are teasing me, I can tell.

Q158 Chairman: It is a serious question.
Mr Bekhradnia: Of course I have read it, yes.

Q159 Chairman: You wrote it.
Mr Bekhradnia: Exactly—at least my colleague Libby Ashton wrote it and I helped her.

Q160 Chairman: Does that answer the question?
Mr Bekhradnia: No, it does not. It does not talk about how many science graduates we need. In fact, it goes so far as to say that that sort of detailed manpower planning is probably unhelpful. What it does say is that if you want to be a knowledge economy, you cannot become a knowledge economy without producing sufficient graduates, but producing sufficient graduates is not going to be sufficient to make you into a knowledge economy; you need all sorts of other things in place as well. That begs the question: what sort of graduates do you want? Is it necessarily the case that more science and engineering graduates will turn you into a knowledge economy, or would you be better off with more—

Q161 Chairman: Can you ever have too many graduates, in your opinion? You are hesitating.
Mr Bekhradnia: I am only hesitating because of the tone in which you put the question. My view is that you cannot have too much education. I think that a better-educated person is a better person, by and large; and so I rejoice when I see more people coming through school.

Q162 Chairman: You are not answering my question.
Mr Bekhradnia: Sorry, I am trying to be helpful—I am getting there. The answer is that you cannot have too many graduates. You cannot have too many A-Level entrants. I am thrilled that there are more and more people staying on at 16 doing A-Levels and then going on to get a degree. What would you say to people otherwise—“sorry, no, stop; we are not going to let you carry on to do any more education; that is it; you have had too much education already”? That is not sustainable.

Q163 Dr Iddon: Why has nobody mentioned the importance of a university to its local economy? If a small or medium-sized enterprise has nowhere to go for advice—no chemistry department, no physics department, no engineering department—and we are teaching forensic science and chiropody and physiotherapy, what does that do to our economy?
Mr Bekhradnia: Those are legitimate issues that do need to be taken into account in looking at this question, I agree.

Q164 Dr Iddon: So you agree that perhaps we are looking at the wrong things.
Mr Bekhradnia: No, I am saying this is another of the issues. There are many different factors that need to be taken into account in looking at this question. The importance of universities in a local economy must be one of them. It is something that has only recently become recognised.

Q165 Mr Key: Chairman, I apologise for missing part of this session. I have had to sit on two select committees at once this afternoon. Are there any circumstances in which the Government should prop up ailing science departments?
Mr Bekhradnia: If by “ailing” you mean not very good, and if by “the Government” you mean through the Government grant to the university, then I think the university might take a strategic decision that it wants to use some of its grant from HEFCE—

Q166 Mr Key: That is not what I asked, is it? I asked should the Government step in.
Mr Bekhradnia: I would say rarely. I cannot think of a situation where that would be—

Q167 Mr Key: So that is a “no”.
Mr Bekhradnia: It is an almost “no”. I hope that you would not want to ask that question definitively without the evidence.
Chairman: Go on, Bahram, come off the fence!

Q168 Mr Key: Would it be beneficial for UK research if the UK had a small number of top-ranking departments that could compete on a world stage?
Mr Bekhradnia: I think it does by and large, yes—and it is beneficial to the UK, of course.

Q169 Mr Key: At the price of the ailing departments in other universities.

Mr Bekhradnia: To some extent, of course, that is what happens. That is what the research assessment exercise and the selective research funding does; it withdraws money from some and gives it to the others.

Q170 Mr Key: Do you think there should be some teaching-only science departments in our universities, where it is reckoned that research is not a great strength?
Mr Bekhradnia: I think there are.

Q171 Mr Key: Is it desirable?
Mr Bekhradnia: It does not have to be an issue. I do not think that the quality of the teaching need suffer as a result of—
Chairman: I wish I had the quotes from the last Secretary of State for Education.

Q172 Mr Key: Why does it not have to be an issue?
Mr Bekhradnia: Because I do not think it follows that because you do not do research you cannot teach.

Q173 Mr Key: But do you not get the impression that some of our universities and some of our science departments are now perceiving themselves to be second-rate, and are saying, "all right, then" and shrugging their shoulders, saying, "let us not bother with research; let us just be teaching science departments"?
Mr Bekhradnia: I doubt if that is what they are doing, but, yes, there are some teaching—

Q174 Mr Key: They are saying that.
Mr Bekhradnia: That they are not very good, "let us not bother"?

Q175 Mr Key: Yes.
Mr Bekhradnia: I doubt it, but I think there are teaching-only science departments, and I know of no evidence that they do not do a good job in teaching their students.

Q176 Mr Key: No-one has suggested that they do not, but it would be quite a departure if the entire structure of the funding of science and research in this country were to somehow have failed—a significant number of university science departments, to actually encourage them to think that that was a good idea.
Mr Bekhradnia: That is a statement—yes, okay.

Q177 Mr Key: Do you agree with it?
Mr Bekhradnia: No.
Chairman: Bahram, it is always a pleasure! Thank you for your frankness in answering our questions.

Witnesses: **Sir Howard Newby,** Chief Executive, and **Mr John Rushforth,** Director, Widening Participation, Higher Education Funding Council for England, examined.

Q178 Chairman: Howard and John, welcome again; we face each other once more. Thank you for coming. You have been sitting through the other session so you have a flavour of the mood we are in! Two of us here are gearing up to talk to the Prime Minister tomorrow morning in a select committee as well. You announced a number of measures to help protect struggling departments recently. How do you square this with the policy of non-intervention that we have been hearing about in decisions of individual universities? Is there a contradiction in this whole process of helping out?
Sir Howard Newby: Can I say, Chairman, first that it is good to see you looking so fit and well and on form—and that is not flannelling you, that is a very sincere comment from me. It is really good to see you. There is a judgment call here, is there not? Are we prepared to see the provision of some subjects completely eliminated from this country because there are absolutely no students who want to be taught it; or are we going to say we should in some cases at least intervene in order to preserve national capacity in provision of those subjects because one never knows of the circumstances in which they will be needed. Traditionally, the English Funding Council has approached that by saying, "in some cases we will periodically look at a list of what we call minority subjects, subjects for which the demand from students is less than 100 nationally, and we will take a view on whether we think there is a case in the national interest to sustain provision of those subjects, even though very few students want them."

Q179 Chairman: What guides you in making those decisions? Is it the actual jobs that they are going to get? You must agree that there is no use educating people unless there are jobs connected somewhere, either directly with the subject or indirectly. It seems to be nonsense not to have that kind of analysis.
Sir Howard Newby: So far that has not been the case, no. The subjects we have supported through our minority subjects programme—the argument really has been one of maintaining strategic capacity nationally. Even if there were no students who wanted to learn them, and even if they were not getting jobs afterwards, we still feel in the long run there is a case for sustaining in this country some capacity. The vast majority of these subjects are what we call exotic languages, although they do include some science and technology subjects—paper-making technology for example, and shoe and leather technology have been two in particular, where we simply felt that it is in the national interest to take a long-term view and sustain capacity, even in the absence of student demand.

Q180 Chairman: In departments do you think the financial considerations weigh heavily in terms of the decisions that are made?
Sir Howard Newby: Yes, of course. What we have been seeing recently are two sets of issues with regard to the decrease in the number of science departments. One has been the decline of student demand in not all science subjects, but certainly in

physics, chemistry, mathematics and most branches of engineering. I also add to that, by the way, modern languages. That has been one factor. The other factor is that universities have become much more aware of the need to invest in those areas where they have greatest strength and disinvest from those where they have relative weakness, to sustain their long-term position. In some cases, therefore, we have seen closures of departments in subjects even where there has been buoyant student demand.

Q181 Chairman: In your written evidence you say there is no link between grant allocation and financial viability of departments; so what does determine financial viability of departments?
Sir Howard Newby: At the macro level, of course there is an overall link because the HEFCE grant was the block grant to universities representing roughly 40% of their total income, and of course they receive income from other sources. We do not line-item our provision; we do not say, "here is so much money for this and so much money for that"; it is a matter for local managements to manage their resources according to how they perceive their best interests. We have the situation at the present time therefore where, despite what may be said in the press, the amount of money per student going in to support teaching in laboratory-based subjects has gone up in the last year, and we have also seen a situation in which the total money for research through the research assessment exercise has also gone up in these subjects, and yet we are still seeing departmental closures in a small number of cases.

Q182 Chairman: Is that because people are determining what is a strategic national or local kind of departmental decision as to which kind of department should be open? Who decides what is strategic, and who decides that architecture at Cambridge is more important than at Exeter?
Sir Howard Newby: The strategic decisions of this kind are made by the senior managements of universities locally, so there is an issue about whether the sum total of individual institutional interests add up to an overall national interest. It is not necessarily the case, and that to our mind does present the basis at least for having a look at this and seeing where we might wish to intervene.

Q183 Chairman: Do you think a vice chancellor of a university, and a Nobel Prize-Winner in chemistry would close a chemistry department rather than a social services vice-chancellor, just to name but one?
Sir Howard Newby: Chairman, as someone with a social science background who became a vice chancellor of a major science-based university, I think by the time you get to be a vice-chancellor, with one or two rare exceptions, it does not matter too much what your disciplinary background is. There are some exceptions.

Q184 Chairman: You are a financial manager more than—
Sir Howard Newby: I would like to say we are an academic manager first and foremost, and that finances come behind the academic mission. Certainly, with the exceptions of places like the London School of Economics or Imperial College, which are rather more specialist institutions, for broadly-based multi-faculty universities your disciplinary background is of less relevance.

Q185 Dr Iddon: Why are ex colleges of advanced technology, which were solely science and engineering based, like the one I used to teach at in Salford—they have almost completely shed their science and engineering.
Sir Howard Newby: By and large they have done so in response to student demand. It has indeed been one of the ironies of the expansion during the late eighties and nineties, which coincided with the granting of full university status to the former polytechnics; the new universities expanded far more in the social sciences and humanities than in the science and engineering side.

Q186 Dr Turner: What do you think are the main reasons for struggling departments? People have blamed the HEFCE funding formula and others simply attribute it to falling student demand. It certainly is not always falling student demand, so what do you think are the principal reasons?
Sir Howard Newby: Are you talking about science departments or generally?

Q187 Dr Turner: We are talking principally about science departments.
Sir Howard Newby: I do insist that this is also a problem with modern languages and some other subjects—land-based studies for example. The primary drivers have been either falling student demand or poor research performance, or crucially the combination of the two. The vast majority of those science departments which had closed—and obviously King's College London and now Exeter are exceptions to this—closed as a result of being small in scale, attracting fewer students, and having poor research performance—a combination of the two.

Q188 Dr Turner: You propose to intervene in chosen cases to address the supply of science courses, but not to do anything about the problem of falling student numbers. How effective do you think it will be just dealing with the supply side and not encouraging more applicants?
Sir Howard Newby: I feel very strongly that we should not address a demand-side problem through supply-side solutions and vice versa. I should say that we have been addressing the demand-side problem, especially in chemistry. The last time I appeared before this Committee I explained that for three years we have been working with the Royal Society of Chemistry on a number of schemes, working in schools, with employers, with university chemistry departments, to boost the demand for chemistry, and we began to discuss with the Institute of Physics and the Royal Academy of Engineering

expanding that model into those subjects. There is something we can do, and there is something we are doing; but of course we are not responsible for the schools and FE colleges, so what we can do is fairly limited.

Mr John Rushforth: Some of the more general things we have been doing to try and stimulate demand as part of the wider participation, where we are supporting universities and colleges to provide mentors, master classes and a range of subjects across the piece, has the impact not only of attracting people into higher education, but also makes them understand some of the possibilities; and just the ability to go into a university and play with the equipment and the possibilities within that environment can sometimes capture the imagination. Half the problem is the constraints operating in schools, in terms of how science is taught.

Q189 Dr Turner: What about the justification for keeping open unpopular departments by filling them with students that are of less quality than more picky departments can demand? Do you think there is any justification for that?

Sir Howard Newby: If those students who are being admitted to those departments can clearly benefit both personally and benefit society from graduating in those subjects, then I see no problem with that. What we must not do is lower standards; that would be wrong, and it would be wrong for the students—we cannot offer them a false prospectus by admitting them on to degree programmes that are clearly sub-standard. What is the point of that? One also has to recognise that there is a national macro level problem about the macro demand and supply in gross terms in departments throughout the country. There is also a more micro level problem: the regional and even sub-regional distribution of provision is an issue. I commented on this the last time I spoke to you. It may well be the case in some circumstances that nationally there appears not to be a problem, whereas regionally there could very well be, and vice versa. We have some concerns at a regional level about the access of well-qualified students to good-quality degree schemes in the science subjects, when in some parts of the country they are not very thick on the ground.

Q190 Dr Turner: Do you think there is going to be any end to the problem of science departments? Where do you think we are going to be in ten years' time? How serious do you think it is as a threat to our future economy?

Sir Howard Newby: I think it is a threat to our future economy. I do not think there is a one-to-one relationship between the volume of science graduates and the performance of the economy, but there certainly is a relationship. If one looks around the world, this is a global problem. Outside south-east Asia virtually all countries are suffering from a decline in demand from young people to study science and technology subjects, but—and there are some buts here—it is not uniform across all sciences; the problems in biological sciences and medicine are not nearly so great, either here or in other countries. One part of the issue there is that we find that the biological sciences and medicine attract female students in very large numbers, which on the whole, alas, physics, chemistry, engineering and mathematics do not. One country that has tried to address this problem with some success has been Canada. It has reorganised its school curriculum to be more attractive to girls at the age of 13–14 when they are choosing when to specialise. There may be some lessons we could learn there in this country.

Q191 Chairman: How could you do that, Howard?

Sir Howard Newby: They dropped the disciplinary emphasis. They did not teach separate maths, physics, chemistry and biology courses, but rather taught around themed courses related to problems of interest to students. They taught—

Q192 Chairman: Like climate change.

Sir Howard Newby: Climate change, the human body and things like that.

Q193 Chairman: Real issues that are valuable in their lives. How strange! Why has that not happened here, then?

Sir Howard Newby: Because, Chairman, if I may say so, the way in which the curriculum is still organised is locked into a rather nineteenth century conception of what the disciplines are all about.

Q194 Mr Key: Why is the situation different in south-east Asia?

Sir Howard Newby: I could not say with all honesty why, but I suspect it is because in the school system there is a much greater compulsory maths and science teaching to a much higher age level than there is in this country and other parts of the world.

Mr John Rushforth: Even in Japan, with good follow-through, there is still a feeling that their children are beginning to be turned off mathematics, for example, even then.

Q195 Mr Key: The best British universities, for example Southampton—it is specifically recruiting science students for undergraduate courses from the Far East and south-east Asia. If they are feeling that they must become a global university, which they are, does this not mean that they are going to be in a completely different league from those universities which are feeling that they cannot compete at all, and must concentrate on just teaching and abandon the research? How do you reconcile those two? You have said in your evidence that you wish to ensure that the best teaching goes ahead, but that you are prepared somehow to find a way of keeping the other university departments open.

Sir Howard Newby: One of the main drivers of competitiveness globally is research performance as much as teaching performance. We now know that science research especially is really a global business, and so there is a question about how vital it is to this country to sustain long-term the most excellent cutting-edge science research in this country. I believe strongly in that, and that is my Council's policy to do that; it is its main priority. There is then an issue about how far research is linked to teaching in terms of informing teaching quality. I was present just now when you were asking Bahram Bekhradnia about this. It is necessary, in my view, for higher education teaching to be informed by the latest research thinking. That is often what makes higher education higher. It is not the same thing as saying all high-quality teachers in higher education must be active researchers. They certainly must have access to the knowledge that is produced by the leading-edge research. It is quite possible to organise affairs so that university science departments that are predominantly teaching, nevertheless have access to the kind of leading-edge research, knowledge and information that comes out of the cutting-edge research departments. If you ask how many leading-edge chemistry departments the country needs or can support, the answer is very different about whether we are talking about leading research departments or teaching departments.

Q196 Dr Turner: You mentioned some of the causes of departments closing—the fact that they may be small departments, inefficient in performance, and falling student demand. I am a chemist, as you probably know, and in chemistry circles the steepness of the cliff between five-star departments and grade-4 rated departments is far too steep, say the chemists. That is coupled with the fact that you, namely HEFCE, have changed the funding formula against the sciences from 1.2 to 1.7, along with not-often-mentioned rapidly inflationary costs in teaching in science. This Committee has looked at the cost of journals, which is ramping ahead of inflation; there is the cost of instruments that have to be imported; the cost of chemicals; and the cost of laboratory refurbishments. I put it to you, Sir Howard, that there is no way that the current dual support system is producing the full costs of running a science department.

Sir Howard Newby: Let me break that question down. First of all, on the issue of research funding, I wish we had more resources to put into research funding in our universities, but, as you know, the quantum of that is decided essentially out of the spending review through the Treasury. Given the money we have for this, the question my board and I have to ask ourselves is what is our first priority. Our first priority is to sustain truly world-class science research in this country; then, as I often say, we work our way down until the money runs out. At the moment, it runs out at about two-thirds of the way through the grade-4 departments. I wish we could fully fund the grade 4s, but we do not have the resources to do so. I do not think, with respect, it is in the national interest for it to be taken away from five-star.

Q197 Dr Turner: Why is the cliff so steep?

Sir Howard Newby: We have tried to work out what are the real costs of sustaining five-star and grade 5 departments and, as I say, work our way down. Your other question was about the ratios of teaching. You refer quite correctly to the fact that the ratio between classroom-based and laboratory-based subjects has been changed from 2.0 to 1.7. If I could take the Committee through the thinking on that, I would be grateful. First, we do not sit in Bristol and think these numbers up; they are based on the returns which universities feed back to us on their expenditure in the four price bands that we allocate. They are classroom-based subjects laboratory-based subjects; a hybrid between the two, part classroom and part laboratory; and medicine. We reviewed it a couple of years ago and found that roughly speaking 70% of the total cost of teaching, not research, goes in salaries. There is very little differential between classroom-based and laboratory-based subjects in terms of teaching salaries. A law professor, I can assure you, gets a lot more than a chemistry professor, for example. The next item—and this is quite interesting—is the use of IT in teaching. Five or 10 years ago it was only science and engineering departments which were making use of information/communication technology in the teaching of their students. That is no longer true: all departments are major users of IT, and the IT support we put into universities is heavily—and increasingly heavily—used by all the students. That is one of the reasons for the narrowing of the differential. Thirdly, perhaps looking around when most of us were students, chemistry and other science-based subjects were taught in laboratories through live experiments. Partly for health and safety reasons, partly because of the reducing cost of IT, that is less the case. More is taught through simulation rather than through live experiment, and that has also reduced the cost relative to classroom-based subjects. We put all that together, and the results are as you describe them; but I must insist that, even so, the amount of money given to universities for teaching classroom-based subjects has gone up, not down. The ratios have changed, but the amounts have gone up. Finally, I would say that successive spending reviews—not just the most recent one, but the one before that and the one before that—have delivered to the higher education sector far greater increases in research expenditure than teaching expenditure. The money that we receive at HEFCE for teaching students in the sector stopped going down, as you know, and it has really just levelled off and shown a very tiny increase; so the amounts we have to distribute are limited. I would say to the Committee that overall in the sector, if you cost it out, all the sector is losing money on its undergraduate teaching; in other words, teaching is under-funded in the university system, despite the efforts the Government has made to reverse 20 years of previous decline.

Q198 Dr Iddon: Are you accepting the basis of my question; that science, engineering and technology departments are inadequately funded and that is the reason why they are closing? Is that a "yes" or a "no"?

Sir Howard Newby: They are closing primarily because of declining student demand. I come back to what I said earlier: putting more money into those departments will not produce a single additional student; so we come back to the very difficult policy issue about whether we should sustain a group of departments even in the absence of falling student demand for them, in the hope that at some time in the future, through the demand-side interventions you have heard about in schools, demand will pick up again. It is true that once a laboratory-based subject is closed, it is very difficult both in terms of costs and all sorts of other reasons to revive it again.

Q199 Dr Iddon: Exeter was essentially a thriving department. It was not going through a clearance scheme. How can a vice chancellor such as Vice Chancellor Smith at Exeter justify the closure of the department? He has been in front of the Committee both informally and formally and he tells us that he does not have enough money to run the chemistry department at Exeter. That is what the vice chancellors are telling us. You have not answered the question in terms of "yes" or "no", but I put it to you again that the amount of money for running science, engineering and technology departments, wherever the funding comes from in this dual support system, is inadequate. Do you agree or not?
Sir Howard Newby: I agree that teaching is under-funded, and it us under-funded in the science, engineering and technology subjects. The particular case of Exeter is one, as I understand it, that the university made a strategic decision to improve its overall research performance, and made a decision to invest in those parts of the university which it feels can bring in the greatest return. In that respect I agree with you. I did say earlier that the case of King's College and Exeter, and the combination I described earlier of poor research performance coinciding with lowering student demand, did not apply.

Q200 Dr Iddon: Why do we not put more pressure on vice chancellors to do what we do with school head teachers? If a school is failing, pressure is applied, perhaps another school is brought in to turn that failing school around. Why do you let these important departments all over the country, in whatever subject, and outside SET subjects as well—why did you just let them fail? Why do we not tell the vice chancellors to do their job and change the management and make the departments work? Is that another way of tackling it? If the funding is right, as you seem to be saying, why do we not make the management work instead?
Sir Howard Newby: I do not think, by any stretch of the imagination, that Exeter University could be described as a failing university. I come back to this point: one of the things we have to tackle is that managements in these universities are making their own decisions, on the basis of their own institutional interests, and they make their investments as they see fit. I accept and have accepted that it is not always the case, with 100 or more separate university institutions making their own individual decisions about these matters, that it necessarily adds up to an overall national interest. That is the balance we have to get right. We do not want to micro manage universities. It is not the role of funding councils to second-guess internal management decisions of universities. On the other hand, we have to recognise that there is a national interest, which needs to be secured and protected.

Q201 Dr Iddon: If all 4-rated departments in chemistry, for example, were allowed to close because of the market, which is what is operating at the moment, and that is the reason they are closing, where do the five-star departments recruit their staff from?
Sir Howard Newby: With respect, I do not think the two 4-rated departments in England which have closed—Exeter's proposed closure and King's—have closed for those reasons. There is a case in Wales, in Swansea, but that is outside my area, as you well know. Those departments that have closed have closed because they have been below grade 4, and they are small and are attracting declining student numbers.

Q202 Chairman: Who do you think has got us into this pickle with higher education?
Sir Howard Newby: Which pickle are you referring to here, Chairman?

Q203 Chairman: Closure of departments and just general demoralisation and restructuring that is going on in universities and so on.
Sir Howard Newby: Until very recently we had, did we not, 20 years of chronic under-funding in higher education, both in teaching and in research? As I was hinting earlier, the research side has been very vigorously addressed in the last seven years. The teaching side has been stabilised, but I do not think the kind of investment has been put in on the teaching side from government that has been put in on the research side. With the introduction of variable fees, there is now in prospect some increase of funding coming through on the teaching side as well, but we shall have to see how universities choose to spend that money.

Q204 Chairman: That is all a bit speculative; you do not really know what is going to happen in local regional universities, do you, in terms of the fees situation? They are all charging the same, basically, anyway.
Sir Howard Newby: Most of them are going to charge the £3,000 maximum fee, but the currency in which they will deal will be the bursary support, which will vary very considerable. The actual net gain they receive will be very variable, even though the fee they charge will be broadly similar.

Q205 Chairman: Will HEFCE survive if teaching is where you say it is at the minute? Has HEFCE got responsibility for a lack of determination or what? The rumour mill circulates, as you know, but after another general election will HEFCE be scrutinised and perhaps disappear, and some other way of funding teaching in universities be substituted?
Sir Howard Newby: We always welcome scrutiny. We can always do better. Whether you are suggesting that universities should be directly

funded by government, I, as you might expect, do not think that is the way to go. In fact, most of the countries are going the other way. Do I think that HEFCE has a responsibility to secure the national interest? I very much do. We will, especially with the introduction of variable fees, define what that national interest is more clearly and pursue it quite vigorously. I would look to any government support to assist us in that.

Q206 Chairman: You do not think there will be crisis after crisis until these decisions are made?
Sir Howard Newby: "Crisis", Chairman, is a rather over-used word.

Q207 Chairman: You know what I mean!
Sir Howard Newby: I do.

Q208 Chairman: If I was a chemistry student at Exeter and you were, you would be pretty T'd off really.
Sir Howard Newby: I think the responsibilities to students we have to place at the centre of what we are about, and we certainly do that as a funding council. The key to the future will be to allow the sector to remain dynamic and to change. That will mean closures occasionally and will mean new avenues opening up. We do not want to remove that from the sector. Equally, we have to ensure that opportunities are available to students, wherever they may live, to pursue science and technology subjects for the benefit not only of themselves but the nation as a whole. We will need to consider very carefully—which is obviously what the Secretary of State's letter is all about—the balance between market forces and university autonomy on the one hand, and a body like the Funding Council intervening in cases of market failure, either locally or nationally on the other.
Chairman: Howard, John, we have to stop now because there is about to be a vote. We would love to go on, but can I say "thank you" for your measured approach to some serious matters—not a crisis, but serious matters!

Monday 28 February 2005

Members present:

Dr Ian Gibson, in the Chair

Paul Farrelly
Dr Evan Harris
Dr Brian Iddon
Mr Robert Key
Mr Tony McWalter
Dr Desmond Turner

Witnesses: **Professor Ian Diamond,** Research Councils UK, and **Professor Sir Keith O'Nions,** Director General of the Research Councils, examined.

Q209 Chairman: Professor Diamond, Professor O'Nions, thank you very much for coming along and helping us. We are sorry we are late. There is something else going on downstairs and we are trying to keep in touch with that too. You are old hands at this game and you know most of the people here. If we concentrated research in a small number of excellent departments would you consider that desirable or are there disadvantages in it?
Professor O'Nions: I think it is an important question, that research is highly concentrated in a relatively small number of departments without that being an explicit policy good, both in terms of the Higher Education Funding Council's allocations through the Research Assessment Exercise and the research councils. The numbers are something like 46% of research council expenditure is within 10 universities and just over 80% of it is within 25 universities. The numbers for HEFCE are broadly comparable to that. That is an outcome of excellence in terms of the research councils funding the best people wherever they are, in terms of HEFCE supporting the best departmental strengths wherever they are. Your question is: is that a desirable situation? I think it is an inevitable situation in terms of the resources we have available and the very clear desire and indeed requirement within the ten-year framework that—

Q210 Chairman: Does that mean though that academically it would not be the best way forward? You have picked on resources. What about academic discoveries, teaching and so on?
Professor O'Nions: In terms of teaching, clearly teaching is taking place in most subjects in a much larger number than 25 universities where research is highly concentrated. I think your question could resolve into, is it possible to teach at a very high level without having a research intensive operation? As you know, that has been looked at to some extent by Professor Graham Davies and I do not think you can assume that it will just happen in a completely *laissez-faire* situation. With appropriate connectivity and so on I think high quality teaching can take place outside the research intensive universities. Can I just take an example—and apologies for the aside. In the United States there is some very high quality teaching in a large number of both private and state universities which does not go beyond masters level courses; they do not have a PhD programme. It clearly can occur and should occur. Whether we have the right encouragement for it to happen in a proper way here is an issue that was partly addressed by Professor Graham Davies.

Q211 Chairman: What about research? The economy is a big thing. If we have these elite departments in universities is that going to make a difference to our science base? You know that we are doing a lot for the economy in terms of science and so on. If we are having elite universities doing this research relating to spin-outs or whatever it is, is that the way forward, do you think?
Professor O'Nions: It has to be part of the way forward.

Q212 Chairman: What is the other part?
Professor O'Nions: Let me just say that part of the way forward is almost a précis of what you said. We need to have world class and internationally competitive research and science to be a player in what is a globalised scene and to understand what is going on elsewhere. The exploitation of that is clearly a very big part of the equation in a continually ongoing globalisation of research. The other part is the extent to which universities which are not research intensive, which are not getting a significant proportion of research council or Higher Education Funding Council money have a role in terms of innovation and working with RDAs and other businesses and so on. My personal view is that this is an extremely important and possibly under-developed role. I will finish by saying that on the Higher Education Innovation Fund, which we are in discussions on at the moment, talking to universities that are not the research intensive ones, they enormously welcome the stimulus that the funding there has given them and hopefully in the future will give them towards making linkages with businesses and through the RDAs and so on. There is a lot going on there and we probably understand it rather less well than we do the research intensive ones.

Q213 Chairman: Do you think that if you were young again and were in one of these elite institutions you would find it difficult to get funding and it might make you get on the first plane across the pond?
Professor O'Nions: I was one of those people that got on the plane, without apology. I emigrated to Canada and I took a PhD in Canada. I came back to Oxford. I moved to Columbia in New York. I came back to Cambridge and have finally stayed. That

was nothing to do with leaving sinking ships. It is the way in which many of my generation developed their careers and probably the present generation will also work in that scene.

Q214 Chairman: When they come back will they get grants or are they still too young?
Professor O'Nions: First class people are getting funded in Britain and have done for a long time.
Professor Diamond: The best people are getting funded and I would also say that a number of research councils have also a view of the research career and are taking, if you like, a life course perspective on the research career and have, for example, first grant schemes for researchers who have not been funded, because sometimes it is important to get people on the ladder and started on their career. I am not quite sure if your question was about being a young person in one of the elite universities.

Q215 Chairman: Yes.
Professor Diamond: I think it is important that we do not miss the small pockets of real excellence that exist outside the 25 or so universities that Keith has highlighted.

Q216 Chairman: So if elitism is removed tomorrow will there be less chance of them getting support?
Professor Diamond: I do not think so. The research councils' perspective is very clear and that is to fund excellent research wherever one finds it. If you look at EPSRC or ESRC you will find research funding in very many more universities, and indeed over 100 universities do receive research council funding. Where there are pockets of excellence and where there are particularly junior pockets of excellence we do try to enable there to be, for example, something like hubs and spokes models which have the best junior able to be part of some of the critical masses of larger centres, particularly where there is expensive equipment that is required to be used to take forward research. There are huge possibilities so long as we make that happen.
Professor O'Nions: Can I take your question a bit more head-on? The measure for me is partly whether people do choose, for the right reasons, to develop part of their careers outside the UK. I think that should and always will be the case. The other side of the coin is the extent to which the UK is attractive to people from other countries to come and spend part of their career here. It is uneven but I think you can see quite a healthy situation. We are attracting some outstanding people to the UK in some areas of science. I am not saying everything is perfect but I think it is very useful now.

Q217 Mr Key: But all this depends, does it not, upon growth in the research councils' budget? When the settlement following the spending review is announced, and we anticipate it within the next week, that will, will it not, show that there is going to be virtually no growth in the research councils' budget and if there is not any research council growth how can you achieve what you are now saying you wish to achieve?
Professor O'Nions: Let me give you as good an indication as I can because obviously we are in a position of advising the Secretary of State on what the allocations to research councils will be. Within the next week or ten days I hope the announcement is made. I think you will see very substantial growth to research council budgets but I will address it a little bit in detail. The priorities that are set out in the ten-year framework are to sustain the infrastructure and the careers of individuals and research students and so on. Quite a large amount of the additional money going to research councils and through them to the universities will be to support full economic costs, ie, fixed volume, bringing more money in on the back of a particular grant. It will be to increase fellowships, stipends and so on.

Q218 Chairman: You are addressing the problem?
Professor O'Nions: There will be very considerably more money. Will the volume of research grow very greatly as a result of that? The answer is no, it will not.

Q219 Dr Harris: I just want to explore more deeply the impact of dual support on the trend towards concentration. How much do you think the fact that there is this dual support system plays into this trend of research concentration in a few institutions?
Professor O'Nions: I think quite greatly. Convergence of policies between the Higher Education Funding Councils to concentrate their funds selectively and to fund excellence, which I believe was the evidence that Howard Newby gave you quite recently, is that basically when you have funded 5*/5 departments somewhere in funding 4 departments he runs out of money. That in parallel with funding the best international quality research, wherever it occurs in the system, as Ian Diamond has enunciated, with the available resources and the availability of world class people, has driven it into quite a highly concentrated mode, as we have discussed.

Q220 Dr Harris: If it was the view that this had gone too far or it was a bad thing to do for strategic reasons to have this concentration—I am not asking you to agree; I am just asking you to assume it as a policy decision—do you think it is possible to reverse the trend to the degree to which it is considered necessary to do so, which may not be a lot, under the current system of dual support, or do you think new structures or new streams would be required to do that?
Professor O'Nions: I think it is an extremely important question and one I would like to be taken very seriously, whether you are talking about chemistry, whether you are talking about physics or whether you are talking about modern languages. We have to look very carefully at the effects of this on autonomous decisions that universities take and view what the impact of that is on the national scene. Let me just look at two sides. I will not say very much

about the Higher Education Funding Councils because you have probably got the information you want there and what the Secretary of State for Education asked the funding councils to do, and the committee that is looking into strategic subjects on behalf of HEFCE under Gareth Roberts. I will just move to the research council side and I think it will be very clear in the allocations in a week or so's time. Well before SRO4 reported we were looking very carefully at what we called health of disciplines, ie, those subject areas which were going in the wrong direction for the perceived need of international quality or the national need. This has been addressed. We will respond in the allocations to the priorities of the research councils. To give you a flavour of where some of the very strong arguments were made, there were significant concerns around the areas of the physical sciences, some aspects of engineering and so on in health of disciplines, and I think you will see that that has been responded to and there are others too, in the allocations. The answer is, absolutely yes. Clearly my responsibility is more on the research side so we are responding there. I think there is both funding and structure in the Higher Education Funding Councils for them to take a considered view. That is the answer to a hypothetical question.

Q221 Dr Harris: I just want to make sure I understood your answer. If it was considered that something would have to be done to reverse this trend towards research concentration do you think the structure is adequate despite or because of dual support and that there is enough flow of funding in the flexible pipeline you are describing of health of disciplines, not only flexible but supposedly tasked towards these issues in order to achieve a policy change in respect of concentration, if that was what was required?
Professor O'Nions: As you repeated the question I have either understood it better or it had a slightly different twist to it. If it is a matter of reversing the concentration all the statements that I made about responding to health of disciplines in a research mode would not necessarily do anything about concentration into numbers of universities because we are responding to the health of that subject in a research centre across the nation, and it may or may not result in a distribution between numbers of universities. When one looks at it from a Higher Education Funding Council point of view, where you are looking primarily at undergraduate teaching and support of that, then their ability to intervene is I think really dependent upon views that ministers have yet to take and I would not like to second-guess the work that they have been doing. Is the machinery there in the Higher Education Funding Councils? Wait and see is my answer.

Q222 Dr Harris: Let us say that ministers came to you, and I am not asking you to pre-empt that; I am giving you a hypothetical situation, what advice would you give them? Sir Keith, with the dual support system is it your view, and we will be asking HEFCE what they think of you as well, that the structure here is sufficient if you change policy to reverse this move towards research concentration or would you be advising—and obviously this is only general policy—that one would have to really change the structure if that was the path that ministers wanted to go down?
Professor O'Nions: If the question was, do I think it would be a good policy to reverse the research concentration in our universities through the behaviour of the research councils such that—

Q223 Dr Harris: And HEFCE.
Professor O'Nions: Let me just deal with one. There is a disconnect. They are very much arm's length from one another—then my advice on research council funding would be no because I think a policy where you respond to the best people, wherever they are and wherever they happen to be in the system, is the right one and it is the only one that is sensible for the research councils. When you come to the Higher Education Funding Councils that are looking at departments and their performance and so on, obviously they have some different levers available to them. My answer would be no, frankly, on the allocation of research funds of research councils. In terms of Higher Education Funding Councils all sorts of other things are happening and without digressing some quite different things are beginning to happen in Scotland which are rather interesting.

Q224 Dr Harris: My second question is around whether there is an vicious cycle. If again one takes the view that strategically we ought not to have such a concentration because we might want to broaden and deepen at some point, and we cannot do that if we are very concentrated already, do you see the danger that some institutions that are falling behind on getting funding from either arm simply do not have the critical mass ever to be able to catch up again because they just do not have the research infrastructure if they are not getting the RAE funding, such as the step? Again, if you were advising about the need to have flexibility in capacity would that be something that we would need to change on that basis?
Professor O'Nions: I understand your point and I understand the question, but what this would be appealing to is, do we have the wherewithal or the desire to move away from the situation where 55% of our research active staff returned in research assessment exercises are now in 5*/5 departments in relatively large concentrations? To reverse that is I think very undesirable at the present time. A large amount of funds may be able to do that but to move away from the international excellence that that has been achieved to distribute the things more widely is a policy which would be curious to follow after all the benefits in terms of international competitiveness and career structures that the selective funding and "concentration" have achieved.

Q225 Dr Harris: The other part of this vicious cycle is that, given that many research councils, quite rightly, one might say, require evidence of multidisciplinary cross-departmental working, and indeed that is attractive and recommended, and that is clearly easier to do within an institution than across institutions, whatever anyone says, is it right that isolated departments that are excellent and are still getting the research council grants find it harder to do that at the same level of excellence because they do not have the mass of well-funded other departments around them with which to interact in a multidisciplinary way to attract these cross-cutting research grants that research councils are so keen on?

Professor Diamond: I take your point but I do feel that many of the research councils have in place strategies which enable the opportunities for those kinds of links to happen. You simply do not great interdisciplinary research happening by enabling people to just get together in five minutes. You have to enable the conversations to take place over time. Research councils do fund seminar series, for example, which enable the best researchers, wherever they are from, to come together, to talk, to start to get these interdisciplinary conversations going. While I take your point that it may be easier to get that across the same institution, we are not in this country in a position where the geography is so enormous that we cannot enable conversations to start and we have, through for example the development of the e-science the ability for councils to work together across universities and very many do. I think you will find a very high proportion of many of the research council grants go to colleagues from more than one university.

Q226 Dr Iddon: Do you see any need for a strong regional research presence?

Professor O'Nions: I turns out that most regions in the UK do have a presence of 5* and 5 departments. I do not think we have a full enough analysis of the situation to know whether it would have a deleterious effect on a particular region if it did not have one or two 5* departments in strategically important subjects. If you asked the question, is there a regional role for the university system to engage with commerce and innovation and so on, most certainly yes, and particularly when you widen it away from the so-called elite or non-research intensive universities, but I will not repeat the same points that I made to the Chairman at the beginning of this evidence.

Q227 Dr Iddon: Professor Diamond, do you have any difficulty in squaring your commitment to the research councils funding excellence wherever you find it with promoting a regional research presence?

Professor Diamond: No, we do not. We work very closely with the RDAs and I believe over the next couple of years we will be working more closely with them. Different councils sit on, for example, on the science committees of different RDAs and where appropriate regional activity happens. In some of the research councils research precisely on regional economy is a terribly important thing. I think it is important that we do have regional strategies. I think it is deeply important for this country that we interact with the RDAs and the regions but I think it is a real problem that that disengages with the policy that we really must fund the very best science work where we find it.

Q228 Dr Iddon: Professor O'Nions, you were in praise of the regional clustering of universities and businesses in the innovation process as being good for the economy. What evidence have you got to demonstrate that this does actually work successfully and are you carrying out any investigations to justify this?

Professor O'Nions: That is an important question. Given the very small number of years for which this innovation fund has been running, and it is only a few, I think it is too early for us to hold out great successes of innovation and green shoots and so on. Probably what we are looking at, and I am talking a great deal to universities in various parts of the country at the moment, is evidence of a high level of activity and also enthusiasm for that engagement. Rationally at this stage it is that level of activity and the enthusiasm with which that is taking place on both sides, the university side and the business side, which is what we would appeal to. Yes, I agree. At some point, after sustained investment in these areas, we actually have to be very clear about what it is delivering. On this particular one we are still a few years away from a reasonable expectation of seeing measurable economic benefit.

Professor Diamond: There is some really interesting ESRC research from the University of Nottingham on the best practice for spinning out, so there is research going on about it. I absolutely agree with what Keith is saying, that it will take a few more years before we can properly judge the economic impact of that. One can see initially a number of high profile successes.

Q229 Dr Iddon: Given that the regional programme is successful are you convinced that there are enough jobs, proper graduate jobs, in the regions for graduates that emerge from those universities?

Professor O'Nions: I can speak on a couple of subjects where I have information but I am not sure how long the Chairman wants to persist.

Q230 Chairman: One example will do.

Professor O'Nions: Perhaps I can take physics and chemistry as a combined example. I was anticipating that this may be where you would focus. We know a lot about the supply side and all the statistical information on that, but on the demand side by business, ie, are there enough people in those areas and are there jobs, again, we do not have absolutely thorough demographic analysis. At the centre we have not considered doing this, but there is a lot of anecdotal evidence through the Royal Society of Chemistry and the Institute of Physics and a recent report which PricewaterhouseCooper did for both of those organisations and there is no question that they are employed very quickly. If anything there is occasionally on an anecdotal basis a shortage of supply of people of the right calibre. Given the percentages of graduates from that who go purely into physics or chemistry type employment, I do not think getting jobs is any problem and in fact their lifetime salary is very substantially higher than in any other area of graduates. If you would like more detail I am very happy to write and give you the information.

Q231 Dr Iddon: The introduction of top-up fees has provided something of a price barrier to students and something of an incentive to study closer to home if they can. Do you think that the regional undergraduate science provision is sufficient to cater for this possibility or do we have to accept that students are going to have to leave their region if they want to do chemistry or physics or whatever?
Professor Diamond: I think we very simply have to look at the demographics of what the demand will be. It is not absolutely clear at the moment that there will be large numbers of students who will be forced to travel who would not have been forced to travel in the first place. You would need to study that in further detail.

Q232 Paul Farrelly: Variable tuition fees have just been mentioned. I have got a concern about the possibility that the pressure which is already within the system from the research assessment exercise that we are already seeing may be reinforced by the introduction of a limited market. For example, those institutions best able to command the top fees of £3,000 or more in the future are likely to be the ones that succeed even more in the future rather than those that are able to charge lesser amounts. Do you have any concerns that there may be self-reinforcing effects or have you seen any evidence in the way that scientists position themselves in the future market that this is already taking place?
Professor O'Nions: I do not have a deep analysis but if you ask the question have I seen any evidence of that, at this stage no, I have not. Am I concerned about it? Taking off my research council hat and all the rest of it, I am quite concerned as to what sort of behaviours this may drive. We have to wait and see. My experience in most things to do with education and science is that when you change the rules a little bit it may be totally well-intentioned and so on but one often induces some behaviour which one might not have anticipated. All I can say is that we have to look at this and watch it very carefully.

Q233 Paul Farrelly: At which point do you think it might be appropriate to take stock and produce some kind of meaningful analysis? At what point in time?
Professor O'Nions: Within the United Kingdom we have several games in play at the same time. We have a different game in England than what is going on in Scotland so we will have the national comparisons there. I suspect that two or three or four years down the road we should start to see some of the trends emerging through applications and we will have to watch it very carefully.
Professor Diamond: I suspect this is an area which is going to be researched fairly heavily by funders to ensure that there are some things like milestone check times just to see how things are going.

Q234 Dr Turner: To what extent should skill shortages be taken into account when the government sets its higher education policy? Do you think skills shortages justify the intervention of the government in the affairs of individual universities? I do not have to remind you of recent examples.
Professor O'Nions: I think skill shortages are something governments have to take seriously. As I said, in effect we have been looking at skill shortages and health of disciplines in a number of areas. Let me again allude to one that should appear and I expect will appear in the allocations of funding councils. Research councils have expressed their concerns as to whether we have an adequate skill set to support the present White Paper on energy, keeping the Nuclear options open, across the piece. I think that is a legitimate area to intervene in and to respond to those skills. That is relatively easy and proper to do with research councils. Intervening in the affairs of an individual university and maintaining their autonomy is obviously a much more sensitive area but if the collective decisions are autonomous decisions and are driving things not within the national interest, we have to have a response there. I think everybody would want to stop short of intervening in the affairs directly of a university. That would be a very big change for us, but I think there are probably other ways of loading the dice and shifting the playing field. I think that is a responsibility of government.

Q235 Chairman: But have we got target numbers in mind? How many plumbers do we need? How many doctors do we need? I can never find figures. Do you know figures?
Professor O'Nions: Even on physics and chemistry where you might have expected I had done a reasonable amount of homework in advance of this meeting, I come clean and say that we cannot go very much beyond the anecdotal evidence of whether supply is meeting demand and what the demand is. It is not bad news but we do not have from those particular areas that sort of analysis. Those numbers go up and down but I do not think we have good trend numbers.

Q236 Chairman: So we do not have a national plan of how many physicists and chemists and medical students we need or what?
Professor O'Nions: Not that I have noticed. I believe we should look at the very least at the feasibility of doing research in that area which gives us an outcome that is robust and has meaning.

Q237 Chairman: Do you not find this very worrying, that you do not know why you are educating people for jobs?
Professor O'Nions: With respect, I think we know why we are educating people.

Q238 Chairman: Yes, but I mean for jobs.
Professor O'Nions: There is not a one-to-one correlation between what people do in a degree and what sort of job they do. People in particle physics and astronomy go off and do other sorts of things and are much welcomed by their employers. There are numerous employers who will say, "We actually quite like hiring somebody that has come out of an astrophysics undergraduate degree" or this, that and the other. I think it is a very difficult thing to do.

Q239 Chairman: There is a real contradiction here, Ian, is there not, because you believe in telling me numbers, do you not? I thought I saw it in your evidence.
Professor Diamond: We are very comfortable that at a research council level if our task is to ensure the future health of the research base then we can start to make some estimates of the numbers of researchers (or academics more broadly defined) that would be required to maintain a healthy research base. We have given you the paper which RCUK has put together. That is one aspect of this entire question. We do have a pretty good handle on the demand for the academic research end. That particular paper which you have seen is being extended and over the summer we will be taking into account the business and industry demand for research level people so that we can talk about that. That is at the PhD level. I do believe that there is potentially a need to take this question further forward and to ask some questions about whether you have likely demand for people with different skills. That is a different piece of research and a piece of research that would need to be done. That is taking, if you like, the demand for undergraduates with particular skills. At the higher level that is work that has been done for researchers and is currently being extended for industry.

Q240 Dr Harris: Keith, you said that the evidence from employers about skill shortages was anecdotal even with physics and chemistry. Are you taking too narrow a definition of employers because I would have thought that a group of employers would be all secondary school science departments where there is very clear data evidence for skill shortage. Should we not be thinking more widely than industry when looking at the health of science and is there not good data to suggest that we are desperately short of science graduates?
Professor O'Nions: I accept that criticism totally and I was taking that more narrowly. Where we have got evidence which is a bit beyond the anecdotal. We have talked to the Institute of Physics and the Royal Society of Chemistry and organisations of that sort which are representing the professions, and you are absolutely right: if you look at where these graduates go at PhD level and so on, teaching and schools and that sector does have a very big demand and clearly there are not enough people. That goes beyond the anecdotal. That is fact. In terms of employment outside that sector, whether it is people who are employed as a chemist or a physicist or a pharmacist or go into sectors where those skills are welcome, then I have nothing to add to what Ian has said.
Professor Diamond: I think we would all agree, for example, that in the IOP data that 60% of all physics graduates should end up as schoolteachers to fill the demand is hard data that we should accept. Having said that, there is more than just a supply issue from the higher education system that we are going to have to address. It has to be attractive to become a physics teacher in a school and there is a whole set of questions there that we really do have to get on board.

Q241 Mr Key: Chairman, we know that 46.1% of academic staff in civil engineering, 45.6% of academic staff in mathematics are aged 50 or over. Please can you give us your take on the retirement time bomb?
Professor Diamond: I have spoken to you twice before on this. It is something we take extremely seriously. Anyone who gives a presentation on just about anything at the moment sees my graphs on this. It is a critical issue and it is one where I suspect the allocations process will see a number of initiatives which are being aimed at addressing this. I can speak for the ESRC where it is likely that our strategic plan will particularly say things about areas such as economics or social science where the sorts of percentages are not unlike those you have just described.

Q242 Dr Turner: There is evidence that suggests that the UK does have sufficient science graduates but what it does not have is a business sector that has created sufficient demand for them. What do you think government could take to encourage demand for science graduates for employers? If there is no demand for science graduates then the incentive for students to enter science degrees is clearly undermined.
Professor Diamond: That is a fair point. If there were streams of science graduates in the unemployed queue then we would have to worry but I do think it is important that government and indeed the research councils engage with industry to identify what the demand is and to encourage it more. I think Keith probably will agree that the science investment framework, the achievement of which does require an increased engagement with industry and the funders' forum, has meetings with industry to ensure that starts to happen, is an essential part of this agenda.
Professor O'Nions: I am looking at the precise numbers. Looking at production of graduates in the UK, both graduates in the various sciences and PhDs, the numbers have grown very considerably. We have gone back just over the last ten years and our total number of science and engineering graduates has grown very substantially, I can give you the precise numbers if you want them, and so have our PhD graduates also grown. It is a fact though that most of that growth is in the life sciences with a very big increase in the biomedical and life sciences, which has been very healthy, and a large

number of women have also gone into that which is good news, so there is a very strong perception that there are job opportunities both in the public and private sectors. There has been a relative decrease in physical sciences and engineering over the same period and so I think probably your interpretation of that is correct. Also, in terms of PhD output, there is an overall decrease in chemistry and it is fairly even in physics. We have seen a big growth overall but it is very strongly concentrated at the biomedical/life science end. The point you made certainly applies to the physical sciences.

Q243 Dr Harris: Another point that has been made by industry is that although there are ample science graduates as far as they are concerned, they do have concern about whether they have the right practical skills for their purposes. What do you suggest universities can do about that?
Professor O'Nions: Where practical education is deficient in both research and vocational mode, whether it be in life sciences or whether it be in laboratory chemistry, then I think it is for universities to listen very carefully to that and respond accordingly.

Q244 Dr Iddon: We saw some students recently who felt that science careers were not as lucrative or presented as stable a prospect as some other careers. Do you think they are right?
Professor O'Nions: You could answer for that in all sorts of ways. If we look at the biomedical and life sciences end and prospects in the pharmaceutical industry in this country, which is one of our very powerful sectors, that might not be true. If you go to some other areas probably people realise that the way to the top in many business is not to try and build up a scientific career but to shift to the management side quite quickly. I think perceptions probably differ a great deal from one area to another, depending upon their view of where the UK economy is going, and over a generation we have seen a pretty big shift from manufacturing to services. The services sector offers very many exciting careers for many people. With some exceptions it is rather less R&D intensive than aerospace or pharmaceuticals.

Q245 Dr Jack: On the other hand the Institute of Physics and the Royal Society of Chemistry have recently published a survey which they have carried out which shows that science graduates earn more than their counterparts in the arts and humanities. Why do you think that is the case?
Professor O'Nions: I hope they are comparing like with like. I have also seen that and I think that over a career it is something like £187,000 higher overall salary for a PhD graduate in physical sciences relative to an arts and humanities graduate. Assuming that they are comparing like with like, I think it probably shows the salary differentials that are often the case. At least half of our physical science graduates go into business and into industry and salaries there have become more competitive.
Professor Diamond: That was at PhD level. A very high proportion of the arts and humanities graduates go into academia. I think you commented that there are relative differentials there and elsewhere.

Q246 Dr Iddon: Do you know what percentage of science graduates enter into a career in science as distinct from going elsewhere?
Professor O'Nions: I do, but if you will bear with me and ask a different question, I will come back to that and find you the number.

Q247 Chairman: Professor O'Nions, you can send it in to us if you like.
Professor O'Nions: Okay.

Q248 Dr Iddon: My last question is do you think it is possible for science graduates to earn as much in a science career as they can by going into a city career, for example?
Professor Diamond: There is a fundamental caveat which you have to ask and that is to say how successful are they going to be? If you go into the city and if you are hugely successful, you might make more than in a science career. Then there is the distribution, if you look at the average scientist who is going into a decent career, for example the pharmaceutical industry, then I suspect the career earnings would be similar to the average person going into the financial sector and they may even have a more secure job. I think I have to say we need to look very carefully at the data, but it is not necessarily the case that the differentials are huge. I am happy to see what data exist.
Professor O'Nions: Of all the PhDs who graduated in physical science and engineering in 2003, 79% of them were in jobs in 2004, which is very good news, and 42% were in jobs where they were in research roles and of those about half were in the educational system.

Q249 Chairman: Professor O'Nions, I have seen dozens of figures like that, but they only last for one year, then students disappear into the world and we do not have a second year, a fifth year or a 10th year.
Professor O'Nions: You are absolutely right. That is first destination data, but it is the data which we have. It is extremely difficult. What I would love to have is second and tertiary data and see how people's careers develop and see what value they have added. It is very, very hard to get that information, but it is the sort of thing we must collect progressively.
Professor Diamond: There is some research by Peter Elias, at the University of Warrick, which I do not have the results of on the tip of my tongue, but I will let you have them, which uses some of the very rich cohort data that we have to answer some of those questions.
Chairman: If you think it is worth going into science, then prove it to us from the data you have got.

Q250 Dr Iddon: We were talking earlier about the concentration of research in a fairly limited number of universities. Is there any evidence now being accrued that students coming out of those particular universities attract higher career salaries than students coming out of the other universities?

Professor O'Nions: If there is data on that, with apology, I am afraid I do not know the answer to that question.

Q251 Dr Iddon: It does not exist at the moment?

Professor O'Nions: If it does, I have not come across it. I think we should drop you a note to say yea or nay on that.

Q252 Paul Farrelly: The issue of science departments closing landed right on my doorstep in Newcastle-under-Lyme, before Christmas because Keele University became one of those that is proposing to close its physics department and had some difficulties in sustaining its chemistry department previously. My concern is not research, although it would be lovely to have lots of five-star rated research departments at the universities, my concern is teaching. There was a possibility that the students in my area, who wanted or had to stay local, were not going to have, in North Staffordshire, any courses where they could learn physics as well as other subjects. I want to touch on an aspect of the White Paper, which has not been developed, which is the creation and the obstacles of the creation of teaching-only departments in science. What is your view on that and how does the system work? Is it stacked for or against the creation of good teaching departments? If the system can be improved, particularly in terms of funding, what can we do to create good teaching-only departments?

Professor O'Nions: I completely share your concerns and I worry as much as you do about only being able to teach if you have a simple connectivity to world class research. I believe that is going to mean teaching will take place in about the same number of departments where research is going on, which is a couple of tens at that sort of level, and it is extremely important. I think when we moved to a system of 130 universities, which we have at the moment, very often it took some time for universities to figure out where they were going to go and whether the whole thing had to be academics spending 50% of the time doing research and 50% of the time teaching. It is absolutely clear that is not a situation which exists or, indeed, could be sustained into the future. Your question as to how we have good teaching in departments which are not research intensive at the international or even national level, in some cases, is immensely important. There are many good worked examples in the US. I think it is an area where we have to focus very hard and we need very good quality teaching in universities which are not research intensive. It is the way forward. Graham Davies had a look at that, but there is a lot more work to do. I really think it is a key point.

Q253 Paul Farrelly: Clearly in this respect, following the White Paper we have to focus on the variable tuition fees and the rest of the White Paper, certainly in the public eye, in terms of creating good teaching standing alone from good research to my mind is not being pursued. Do you agree the Government must do more to pursue this?

Professor O'Nions: I do and I think there is a cultural thing here. Looking at some of the private and state funded universities in the US, they are very proud to attract an extremely good calibre across Massachusetts, New Hampshire, and so on. They have first class teaching, they attract good staff and they stop at the Masters level of teaching. They hold their heads high and are proud of what they do and in no sense do they feel they are second rate because they are not research intensive. I do not think we are quite at that point yet in the UK, where, being a non-research intensive university which has a very high quality of teaching, all of those are simultaneously holding their heads high and confident in the way they are going forward. You may find many exceptions to that, but culturally I do not think we are quite at that point.

Professor Diamond: I believe what we have to do is be able to celebrate those departments and ensure the proper links exist between those departments and the research intensives so it is perfectly possible and perfectly acceptable for students who have gone through their initial training there to then move to the research intensive universities, for example to do a PhD or whatever, and the links exist and there is a kind of interaction. Where there are academics who wish to develop a research activity, even though they are working in a teaching intensive university, those links exist as well to enable that to happen. There are many examples of how that can happen. I would agree with Keith about the United States of America and I believe there are some examples here if we search for them. In my view, what we need to do is make the point that there are not just some examples they have been searching for, but there are a number of examples.

Q254 Mr McWalter: Thank you, Chairman. Apologies to you and to our witnesses for an afternoon where I have been scudding in and out. I have a particular interest in mathematics, as Professor Diamond will know, and if I may, I would like to ask you a question. Professor Diamond, you know in your area there are simply not enough people with the appropriate mathematical statistical skills to be able to do some of the work which you would like to see going on, yet, at the same time, we read that the mathematics department at Hull University is about to shut. The reason why is because the Dual Support System has somehow not come up with the funds to allow that activity to subsist and yet, if that was being provided and if people were going to a department like that, which historically has always had a very good record, that might be providing us with just the people with the skills that could then integrate their work with social science and do some of the work which, Professor Diamond, you acknowledge to be absolutely desirable. There is a direct contact between losing these departments and losing the capacity to do the sort of research we need. I am very surprised to hear from the two of you that you are fairly laid back about departmental closures in this sort of system.

Professor Diamond: I would not say we are laid back about the departmental closures, what we say, very clearly, is we have to be able to attract the right number of students and the right number of graduates. I would submit that the whole issue of mathematics is a very, very complex system. At the beginning we need to make sure there are students in schools and so mathematics has to be taught properly and taught in an exciting way that people want to do it at an undergraduate level. Within the undergraduate arena, many mathematic departments, in an intra-university funding public system, have never been able to fund themselves off their own students, the way their funding has existed is through service teaching; service teaching to biology or to economics or to somewhere else. If that increasingly is drawn away, then it becomes very much more difficult for an individual mathematics department to fund itself and then the funding looks precarious. We must work to ensure that kind of opportunity still exists. It is not just a simple matter of saying, "... therefore mathematicians must teach service courses ... " because there has to be ownership of the mathematician to make that exciting because it has to be seen to the social scientists being taught their mathematics by the mathematics professors that it is a really exciting and important thing and there is ownership there. Then at the research council level there is the question of making priorities and highlighting the need for really exciting research challenges which will bring mathematic graduates in and for the mathematic students in schools to see this as exciting. You will find the research councils in a number of cases are now moving into schools to try and develop activity and to make it exciting to young people and to say: "Look, a career in mathematics research is an exciting thing". When the applications run out you are likely also to see a number of prioritising activities from a number of councils, potentially including my own, which will prioritise some of these areas to try and make a mathematics career in research broadly defined "extremely exciting". It is absolutely crucial we do that.

Q255 Dr Harris: Do you think university science departments are closing or are threatened with closure by a shortage of student demand to go there? Is there a lack of applicants?

Professor O'Nions: I think there are two things: in some cases it is very clearly a lack of applicants, and just to go to mathematics, Ian is right, the problem is primarily in schools in mathematics. It is 25% down in the last four or five years for candidates taking A levels and when you have got a backdrop of such a reduction and the demand is dropping, clearly it is going to have a big impact. In other areas it may not be just demand, there may be other questions about perceived affordability of teaching that subject within a university, where it is making decisions about the amount of income it has got and the cost of teaching particular subjects and its aspirations for research assessment type exercises and so on. I think there are two drivers, but in mathematics it is demand which is a huge problem. There is an enormous drop in the number of people doing A level mathematics.

Q256 Dr Harris: Do you share the view that the absence of teachers in secondary schools with science degrees makes it more difficult and has the effect of having less encouragement on students to do sciences, particularly women teachers or women students in the physics and chemistry subjects, whereas if there were as many women going into science degrees as men, you would not have the shortage that you postulated? Is that a particular problem in your view?

Professor Sir Keith O'Nions: It is a problem, I agree.

Professor Diamond: Absolutely no doubt. I would just say that it is not just in physics and chemistry but it is also in mathematics and subjects such as economics.

Q257 Dr Harris: What would you say to the view, if you were again advising people, that graduates with higher levels of debt are more likely to go into well-paid jobs than less well-paid public sector jobs, particularly if they think their career earnings may be reduced because of family commitments, and therefore they will be paying off debt for longer? Let us assume these are sensible people who can count and work out the impact of debt and the impact of higher salaries and paying off that debt.

Professor Sir Keith O'Nions: I think I have to give you a completely honest answer and say I will see what evidence we have got, and what analysis there is.

Professor Diamond: We really need an evidence base to answer that question.

Q258 Dr Harris: Are you saying it is your understanding that the system of increasing debt has been introduced without that evidence on public sector jobs, particularly in science, being produced?

Professor Sir Keith O'Nions: You cannot have the evidence within the UK because we have switched from one regime to another, so you have to go outside the UK and look at that situation. Once you go out of the UK where students are accumulating large amounts of lifetime debt, you really have to go to the United States, comparing people in America, relative to their income, expectations and lifestyles, and how employees deal with debt situations. I hope it was looked at carefully by politicians here in the UK, but it does not necessarily mean that even the US experience will directly translate into this country.

Q259 Dr Harris: Let us say you are bright—and this is hypothetical now—

Professor Sir Keith O'Nions: It is totally hypothetical just for the occasion, I accept!

Q260 Dr Harris: You are a top student and you end up having paid for fees and having £12–15,000 of debt, and you are offered a salary in the City, with your maths degree, of £25,000, with a joining-up fee of a capital amount to pay off the debts, or they say, "no, go and teach another year on whatever student teachers get and then go and be a maths teacher in the public sector or even a maths lecturer." Heaven forfend! What would you do, if you are bright?

Professor Sir Keith O'Nions: The playing field is so tilted—and I accept that—that you would need a pretty strong power of conviction that teaching was the right thing to do with your life, rather than going the alternative route.

Q261 Dr Harris: Finally, what about the question of incentives? Do you have any evidence that the incentives that are Government-sponsored, for example with bursaries and post amelioration schemes, if you like, are working?

Professor Sir Keith O'Nions: Only anecdotal. I do not have analysis of that.

Q262 Dr Harris: It is not your direct responsibility, but I thought in policy terms you would have an interest as someone looking beyond anecdote for the debt.

Professor Sir Keith O'Nions: I certainly have an interest, and all of my good colleagues sitting here in the one-and-nine-pennies will get some information to you.

Chairman: The answer I often get is, "get a well-paid job and you do not have to pay anything back". That is the Government line.

Q263 Paul Farrelly: It is clear—again on my doorstep, taking Keele as an example—that closure is not just affecting science departments. In my area students locally cannot be taught the classic French and German combination, and therefore that will impact on the people coming to do French. Given that, is there any reason why science should be a reason for special pleading? Are science departments, because of the system, under more pressure than other departments; or is the problem across the board?

Professor Diamond: It is worth remembering that Charles Clarke, the former Minister of Education, sent a letter to HEFCE on strategic studies, which included modern languages. It is our understanding that the HEFCE board have added, in addition, quantitative social science to those strategic subjects. The prescription of the research councils is that that is entirely appropriate, and I would also have to say that AHRB, BBSRC, EPSRC and ESRC are all currently in conversations with the funding councils about ensuring that there are initiatives to ensure the health of disciplines in their areas. Those with AHRB, ESRC, do include modern languages, as you describe, because it will be important—not just modern languages, but languages more generally. It is important that we have that base if we are to compete in the global economy that we find ourselves in.

Professor Sir Keith O'Nions: I agree exactly with that: modern languages is just as important as sciences. The only point I would add is that in relation to teaching in engineering and physical sciences, if you are going to respond to the point made earlier and have the practice part of it properly taught in laboratories and so on, it does quickly become very expensive when you add in the extra infrastructure required.

Q264 Mr McWalter: You say it is very important but students are just going in the market now, and they do not want to do any subject that involves difficulty—if they cannot read it immediately, whether it is maths or German. Is it not about time you took a much more strategic view of these things and were more emphatic about the skills that are needed and make dispositions to ensure that our universities respond not to the market but to the needs of the country?

Professor Sir Keith O'Nions: I am very content that we should respond to skills requirements and so on, and we have had a to and fro on that which has been extremely healthy. However, I would toss the ball back and say that you can do so much at that demand end of things in terms of jobs, but the problems we are talking about here are really pretty deeply rooted in the schools and the system of education. In terms of mathematics, we cannot deal with that at this end of the world, with a 25% drop in people taking A-Levels, and there is a real question whether mathematics has to be taught more broadly as part of a system. There are fundamental questions about A-Levels.

Q265 Chairman: If there is an ailing science department, should the Government bale them out—yes or no? They are going to close it: would you bale them out?

Professor Sir Keith O'Nions: In general, no, but if there is a specific need that is identified and there is a context of a national need, then one may make a strategic choice, but as a general rule, no.

Q266 Chairman: Why should we not bale them out Ian?

Professor Diamond: Firstly, universities are autonomous and make their own decisions, and, secondly, we would say we have to simply ensure that there is a real national provision, and that is what we are trying very hard to do. Where we can identify that there are disciplines that require first aid or in emerging disciplines where there will be a need for demand, that is where we must take strategic decisions to ensure happening, and in so doing I cannot see that baling out that department, unless there are contextual and real reasons—

Q267 Chairman: So what are you going to do if more departments are closing? It is predicted that lots of departments are going to close. This is not the end of it. We are getting into a crisis situation with science departments, or am I exaggerating?

Professor Sir Keith O'Nions: You might be exaggerating slightly Chairman, at the risk of disagreeing. If we look at chemistry and physics, there are two closures in chemistry that are quite exceptional in the long term, ie, grade 4 departments, King's College and Exeter. The other departments that have closed over the years are mostly chemistry and physics departments that have been grade one and grade two departments. We must fully accept that we have not got the deeper demographic analysis to give a response to the simple question—

Chairman: Come on, Keith, the pattern is happening across the country. There is Newcastle; there is Hull.

Mr McWalter: Swansea, Hertfordshire.

Q268 Chairman: It is growing, and you are staring at it and doing nothing about it.

Professor Sir Keith O'Nions: I do not accept we are doing nothing about it because where levers are in my hands or Ian's hands, we are actually doing quite a lot. We are looking very much at the research end, and I think we are behaving in a proactive and very sensible way. I would not accept that we are doing nothing about it. Are we concerned about departments closing and not understanding fully the implications of the continuation of that trend? Yes, I share the concerns, and I would join your appeal and prepare to play a full part in seeing whether we can make robust, sensible analysis forecasts around the continuation—

Q269 Chairman: Okay, well, we will see you on the next picket line in that case. Thank you very much.

Witnesses: **Dr Bob Bushaway,** Vice Chair, Association for University Research and Industry Links, **Mr Nick Buckland,** Vice Chair, South West of England Regional Development Agency, and **Dr Ed Metcalfe,** Head of Science, Technology, Entrepreneurship and Management, South East England Development Agency, examined.

Chairman: Thank you very much for sitting through the last session. Thank you for coming.

Q270 Dr Harris: What evidence do you think there is for a link between the volume of science and in a sense the volume of science graduates—assuming that is associated with the volume of science-based work in industry being done in the country—and economic performance?

Dr Metcalfe: If we compare ourselves with other countries, and we aspire to have a stronger research and development base in the country, there seems to be quite a direct correlation between the R&D investment in the country and the number of researchers in the country, so we do not have as many researchers as other countries maybe. If we do not have as many researchers as other countries do, then it does raise a question as to whether we are going to continue to be competitive.

Q271 Dr Harris: So do you believe that having more researchers and therefore more research is a prerequisite or important component of economic growth?

Mr Metcalfe: I think it would be dangerous not to assume that.

Q272 Dr Harris: So RDA money is best spent in respect of economic growth on science and research investment than say arts and museums simply from a measure of economic growth?

Mr Metcalfe: We have both a regeneration and sustainability function and also a need to promote the knowledge economy within the region. If you like, it is left hand and right hand and we have to do both those things.

Q273 Dr Harris: You heard the previous session where it was not clear whether there was any good data, as opposed to anecdotes, which is not really data and certainly not information; but there is not good evidence about what the shortage is. There is a feeling that we do not have enough. Do you have, from your knowledge, what the appropriate proportion is?

Mr Metcalfe: We know when we ask our companies that they will not make predictions. They will not say how many workers they will need in five or ten years' time. The best evidence we have is comparing ourselves with our international competitors. The OECD data, which we quoted in our references, suggests we are quite a long way behind. One interpretation of that is that we need about another 50,000 researchers if we are going to match a 2.5% GDA target of expenditure in R&D over the next 10 years, so we need another 5,000 researchers per year on that measure. It is not just a question of standing still, it is a question of increasing the number of researchers.

Mr Buckland: We are looking at trying to get that data, and looking at the various key sectors that the RDAs are working with. We are asking those companies who are engaging in those sectors what their requirements are. It is extremely difficult to get exact data from them.

Q274 Dr Harris: The second part of my question is about the role that government should play, because government has an interest in economic growth, and you have just agreed that the number of people feeding through into science active areas is important, and government funds in this country the bulk of the level 4 training and higher of scientists, so you would have thought that government has an important interest in managing the system. Certainly, for medical graduates there is a quota, meaning there is a controlled number, and then there is a controlled number through. Yet whenever anyone mentions having more control of how the Government spends its money in universities in order to achieve government policy, which it has been voted to do, people say, "get away; it is university independence; how dare you!" What is your perspective on that debate?

Mr Metcalfe: The evidence of history on teacher training is that it is very difficult to predict what we will need, so control must not be over prescriptive. I think we probably have to use carrots rather than have very specific targets. It is not just asking the universities to take on more science undergraduates; the problem is much earlier and is about getting 11-year olds engaged in being interested in science, and 16-year olds beginning to make the right career choices, and all the way through to graduates. There are a number of choices that they will make. Just saying to universities "you must produce more scientists" is not really going to answer the problem.

Q275 Dr Harris: Is that right, because I still have a very good argument to say that government should not say to the people it funds almost 100% for a policy that everyone is agreed with, that they do not want more places for—I do not want to pick on media studies, but let us use that—they want more places for scientists. They will pay, and they will pay for scientists, not for media studies. A company, when it has a training programme for the shop floor does not say, "we will let our employees choose what they want to do, and if they want to do something that is less useful to us that is fine because we want our training department to be autonomous and independent". No, they do not say that. They say: "This is what we want; this is what we have paid for and we are going to measure you on these outcomes. How you deliver it may be up to you, but that is what we want." Please argue with that!
Mr Metcalfe: I can understand the argument, and it is very tempting, but I think it needs to be done through influence and encouragement rather than giving very specific targets, because I am not sure that we know what the targets are.

Q276 Dr Harris: I did not mention targets. I just meant that you require them to do it more.
Mr Buckland: A good example is in answer to the closure of Exeter's chemistry department. Across the region in the south west we have worked with HERDA and HEFCE in looking at the level of chemistry provision across the region, and that has been taken up by Bath and Bristol; so the level of offer within the region is still at the same level. It is also the fact that the level of offer from Exeter in terms of its science base is about the same because the biosciences, medical sciences and physics are available there. It is done through working together and in partnership.

Q277 Dr Turner: There is some evidence to suggest that employers are not making the best use of graduates that are available to them. To what extent do you think this is the case? Do you think there is a problem there?
Mr Buckland: I see no evidence of that.

Q278 Dr Turner: It would be consistent with the criticisms of the Lambert report that businesses are not making enough potential connections with universities. If they are not doing that, you would not be surprised to find that they were not making the best use of graduates either.
Dr Bushaway: We would certainly agree, in AURIL, with the Lambert conclusions that there were demand-side problems on graduate recruitment and employment particularly in the science/technology areas as far as employers were concerned, and particularly, as Lambert identifies, there is a problem with the smaller sized business where, if they are not already a hi-tech spin-out, there simply is not the experience of graduate recruitment.

Q279 Chairman: In the States, when they recruit students, industry fund the open days, put the mums and dads up in houses and so on, and their whole emphasis is to try and keep those people that go through their system in that region so that the skills do not migrate elsewhere. In every county I go to, they are always complaining about skills migrating to London or somewhere. What do you say about that? What are you doing about that?
Mr Metcalfe: It depends whether you are talking about undergraduates or postgraduates. We lose undergraduates to other regions, but we have a net in-flow of postgraduates. Some of the regions have developed graduate retention schemes, which are to encourage graduates, particularly with SMEs, which are the most important group to get to. There is evidence from work that East Midlands have done that that has been quite beneficial. It is still at early stages. There are schemes in place. The multi-nationals by and large will recruit wherever they can get—

Q280 Chairman: That is postgraduate; tell me about undergraduates and what any of these agencies do with them. Do you know an undergraduate when you see one? Do you ever meet undergraduates?
Mr Metcalfe: Keeping them in the region?

Q281 Chairman: Yes. That is your job.
Mr Metcalfe: Some regions have schemes for keeping graduates in the region.

Q282 Chairman: I am talking about undergraduates, young people who are in the main being trained and are worried about getting jobs.
Dr Bushaway: In the West Midlands there is a grad-link scheme aimed specifically at undergraduates who then graduate from the universities of the region to retain them as far as possible.

Q283 Chairman: Does it work?
Dr Bushaway: It has only been running for two years, but it is supported by the Advantage West Midlands (AWM), the regional development agency for the West Midlands, and the jury is out on whether it will be a success. Certainly it is recognised as an issue that must be addressed at the regional level.
Mr Buckland: We are doing similar sorts of things in the south-west. We have a website that is useful for employers and graduates, to retain them in the region. If you look at before undergraduate level,

through the Year in Industry programme we have seen it working quite well in the south-west, whereby we encourage people to go into engineering. We have worked with SMEs in that area and that programme has started to get SMEs that would never think of taking graduates, or sponsoring people through university, to start approaching that, and there have been some success stories there.

Q284 Dr Turner: Do any of you know what proportion of new graduates take up jobs in the region in which they studied, and are there enough graduate opportunities in each region to enable that to happen?
Mr Metcalfe: I do not have the data to hand. I am sorry, I am trying to think, but I cannot remember what—

Q285 Chairman: This is surprising, is it not? You knew you were coming to answer questions about development of higher education, for goodness sake!
Mr Metcalfe: I am not sure whether that data exists.

Q286 Chairman: Ah, you do not have the data.
Mr Metcalfe: Yes.

Q287 Mr Key: I just wanted to ask how on earth does a regional development agency know what the employers want in terms of science graduates, or indeed what is available? Do you have that data?
Mr Buckland: We have evidence of what is available in the disciplines. We know, for example, how many chemists are produced in the region. But it is very difficult to understand what the employer demand is. We can ask individual employers and we cannot get hard evidence.

Q288 Mr Key: I entirely understand that. In my own case I am right on the periphery of the south-west regional development agency, and we have excellent staff in Wiltshire who are focused on the Wiltshire issue, but as far as I can see they spend an awful lot of their time talking to other agencies, people like Business Link and the South Wiltshire Economic Partnership and all these people; and nobody can get their hands on what the employers really think, especially the SMEs. Do you think that is fair?
Mr Buckland: We do work with the various sectors. We are trying to get that information, but it is extremely difficult to get the information from the employers and employers' organisations. We do have that problem.
Dr Bushaway: One of the problems, which has not been touched on, is the one about a lack of longitudinal data. Even though we have first destination returns, we do not necessarily know what happens in five or ten years in a graduate career, post-graduation.

Q289 Dr Iddon: If we produce more scientists in any one of your regions, do you think that would lead to an increase in employment of scientists within the region? In other words, would it expand the economy?
Mr Buckland: There are examples where that has happened. In north Cornwall there are quite a number of companies in the pharmaceutical arena and those companies have grown up and have actually imported graduates and postgraduates into those companies. There are examples where that has happened. These clusters can encourage those people.

Q290 Dr Iddon: It is very expensive to train a medic or a dentist, and there are arguments to say that perhaps the state should require people trained in those highly expensive disciplines to give so much time back to the state before they go into an alternative career or go into private practice. To a lesser degree you could say the same about scientists. Are you happy that we train scientists expensively and then allow them to flutter all over the place into the City? Does that matter in other words?
Mr Buckland: There are some companies in the private sector that apply handcuffs to people who they train, so that is an example of where one could do it. That is a matter of policy rather than something—

Q291 Dr Iddon: Would you agree that it is a good idea to encourage expensively trained scientists to stay in science at least for a limited period before they expand their horizons a bit?
Dr Bushaway: That used to happen of course in a very commonplace way through private sector industrial sponsorship of students. What seems to have died is that market-side engagement with students at either individual levels or within subject areas or within universities, actually to provide those golden "hellos" or whatever you want to say, to encourage that loyalty link. Somewhere along the line in the last twenty years, on both sides, that link was broken in the decline of those kinds of sponsorship.

Q292 Dr Iddon: I do not want to put words into your mouth but would you not agree that it is rather sad that those universities that have done things like sandwich courses are now disappearing because they are not seen to be the kind of universities where we should concentrate research?
Dr Bushaway: I am not sure that I know the answer for the particular individual institutions you might be thinking of, but again in sandwich courses there has to be the demand-side support for the placements and the engagement that again goes on, and that is increasingly difficult to engage with.

Q293 Dr Iddon: I was thinking of Salford, the largest chemistry department in the country in the seventies, which has now gone completely, the department about which AstraZeneca spoke very highly, and many of its graduates in Cheshire have come from that now extinct department.
Dr Bushaway: Anecdotally, Salford is an example of a university that has experienced the ups and downs of the demand-side support over the years, and has therefore had experiences that have not made it very easy for them to see exactly which way to go in the

future as regards their investments and which courses and subjects to do, because it has not been clear what industrial demand-side take-up there will be.

Q294 Dr Iddon: Or is it the fact that universities like Salford—and there are many of them—I just choose that because that is where I used to teach—that engaged with industry very heavily in the past—their academics for example were doing reports that were never publishable and therefore not accountable in the research assessment exercise, are the very ones that have suffered in the present climate.
Dr Bushaway: You are thinking with respect to the assessment of research and therefore the funding flowing from that. That has been a well-recognised omission in the way the research assessment exercise has been conducted in the past, and we are assured for the exercise forthcoming in 2008 that that will be addressed so that so-called applicable research in that form, in reports to companies and so forth, will be eligible for return and for assessment.

Q295 Dr Iddon: It is a bit late, if I may say so.
Dr Bushaway: Well, yes, I probably would agree with you.

Q296 Chairman: In terms of regional development and the economy, is there a strict correlation between these science departments? Does a strong local economy depend on a strong university science input in your opinion and experience?
Mr Buckland: I would say yes.

Q297 Chairman: How do you know that?
Mr Buckland: If you look at some of the links between the areas, in Bristol for example in the south-west, there is a very strong link there between the computer industry, with Hewlett Packard's laboratories there, and Motorola's laboratory in Bristol, based on the strength of the university departments. There is evidence.
Dr Bushaway: If you move from the micro to the macro, all the evidence that is available from OECD countries indicates that that correlation is there.

Q298 Chairman: In the world that you guys move in, are you envious that in some regions they have got this right and you are still trying, or just poking about doing a little?
Mr Buckland: I think all regions are trying hard to do this. Some have had more success than others, but we are not starting from a level base.

Q299 Chairman: Do you have a committee of science/technology/engineering in your region that puts the boot in to universities and businesses and so on to get it together?
Mr Buckland: We have a shadow science and industry council, but other regions already had science and industry councils set up and we are the second generation and are looking at what they have done to succeed.

Q300 Chairman: But do they do anything? Has anything happened because of it that you can point to and say, "that only happened because there was such a committee"?
Mr Metcalfe: It is still early days, but our science council is a little bit older. Interestingly, the large companies in the region cite skills supply as one of the reasons that they are there. If you ask them for the top three reasons why they are there, supply of skills is usually in the top three. One of the things that the science industry council agrees on unanimously is the need to maintain and increase the skills supply. We had a bit of debate in the early days about what we meant by the skills supply, and it became clear that we were talking about different kinds of scientists. Some companies want out-and-out researchers with firsts and PhDs, and other companies want more technical graduates. They were talking different languages, but once they understood one another, there is a need for—

Q301 Chairman: Is not the real truth that universities do not know who the hell you are, or care? They make their own autonomous decisions—several of them have closed their science departments for other reasons—and they do not consult you, and you are left with the draught. You have a region without chemistry or physics or whatever and you just have to suck it and see. Is that not the reflection of what is happening?
Mr Buckland: I disagree with that because all RDAs have a vice chancellor on their board, so there is a linkage there; and we have linkage with the regional HERDAs as well.

Q302 Chairman: Is Steve Smith on your board?
Mr Buckland: I know Steve Smith very well, but we have Eric Thomas, who is the Vice Chancellor at Bristol. We work with vice chancellors. We were informed by Steve Smith just prior to their announcement, but that was obviously an internal university—

Q303 Chairman: What did you say—"too bad"?
Mr Buckland: No, we—

Q304 Chairman: Did you say, "This is going to really, really hurt our interaction with business and universities"?
Mr Buckland: We work with the universities in the region, so, as I said earlier, we have the same level of provision of chemistry within the region and they have pushed into their strengths, and are at roughly the same level of capacity.

Q305 Chairman: Do you really believe, Nick, that regional development is the big idea that is bearing the fruit of science development, irrespective of the odd department closing?
Mr Buckland: I think there are difficulties with these departments closing, and we have to make sure that we have the balance in the region to take up the requirements of the region; so we have to look at it on that strategic level across the region.

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Q306 Dr Turner: How worried would you be about the economy of your region if one of the core science subjects became extinct in it, like chemistry? Would you feel the need to try and intervene? Would you be happy to contemplate that? If Exeter has gone, what if Bristol closed its chemistry department as well? You would not have any chemistry for 100 miles.
Mr Buckland: It would be further than that. I live on the Devon/Cornwall border and we are further away from Bristol than Nottingham is. If you go further down into the peninsula the distances get greater, so there are issues on that. We have to look very closely at that and work with the vice chancellors and—

Q307 Dr Turner: How drastic would the circumstances have to be before you would want to intervene?
Mr Buckland: I think we would monitor that very closely and work closely with the vice chancellors. That is all we could do.

Q308 Dr Turner: Do you think it would be better to preserve lower quality university courses rather than lose them altogether at the regional level? Where would you set your limits?
Mr Metcalfe: I am not quite sure what you mean by "lower quality"; it is quite a loaded question. Certainly, there was a debate earlier about teaching-only departments, and it may well be necessary to have some form of outposts or hubs and spokes associated with some of the main universities where subjects are taught locally and feed in at a higher level, perhaps final year or postgraduate level into larger universities. There have been some very good successes. Certainly Plymouth, with its foundation degrees out in local FE colleges and then feeding it to the centre, has worked extremely well. That is a very successful programme.

Q309 Dr Turner: What about the sector skills councils? How much influence do they have over university courses in particular? Do you think they should have more influence?
Mr Metcalfe: The Lambert report was quite specific, that they should have more influence on curriculum development and course delivery. Of course, they are still fairly new, but we have worked with some of the sector skills councils, and e-Skills UK particularly. The problem is perhaps the supply of graduates in a certain area. They are saying, "we are not getting the right kind of graduates" and the university was saying, "of course you are; we are producing firsts and 2.1s and good degrees and you are employing them, so what is the problem?" When we got involved we understood that the employers were looking for a certain kind of graduate, and we helped them develop a degree that is now being developed within the universities, so there is a solution.

Q310 Paul Farrelly: We have mentioned the teaching debate, which we had earlier, and perhaps you will forgive me for mentioning Keele University for the third time. We have a nice little science park developing next to Keele and it is particularly developing a medical cluster, based on a lot of NHS investments going in, and that indeed is part of the RDA's economic strategy and fully supported by Advantage West Midlands. However, many people argue that that sits ill with Keele—not expansion of science in terms of research or teaching but actually a contraction that we have seen. It does not provide the best narrative or advertisement for developing a science capability. The question is not what RDAs can do to stop this, because I think it is very limited at the moment, but what would be the one way in the future in which you would recommend that we might consider for you to improve your level of influence over what is happening and what is supported at an RDA level in terms of the economic development of the region?
Mr Metcalfe: One of the things we are beginning to do in our universities is to encourage people to work together more closely. If universities worked at a sub-regional level, certainly in a larger region like mine as a cluster, collectively—we are coming from the business support end, but there are other indications for this, so collectively they produce what the region needs. They can perhaps agree amongst themselves; there is a chemistry department, a physics department, and as long as the travel times between the universities and businesses are not too high, you can see how the model might work. There is the beginning of such a model in the West Focus Consortium, which is based in West London, going out along the Thames; we have six universities coming together, initially around the HEIF proposal, but we see no reason why that should not extend to subject provision.
Mr Buckland: In Exeter, for example, the RDA there has been investing with them and developing an innovation centre, and relating that to some of their strengths. Certainly, the Peninsular (Exeter) Medical School is developing that area and activity, so we are working together.
Dr Bushaway: The problem really is the sub-regional question. If regions are to be cohesive, then you must play your assets as a team and you must look at what you have got to do. The problem for the RDA is that you are really asking them to be counter-intuitive. If the reasons for closure are because funding levels are insufficient to sustain the activity, and that is because the quality levels under a selective system are not bringing in enough resource, it is surely then counter-intuitive for the RDA to effectively support what is then a sub-regional lame duck and to go against the policy of national selectivity? We can argue—and you were doing that with the previous witnesses—whether that policy is correct, but as long as it is there it seems to me that it is very difficult to see the RDA having to come in and pick up the baton on almost a counter-intuitive basis.

Q311 Dr Turner: How much of this is chicken and egg? Obviously, it must be more difficult to sustain a department either an undergraduate or research department, if there is not a strong science-based industry presence in the region as well. What happens in your regions? Which do you think is coming first?

Dr Bushaway: There are four legs to this particular stool. The one is national policy, as reflected in the research councils and HEFCE, or the councils generally; the second is the demand-side that is coming from employers and businesses, whether they are within the region or nationally or whatever; the third then is the supply-side stimulation at the primary and secondary level, and is there a flow through to universities of the right kinds of students with the right kinds of backgrounds at primary and secondary level; and then the fourth is the university leg where you have got to then deal with all three and make sure that you are able to respond as effectively as you can; but you are an autonomous and independently financed organisation whose job, through its own governing council, is to sustain its business. It is a complex interaction between those four issues. It would be wrong to suggest that I know the answer as to when that balance got out of kilter, whether it was at national policy level or the law of unintended consequences, or whether somewhere along the line we have lost the demand-side, or we have problems lower down the supply-side chain; but somewhere there, in all four of those issues and their inter-relatedness, has to be the answer to the question.

Dr Iddon: The Medical Research Council, thank God, say that in order to address the inequalities of health which exist across the regions of the United Kingdom, there should be a key medical school in each of those regions. The northern regions have suffered badly in the decline of major manufacturing industries in those regions, and just as the inequalities of health are greater up there, the inequalities of regeneration and the science base are less up there than they are in the south. Nothing annoyed the north-west more than when the Daresbury Synchatron disappeared almost and became the Diamond Synchatron Project in Oxfordshire. It just seems to people who live in the north that there is a greater and greater concentration in the red-hot economy of the south, when we should be regenerating the northern regions by preserving a high standard of science bases.

Q312 Chairman: If I can paraphrase that, why do the universities like Cambridge do better than Bolton? Is it something in the water? Is it the soil? What is it?

Mr Metcalfe: There is quite a few hundred years' history in that. The northern RDAs have invested quite heavily in supporting the universities and industrial R&D support, so the north-east for example has set up centres of excellence, which have had quite substantial investments in supporting universities and helping them work more closely with business. The RDAs are very aware of these disparities; in fact, it is the northern RDAs that led the way—

Q313 Dr Iddon: Is the science establishment supporting them?

Mr Metcalfe: I am not quite sure what you mean by "the science establishment": do you mean—

Q314 Dr Iddon: I am talking about the power of Oxford, Cambridge and London, as the Chairman implied. Are we not losing out to the golden triangle, because that is where the academic power lies?

Mr Metcalfe: I think the golden triangle sees a lot more investment from the RDAs in the north going up there, and they say to us, "why are you not investing as much as in the north?" There is a lot going on up there to try and help redress the disparities. I think you have to do both; you have to invest to support science development in the north, and also you have to keep the triangle going.

Dr Bushaway: One of the most important things that has not really been touched on, as far as I can see, in this debate is the business of regional retention of intellectual property and its management. That seems to be where Cambridge does particularly well. If you take elsewhere, the Synchatron example, it was true that for the old-style public sector research establishments the package around how intellectual property was generated and how it was retained and how it was commercialised was very, very unclear, and I suspect most of the commercialisation that would generate from that kind of activity would simply lead the way either to other regions or outside the country. One of the things that Lambert really hit on was the business of better management of intellectual property. We do need to endorse what that was saying and create the Cambridge phenomenon all over the country, all over the other regions. There does not seem to me to be any inherent principles that should prevent that.

Q315 Chairman: The Cambridge phenomenon gets this name, and we can ask how it started; it was three guys in a pub actually! It is not very sophisticated science, getting the small businesses going. That could happen in Bolton or in any place really. What are you doing to encourage that to happen, is what we want to know.

Dr Bushaway: I think in all the regions, as far as the universities engaged with RDAs are concerned, we are all looking at how we can commercialise IP more effectively for the benefit of the region. It is now embedded in regional economic strategy. It is encouraged, for example, in the AWM sub-regional investment in strategic funds for drawing out IP and commercialising, and—

Q316 Chairman: Bob, while you are looking at it, the Chinese and the Indians are doing it. They do not mess about with committee after committee after committee, and report after report, coloured and beautiful as they are; they get on and do it.

Dr Bushaway: Everything is new in the current situation as far as the England regions are concerned, and from the university perspective there is a perception that the regional development agencies are working out a wholly new set of procedures and administrative arrangements. They are relatively immature bodies in the best possible sense of the word.

Mr Buckland: We are investing. I have mentioned the innovation centres that we are investing in with universities, and science parks as well. Again, in the south-west, there are some very good examples of that, like Tamar Science Park in Plymouth. There is some science park activity going on in Cornwall, and some of the activity has been in train or on the books for something like 10 or 15 years. In Bristol we are now investing in that and making that happen, so there is investment happening there.

Q317 Chairman: Your confidence comes through but we are doubtful.

Mr Metcalfe: That will grow because from April this year we will have a new role. We will be measured on how well we have got business and universities to work together, and we will be investing in that.

Chairman: We will watch and wait. Thank you very much indeed.

Wednesday 2 March 2005

Members present:

Dr Ian Gibson, in the Chair

Dr Evan Harris
Dr Brian Iddon
Mr Robert Key
Dr Desmond Turner

Witnesses: **Professor Bob Boucher,** Fellow, Royal Academy of Engineering, **Dr Simon Campbell,** President, Royal Society of Chemistry, **Professor Peter Main,** Director, Education and Science, Institute of Physics, **Professor Sir Tom Blundell,** President, Biosciences Federation and **Professor Amanda Chetwynd,** Vice President, London Mathematical Society, examined.

Q318 Chairman: Thank you very much for coming. We are on time and we will try and have you all finished by 11.00 if we have sharp answers. You are a huge team, so I hope you have agreed amongst yourselves how you will answer because five answers to every question will take all day and we are not going to sit here all day and I am sure you do not want to. Thank you very much for coming to help us. You know that science teaching and research in universities and what is happening is a serious issue and we wish to obtain information from you. You will know that university science and technology departments have closed recently. Do you care very much, does it matter at all or are we exaggerating it? Who wants to start off answering this question? Tom, you are a man who is often keen with views on universities.

Professor Sir Tom Blundell: Of course it matters but we must have a policy which is related to research and teaching. In the biological sciences, we have had increasing numbers of students but of course we have not had increases of funding. The problems for chemistry and physics are rather different, but of course both of these affect biology as well as chemistry and physics and maths because we need a multidisciplinary university with chemistry and physics teaching to be strong if biology is going to be strong. There are some pressures on biological science departments as well. Even in Cambridge, we are having to merge two departments because resources have decreased as a result of RAE4, so closures are not confined to the physical sciences. I should let my colleagues from the other societies respond.

Dr Campbell: Of course it matters. The Government have stressed that they see science and technology as the future for the economy of the country and therefore we do need trained scientists, so of course it matters. The worry that we have at the moment is that the closures we are seeing are cost driven and random. There is no sense of a national strategy and there is no sense of regional needs. As students see closures occurring, they will be concerned about taking chemistry at other institutions. We are very concerned that we are going to see a domino effect. So, yes, it does matter and the key issue is that chemistry has to be properly funded. It is an expensive subject but the return to the country with respect to the chemicals industry, which is a major manufacturing sector, is enormous. The pharmaceutical industry is one of the few industries that is world class. The return on investment in a chemistry degree is higher than most other subjects. So, yes, it is expensive to teach and do research in chemistry but the economic returns to the country and the individual are enormous. So, yes, it matters and it matters very seriously for the future economic state of the nation.

Q319 Chairman: Since you are talking, Simon, you are doing a report at the minute in the Royal Society of Chemistry. What have you found so far? What are the preliminary observations?

Dr Campbell: The report on . . . ?

Q320 Chairman: The report on the future of chemistry departments in universities and the income and expenditure into chemistry in universities.

Dr Campbell: We have surveyed eight chemistry departments across the country and all of them are running at a loss. The loss range is between 20 to 60% of their budget. In every case, research is subsidising teaching. The whole sector is running at a loss. We heard in the previous session that probably no chemistry department is sustainable under the—

Q321 Chairman: They should all close down would be the automatic monetarist view.

Dr Campbell: No. I think, if you take Tom's point, chemistry is very important in its own right and underpins so many other areas of science. We saw that the NIMR decided to go to University College rather than Kings because of the strength of physics and chemistry. So, rather than closing chemistry down, it needs to be supported and incentive provided for universities to continue teaching—

Q322 Chairman: Simon, we will return to the autonomy of universities later but, if they are independent, they have to make tough decisions and, if chemistry departments are running at a loss, what is the message?

Dr Campbell: The message to the Government is that chemistry must be properly funded. You could argue another way, that the Government are compromising university autonomy by not funding chemistry and other physical sciences. They are forcing vice chancellors to make choices that they do not want to make. Many vice chancellors do not

2 March 2005 Professor Bob Boucher, Dr Simon Campbell, Professor Peter Main, Professor Sir Tom Blundell and Professor Amanda Chetwynd

want to close their chemistry and physical science departments but are being forced to do it because of the chronic under-funding.

Professor Sir Tom Blundell: The funding for all subjects is less than we require. Analysis of even the biological subjects shows that we do not have sufficient funding for teaching or of course for the infrastructure for research, although that is looking better with the present Government's policies with SRIF etc. But it is under-funding generally because HEFCE has not really calculated how much science costs to teach and research.

Professor Main: I could repeat almost everything that Simon has said; I will not of course. Almost every physics department in the country that we speak to is running in the red. My own department—I was Head of Department at Nottingham two years ago—was the equivalent of eight to 10 members of staff in the red, even though we had one of the highest student:staff ratios in the country. So, there is something wrong with the financial models in various universities. Just to answer your original question, about the demand for physicists—do we need them? Is it a problem? There is plenty of evidence that physicists are in high demand. The study referred to the salaries of physics, chemistry and engineering graduates being higher than for most other subjects, certainly all the arts and humanities subjects, is really evidence for that and the other piece of evidence that I always put forward for the demand for physicists and scientists is the shortage of school teachers. You just cannot get physics graduates to become school teachers and the reason for that is quite simply that they can do other things with higher salaries and less hassle.

Professor Boucher: The strategy being adopted in the universities is basically one that has been described as "last man standing", that is that I, as a vice chancellor, would certainly not want to close any of my science and engineering departments and I have to say that they are all tolerably healthy and there is no risk of that but, in the event that a chemistry department is in deficit, what any vice chancellor would seek to do in order to maintain a healthy provision across the sciences is to subsidise—it is known as collegiality within universities—that department for a number of years, but you cannot go forever doing that. The issue therefore is future confidence in the prospects for that department. Today on page 2 of the *Financial Times*, there are two articles. One says that the future exploitation of oil and gas in this country is threatened by the lack of graduate engineering supply. The second one says that, in the areas of the environment where we have to deal with coastal defences and flood protection in the future, we simply do not have enough civil engineers. There you are referring to people who made their career choices six and seven years ago but you want them today and they did not know six or seven years ago that there would be jobs going paying reasonable salaries. One of the fundamental problems appears to me to be summarised in a graph I saw in a report by Professor Alan Smithers about three years ago looking at a 10 year trend of students leaving school with at least two science A levels, which included mathematics by the way, and, from the independent sector, the line was flat—it wobbled a little but basically it was flat. Over 10 years, the number of students leaving independent sector with two science A levels was flat. In the state sector, it dropped from—and I have forgotten—three or four times the independent sector until, at the point at which the report was produced, the 15 or 16% of the students educated in the independent sector were producing 50% of the students with two science A levels. So, the state school sector has seen a tremendous fall in the qualified output to study science and engineering at universities, a deeply fundament problem, in my view. Then, when students come to university, we have seen improvements in science funding for research. On the teaching side, many teaching laboratories for chemistry, physics, engineering and so on are mahogany benches and out-of-date equipment, so it is not surprising that the kids are not turned on.

Professor Chetwynd: I think the maths case is just a little different. At the moment, we only have about 60 universities still teaching full maths degrees in Britain and yet mathematics obviously underpins all the subjects that are here in front of you today, but it also underpins social science subjects and management. All such subjects doing research in universities need the dynamic ever-changing maths research that is going on to make sure they are successful.

Q323 Chairman: My last question is to you, Simon. One thing that disturbed some of us on this Committee was a young student from Exeter from the chemistry department which was closing reading about it in the media. Was that fuelled by a press release from the Royal Society of Chemistry, the media intervention in that, because she said quite clearly to us that she learnt about it in the media first?

Dr Campbell: My recollection is that the press release from the Royal Society of Chemistry went out the evening before the formal announcement. So, I cannot answer your question because I do not know how she came by that information. It went out the evening before the formal announcement.

Q324 Chairman: It could have been in the papers the next morning before the students were told by the tutors or vice chancellor.

Dr Campbell: I cannot answer that question; I was in South Africa. All I can say is that the press release went out the morning before.

Q325 Chairman: Could I ask the Royal Society of Chemistry to give us a statement on that, please.

Dr Campbell: Yes.

Q326 Dr Turner: There has long been discussion about skill shortage in science and technology subjects, much of it anecdotal of course. We do not really know what the numbers are in any discipline

with any reliability. Can you—and I guess it is going to need an answer from everybody on behalf of each discipline—quickly tell us how you think your discipline is affected in terms of skill shortage.
Dr Campbell: In terms of students taking A levels, there has been no change in chemistry over the last decade. In terms of undergraduates taking chemistry at university, since 2000 the number has been constant at around 3,500 and went up slightly last year. With respect to chemistry needs, we need skilled graduates and PhDs in the pharmaceutical industry, the chemical industry, in teaching and all walks of life. If chemists are involved throughout society and scientists are involved throughout society, I think that would be beneficial.

Q327 Dr Turner: Can you put a percentage on the increase in the numbers of graduates that you think would be desirable?
Dr Campbell: I cannot; I hope my colleagues can. I cannot give you an accurate figure, no.
I would think fully funding the current crop of graduates and research students is what we should concentrate on and then worry about increasing numbers later.
Professor Boucher: It is the case that, as you say, the evidence is largely anecdotal and the Royal Academy of Engineering does hear from its fellows in industry that they are unable to recruit enough engineering talent and I quoted today the two examples in the *FT* of the shortage of engineers in those two key disciplines. The fact is that currently, on graduation, 85% of students graduating in engineering and indeed the sciences are in employment at the muster date, which is 31 December year of graduation. There are higher figures but that is a pretty high figure. So, it does suggest that there is demand. I have to confess that, when I look at salaries, the average starting salary in 2003 nationally, the last one available, for industrial graduates was £17,000 which is not in the high zone. So, it does suggest that some of the problem is one of appropriate salaries. Then you ask yourself, why does the market not work? It is a conundrum that I have never been able to solve. When there is a shortage of supply, normally the price goes up and there is a market response and, in this area, I simply do not understand what is going on. Sir David King suggested that the United States have solved this problem by importing. 50% of all graduate engineers in employment in the United States today were not born in the United States and that probably has dampened the market in the United States keeping salaries low there and that has had a ripple effect. That is one explanation I have received.
Professor Main: For physics, just following Simon's lead, the A levels have fallen dramatically. In the last 15 years or so, we have lost 30% of people who do physics A level and that is very serious because it does not only affect physics of course, it underpins so much of other science, particularly engineering. So, the cohort that we can all draw upon has dropped considerably in recent years. Undergraduate numbers have been reasonably flat in physics. I think it is probably fair to say that we are now at a position where the number of people who want to do physics is approximately equal to the number of people who do study physics. There are essentially no students who are turned away. Anyone who wants to do the subject can. I would anticipate that, over the next few years, if nothing else happens, we will see a steady fall off from hereon. I think that is almost inevitable from the situation that we have now. In terms of how many physicists we need, this is a really difficult problem. I will repeat the point I made about the teaching. There is considerable evidence that there are not enough physicists around because we do need more professional physicists to become teachers and they just will not do that while the prospects for them are so buoyant in the private sector and so on. What your question illustrates is the complete lack of planning that we have in the higher education market because you could ask the same question of any subject almost, with the exception of the controlled professions like doctors and so on, and no one would know. I mean, how many psychologists do we need? The number of psychologists is going through the roof at the moment. How many do we need is the sort of question that I do not think anyone can answer. I think that what we really do need—Simon mentioned it at the beginning—is a national strategy whereby we do look at the higher education market all the way round and try and see how many graduates we might need in different subjects and, if we do identify some serious shortages, then we should really try and do something proactive to prevent those shortages.

Q328 Dr Turner: I guess the picture is slightly different with biological sciences because they seem a little sexier and some people are foolish enough to think that they are easier.
Professor Sir Tom Blundell: It is very uneven in biology. We are looking at a spectrum of science where, as it were, the population of students is moving across. So, within the biological sciences, we have less biochemists and more psychologists and brain scientists. The total numbers hide the real problems. The problems, I think, in terms of supply that we find from the industry and from other employers are rather specific and I can give you three areas where this is true. The pharmaceutical industry is exercised by the fact that too few people have skills with animal science because a lot of their operations depend on animal experiments and they have asked us to increase in that area. The Society of Microbiology has huge concerns about microbiology which obviously underpins very many areas of public health as well as key areas in industry. I think much of this has been affected by the very low, unreasonably low, cost of antibiotics and the calculations that industry makes as to whether it is worthwhile doing research in that area due to the very high costs of doing real microbial research. This affects employment opportunities and the aspirations of the young to study in the area. I think we are in danger of having too few practitioners in

the area which means that a lot of our hospitals are going to depend on people who really do not have practical experience. The other area, which may surprise you, is the agricultural science area and I think that is maybe because agricultural science having large animals is so very expensive, it cannot be done within an interdisciplinary context of the normal university and is beginning to occur only in specific institutions. I think they are just three examples against this huge increase of people on the psychology end if you like where there are real problems within the spectrum. I think one of the message is that we have to really look very carefully at what students are doing and not just class everybody together as biologists.

Professor Chetwynd: In terms of mathematics, we know that there has been a 25% fall in the number of students doing mathematics A level over the last 20 years. The number going into maths degrees has slightly increased but nothing like the huge general increase in numbers going into university. We know that there is a lack of maths teachers. In the last figures I have seen, there was a target for the numbers of new teachers they wanted and they got 25% less than that. We know that mathematicians can command very high salaries, 10% higher than an average graduate, so there must be a demand and therefore we assume there is not a sufficient supply. The recent international review of mathematics research was very concerned about the shortage of young people going into research in mathematics. One example where we can see that we do not have enough well trained mathematicians is the Government's Office of National Statistics. They do not have enough well trained mathematicians; they cannot even count more accurately than within 20% the number of people living in Westminster.

Q329 Dr Turner: To what extent do you feel companies are using science graduates properly and wanting research deals and are able to use them commercially to increase their competitiveness? If companies were producing a real market pull for good graduates, do you not think that this could in the long term make quite a bit change in the situation?

Professor Boucher: There has been a recent international study of engineering in the United Kingdom and one of the remarks made by that international panel was the failure generally in engineering—and I do think this applies much more widely than engineering—to recruit people whom I have often described as technology absorbers, that is to say people with higher degrees who are capable of identifying opportunities offered by new technologies and new science in the marketplace to absorb it into the companies. It is the culture of British industry that generally people with higher degrees were not particularly valued, certainly not in the way they are in the United States. Consequently, I think that does hamper the capacity of many businesses to absorb change and new technologies and new ideas.

Dr Campbell: May I speak for the pharmaceutical industry and the biotech industry. Well-trained scientists are highly valued in the pharmaceutical industry. The pharmaceutical industry is one of the few sectors that the DTI scoreboard said was world class. So, I think there is a very good market for trained scientists in the pharmaceutical industry. Interestingly, over the last 10 years, the company I worked for is now taking 20% of its intake from continental Europe whereas, 10 years ago, it took nothing from continental Europe, so there has been a shift there. If you look at the biotech industry which Tom Blundell is involved with, a lot of the spinouts are chemistry driven and a lot of the spinouts have a high demand for highly trained graduates and PhDs.

Professor Sir Tom Blundell: There is certainly a huge demand for medicinal chemists in even the mainline biotech companies.

Professor Main: Could I just almost challenge the basis of the question because the implication is that the market from salaries would feed back to the choice of A levels which of course is what is driving everything, the student choice at university. There is no evidence that that happens and there seems to be a mismatch in the market. You have the employers' market and you have the market for higher education and it seems to me that the market for higher education is being driven entirely by student choice and that is ill informed student choice and that, I think, is probably one of the largest problems we will face.

Q330 Dr Turner: One of the other things that graduates want is satisfaction out of their work and if there is quality research being done in companies, that is also going to be an attraction. Am I right in drawing the correlation between the investment in R&D as a percentage of turnover typically in, say, the engineering industry, contrasting that with that in pharmaceuticals where the picture is completely different?

Dr Campbell: The pharmaceutical industry invests about 15% of its turnover in R&D. Engineering is lower, but I cannot make any further comment on that.

Professor Boucher: The big research funders of course are Pharma, Aerospace and there is a third one which I have forgotten. Generally speaking, across most of British industry, we know from our national statistics in terms of the per cent of spend that goes into R&D in this country, we are below the average and the Government have set targets to try and raise that. I think it is a chronic issue in British business and industry.

Professor Sir Tom Blundell: Can I make a comment about the new kind of market for graduates that I see in the Cambridge area? People come to Cambridge to work in companies like the one I founded, Astex, not to work in a specific company for all time but to work as part of a community in the biotech area or IT areas. I think that the new concept of an exciting career of moving on from company to company with new challenges all the time has really replaced the concept of a large company providing careers throughout one's life. That aspect of careers could be advertised by universities a little more. Students realise it when they get to university, I think they realise the excitement, younger students probably do not see that kind of opportunity when they are in schools.

Chairman: We have 20 minutes left and there are at least five or six questions. You are really going to have to try—I know it is difficult because you have a lot to say—and be precise and I will ask the Committee to be precise in their questions.

Q331 Dr Harris: I am restricting my questions to the Royal Society of Chemistry and the Institute of Physics mainly because I want to ask about the specifics of what is going on at the moment. The Institute of Physics say in their evidence that they would never want to prevent students from taking, say, history or media studies but it must be made clear to them that, in so doing, they will severely hamper their career opportunities etc. What is wrong with actually saying to the Government, "There is a need to have more physics, chemistry and maths graduates and therefore we are going to effectively restrict the choice opportunities of those other subjects in order to help careers advice push people into the areas of study that the country needs which are currently funded by the taxpayer through the Government"? Why not? We do it for medicine.

Professor Main: You do not actually do it for medicine in the sense that you prevent other people from doing degrees. You do it for medicine in that you cap the number of people who enter medical degrees. Is that what you mean?

Q332 Dr Harris: What about if you force the expansion in medicine? There has been an expansion in medical student numbers and, if there is an overall limit to the number of students, which is in the evidence that the Institute of Physics give, more popular departments where you can increase easily and get more money in and it is good value squeezes the smaller departments. That is made clear here. Why not reverse that trend at least? It may not be depriving all the choice but it should restrict choice, clearly.

Professor Main: You mean by restricting choice for subjects which the nation deems to be not satisfactory?

Q333 Dr Harris: Let us say that actually you have less of a chance of getting in to study media studies than you do at the moment because there are fewer places because it has been made worthwhile by the Government in a proactive way for universities to offer more places to chemists, of the required quality obviously, than it is for media studies. Halve the funding for students of media studies, double it for chemistry.

Professor Main: I think there are two issues there. One is whether or not we go into a social engineering position and I think I would be reluctant to recommend that we actually say that you start to cap certain courses in order to promote chemistry and physics. I hope we would promote chemistry and physics. What I would say is that the way perhaps to do it is the financial way, to recognise that the returns on science subjects, physics and chemistry graduates, is greater than the return on the art subjects and to subsequently increase the funding that you would get for teaching SET subjects and to make that argument about the employability, the prospects for physics and chemistry graduates, well known to students in order that there is a demand for the physics and chemistry courses.

Q334 Dr Harris: Dr Campbell said in an earlier answer that he would want to concentrate first on proper funding of the numbers doing chemistry at the moment before thinking of expanding the numbers. Was that an accurate paraphrasing of what you said?

Dr Campbell: Yes.

Q335 Dr Harris: If so, what are we going to do about the shortage of chemistry teachers unless we increase the numbers going through?

Dr Campbell: I think we have to take first things first. The science base is crumbling through chronic under funding and I think we have to stabilise the science base that has been chronically under funded. Let us stabilise the science base first and then think about expansion. Coming back to your question, I think we are seeing inappropriate choice of A level subjects. In our day, physics, chemistry and maths were the norm and one went on from there. Now, it is chemistry, medieval art and Japanese and unfortunately that does not set you for a career in science. So, I think there is a difficulty there. With respect to funding, the Government are going to have to make some hard decisions. The Head of the Forensic Science Service last week, or the week before maybe, in this Committee said, "How are we going to employ all the forensic scientists we are training?" We certainly do not hear those comments about physics, chemistry, biology and maths. If there are subjects where there are graduates being overproduced, I think the Government have to decide to shift some of that funding to subjects such as the physical sciences and maths where we know there are good employment opportunities and where we know there is chronic under funding. Yes, there are some hard decisions and, if it is a fixed budget game, then subjects such as the physical sciences need to be reinforced possibly at the expense of other subjects where graduates are being overproduced.

Professor Main: Ultimately, you cannot create demand if it is not there. It is all very well saying that we can reduce the number of media studies people, but those people probably will not want to choose to do physics and chemistry. So, it is really about increasing the demand for the subjects that we want. I do not find it personally very helpful to go around trying to criticise other subjects that happen to be popular amongst students.

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Q336 Dr Harris: Is it sensible, if we are short of people who are capable of completing physics and chemistry degrees and then potentially going in to teach that at school, to actually have a situation where, assuming that they are of the necessary quality, I am not asking to reduce that, there is ever over-subscription for chemistry and physics places in universities with adequately competent people? Is that sensible? That is why I raised the question as to whether it is satisfactory, even on the short term, to just concentrate on doing what we have now better funded rather than immediately seek to ensure that we increase the throughput in the hope, with other policies, that they start teaching these subjects in schools and saying, "I did it, you should do it"?

Dr Campbell: I think increasing the throughput is the longer term. Clearly, we have to work harder with teachers and we have to work harder in schools. Increasing throughput is a longer term objective. There is a short-term objective of properly funding physical sciences in the UK. If we wait until 2008 for the HEFCE review, then we will see closure after closure and the science base will have eroded. There is a short-term problem of under funding that we must address and there is a longer-term problem of increasing throughput.

Q337 Dr Harris: Finally from me, there is this question that was raised yesterday in the science question time which I think many people here heard which is about what this survey meant showing that science graduates have good earning capacity and this might lure children away from studying photography into studying chemistry at the appropriate point, which I think is a moot point. One of the questions raised was whether that required significant numbers of chemistry, physics and maths graduates to go into the City in order to get that lifetime earning potential or whether that study related to people who included chemistry and physics teachers only and people in industry and people in academia or whether it was everyone with a degree.

Professor Main: The technical answer to the question is that it is everyone with a degree and the survey was carried out looking at the labour force survey, using data from that and comparing graduates of particular disciplines regardless of the job that they subsequently went into. What it illustrates actually to me is the sheer applicability of degrees in subjects such as engineering, chemistry and physics across the board. In terms of physics, you will find physicists in dozens of departments in many universities.

Q338 Mr Key: How well does the research assessment exercise measure the usefulness of a department?

Professor Boucher: Could I quote something from a recent international study of engineering which I think produced some revealing facts on this. The review panel was comprised of eminent engineers from around the world and they looked at both quality of research and what they called impact of research and the impact was measured by exploitation by industry, pay from spinout companies and so on. They produced a scatter diagram of quality on the vertical axis and impact on the horizontal axis. The interesting point was that, if you cut that into four quadrants, the bottom right-hand quadrant was unpopulated. In other words, the higher the quality of the research that they measured, the greater was the impact in terms of its usefulness and its application. So, that is just one study that indicates that clearly there is a correlation between . . . What it says is that doing research at the highest international standards is more likely to produce benefits to industry that are exploited.

Professor Sir Tom Blundell: Could I just make a comment in terms of the biotechnology area. Of those in my university, Cambridge who have been active in translating their research and have been involved in spinouts, many of them, in fact the majority of them, are exactly those who are likely to get into the Royal Society. There is a very strong correlation between innovation in the science in the academic sense and innovation in terms of spinouts and translational activities of that kind. There is not an anti-correlation as many people assume. The other thing just to note is that all the small new companies are around Cambridge, Oxford and London. They are not around universities that do not have good RAE scores.

Professor Chetwynd: The RAE properly funds five, five-star and six-star departments but it does not properly fund grade four departments and grade four departments have work of national importance. The other point to note particularly for mathematics is that the RAE makes research concentrations in universities rather than spreading it and, with mathematics, there is no financial argument for concentration because we do not use expensive equipment.

Q339 Mr Key: Professor Chetwynd, if you were in HEFCE's position, would you take some of the money away from five and five-star departments in order to support grade four or lower?

Professor Chetwynd: I would make the cliff less steep and I would put more money in altogether.

Q340 Mr Key: Does anyone wish to comment on that?

Dr Campbell: I think the problem, as Brian said this morning, is that the cliff is very steep between five-star, five and fours and that is the problem, but we need more money.

Q341 Mr Key: Do those institutions that are at the bottom of that cliff have any hope realistically of ever catching up or are they just condemned to receive less funding?

Professor Boucher: When you say "institutions", I think you mean subjects.

Q342 Mr Key: Yes.
Professor Boucher: Subjects within institutions and the answer comes back to my point earlier about cross-subsidy and collegiality. The guidance to R&D said there were three things you could do if you did not have top class: you could fix it, sell it or close it. That is what a vice chancellor faces when looking at a department. So, if you have a chemistry department that is a grade four for example and you are in a university that seeks to be comprehensive, your first attempt is going to be to fix, so you will cross-subsidise. However, as I said earlier, it can only go on for so long. There is a limit to collegiality. It boils down to a fine relationship at the end of the day.
Professor Main: Can I just add something on the University of Newcastle because that was one of the central factors in the University of Newcastle, that the vice chancellor then felt that the physics department was not capable of being taken up to a grade five with the sort of investment money that was available.

Q343 Chairman: Just to challenge Tom Blundell, there are other universities producing good spinout companies as well: Newcastle, Dundee, Manchester and so on. That argues that all over the country there is excellence. You are perpetuating the myth that Oxford and Cambridge rule the higher education system.
Professor Sir Tom Blundell: I think that you need to talk to the venture capitalists and others and see where they are actually investing funding. As it happens, you have mentioned three of the very good universities which I think in a way supports my point. Manchester and Dundee, for example, have superb biological sciences with a lot of understanding of translation but there is this question of critical mass. If you talk to venture capitalists, I think you will find that they would prefer to put in most of the funding in the other corridor.

Q344 Chairman: Is there any university department anywhere in this country that does not have a five or five-star that you know of? In my opinion, they all have one or two or three or four. So, there is excellence everywhere.
Professor Sir Tom Blundell: Yes, but I think what you need is critical mass because the way that small companies work, as I said before, is that you have a community of individuals who move between companies. I think you need the whole range of activities to get that sort of culture. I think that it can be done around Manchester and it can certainly be done around Dundee, but I do not think you can do it around one five-star department.

Q345 Dr Harris: The unit of funding was criticised by the current Government for falling year on year under the Conservative Government up to 1997. Have you seen a significant increase in the unit of funding in your department per student since 1997?
Professor Boucher: Unit of funding for teaching?

Q346 Dr Harris: Yes.
Professor Boucher: That has first stabilised and then increased by very small percentages, sometimes level with inflation, sometimes 0.5% above inflation. Remember, we are talking about an historically under funded system. The reason that, from time to time, the emergency brigade comes in with money to deal with capital and maintenance backlog is because basically there is not full economic funding of teaching and we conduct the exercise at a loss and it is not surprising therefore that we are not able to steward funds to replace our equipment and repair our buildings because it is chronically under funded. So, yes, there has been a modest increase bit it is an increase that is still in a situation where there is chronic under funding.

Q347 Dr Harris: In some of the evidence we had, HEFCE stated that the resource for SET subjects actually increased by 5.5% despite the weighting of the SET subjects changing from 2% to 1.7%. Do you recognise that increase?
Professor Chetwynd: Mathematics is not at that level, it has decreased, and HEFCE say that research helps out the teaching funding, so it is not sufficient.

Q348 Dr Harris: Do you think that is a problem with the mathematics and HEFCE in their calculations?
Professor Chetwynd: I do.
Chairman: Publish or be damned!

Q349 Dr Harris: Perhaps you can give us a critique because that might be useful because there cannot be two answers.
Professor Chetwynd: Also, in mathematics cases, service teaching with mathematics does, that is not properly funded and it therefore makes departments want to do their own service teaching and that causes more problems again.
Professor Sir Tom Blundell: We have done an analysis in our school in Cambridge and I think the teaching looks as if it is about one third under funded and that is actually funded through research activity. So, I think what is happening in many universities is that the research funding coming in through QR and other mechanisms is actually enabling us to put on high quality projects and research program training in the second and third years of degrees. Many people seem to think that teaching has been funding research but it is clearly the other way round and we need to, in our school, increase funding for teaching. In Cambridge Biological Sciences the total funding for teaching out of the £24 million we have is probably running at something like a third and we need to increase it by £3 million.

Q350 Dr Harris: Are teaching only departments viable professionally and could it be done financially, though clearly not now?
Professor Sir Tom Blundell: My analysis of it in our subject is that you can certainly teach very well with some lecturers just doing teaching and little research but I think it is going to be very difficult to put on

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high quality honours degrees without having the research-led environment. I think we are therefore going to have mainly teaching universities in some areas, but there will have to be some arrangement between institutions, perhaps on a regional basis, so that people can move to the research-led part perhaps in the third year to make it a proper degree.
Professor Main: One possible model that you might look at is to look at things in a different way and have perhaps institutions that could teach you degree level science and physics in my case say for the first couple of years. Most departments really share the first two years of syllabus and curriculum and the research tends to enter in the third and fourth years and it might be possible to have institutions teaching the subject to this sort of common basic level and then people could leave those teaching only institutions and possibly become school teachers—it might be another route to improve school teachers—whereas the ones who wanted to go off and do professional research and become professional scientists would move to the research institutions.

Q351 Dr Harris: Is there anything good you can say about the decision to go from 2% in the waiting to 1.7%? It was described by someone yesterday at the Royal Society of Chemistry meeting as effectively vandalism, the stroke of a bureaucrat's pen, threatening the viability of departments. Can you see any reason why that should have been done?
Professor Boucher: No.

Q352 Chairman: So, here we are. Suddenly there is a TV programme and everybody gets keen on science and they flood in there, so all departments will be saved. Will they just because the student demand has increased? Do you have the confidence to believe that?
Professor Main: I am fairly confident that the reduction or at least the lack of increase in student demand has been the main reason why physics departments have closed. I am absolutely certain that the bigger departments, having seen the fall of the unit of resource just referred to, in order to keep their finances stable, have taken more and more students. I can point to some universities that have almost doubled their student quota as a result of that, including Nottingham.

Q353 Chairman: Has that saved their bacon or not?
Professor Main: It has preserved their bacon for the time being.

Q354 Chairman: But you have no confidence in the future then?
Professor Main: I have no confidence that, if the situation remains as it is now, we will not just keep—

Q355 Chairman: So science in higher education is in a mess.
Professor Main: We will keep losing departments off the bottom.
Dr Campbell: May I just come back to the point about Exeter? The number of students applying for chemistry at Exeter went up by 20% last year and still the department closed.

Q356 Chairman: That is a point, yes.
Dr Campbell: The numbers of students in Kings went up and in Queen Mary College went up. So, even when there is a healthy student demand, finances are forcing closure.

Q357 Chairman: So, the answer that we have more students going in and we have more people doing the subjects at schools is a simplistic analysis of what is going on in our higher education system. Is that not true?
Dr Campbell: The simplistic analysis is that where we have healthy student demand, finance is forcing closure of departments.
Professor Boucher: However, Chairman, it has to be said that, if you look at the university as an entity, if the university wants to expand its chemistry department by 50%, that would presumably be, without additional funding, at the expense of psychology and history, it would be at the expense of a lower cost entity. So, the university would now be running more expensive courses with the same funding.

Q358 Chairman: Come on, think out of your box just quickly. Should the kind of university you want be determined by these factors? What do you really believe in for higher education in this country? Where is your vision? What do you want? You are struggling to keep departments open, to get students. What a life! What a misery!
Professor Chetwynd: We want well taught students in school who can see the value of science and enjoy and have the thrill of the subjects which all of us did have and who will then go on to study them at university.
Professor Boucher: A supply of educated students who perhaps are assisted in making appropriate choices for their careers.
Dr Iddon: I have a declared registered interest which involves my relationship with the Royal Society of Chemistry.
Chairman: Thank you, that will be recorded.
Dr Iddon: I want to talk about something that I think Simon raised earlier, the autonomy for universities. I put it to the panel that the numbers coming out of medical schools have been carefully controlled, the numbers coming out of dentistry schools have been carefully controlled, there has been a cap-on undergraduate numbers in universities in the past. Come on, is this autonomy of universities not a myth?

Q359 Chairman: You do as you are told! Come on! Top-up fees? Yes, we will have them.
Professor Boucher: Plainly it is not a myth because you can see for yourself how universities have diversified in the courses they offer to students coming to them over the years. So, there clearly is a

high degree of university autonomy. The fact is of course in medicine and dentistry, the ones you quote, what you have done there is to cap over-demand.

Q360 Dr Iddon: Why should we do that? If students want to study medicine or any other subject, why should we not let them? That seems to be the philosophy. Why do we have to cap medicine?
Professor Boucher: You have to ask those who fund it because we do not cap medicine, we are formally capped.

Q361 Chairman: They say it is you who make the decisions.
Professor Boucher: No, not in medicine. That is certainly not the case.

Q362 Chairman: That is true of medicine but we are looking at science.
Professor Boucher: The point is the point that we came to earlier, that restricting student choice to study other subjects is not necessarily going to drive them into subjects which they are not motivated to study. So, you come back to the issue of first of all maintaining the system, keeping stability—I think that is the very first, stability—and the second one is the problem in the schools, it is a problem with the supply of educated students with an appropriate grounding in the sciences who are motivated to study the sciences and that does not appear to be happening at the moment.

Q363 Dr Iddon: Do vice chancellors not make their strategic decisions based on where the funding is available? In other words, if loads of students want to do forensic science, the universities shift in that direction. There does not seem to be any sensible strategic planning, if I may say so, with the national interest in mind.
Professor Chetwynd: They are planning locally; they have a strategic local plan. I do not think you can expect universities to have a global plan. The Government should set that.
Professor Main: If you are asking the question, should we have a national science strategy, I would answer very firmly, "Yes, we should." What is happening in universities is that the vice chancellors are responding to the economic environment which has been created by the Government. The economic environment that we have at the moment is that everything is being driven by student choice and student choice, for whatever reason, is moving into what I would call softer subjects, subjects that do not require specific A levels at entry, and subjects, as it appears to be the case, which do not have good employment prospects. That type of environment, which is a direct result, I believe, of recent Government policy, is the one in which vice chancellors have to operate. They do have a certain amount of autonomy. The sort of capping you are talking about, I agree with Bob entirely, is in subjects where there is high demand and subjects which are also very vocational. Of course, in the case of doctors, you have essentially one very large employer of doctors and you can predict very easily how many graduates you need. It is not so easy in science and engineering to do that and often we are producing graduates for where we will be in ten years' time and it is very difficult to predict that.
Dr Campbell: I just want to come back to the point Brian raised about university autonomy. Let us go back to Exeter again. The vice chancellor decided to close chemistry. I understand that Lord Sainsbury had no prior notice and Sir David King had no prior notice and they and HEFCE were not able to influence that decision. I would say that is university autonomy but not being exercised in a way that I would like to see it exercised.
Chairman: They could cut the money off next year.

Q364 Dr Harris: My last question is, if we really want to build a good reservoir—and I emphasise this—of good quality SET undergraduates, do we think we should give them incentives like financial incentives, a grant for example, to encourage them to do the subject, whatever the subject is in SET?
Professor Chetwynd: I think we have to do that certainly initially because we must get better teachers into the schools, well-qualified science teachers into the schools. We have to do something to attract the students to study the subjects in schools.
Professor Boucher: I think one would not say "no" to almost anything that would help at the margins in the current crisis.

Q365 Chairman: Tom, you have been salivating there! I can see you are itching to say it.
Professor Sir Tom Blundell: I think at the postgraduate level maybe we are just seeing a model now. I look back a year or so ago and saw almost no change in response to the increasing stipends. This year, it has changed radically. We have a very large number of students coming through at postgraduate level, much more healthy. I would have thought that if we do something like that at the undergraduate level as well, we might hope to—

Q366 Chairman: Are there figures on that, Tom, or is it just your feeling?
Professor Sir Tom Blundell: I think it is too early to get figures. I am just telling you what has happened in my department and my school. We are hugely oversubscribed this year and I find it extremely encouraging.

Q367 Dr Harris: Could it be that higher levels of debt, which are going to happen now obviously, might actually negate the impact that raised stipends are having because you are back to square one?
Professor Sir Tom Blundell: I was presented with all these kinds of arguments. Just recently I have actually seen a turn round, so I am now optimistic that that fraction with the higher stipend—

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Q368 Dr Harris: There is bound to be more debt because top-up debt has not yet been imposed and you are aware that is going to come down the line?
Professor Sir Tom Blundell: Yes.
Chairman: I think it is probably a good point to end that with a little optimism shining through. Thankyou very much. We will be meeting the sages, the vice chancellors, next week, Bob and some others, and we will look forward to their vision and what they are going to do about it and how they see their miserable lives or optimistic lives! Thank you very much.

Witnesses: **Professor Richard Bruckdorfer,** Department of Biochemistry and Molecular Biology, University College London, and President of University College London AUT branch, and **Mr Malcolm Keight,** AUT Deputy General Secretary, examined.

Chairman: We will try and keep this session short and sharp because you have heard the matters before and I am sure you can amplify some and disagree with others, but we will try and give you a chance to get you to put some ideas forward. We are looking for the big ideas basically, what you think should be done, rather than moaning and whinging about what has happened. We know what has happened. Thank you very, very much for coming from the AUT. Brian wants to declare something.
Dr Iddon: Can I declare another interest in that I am a member of the AUT.

Q369 Chairman: Brian is a member of so many societies! I am not currently a member of the AUT, so I am all right! We have heard from students that careers in research are unappealing because of the lack of job security and poor pay. Is this true? Is that your general feeling?
Professor Bruckdorfer: Not only students but even the post-docs who have already moved into that area are extremely anxious about their prospects for the future. Certainly, postgraduate students see that as a major problem. I am a biochemist, by the way, so am doing a little better in the biological sciences.

Q370 Chairman: You do not have to declare that!
Professor Bruckdorfer: I think they look at us very closely because they see at close quarters what our lives are about. A number of them want to do research but they think twice about becoming a university teacher who is also doing research. That is undoubtedly something that is crossing their minds.

Q371 Chairman: What would make our young people want to be in careers that some of us were in? Miserable as it was, we were there and we did our work and enjoyed it.
Professor Bruckdorfer: All the positive messages come out on biological sciences particularly, through the television and they see the wonderful things that we all do as scientists but chemistry and physics get far less exposure in that respect. A great deal of it is disease related. So, many of them quite enjoy something that is going to—

Q372 Chairman: Dr Who was not good enough!
Professor Bruckdorfer: That is right. I think that young people do have an altruistic streak which is appealed to through things that they see on the television and read in the press, but of course they get a bit more hardnosed a little later on when they are thinking about a career and money becomes an important factor in it. I do not think that scientists generally and certainly not university staff are perceived as people, by the look of their clothes as they are walking around the department—

Q373 Chairman: You also know that they have these short-term contracts too and you have this EU Directive. Is that going to help at all?
Professor Bruckdorfer: We are trying to make it help. Undoubtedly, the short-term contract issue is a very, very potent issue. I have a particular client, a member of our AUT, who has been on a short-term contract for 24 years, Dr Cecil Thompson, a Afro-Caribbean of whom we have few in the profession, who at the moment is being threatened with redundancy because he has been on short-term contracts all this time. You have heard before you Dr Eva Link in other sessions here similar sorts of problems that have been raised. We really do have people moving out and deciding to do something like accountancy. School teaching has become more appealing again up to a point because the salaries are somewhat better. They are extremely financially driven and that overtakes the altruistic feelings that they originally had.

Q374 Chairman: Are you saying that the directive is no good in effect or for people who are coming into the profession, they will be all right?
Mr Keight: There are signs that some institutions are beginning to respond to the directive which will have a real impact in July 2006. Institutions such as Reading, Surrey and Bristol are coming up with very good statements of intent. At the moment, that is not feeding through into the statistics.

Q375 Chairman: The world is full of statements of intent but where is it actually happening that they are going to do it, where they have actually recruited people and have said, "There will be a job providing you go through the two or three hurdles—good teacher, good research or whatever"? Why is that happening?
Mr Keight: It is not feeding through in terms of statistics. Statistics still show 93% of research staff employed on fixed-term contracts. Apart from the inertia of employers in actually converting those statements of intent into practice—

Q376 Chairman: Who are the employers?
Mr Keight: University institutions.

Q377 Chairman: Do you equate an employer with the vice chancellor of a university or some democratic system that has passed us by?
Mr Keight: Certainly the democratic system does not function in terms of determining individual contracts. The point I would like to add is that what would seriously undermine the impact of the fixed-term employment regulations is the attitude of certain Research Councils, most notably the MRC and also the EPSRC, that still seem to want to live in a world where academics have to run the gauntlet of series of fixed-term contracts to stand any chance whatsoever of establishing a career and they really must review their polices and ensure that the benefits of the regulations are completely . . .

Q378 Dr Turner: We hear critiques of the concentration of research funding into the golden triangle: 40% goes into the golden triangle and you are lucky enough to be in it, Professor.
Professor Bruckdorfer: Yes.

Q379 Dr Turner: Is this in fact desirable and are there disadvantages? The Royal Academy of Engineering in their evidence told us that any further concentration would damage the ability of young researchers in less favoured institutions to win funding and affect the flow of talent. Have you concentrated quite enough already, thank you very much? Do you think it is going to be deleterious to the whole national higher education system if there is any further concentration?
Mr Keight: The short answer is, "yes". There has been a great deal of information produced recently showing that if you look at departments graded as four and assume that they are not going to survive, then there will be a great dearth, certainly in physics and chemistry, in places like the north west of England, East Anglia, the south and the south west. If you ally that with the trend to increased home base students, that means that they are going to be denied that quality of education which a greater dispersion has had in the past and clearly that is a major problem.

Q380 Dr Turner: There would also be no research in those areas.
Mr Keight: Indeed and certainly the policy which the DfES in particular has been pursuing for 20 years now that somehow there is a way of separating the funding between teaching and research means that early examples of the practice in institutions is to either give people emphasis on research or give it up altogether because the funding is not there. So, to try and separate the two means that the system becomes unviable.

Q381 Dr Turner: Do you have a different view from within the golden triangle?
Professor Bruckdorfer: As somebody brought up in the north of England and having studied at the University of Liverpool, I certainly have my prejudices to maintain the presence of all of these activities in the north of England and other parts of the UK. I am a prime example: I was brought up on a council housing estate and my natural inclination was to go to my local university which happened to be, in this case, Liverpool. Maybe things have changed, people become a little more global than they used to be in what their choices are, but I think that first of all, if there were no research in these universities, that would be quite catastrophic. The central part of our activities—and certainly I am very much engaged in training third year biochemists as well as medical students who are doing intercalated BScs, is the research project. You have to have people there on the ground to be able to sustain them. We have a serious financial problem every year because the staff ask, "Where is the money to actually run these projects?" We give them about £300 for each project to actually sustain the project and probably most of that actually comes out of their other research funds. Teaching is being supported, as was said earlier, by that research and I do not see how projects of that nature and actual practical training can be done in a university which has no research activity. That is why the traditional department had a mixture of people, most of whom were both active in research and teaching, a minority were the FRSs etc who were just doing research and occasionally popped in and gave a lecture, and there were a few who administered the teaching and did quite a bit of the teaching themselves. So, we had a mixture of university staff and that was a mixed and happy department. Now, as the students will tell you, most of the staff are anxious about their research output and that is done to the detriment of the teaching and students actually complain that they are not getting the benefit of those staff.

Q382 Dr Turner: What is your view on what is causing this concentration? Is the effect of RAE, for instance, having an adverse effect increasing the concentration and killing off four departments which get nothing or practically nothing, nobody else gets anything and even five departments have lost value in the last redistribution and only five-star departments getting anywhere near the proper HEFCE funding? Can you see any ways forward that can reduce this concentration because you both seem to be agreed that it is unhealthy?
Professor Bruckdorfer: It is and, as was indicated before, it is likely to be solved by putting more money into it. I think nobody is against having periodic assessments of the performance of departments, but one of my colleagues mentioned to me that we go through this schizophrenic cycle where one minute we are all researchers to impress the RAE and the next minute the TQA comes along out in another cycle and suddenly we are all teachers. It seems that one way of getting around that is to actually have a system of assessment that looks at the total activities of the department and the requirements of that department in order to deliver them, maybe on the six year cycle that I believe your Committee was thinking about earlier, but undoubtedly setting people against each other

because everybody is looking out for their own position. It is not a healthy atmosphere within university departments at the moment and we really have to get away from that. To an extent, going back to the previous question, that the profession is looking unattractive.

Q383 Mr Key: Should we support low-rated regional south provision just to ensure that it is available to local students?
Professor Bruckdorfer: First of all, when you say "low", I do not think that four is low. Four is actually a very reasonable sort of figure for a department to actually have and shows probably mixtures of strengths within that department. Not everybody is research active. Some may be internationally active and some of them may be just of national reputation. It does give an incentive for a department to actually improve itself. If you only have all fives, what happens if those fives actually become less impressive and become four later, who are you going to replace them with because there is no other four that can come up and improve itself because it will have already been smashed as a research department? That is my concern. You are going to reduce the base of science in the UK totally and I am thinking that, for the future, where are all the great centres of science going to go? I suspect it is going to go to China and India in the future and not to the UK. If you look at United States and at Britain, very many research departments are sustained by people coming in to become post-docs from India and China and taking some of those techniques back home again because many of our youngsters do not actually want to have the rigour of being a post-doc and wondering about where the next grant is coming from. I think that we really do have to think very hard. Do we want to maintain Britain as a centre of excellence? I do not think it is done by just cutting off all the roots and just maintaining the flower in the middle.

Q384 Mr Key: You said in your evidence that there is—and I quote—"very little sign of any strategic thinking about regional provision." Is there a direct linkage between centres of strong research and better regional economic growth?
Mr Keight: I have to say that there is very little evidence. The regional development authorities are, I think, just beginning to identify the significance of higher education institutions to the economic development of their regions. The evidence on the ground is very slim. In terms of general observation, one can obviously see, if one looks at Manchester and the Liverpool area, clearly Manchester University is central to the economy of the North West. If you talk about East Anglia which is not particularly well provided; it has Cambridge sitting in the middle of it and there is an area of technological development around Cambridge but, for the rest of East Anglia, it is extremely poorly served and I think the economy probably bears that out. I think that the regional development authorities really need to wake up to just what it does mean to have the potential of a successful series of higher education institutions within their regions.

Q385 Chairman: What do you think the effect of the variable top-up fees is going to be? I know that it is guesswork at the moment.
Professor Bruckdorfer: Malcolm Grant, who is our Provost, told us that the net increase in our income at UCL resulting from top-up fees would be 2% in terms of the effect it is going to have on our whole . . .

Q386 Chairman: What about the entry of students, Richard? Will that make them live at home, for example?
Professor Bruckdorfer: I think it would force a number of them to live at home and again it is going to be discriminatory against those who have lesser incomes.

Q387 Chairman: Do you agree, Malcolm, in your position?
Mr Keight: Yes. The last estimate, although it keeps rising, is that, with the introduction of top-up fees, students will graduate with an average debt of £21,000. Obviously, there are ways of limiting that debt.

Q388 Chairman: Is the AUT position to get the students out from home, get them out from under the feet of their guardians, parents or whatever?
Mr Keight: It is not for us to say what choice students make in that respect.

Q389 Chairman: Does the policy that institutes that they stay at home as against them going somewhere across the country and meeting other people influence the kind of education they get? You must have a view on that.
Mr Keight: I think one can always say that that experience, which most of our generation had, was beneficial and was part of the higher education experience.

Q390 Chairman: The working class boy next to you went to Liverpool, for goodness sake, another working class area. He never went to Cambridge or Oxford.
Professor Bruckdorfer: I think it will be interesting to look at France because they have a policy largely of keeping people in their areas unless you are going to one of the *grands écoles*. They very much do organise their universities in that way. Undoubtedly, there is a beneficial experience outside pure education in going to live independently somewhere else.

Q391 Chairman: Malcolm, I interrupted you. You ought to say what you wanted to say.
Mr Keight: I was just saying that those choices will be made by students for their own reasons and it is not really for us to say what those choices should be but what they should not be is a denial of that choice through funding and other incentives to enable students to study at the institution of their choice.

Q392 Dr Iddon: The evidence we have received from universities is that they do not support moves which would lead to the Government directly interfering in the academic and research priorities of individual universities, yet we have received other evidence, it would not surprise you if it came from Exeter University's chemistry department where the staff there would be glad if the Government had intervened to prevent the closure of Exeter. My question is, do you think there are any circumstances when the Government should intervene in the management of universities and particularly to prevent closure of departments?
Mr Keight: I think the short answer to that is "yes". Clearly, the autonomy of institutions is vital to a democratic society and I think that is something that we must always guard preciously. Having said that, clearly Government, through their funding regimes, are creating an environment which British institutions work in and, if they create an environment which leads to—and I will come back to Exeter in a moment because that is not the best example—subjects being lost, subjects of strategic importance, subjects like physic, chemistry and maths being lost through the nature of the funding regime, then obviously the Government are creating a wrong environment and that does, as Richard suggested earlier, need a root and branch review. Where one gets decisions such as Exeter where a good university decides to close a strategically important subject where student demand is buoyant and research is created of national, and some would say international, excellence, one must raise questions as to why individual institutions make that sort of choice. If the environment generally did not provide institutions with excuses to make those sorts of choices, then it would be more difficult.

Q393 Dr Iddon: What do you think the Government could do to save Exeter, just to take one example? There are others of course as well.
Mr Keight: I think the previous Secretary of State has taken the first step to flag up or ask the funding council to flag up that the Government do regard subjects as strategically important and too important simply to be left to the short-term demands of the market. That is the first valuable step. One would hope that the funding council would respond to that by demonstrating to these institutions, which have some very diligent accountants, to indicate that there are financial incentives to retaining these strategically important subjects.

Q394 Chairman: My last question is, would you take money from five and five-star departments and put it in fours at this moment in time?
Mr Keight: Given that more than enough money has already been expended in the E-university, I suppose it will have to come from somewhere else and again, as has been said, a slightly reduced gradient in terms of the cliff—

Q395 Chairman: Amongst the comrades in universities, they are helping somebody else. You have told me that grade-four departments are brilliant. Let us take the money from the excellence and give it to the fours. Is it not the problem that they do not want to give it?
Mr Keight: Robbing Peter to pay Paul—

Q396 Chairman: Well, at this moment in time until we get it straight. You could take the money now, you could argue for that and say, "We want more money from the fives to go into fours to keep them alive." That is often used as the argument.
Mr Keight: In terms of a short-term stopgap, then that would be . . .
Professor Bruckdorfer: It is the least worse option.

Q397 Chairman: Why are students not sitting in any more to protect departments? What is gone wrong?
Professor Bruckdorfer: Oh, my goodness! They have been depoliticised considerably.

Q398 Dr Harris: I just want to bring you back to this question of scientific careers in teaching. Is it a rational point of view that more people/students/graduates will go into teaching and research and lecturing, which are relatively less well paid, and all we have to do is increase their level of debt burden under the Government's new plans? Do you think there is a rational argument for that?
Mr Keight: You have to make the career attractive and it is anything but that at the moment. The biggest disincentive is that immensely demanding apprenticeship through years of postgraduate study which is not recognised in salary levels. We are not just about moving post-doctorate salary levels up to average graduate salary levels in the economy generally. So, there is still a lot more to be done there. Having to cope with that is also allied to this notion which is still held by some of the Research Councils that, in order to get into the (inaudible), you are expected to go through two, three or four fixed-term contracts and you may find that, if you do not make it, you are on fixed-term contracts for life.

Q399 Dr Harris: Perhaps you would like to comment on my question which was about debt. What I am trying to get at is, do you think that the problem in recruiting science graduates into teaching in schools or lecturing or into research is going to be made more difficult if the level of debt increases as it is Government policy to do?
Professor Bruckdorfer: The debt?

Q400 Dr Harris: The debt of graduates?
Professor Bruckdorfer: As far as school teaching is concerned, I would have thought that if there are adequate methods of funding teacher training in which they get a reasonable stipend to do that and if the debt repayment is held off until afterwards, which is I think the normal practice, and if there is proper remuneration as a teacher, that situation might improve. In fact, in biological sciences, I do not think there is a problem at all. They are paid the same. For some reason, there are rather specific

issues especially related to physics teaching. My daughter happens to be a physics teacher; she is family raising at the moment and she will ultimately no doubt go back to that profession. It is interesting that so few girls generally interest themselves in physics. I am not quite sure why that is but that has been a tradition for some time. So, it is a continuing factor that increasingly teaching is becoming a female profession. That is as far as the school teachers are concerned. I think the major problem as far as lecturing is concerned and becoming a lecturer or university professor is concerned is partly that they are low paid generally which has been a sore for many years and I do not want to go over that problem at this stage but, in addition to that, are the general anxieties that staff have and that rubs off on to the students, especially postgraduate students, and, as a result of that, that is seen as an unattractive option. I do not think so far that has been influenced so much by levels of debt, but I can fully imagine that it will get worse as we get top-up fees and the debt actually increases.

Chairman: Thank you very much, indeed. I know you could carry on for hours but you have given us a few straight messages that are very helpful from the coalface, as it were.

Wednesday 9 March 2005

Members present:

Dr Ian Gibson, in the Chair

Dr Evan Harris	Mr Robert Key
Dr Brian Iddon	Mr Tony McWalter

Witnesses: **Professor David Eastwood,** Vice Chancellor, University of East Anglia, **Professor Alasdair Smith,** Vice Chancellor, University of Sussex, Chair, 1994 Group, **Professor Steve Smith,** Vice Chancellor, University of Exeter, and **Professor Michael Sterling,** Vice Chancellor, University of Birmingham, Chair, Russell Group, examined.

Chairman: Thank you very much for coming to help us in our inquiry. The reason we are not so many this morning is because some of my colleagues have got problems in their constituencies with a General Election looming and so on and so I had to let them off. On Monday night we had a seven hour session talking about human embryology and we were trying to iron out in a bigger committee how to handle that and that is a really big issue.

Dr Iddon: Could I just declare two interests before we start? I am a Fellow of the Royal Society of Chemistry and a Member of the Association of University Teachers.

Q401 Chairman: HEFCE has announced a number of measures to help protect struggling departments of regional or national importance. How do you square this with a policy of non-intervention in the individual university's autonomy and so on? They are trying to impose something on you. Do you think there is a contradiction? I am talking about RDAs and all that kind of stuff. Is it interfering with your autonomy in any way?

Professor Alasdair Smith: I am not sure what specific HEFCE interventions you are talking about.

Q402 Chairman: I am talking about the kind of decisions they make about financing which might impose on you the closure of certain departments and so on. Is that being accelerated or ameliorated or whatever by these kinds of decisions?

Professor Alasdair Smith: I think there are two factors that have put some departments under pressure. One of them is the issue of HEFCE's funding formulae as between subjects and as between different levels of research performance, but the main influence arises from student demand which is not a HEFCE policy issue.

Q403 Chairman: I am thinking more of HEFCE saying they need these particular departments in your universities. What do you say to them when that happens, that they should run away and be good boys and girls, or has it not happened yet?

Professor Steve Smith: We have found HEFCE to be an enormously supportive broker. They have worked with us and other universities in the region to come up with a solution which actually increases the number of funded places for chemistry in the south-west. Our analysis is that by working collaboratively through HEFCE we have been able to come to a solution which we think strengthens chemistry provision in the long term, and I welcome that role of HEFCE as a broker rather than a manager or a planner.

Q404 Chairman: Has it propped up ailing science departments in any way?

Professor Steve Smith: I think what it has done is to balance two factors. One is the need for individual institutions to make strategic judgments about where to invest, the other is regional and national needs. The outcome of what they have done in our case has been to strengthen science provision in the region by allowing us to spend the same amount of money on science but on fewer subjects and putting extra resource into Bristol and Bath which enables them to make their chemistry provision more sustainable.

Q405 Chairman: Do you wish they had intervened much sooner and kept chemistry at Exeter? Let us suppose they had done this a year ago and they had propped you up by whatever mechanism, even extra money, what would you say to that?

Professor Steve Smith: That is a very delicate question. Of course, any vice chancellor would like the Funding Council to write them a cheque, but then every other vice chancellor has a right and that is the issue. We think the solution they have come up with, which is to preserve the provision of chemistry in the region, is actually the best for the south-west in the long run. We think that is probably the best solution we could have had.

Q406 Chairman: Did the other vice chancellors welcome interaction of that kind? It may not have happened yet, of course, but would you welcome it? Are you talking to them about the possibility?

Professor Sterling: I think there is a role for HEFCE as a broker when subjects are in difficulty because they obviously can operate confidentially and vice chancellors can approach them and say they are having difficulty with a particular subject and HEFCE can put them in touch with somebody else that might be willing to take those students. I see it less as a top-down intervention more as a brokering role. Where I have a slightly different view from HEFCE is in relation to the unit of resource where the evidence that you received from Sir Howard was that there was not a connection between the spend per student in a subject area and the demand for that subject. I think he said that it would not generate a single additional student. I do not agree with that. I believe that there is a coupling because if a course is well staffed, if it has attractive laboratories and a highly interactive environment for the students, that encourages applicants to come forward for that subject area and so effectively that generates the extra student demand, whereas if the student sees poor laboratories when they come round they are unlikely to choose to do that subject.

Professor Eastwood: My experience has been of helpful discussions with the Chief Executive of the Funding Council when I have been facing difficult decisions over the future of some provision at the university. I think there are two issues here. Steve referred to the regional issue in the case of larger subjects such as chemistry. There is also a national issue in the case of some minority subjects and I think HEFCE and the vice chancellors are very sensitive to the issue of being the provider of last resort. I think there are different kinds of issues depending on the subject area we are talking about. For most vice chancellors the facilitating role that colleagues have referred to, which HEFCE can play, is important. We would resist for all sorts of reasons a strict planning role.

Professor Alasdair Smith: I agree with my colleagues that HEFCE is a helpful body when we face particular pressure. Perhaps I can respond to something else that you said, Chairman, or respond in a slightly more general way. I think we have to be very wary of the notion of setting up safety nets for subjects which are in national difficulty. The evidence—and it is in the new *UUK Patterns of Higher Education Institutions* document which I think has been submitted to you—is that the system as a whole responds rather slowly to changes in student demand and the danger of having HEFCE taking on the role of helping subjects that are in difficulty is that it will make the system still slower to respond and it will encourage too many struggling departments to be kept going when a bit of rationalisation is actually in the national interest.

Q407 Chairman: You have talked about the national and international interests and so on, but who makes that decision? Is it the university, the Government, the region or *The Times Higher* who makes that decision?

Professor Alasdair Smith: In the end the decisions are made by universities responding to various pressures and incentives, particularly the pressures and incentives that come from student demand and from the provision of research funding.

Q408 Chairman: I am talking about strategic national funding. One could say what do the students know about that? Somebody has to make the decision that Chinese is what every young person in this country should speak. I could make a case for that. With billions going into science and China growing and so on it would be helpful if we spoke Chinese rather than forcing them to speak English.

Professor Alasdair Smith: I think there is quite a lot of evidence that the student market is pretty sophisticated in working out from information about different salary levels what is happening to demand. The student market works as well as any system of national manpower planning would do. Of course there is a role for strategic national decisions at the level of funding, particularly for research.

Q409 Chairman: Is this made at a government department level?

Professor Alasdair Smith: That is right.

Professor Sterling: I think the professions have a strong role to play here. As you know, I am an engineer and the engineering profession saw a downturn in the number of engineering applications coming forward pretty well across the board in all subject areas about five or six years ago. So the profession, together with the universities and the lead bodies in engineering, set out on a course to influence the media to produce more material about engineering. You must have noticed on television more programmes about civil engineering and mechanical engineering. It is my contention—and I cannot prove it—that the rise in engineering applications now is directly related to those initiatives that we took five or six years ago and that is particularly so because it is mechanical and civil engineering that have seen the biggest increases in recent times.

Q410 Chairman: Who made that decision, Michael, was it the Royal Academy of Engineering?

Professor Sterling: Yes, them together with all the professional institutions.

Q411 Chairman: So it was the profession generally.

Professor Sterling: The profession was very concerned about the downturn and the inability of a university to fill places with high quality students and so we set out deliberately to engage the media in that process. It is my contention that that has had a very positive effect. I am sure the same could be done in other disciplines as well. In physics their bursary scheme of £1,000 a year is already attracting increased student interest. Positive intervention can influence the market for strategic purposes.

Professor Steve Smith: I would very much agree with Michael and Alasdair. I cannot see a role for any one body in deciding this. I think there is a very delicate set of discussions to be had, especially about what the nation actually needs and I think the evidence base there is not clear. A lot of people make assertions about what the nation needs, but I am not sure either that we know or that any one body is actually the relevant body to make that decision.

Professor Eastwood: The only other point I would make is that sometimes what is badged strategic cuts goes in different directions. Currently we have had a debate focusing on chemistry and on the provision of undergraduate places, but there is a parallel debate to be had about the research base in a subject such as chemistry and being internationally competitive. I think there is a broad consensus that if we are to be, and to remain, internationally competitive size matters, critical mass matters and therefore the policy, which is in effect a settled policy of the concentration of research resources, is the right one. Once you commit to that kind of policy in an expensive research-led discipline then it will have consequences for the provision of undergraduate teaching.

Q412 Chairman: What about the incentives that Government could give? When you are planning you must think Government ought to be looking for support in certain areas and so on and yet you have got autonomy and so on, but you influence Government. What should happen in that area? What should Government be doing? Should there be another letter from the Minister?

Professor Sterling: I think there is something very positive that Government can do and it need not cost very much money either and that is to introduce the concept of national scholarships in areas that the Government sees as of strategic national importance. There need not be very many of them and they need not cost very much money. It is more the message that is given to perspective applicants rather than the actual sum of money that they would get that is important. That will be even more important as we move post-2006 with the increased tuition fees. That message will be well received by students because they are thinking more about the value of the course that they are going to do. I am not talking about hundreds of millions of pounds of intervention. This is a message that Government cares about these particular subject areas.

Professor Alasdair Smith: I completely agree with what Michael says; that is the sensible way to intervene because the problem in these subjects is a problem of student demand, so tackling the issue of incentivising student demand is the right way to take it forward.

Professor Steve Smith: I agree with that.

Professor Eastwood: The other point I would make is that where I think Government can and should intervene is with what is happening in secondary schools. There are other things in other areas of the education sector that Government could do very positively which would change the demand situation.

Q413 Chairman: How would you describe what we have done in secondary schools since 1997?

Professor Eastwood: Do you mean in general?

Q414 Chairman: In incentivising young people to do sciences.

Professor Eastwood: The record is a mixed one. My colleagues in my school of education tell me there is quite good evidence that in some areas the supply of teachers for science subjects is improving, most notably in the biological sciences. There is a genuine problem for colleagues in the secondary sector of science teaching because they are preparing some young people who are going to go on to study science at university and others are trying to create a higher form of scientific literacy for people who are not going to be scientists, and I think there are some real curriculum challenges there and some of the inflexibilities in the national curriculum have not been helpful. Most colleagues in schools would say if there was more investment in labs, in the ability to do science hands-on, to be enthused about doing science, that would move things forward. I think there is more that can be done and I say that without a reference to Tomlinson!

Q415 Chairman: You will notice a lot of money has been put into science this week without any discussion of those issues whatsoever that I have seen. I may be wrong about that. Is that how you see it too? The billions going into Biotech and so on, does that excite you?

Professor Sterling: It does. I believe that this Government has been very helpful to science and technology in terms of the additional research monies that have been going in. Obviously you have to pick winners in broad areas, which I think is what is being done at the moment. I welcome the additional money that has come into science and technology.

Q416 Dr Iddon: Do you think the media has been helpful or unhelpful with respect to SET subjects?

Professor Sterling: I think it depends on which particular media one is looking at.

Q417 Chairman: Let us start with John Humphrys, shall we?

Professor Sterling: I was thinking more of the TV media as they have been very helpful in my view. They have engaged with the agenda, particularly in engineering and increasingly in science and in explaining what a scientific or an engineering career is about. Perhaps the printed media are more about looking for a story and, therefore, closures and problems are more exciting than the underlying reality.

Q418 Dr Iddon: I was thinking in particular of the way that they have dealt with the environmental lobby.

Professor Sterling: The arguments around climate change and so on are very complicated. I sit on the Prime Minister's Science and Technology Advisory Council and that is one of the issues on energy particularly that we have been wrestling with. It is about trying to understand precisely what is going on and what should be done. It is very difficult for media to encapsulate those complex arguments for a lay readership and so I sympathise with the difficulty, but you tend to get a sensationalism in terms of what is going to happen to global matters, such as whether we are going to warm or cool as a planet, and those become the dominant issues rather than the underlying scientific argument.

Q419 Dr Iddon: Student demand has been blamed for SET departmental closures a lot, but the fact is that Exeter was doing well, Swansea was doing well and other university chemistry departments and physics departments were doing quite well and yet they have been closed. What factors are determining these closures as well as student demand?

Professor Steve Smith: I think we have to be very careful about the student demand question. The fact that has interested me most is that six institutions approached us about taking the chemistry students that we have at Exeter and each of them offered to take more students than we had. That means that there was clear capacity in those institutions. In our case chemistry met its quota, but that intake was 36 single honours students last year with the same cost base and at the same price band as biology which took in 96. Biology made a small profit on teaching and chemistry lost £188,000. The number of students and the qualifications they have is a very delicate issue. Our quota was an adjustment between the number of students with the right grade that we could get and the places available. Our quota in chemistry had gone down 21% in five years because the quality students were not there. My view on it all is that to be successful, for example, chemistry needs to be both five or five star and have good student demand and if any one of those is called into question I think it makes it very vulnerable. I imagine that the picture around the country is of five or five star chemistry departments that actually lose money despite getting students. I think there are two important things here. One is the issue of the research resource and the second is the ability to recruit at the right level, and I think there is a very serious issue about the number of students that wish to study chemistry.

Q420 Dr Iddon: Is that agreed across the table?

Professor Alasdair Smith: Yes.

Professor Sterling: Yes.

Professor Eastwood: I think most of us have had experience of revising down our quotas for a number of particularly the physical sciences. There is an interesting case study out there at the moment which is what is happening to applications in computer science, which are more or less in freefall nationally. It is something that is in some ways puzzling and so we do not yet have a firm analysis as to why this is happening, but what are universities going to do with large investments in computer science departments, computer science being very important to supporting other science, particularly given the rise of computational biology and so forth? There are real challenges there. In my own institution we have to reposition what we do in computer science in order both to support the research base and, we hope, to stem the decline in recruitment.

Q421 Dr Iddon: Why is it that some universities like York, no matter what the RAE exercise has delivered to the individual departments at York, can keep all its departments open, including chemistry?

Professor Steve Smith: The key figure about York is to look at the percentage of staff it has in a four ranking and below. Just off the top of my head, I think 85% of their staff are in five or five star. If you look at all of the closures in the last two years in the physical sciences, in every single case there are institutions that have around 40% or more of their staff in fours and below. There is a picture out there of institutions trying to act strategically to make choices about which subjects to support. I think York is a very strong institution across the board and, therefore, if you have got some activity, wherever it is, in a strong institution you can cross-subsidise, but once you have got very expensive sciences, which are four ranking, the costs of cross-subsidy would be such as to hold back investment in other areas of success.

Q422 Dr Iddon: Our information is that at Exeter the Engineering Department was losing more money than chemistry.

Professor Steve Smith: Correct.

Q423 Dr Iddon: But you have managed to maintain that department. How can that be? What decisions led you to close chemistry and keep engineering open even though engineering was making a greater loss?

Professor Steve Smith: Firstly, we have to delve a little bit behind the phrase "keep engineering open". In the School of Engineering, Computer Science and Maths we have lost 36 members of staff; in chemistry we have lost 24, so we have undertaken major surgery in engineering as well. Engineering was a part of a school that had some five ranking activity, so there was been inbuilt cross-subsidy. Engineering was having no problems in getting students and its research grant income was increasing. In chemistry student numbers were in decline, it had lost £3.5 million in five years and it was also losing research grant income, there was a 36% decline in chemistry research income in three years. We made the decision to invest in biosciences by taking the deficit in chemistry and reinvesting that money back in the new school. In engineering we were able to make the cuts required to balance the books by cutting out activity across the range of activity in the school. So it was actually a detailed management decision about how to configure those two science areas best for the markets that they were facing.

Q424 Dr Iddon: The Royal Society of Chemistry believes that we are merely "fire fighting" at the moment to meet short-term financial targets and that we are not looking at the long-term view in universities. What would happen if there was quite a significant swing back in favour of chemistry, physics and mathematics? Would you have the capacity to open those departments again and, if so, how would you do it?

Professor Sterling: I think there is a misconception that chemistry only exists within a chemistry department. In fact, the subject boundaries are quite permeable. Biosciences might have a lot of chemists in it, even medicine might and chemical engineering. What tends to happen is that if there is a decline in interest in one subject area you might dissolve the departmental boundary, but those chemists end up in other areas and that process can be reversed. It is expensive if you are starting from nothing because there might be no laboratories and they are expensive to equip. Unless you are coming out of science completely the process is reversible but, admittedly, at a cost.

Q425 Dr Iddon: My old university, Salford, had one of the best chemistry collections in terms of textbooks and journals, complete runs of journals, chemical abstracts, things like that. Are you able to maintain that just in case for the future or are your libraries abandoning those collections which are extremely valuable?

Professor Eastwood: Given the rise of e.publishing those issues are less difficult than they used to be. It is possible to get into a field and to buy a research resource in the way that you could not have done so 15 years ago. Perhaps I could give a local example of what Michael is talking about. In the brief hiatus between your chairman being at my university and me being at my university physics was closed at UEA and transferred to Bath. There are now more physicists on the staff at UEA than there were when we had the School of Physics. Colleagues in the science faculty at UEA are looking at ways in which we can grow our natural sciences degree in order to research the physics provision and at the same time try to create some kind of regional provision both of foundation science and of physics in a region where physics is under-provided. I do not think what Michael is talking about is simply hypothetical. Given the different alignment of disciplines and given multi-disciplinarity in a lot of institutions, subjects which might disappear in the sense of being badged into a department can continue a half life and from that half life there can be some regeneration.

Professor Alasdair Smith: Perhaps I can answer your question from a different angle. Sussex, like York, is an institution that has not closed any departments and I think it is important to emphasise that the system as a whole has coped with declining numbers in a variety of ways and closures are not the only way we cope with it. We have coped with the effect of declining student numbers by very considerably reducing the size of our departments of mathematics, physics, chemistry and engineering, and if there were a turnaround nationally then we would have very substantial capacity for expanding those departments back up. From what Steve said earlier about the response of other universities to the closure at Exeter and their capacity to gain additional numbers, I think you would find throughout the system that there is substantial capacity to expand pretty rapidly if the student numbers turned around.

Q426 Chairman: Do you predict that other departments will probably close in universities over the next few years because of this kind of climate that you are operating in?

Professor Sterling: As I understand it there are more than 40 chemistry departments nationally so that is quite a long way from a crisis.

Q427 Chairman: Did I use the word crisis?

Professor Sterling: Not at all, no. The media do though. We have got quite considerable scope for there to be some rationalisation in relation to falling student demand. I very much hope that student demand will turn around because of the media attention to the problem. As the Royal Society of Chemistry and so on address the student in school then it will create additional demand. If there are the good jobs there, particularly as we move post-2006, that will be reflected in student interest in doing those subjects. I am a little more optimistic than everybody else.

Q428 Chairman: Do you think after 2008 the RAE might disappear? Do you think there is a hiatus of mood developing that it has done its dirty work?

Professor Sterling: I think 2008 is still some way off. There are other mechanisms that are worth exploring in relation to the RAE post-2008. The issue is how you distribute a large amount of research money, and the RAE is the mechanism that has evolved over a number of years now but there are other mechanisms that could be proxy for it. I think there are active discussions beginning about what would come after RAE 2008 and I welcome those discussions.

Professor Eastwood: The smart money is on RAE 2008 being the last RAE in this kind of form. There is a discussion to be had before we decide what shape a subsequent RAE should take and that is what QR is for when you have got funding from the Research Councils and other Government departments and that debate is beginning and I think that will sharpen the thinking about what QR should be used for. When we have done that, as Michael says, we can then address what will be the appropriate mechanism for distributing QR in an FEC environment.

Professor Steve Smith: Could I just pick you up on one point? You talked about other departments closing. I think it is very important we note that the effect of the funding formula for fours, fives and five stars is not standing still, it is actually getting worse. This week we have seen the publication of the new HEFCE documentation of grant allocation. You will remember that this academic year if you were a four you got one unit of funding, if you were a five you got 2.7 and if you were a five star you got 3.3, but because they have limited the fours to real terms new growth and increased the funding from five to five stars that ratio has gone from one to 3.0 and then to 3.7, so it is actually making the situation slightly worse comparatively for four ranking departments. So institutions that have a lot of four ranking activity will see the pressure on them as money in effect is pulled from them and given to institutions with more five ranking activity.

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Q429 Mr Key: Professor Sterling, coming back to what you said about RAE, what other mechanisms are being talked about?
Professor Sterling: One of them is a revision to something that used to be called DR, directly research related funding, which was allocating a portion of the QR money originally in response to the amount of research grant income that a university receives. So one bids to Research Councils under OST separately, individually, competitively and if you are successful in that process all of that money was added up and used as the driver for allocating a stream of the research money from HEFCE, so it was still dual support but it was allocated on the basis of research grant and contract money awarded through the OST stream.

Q430 Mr Key: Do you have any other examples you could share with us?
Professor Sterling: The other one that was talked about in the debate about whether 2008 should go ahead is whether the QR money should transfer to OST, which is a big issue for many of us. I am sure there are multiple other possibilities.

Q431 Mr Key: You said earlier that when it came to science funding it was important to pick winners, but who should pick those winners?
Professor Sterling: For example, biotechnology has been a growth area. It is an area where we are strong in the UK. We might well be able to develop that and compete head on with the USA. I think there are quite clear areas where we can compete and I think Lord Sainsbury has been active in identifying what those are.

Q432 Mr Key: Professor Smith, I thought what you said about the Exeter situation was very profound, that it was quite clear that there was a significant surplus of chemistry places in institutions around the south-west. Is it true, therefore, that the real problem you have got here is that we are not attracting the best students into science overall? It is as simple as that. How do we start attracting better students into science?
Professor Steve Smith: I think you have put your finger on what I hope will be one of the very positive outcomes of the debate which really started with the Exeter decision and that is that it does strike me, in complete honesty, that this is not a supply problem, it is a demand problem. Universities do not want to go around shutting expensive facilities. You do not get pleasure from displacing students. You really try not to do this. I think the combination of a situation in which there are fewer well qualified students in many of the sciences than one would need to fill all the cases that are available nationally and the double-whammy of the research funding model means that institutions have to make choices. I think the debate that is needed is very much about what is the right balance of regional provision and national provision bearing in mind the ability and the need for institutions to make autonomous decisions.

Q433 Mr Key: With the wisdom of hindsight, it has really been crazy creating all these chemistry departments all over the country knowing that we are facing a decline in student numbers to fill them.
Professor Steve Smith: I do not know the data, but I do not think there has been a massive growth in chemistry departments. I think what has happened is that there has been a long-term decline in demand in science and engineering subjects and that is the problem.

Q434 Mr Key: So this is a problem that needs to be addressed at secondary school level.
Professor Steve Smith: Absolutely.

Q435 Mr Key: And that means, of course, also influencing the anti-science culture in the country, which comes back to journalism. I think Professor Eastwood spoke of inflexibilities in the national curriculum. What can you identify as inflexibility in the national curriculum that is putting the brake on the number of students coming forward?
Professor Eastwood: Let me turn it around and say that it seems to me that the decline in experimental science in schools is significant. I am a non-scientist so perhaps you should discount what I am now about to say, but a combination of poor facilities, insufficient resource for technicians and intrusive health and safety regulations mean that the excitement of seeing things happen in science is much diminished in schools. A lot of young people in schools are doing science but they do not quite see what the point is. Bringing the excitement back into science teaching is something which is important. I think one of the inflexibilities in the national curriculum is that once in a lifetime choices are made particularly at Key Stage 4 and beyond and there are rigidities, particularly post-16, in the kind of mix of subjects that students tend to go forward into and they were some of the issues that we were trying to grapple with in Tomlinson in trying to build greater flexibility into the system through the deployment of the recommendations. I think there are things there that can be done. I suppose the issue where we will have to wait and see is whether the push in science education in primary schools is going, as those cohorts go through, to change the pattern of take-up in secondary education.

Q436 Mr Key: I attended a science class in a comprehensive school in my constituency two Fridays ago and I was really excited by it because it was using interactive white boards. The frustration of the science teacher was that it was judged by 15 and 16 year olds to be too difficult to take up science and maths subjects in the face of the enormous range of "easy" options both at A-level and also through university. Why bother to work all those extra hours in labs? Why bother with the intellectual hassle when you can surf through in one of the other subjects? Is this not a real problem, that we are giving a false choice to our young people in this country at the moment thinking that they can get away with easy subjects?

Professor Eastwood: I think if you look at the data on so-called "easier" subjects you get a very mixed message. If you look at A-level outcomes and indeed if you look at first-degree outcomes, the subjects that the media often derive as "soft" subjects are harder to get As in and harder to get Firsts in. In my own institution the highest proportion of First Class degrees in the main is in the science disciplines. It depends what you are looking at. Some of those perceptions about harder and easier subjects are misperceptions.

Professor Steve Smith: One of the things that we are very keen to get involved in because we have seen it work, which we would heartily recommend, is the use of student mentors in schools. Fifteen per cent of the Exeter undergraduates in the first year are involved in something called the Students' Associate Scheme whereby they go to schools. Other universities are involved as well. We are now involved in a pilot project to get science undergraduates at Exeter to try and spend time in the classroom every week throughout the year. The evidence is that it is that enthusing of 15- and 16-year olds and maybe earlier by students who have got a real passion for the subject at university that can be very important in turning them on to thinking of it as exciting, and that is something where we certainly will be spending more resource to try and do our bit in the region to improve the access of students into science courses elsewhere.

Q437 Mr Key: In the interests of spreading best practice could I ask you to comment on something that I learnt at this comprehensive school and it was that a very large employer of scientists and engineers nearby, QinetiQ (it used to be DERA), is now offering students identified by the science teachers in the school £20 a week not to get Saturday jobs but to mentor those children in the run up to their A–levels. Is that a good idea?

Professor Sterling: Most certainly, yes.

Chairman: Is £20 enough?

Q438 Mr Key: It seems to be in that school. It is a wonderful school called Upper Avon in Durrington.

Professor Sterling: I think that is marvellous and if others would follow that example it could be very effective.

Q439 Chairman: When you are cutting up the block grant and you have these HEFCE weightings to go on, do you just throw them aside and get on with it anyway or are you guided by them?

Professor Sterling: I think most universities are aware of what the units of resource are by subject area. In the first part it reflects what those units of resource are and the total allocation is done on a student basis and then it looks at the strategic nature of what is coming out of that resource modelling.

Q440 Chairman: So they might not even be realistic in terms of your strategy?

Professor Sterling: What we would do at Birmingham, for example, and have done in the past is to look at chemistry and physics, which have been in deficit, and to say that, as a science and technology leading university, we felt it was important for us to stay in those areas. We have cross-subsidised but we have done it knowingly so that the rest of the university can see how much money it is costing the community to support those subjects while at the same time arguing nationally that we should be increasing the amounts of money for those subject areas which we feel is too low at the moment. You could argue that we could do that internally, but the problem is that one has to take money away at roughly two to one from the arts and humanity subject areas in order to support science and engineering.

Q441 Chairman: Does that cause resentment in the university community or do you not report it?

Professor Sterling: We certainly report it. It is totally transparent. It depends on the level. We have been able to get consensus in terms of the allocations in supporting the science subjects which have been in some financial difficulty. It is interesting now that chemistry at Birmingham is coming out of the difficulties. We are recruiting well. Our applications this year have gone up 38% on last year, a very big increase and that goes part way to addressing a question that I think you asked earlier witnesses about what happens if vice chancellors all take the same decisions at the same time to come out of chemistry, would that not be against the national interest? It is unlikely that vice chancellors would do that because what happens is there is a delayed effect each year. Some vice chancellors decide that strategically chemistry is not important and therefore close it. Those applicants that would have gone to that university are now dispersed across the rest and as that process continues applications at the remaining universities go up and so the viability of their department gets better and that is tending to happen now. We are on the margin of turning over which is why I am a little bit more optimistic than some of the media are. That big increase in applications is also reflected to a lesser extent in physics as well. As universities close down their activities the remaining departments benefit. I do not think there is a likelihood that all of a sudden vice chancellors would say we are coming out of chemistry simultaneously and create zero chemistry departments because it is progressive over the years and there is a feedback mechanism in the process.

Q442 Chairman: When they came up with the teaching funding formula they told us that they consulted a community. Do you think they got their sums wrong or did they consult and then go ahead anyway?

Professor Sterling: The teaching funding HEFCE ran into some difficulties with because the basis of the analysis was flawed in my view. Perhaps I can take a moment to explain why I think it is flawed. They looked at expenditure in each subject area. I

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will take two examples, engineering and chemistry, and compare the two. In chemistry it was held that expenditure was going up. Why was it going up? It was going up because the student number was going down and it was difficult for chemistry staff to find alternative jobs outside the academic world. So essentially you had a high cost base remaining in staffing costs and a declining number of students and therefore your unit cost was going up. If you contrast that with engineering, engineering numbers were going down but staff numbers were also going down because engineering staff could make the transition into the commercial industrial world much more easily, so your cost base was going down. What appeared to happen is that the unit of resource, the spend, was going down for engineering and HEFCE then drew the conclusion that you do not need to spend as much money on engineering because the unit of resource is lower but you need to support science more.

Q443 Chairman: There was a flaw in their allocations.
Professor Sterling: In my view there was.

Q444 Chairman: I guess that put you in somewhat of a mess.
Professor Sterling: At that point we have to smooth that out within an institution, we have to transfer resources and that is one of the arguments for cross-subsidy with an institution, that somehow we do not agree with what is being done and therefore we have to correct that internally.

Q445 Chairman: We have been talking about cross-subsidy between departments, but let us think about cross-subsidy between teaching and research. Everybody who has done research in university knows that you can fiddle your grant money to help students and so on because there is not any teaching budget there. If that is the phenomenon that occurs, how come some departments which just teach and do very little research survive?
Professor Alasdair Smith: The objective evidence from the studies that have been done on full economic costing is that both teaching and research are under-resourced. It is not a matter of one being cross-subsidised at the expense of the other, they are both being subsidised out of universities other income sources.

Q446 Chairman: People have to help the teaching. For example, undergraduates in their final year of doing projects, where does that money come from? There is not a budget necessarily in the department, in the university or in the system and so you have to take it from your research grant in some way. That is a phenomenon that has gone on for a long time. I am asking you about where teaching occurs only. If you have not got that source of money how can you teach undergraduates?
Professor Alasdair Smith: Teaching undergraduates without research funding is not really a resourcing issue, it is an issue of what kind of teaching we want to provide. I think we provide better quality teaching for undergraduates in a research environment, but it is because of the academic environment, it not because of cross-subsidies.

Q447 Chairman: The young people we met were so excited about going to university, not because of the teaching but because they would get a chance to see research and engage with the upfront stuff and that is very important. What we are worried about and other people are worried about is that you have a teaching only department where they do not get that excitement. Some universities will be hybrids and they will not go there. Even if you teach them at school they will say there is nowhere to go. You will not have enough places. I am exaggerating the situation because it will be different across the country, but it is a phenomenon that could blight what we are trying to do.
Professor Sterling: It is difficult in a finite resource world. I think there is a difference between staff that are working themselves at the cutting edge of research and clearly that is an advantage compared with staff that are not. The intermediate category is that those staff that are teaching are aware of where the leading edge of research is even if they are not doing it. That is what I would call scholarship. It is important for all academic staff to be engaged in scholarship even if they personally themselves are not at the cutting edge of research. It is an intermediate position between a teaching only concept where the staff are merely teaching students without an awareness of research and a research led one.

Q448 Chairman: You could go into a department which accentuated teaching as the function and get your promotion based on that so to heck with cutting edge research and so on. You can do just enough, write a book every 10 years or a report or so on, which is an academic exercise and well worthwhile but not what you are trying to do in universities.
Professor Sterling: I would suspect that you and the students are right, that it is more attractive for students to come to a research intensive environment, but we have to recognise that there is only a finite amount of research money to go round.

Q449 Chairman: You have got to be careful with the word environment as that suggests it is the university. They come to the department, the scholar, the teacher, or the subsection of the department, that is what attracts them and that is who they identify with generally. The poor resourcing from alumni shows that they do not identify particularly well with the university in this country.
Professor Sterling: I was meaning environment in the context that you have just said.
Professor Eastwood: The analysis of costs and income based on the TRAC methodology suggested that the deficit was greater on research than it was on teaching and that work has been broadly accepted

by Government because it underpins the rather good funding settlement for research that is now going through where resource for research is increasing on the assumption that research volumes will not go up. So we will get to a point where we think that the research activities of research intensive universities will come back into balance, so in the recent past that cross-subsidisation from research into teaching has not happened, it has not been possible and that explains the phenomenon that you describe, that you can run predominantly teaching departments more or less in balance. It is on research that we have been losing a lot of money, which goes back to Steve's point that if the QR is at grade four level or lower the search base is virtually impossible to sustain.

Q450 Chairman: Do you accept the point that there is cross-subsidy within departments, not globally? I accept the global figure across the whole university sector. I do not deny at all your conclusion. In a department where they have got to make this decision of running their department it is often a cross-subsidy into teaching that makes it difficult for them to get a good grade and which allows them to be susceptible to being a poor four.

Professor Eastwood: It all depends what you think is paying the salaries.

Q451 Chairman: Who do you think pays?

Professor Eastwood: My point is that at departmental level the salaries are already paid. It might show as a deficit on universities internal accounts but the salaries are being paid and so what is being moved around is discretionary spend.

Q452 Chairman: The salaries are now negotiable. We have been told that some professors get more than others and so on. There is not a universal figure to attract the best. There is huge variation in professors, is there not, and you decide who gets what which messes up the whole financing of your departments?

Professor Eastwood: I think you will find they are deeply strategic decisions.

Q453 Chairman: Absolutely.

Professor Eastwood: Consistent with the strategic direction of the university.

Q454 Dr Harris: Would you say that it is the first priority of higher education to sustain truly world class science research in this country?

Professor Sterling: I think it is vital for this country to be conducting world class research because the knock-on effects of not doing that would be so serious on the economy.

Q455 Dr Harris: Let me repeat the question. Is it the first priority of the higher education system and its funders to sustain first class research? Obviously it is important and vital and good.

Professor Sterling: There are two elements to that. Higher education in a university is about teaching and research, it is a combination. I think we have made a case in our Russell Group submission that to try and separate out a research institute that is only doing world class research is very unwise and the combination of the two creates a major strength that takes the teaching of students into the context of the world class research and that combination is important. In aggregate it is important to have strong universities that are active in science and technology. I cannot see that a concept where you could have a set of research institutes that were doing the world class research and somehow still have a set of institutes that were teaching only that were producing world class graduates separately works. That model does not seem to make sense to me.

Q456 Dr Harris: That is a helpful answer. I am not sure if it answers the question about whether it could be described as a first priority. Messages are important here.

Professor Sterling: Financially speaking, teaching is the largest income stream for universities. You have to say that, by the amount of money that is coming in, it is more important than research. You would not have a strong teaching environment that was world class if you were not able to offer a research environment to staff. Staff are motivated by research, they want to explore new knowledge and it is their ability to do that and transfer that to the student that creates world class graduates. The two are properly interlinked. Trying to separate out whether it is teaching that is more important than research I do not think leads us to the right conclusion.

Professor Steve Smith: My take on your question is that it is in the UK's strategic interest to have a variety of institutions delivering outstanding research and outstanding teaching to meet the needs of the economy and of the society. It is a very easy question to ask at one level. The problem is that to say yes or no to it is a trap because, frankly, we do not want an economy that just has a small number of research institutes that do not teach. There is massive vocational teaching need. There is a whole set of developments. For me the key is that all universities are now caught up in a process whereby we are being asked to choose our missions much more carefully and to make sure that we are good at whatever it is that we do. I think that is what has led in part to universities rationalising science provision, that attempt to adjust to the strengths of the individual institution.

Q457 Dr Harris: Is there an argument for saying that if you do not fund research as much as you are doing you can catch that up by refunding it and attracting people in, but if you do not fund teaching and you lose the stream of teachers, particularly in secondary schools, then it is much more difficult to catch up later? Perhaps we are in that situation given the problem of recruiting science specialist teachers in

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secondary schools. There is an argument about sustainability applying greater to teaching than to research.

Professor Steve Smith: That is true, but the slight worry I have about the way you phrased it is that it implies that the problem is a supply problem. I think the problem in science and engineering is a demand problem. It is not about the supply of places, it is about the demand for those places.

Q458 Dr Harris: Perhaps you can clarify it in the context of a shortage of science teachers. Can you just restate that and say for those of us who are not economists and want to deal with teachers rather than graphs of supply and demand what you mean?

Professor Steve Smith: Put very simply, just to take chemistry as an example, there is not a shortage of places for chemistry, there is an excess of places over the number of students that wish to study the subject. The problem is not the institutions cutting back provision as such but the absence of demand that creates that problem.

Q459 Dr Harris: There are two concepts, the supply of graduates and then feeling that they cannot afford the salary of a secondary school teacher with their debt and so forth maybe. If you do not have a supply of chemistry graduates going into teaching then that can create a problem of demand because if you are taught chemistry by someone who has not got chemistry arguably you are less likely to be invigorated enough to want to do it.

Professor Steve Smith: I agree with you.

Professor Eastwood: It is worth making the point that the majority of science graduates go into careers where they cease to be scientists. If we are looking at market effects here, universities are producing more than enough chemists to over-stock schools with chemistry teachers but they are making different career choices.

Q460 Dr Harris: Why do you think it is that graduates with debts choose to go into a well funded private sector job rather than a less well funded public sector job in teaching, in research or in science? I have answered the question in my question because I think it is a statement of the obvious. Argue with me, please, because there are some in Government who believe that debt inspires people to go into less well paid public sector jobs.

Professor Eastwood: My point is a market point, which is that people will go into teaching partly because of salaries, you are right about that. They will also go into teaching because of the excitement of teaching as a career.

Q461 Dr Harris: Do you accept the point I am making, that the higher the debt the more likely you are to get scientists going into jobs where numeracy is well rewarded in the private sector?

Professor Sterling: It comes down to the remuneration of a career. I think students are fairly sophisticated in the choices that they make. They know the subjects that they are strong at, the ones that they like to do, they have an idea about the career they would like to go into and increasingly they are looking at the rewards of that career and that is influencing their choice as they become undergraduates. I think it is up to any profession that feels it is short of graduates to market itself rather better and effectively to have higher remuneration that would attract students into that. Teaching is moving in that direction, is it not? There have been some initiatives for science to attract science teachers into schools which I think are very positive.

Q462 Dr Harris: Or you could reduce debt in certain areas.

Professor Sterling: Indeed. It is all a financial incentive.

Q463 Dr Harris: What justification, if any, would there be for taking funds away from excellent research departments to support struggling departments, to keep the teaching side going and the supply of graduates who might then become teachers lower down the scale?

Professor Sterling: It is what we have been saying: we do not believe there is a supply problem, particularly in physics and chemistry. There are plenty of graduates being produced, so taking money away from high quality provision and putting it into lower quality provision does not seem to me to be good for the national wellbeing in terms of competitiveness.

Q464 Dr Harris: I want finally to cover this question of the RAE distribution because we have been given some interesting information by Professor Smith, which is fascinating and it is in our briefing. It states: "Chemistry was rated 4 both before and after 2001."—this is at Exeter—"In 2001–02"—as a consequence of this fall—"it got £28.2k per member of staff; after the 2001 RAE the sum it received per staff member fell to £16k in 2004–05, a fall of about 42%", even though there has not been a fall in the quality of research as measured by the RAE. Is that satisfactory?

Professor Steve Smith: The facts are quite straightforward and I think every Vice Chancellor in the country knows that whereas five-ranking subjects maintained their value fours were cut enormously, and indeed the figure when our chemistry stayed at four was that it lost 42% of its funding. I think that is an absolutely core issue for science provision in universities. There is no way round it. That is not to say that it is the wrong decision because there is an argument about whether the best thing is to have a small number of well-funded departments or to have a large number of not well-funded departments. That is a crucial debate that the UK has to have about how best to fund research in science. Nonetheless, whereas physics was a four and went to a five, it increased its funding by 86% while chemistry, by staying at four, lost 42% and that is the absolutely clear outcome of the funding method.

Q465 Chairman: You do not think there is a temptation to take sciences, which on average are more expensive, are they not, and say, "That is the easiest thing to do. We have got some areas. We have got a case. Give it to the scientists first. Forget the arts departments"?
Professor Steve Smith: Yes, but as you know, the arts departments and social science departments themselves are competing in an international environment. They are enormously important to the UK economy and society and I think it is very difficult to take QR money earned by the research performance of groups and redistribute it in the long term. It is your point about sustainability. It is all about creating sustainable research strength in the UK and within institutions and thus the debate has to be about where the onus of that funding should go.

Q466 Dr Harris: The problem is that fours have suffered a lot. It is not that they do not have enough money for the fours. Do you think four-rated set departments are financially viable?
Professor Steve Smith: My view, and this was covered before you arrived, is that any department that is a four has trouble. It is particularly problematic if it is in an institution where there are a lot of fours.

Q467 Dr Harris: I do not want you to repeat what you have said already. I think you were saying that if we are going to have this effect it ought not to be a consequence of the RAE in the wash-up but ought to be properly debated and put forward as a policy by the funders rather than just saying, "It is a consequence downstream. It is not our responsibility". Do you say there should be a strategy?
Professor Steve Smith: To be blunt, I think the government has been absolutely clear on the strategy. The White Paper on higher education could not have been clearer. It actually said that it thought the country needed more concentration of research resource and the funding formula is not the kind of technical thing that produces this result. It is the result of a very clear set of decisions about where funding for research should be concentrated.

Q468 Dr Harris: Are you saying the White Paper said that four departments might well close, so be it? I am asking should it not be explicit, and I thought you were saying it should be explicit.
Professor Steve Smith: It did not say four-rated departments should close. It said that universities should concentrate on their strengths and it said there should be more concentration on research resource, and I think that leads to the inevitable consequence of departments closing.
Professor Alasdair Smith: Especially following a research assessment exercise in which a much higher proportion of departments than in the past were created five and five-star, so there had to be some shift of funding in order simply to keep the current level of research concentration.
Professor Sterling: One of the issues for universities in the RAE is not knowing in advance how much unit of resource is associated with the various grades. We all understand perfectly well why it is done the way it is, because there is a finite amount of money that is then carved up when you know that the answer from the RAE as to how many five and five-star departments you have. Were it the other way round then it would make strategic planning within the universities rather easier. If you knew that a four was going to have that amount of money you could plan more effectively but one understands why it is the way it is, because otherwise government would have to come up with additional money if the research ended up being graded rather higher. We understand the mechanisms.

Q469 Mr McWalter: Why do we not go back to the University Grants Committee? After all, that did have a quite clear concept of what the UK strategic interest was and it allocated places and students applied knowing that if they applied, say, to do physics, they were more likely to get into university than if they did some other subjects. At the moment what we have is this absurd situation where most of your funding through HEFCE is on teaching and that is backsides on seats and that money is allocated increasingly to courses that are in demand but actually the country does not need 57 forensic science courses; the country does not even need one, but because that is sexy and trendy students apply to do it and universities meet that demand, taking those people away from the courses that might have been of real benefit to the country.
Professor Alasdair Smith: But this comes back to the issue of supply and demand. There is no point in having a University Grants Committee creating lots of additional places in physics or chemistry if there are not students to fill them. There is no gain to the national interest by having additional empty spaces.

Q470 Mr McWalter: But there is no incentive for a student to do a hard degree like physics rather than an easy degree like business studies (no languages) (no maths), because languages and maths lower the demand for that kind of course. The universities are pandering to an agenda which is increasingly market-driven and is increasingly lowering the quality of the student experience at university.
Professor Alasdair Smith: I would dispute the proposition that arts degrees are of lower quality than science degrees.

Q471 Mr McWalter: I did not say that. I said that business studies without maths or languages are of lower quality than a business studies degree with both those components, and universities have got a very big interest in doing the former kind of course rather than the latter because that gets you more students.
Professor Sterling: Can I pick up the point about UGC because I have been a Vice Chancellor now for almost 15 years so UGC did exist when I was first appointed. It was a different world in those days with

50 or so universities. The whole grants committee went on visits round each of those institutions and therefore arguably knew each of the institutions better than it is possible to do with 140-odd institutions funded by HEFCE alone. It is not possible for HEFCE as a board to go round and know each of the colleges of higher education as well as expanding the university sector. Their detailed knowledge of the sector is necessarily more limited than that of UGC. Whether one could do it for a smaller set of universities is another matter. UGC were operating in a different world.

Chairman: It is late. We could go on for a long time. Can I thank you all very much for coming and answering our questions and giving us of your experience.

Witness: **Dr Kim Howells,** a Member of the House, Minister of State for Lifelong Learning, Further and Higher Education, Department for Education and Skills, examined.

In the absence of the Chairman Dr Brian Iddon was called to the Chair

Q472 Dr Iddon: Can I welcome you, Minister, to what we see as quite an important inquiry and thank you for coming and listening to some of the evidence that the Vice Chancellors were giving. The Chairman apologises for not being here in the Chair for this session. He has another engagement. Can I start by asking you about the measures that HEFCE has recently announced in an attempt to protect struggling SET departments of regional or national importance, presumably as a result of the letter that the previous Secretary of State at the Department for Education and Skills sent out to universities? How do you square that letter and the recent HEFCE advice with the policy of non-intervention in individual universities? There seems to be a tension there somewhere.

Dr Howells: As the committee will know we are prevented by law from instructing HEFCE to do anything. The Secretary of State once a year writes a letter which sets out what it is that the government thinks is required from the Higher Education Funding Council for England and of course it is a means of protecting the academic independence of the university sector and of individual universities. It was an extraordinary thing that Charles Clarke, who was then the Secretary of State, did. The controversy was generated around the fact that Exeter had announced the closure of its chemistry department and a number of other courses. I found it a bit strange first of all that there was a big row about this because other chemistry departments and physics departments had closed but Exeter seemed a very special case. I am not quite sure why that is.

Q473 Dr Iddon: We had a bit of a row about Swansea as well.

Dr Howells: Yes, we had a row about Swansea but it was nothing compared with this row which, as a Welshman, I felt a little bit irked about, but there we are. Charles Clarke did something which was very interesting. He wrote to Sir Howard Newby and asked him if he could give us his help and advice on how we could manage to protect a number of strategic subjects. I remember it was not only science; it also included subjects like modern languages. It was quite interesting that in the weeks that followed there was lots of angry chatter about what constituted a strategic subject and I had friends of mine who are quite distinguished academics saying to me, "How come English is not a strategic subject? How come art is not a strategic subject or drama? The country earns lots of money from these sectors and we ought to be very sensitive to their needs". I think it is a very difficult subject, first of all. The Secretary of State wrote a very clear letter and asked HEFCE to take a look at it and give us their advice and help. They set up a sub-committee which has been looking at the subject and apparently we are to get an interim report about April and final advice in June that is going to tell us what they think is required to be done, but I do not know any details about their deliberations up to now. I do not really want to know them either.

Q474 Dr Iddon: So we do not know at this stage what constitutes a department of strategic or regional importance?

Dr Howells: No. I have got an idea about what they are and I could certainly tell the committee that. I can remember when news of Exeter came through I was sitting next to a Vice Chancellor in my office from another university who said to me, "What is all the fuss about? There are 21 five-rated chemistry departments in this country. That is over-provision", which is what Professor Steve Smith has just said, by the way.

Q475 Dr Iddon: Do you think HEFCE's new powers, if they are regarded as new powers, will be adequate to prevent closures of departments of strategic or national importance?

Dr Howells: I really do not know because I have had no indication of what HEFCE is thinking about this. I think it is going to be tremendously hard for the ship to change direction at this stage because universities, quite properly, are very jealous of their autonomy, their independence, and they do not like being told, nor should they like being told by government or anybody else, what they should or should not teach. Professor Steve Smith was adamant about that. He said, "Look; there is not under-provision. There is over-provision. What there is is slack on the demand side". We are very worried about that but that is perhaps another question we could deal with on this committee.

Q476 Dr Iddon: The government has an excellent policy for the development of science and innovation during a decade and a significant announcement was made this week on that. Are there any incentives that we could make to underpin that strategy, bearing in mind that SET departments are closing at quite a rate at the moment? In other words, does that latter fact affect the government's strategy in any way?
Dr Howells: I think a number of the distinguished academics who were on this bench a few moments ago indicated that the great underlying problem—and it is not unique to this country—is the number of young people who are choosing not to take science subjects. It is something that worries me a great deal. Wherever I have gone in the country, and I have made a point of going to at least one university or college every week since last September, I hear all kinds of different reasons why young people are not opting for science and maths and they range from allegations that the teaching of science up to GCSE is boring, that it is compulsory and therefore the first opportunity students have to drop subjects they drop science and maths. Others say it is because they are hard. I do not know about that. I spoke to one young student in a sixth form college in Scarborough, for example, where there was a rather low number of students round the table who had decided to take STEM subjects. They were, as you and I, Dr Iddon, would have called it, first-year sixth-formers. I asked them who amongst them were studying mathematics or science. Four or five put their hands up. When I asked one young boy, "Why are you studying mathematics?", he said, "I started studying Spanish but it was too difficult", so I do not buy this. I think we underrate the thinking that young people have on this. I think there are plenty of young people around who are perfectly capable of doing so-called difficult subjects, and I dispute that term as well, but they are choosing not to do them. We have to take that very seriously. I do not think you can force people, nor will you ever be able to force people, into those subject areas. We have to look at the way they are taught; we have to look at the national curriculum. One of my colleagues from the department is in this room at the moment and she has been doing a survey of the huge number of initiatives that are out there to try to get young people interested in science and mathematics and engineering and technology, and so far she has filled three volumes with these initiatives. I suspect we are spending as a nation, not just as a department, many millions of pounds on initiatives for which we have very little evidence that they are working. They do not seem to be working.

Q477 Dr Iddon: What about incentives? One of our Vice Chancellors flagged up the idea of scholarships just to send a signal out that this is a subject of strategic importance and perhaps the government might give a few scholarships to study that subject at various universities.
Dr Howells: I think it is an idea worth looking at. There are lots of golden hellos around at the moment, of course, and lots of carrots for people to go into those areas, especially if they are going to teach in those areas. I think the problem is a deeper one than that. I think it is a multi-faceted problem. People also have to have a much clearer idea about what they are going to do with their science degrees. I have heard lots of talk, for example, of engineers being snapped up by law firms and accountancy firms and all sorts of people like that because they like the way engineers think and the way they have been taught. The obvious answer to that is, "Tell engineering companies to pay them a bit more to make it a more attractive source of employment", but then, of course, they will argue that it will reduce their competitiveness. I do not think it is a simple issue at all.

Q478 Dr Harris: The policy options here are not clear so you may well need some research to back that up before you spend money on bursaries or whatever. Do you think there is enough research out there or do you think, for example, that the ESRC could be made interested to do some research into why students are not choosing to do this and what would encourage students to stay in science or become teachers? Is there scope for that sort of work to be done rather than underpinning policy?
Dr Howells: There is an enormous amount of research out there and there are huge numbers of initiatives also out there, many of which are evidence-based, although not all. I wonder where some of them have come from. Perhaps I can try to answer your question by saying what are the best examples I have seen of initiatives to get people interested in science and especially to get them into universities where research is conducted and where science has got a great reputation. I will give you an example. Recently I was at Sheffield University where they have got very close relationships with a number of local schools which have not had records of sending young people to university in the past. What they do there is get third and fourth year medical students to teach groups of these schoolchildren for a day or two days. They teach them how to take blood, how to take blood pressure, how to do the kinds of things that second and third year medical students do at university. It has had a dramatic effect. They have also earmarked at Sheffield I think 22 places for those young people who have had that experience. It has had a remarkable effect on young people wanting to go into those kinds of subjects. If I could mention another one, I went to Bridgwater Further Education College, and at Bridgwater Further Education College they have a very close link with Bristol University. They have got record numbers of students studying chemistry at Bridgwater Further Education College who want to go on to university to study chemistry. Somebody is getting it right.

Q479 Dr Harris: I am sure that is right. I thought you said that it was not entirely clear why students, in the absence of these schemes certainly, are not choosing science. I was just wondering, if you do not know would it not be a good idea to do some research, and I am seeking to find out, if you do not know and it

is a good idea to therefore do some research, who should be doing that research. Should it be the Chief Scientific Officer or should it be a research project by the ESRC, for example?
Dr Howells: That research is going on already and it is being conducted by many people, including the Chief Scientific Officer. It has been being conducted for a very long time and it is being conducted nationally and within regions. I do not think we are short of research. Quite frankly, I do not think we can kick this into touch with another review or consultation. This is a problem that is an immediate one.

Q480 Dr Harris: Can I ask you to ask your department to send us a list of research into the specific question of why students are not choosing to do science at university?
Dr Howells: Yes, we will do that. Whether you will get a good answer is another matter.

Q481 Mr McWalter: Does it matter that the number of students studying sciences at university has declined?
Dr Howells: Yes, I think it does matter. All the developed nations now, and we are talking about knowledge-driven economies, are talking about the centrality of science and advanced research. Universities themselves are increasingly concerned with this. We heard, for example, the new Vice Chancellor of the combined Manchester University talking about building up a war chest of £100 million or £400 million in order to attract two or three or four Nobel Prize winners to the teams to come and teach at the university. British universities do not benchmark themselves against European universities any more; they benchmark themselves against American universities. The most prestigious areas of research and study are in science.

Q482 Mr McWalter: Okay, so it would be a good idea but you do not really have any ideas about what you might do to change things?
Dr Howells: We have got plenty of ideas about how to change things but the problem is not a simple one. I heard your question earlier on although I did not quite follow the logic of what you were saying.

Q483 Mr McWalter: Perhaps I can amplify it. In my previous life I was approached by a university which wanted to do a political economy course and they asked me as an external adviser to advise them on that particular set of arrangements. I made some suggestions and they were very clear that they did not want any reading that involved anything like demanding numeracy from the students. In other words, they were targeting a political economy course but removing quantitative studies because they said that would drive students away, it would lead to lower numbers on the course and hence they were determined not to have that as a component, so I wrote a prospectus without it. It seemed to me that that was an inferior course to one which actually engaged with some of the classical economic works which would have required some degree of quantitative skills. That is going on throughout the whole of the system. People are downgrading courses in order to get the maximum number of students, the minimum number of failures, because that is also very important, to keep the people once you have got them, in order to keep the university bottom line viable. That is what is going on in universities and that is why people do not want a course that involves looking in detail at the Gaussian equation for normal distribution in statistics or whatever because that is forbidding, that is difficult, people find it a switch-off. You have to understand that people do not want to do that and that is why we are losing scientists.
Dr Howells: Mr McWalter, I take what you say and I am not going to ask you to name this university because it would not be an ethical thing to do, but can I say this? I am an avid reader (although I do not believe half of them) of the world comparisons of universities, and at the moment and for quite a while now the lists have been dominated by American and British universities. If we are engaged in this kind of dumbing down of university courses, as you allege we are, why is it that a peer review of research going on in universities in the world keeps coming back to Britain as a centre of great excellence? I really do not understand this. I heard something this morning about research conducted at UCL into diabetes, that they may have found a cure for a certain kind of diabetes. That is going to resonate around the world. That is British university research. Quite frankly, as I go round the country I constantly come across examples of wonderful scientific research, so I do not accept for one moment that somehow research departments or intake into universities is inferior to what it was at some stage or other in the golden past. I do not accept the golden past and I never have done.

Q484 Mr McWalter: The golden past has generated a lot of the work that you are talking about and it comes from a way of organising higher education, and I mentioned earlier the University Grants Committee which gave strong incentives to people to do degrees in chemistry, say, rather than degrees in forensic science. We now have 57 courses in forensic science. None of them equips people to be a forensic scientist and they are taking people away from the more generic careers which would have given them a range of capacities and skills and directed them instead, according to a student's rather narrow perception at 18, to wanting to be a bit like Amanda Burton. At some stage surely the government has got to step in and say that we do not need people to do that so much as we need people to do this. If the government has got some mechanisms for doing that, some sense of direction in the system, that has got to be good for the UK economy, and actually has got to be good for those students as well. We produce more forensic scientists now in a year than work in forensic science in the country in total. What is going on to have that kind of demand being responded to?

Dr Howells: We cannot tell universities what to teach, nor should we. We have talked this morning, and I came in at ten o'clock and listened to the Vice Chancellors. The Vice Chancellors told a tale of people being unwilling to go into, if you like, pure science departments. There was a decline in the numbers that wanted to do that and that decline is borne out in the statistics. What do we do about this? We cannot force people to study those subjects; it is impossible. There are some theories about reducing the tuition fee for those areas, which would mean, of course, that the taxpayer would then have to subsidise the universities to keep up those unit costs. Maybe we ought to debate that. Personally, I do not think it would work. I think the problem is much more deep-rooted and, if you like, the area that those roots are reaching down into is a kind of growing reluctance to study those pure science subjects. It is not everywhere. I do not think a lot of this is to do with the structure of the system. I think it is to do with the quality of teaching. It may well be that the curriculum is too tightly drawn to enable teachers to make science exciting for young people. Mr Key has gone now but he said something very interesting at the start of his questions, where he said he had been at a school recently where the excitement was palpable in a science class that he went to. I am trying to give you examples of schools and colleges where A-levels, for example, are being taught where people are clamouring to get into those departments because they see it as a very exciting prospect for themselves. I think we have got big problems in career advice and all of those things contribute to the choices that people make when it comes to deciding what subjects they want to study. I think we waste an enormous amount of talent, I would agree with you very much in that respect, but it is not a simple problem.

Q485 Mr McWalter: Lord Sainsbury said to this committee just last week that the government were not doing nearly enough to make potential students aware of the significance of the choices that they were exercising when they were choosing courses, and certainly that seems to apply to science-based subjects, so is there not something fairly immediate we should be doing, given that Lord Sainsbury himself thinks that it needs urgent attention, to address that issue?

Dr Howells: Yes. Lord Sainsbury and I are working very closely on this and one of the exercises that we have been doing is trying to find out exactly what agencies and government and everybody else have been trying to do to persuade young people to study what you referred to as those more difficult subjects. The interim evidence, if you like, is that there are literally thousands of initiatives out there, some of which have succeeded, some of which self-evidently are not succeeding. What we have to do is to try to find a much more constructive and focused way forward. You have not asked me this, but if you did ask me—

Q486 Mr McWalter: I will ask you it now.

Dr Howells: I think I would give the responsibility to the universities and colleges. I would say to them, "Come on. Inspire the young people in your region to want to study science and explain to them what it is going to mean at the end of it".

Q487 Dr Iddon: what do you say to those people who argue that it is essential to have good research in a department in order to have excellent teaching in the same department?

Dr Howells: I would have thought first of all that any lecturer worth his or her salt would be interested in what is going on in contemporary research, and I forget which of the Vice Chancellors spoke about scholarship, but there is no excuse for poor teaching and there is no excuse for teachers who are not aware of contemporary research. Whether they are part of it or whether they read about it they ought to be assiduous about following contemporary research. I know there are university departments where they get very little research money but they have great excellence in teaching. I forget who asked the question on the committee earlier this morning about whether it is possible to run a university department without conducting fundamental research. Clearly there are departments that operate like that and seem to do a very good job of it. I was a little bit disappointed; we had four excellent witnesses this morning but there was nobody there from the 92 HEIs where there is a different approach to many of these things. They teach an awful lot of people in this country and the very first visit I made after coming to this job was to the University of the West of England where they have got a research exercise going on which receives a little bit but a crucial bit of funding, where they have collaborated with Bristol University and Bath University to produce some very impressive results. Nobody seems to have talked about collaboration this morning. The White Rose Group in Yorkshire of Leeds, York and Sheffield, three very fine universities, are collaborating on research so that they can take on the most powerful universities in the world in terms of their ability to focus on certain areas of research. That is an important way forward too, I think.

Q488 Dr Iddon: So are we, either by accident or design, moving towards alternative models of arranging our university/higher education systems in this country?

Dr Howells: I think we are. I am certainly on tenterhooks waiting for HEFCE's response to Charles Clarke's letter because we have got to find a way through this, I think. When I speak to Vice Chancellors on or off the record, they usually say to me, "Look: unless somebody can come up with a better method than the RAE"—and the next one is in 2008—"it is the best we have got at the moment". Remember, the sector designs these judgements; government does not do it. The sector is extremely jealous of its own autonomy in these things and if the sector feels that it has got a problem it has got to come up with a solution. I can make the right noises, like any other politician, about what I think we need, and I certainly think we need to strengthen our science base and keep extending it; I think we have got a very strong science base, probably only bettered by the Americans (and those are certain American universities, not all American universities) but there is plenty of room for improvement. I am very distressed that we always seem to be talking down the achievements of British universities because nobody else in the world does. The ratio of European students who want to come to our universities compared to our students wanting to go to European ones I think Barry Sheerman said was three to one. That is not only because we speak English but it is also because our universities have a world reputation for excellence.

Q489 Dr Iddon: Do you agree that a regional presence for subjects of strategic importance is the way forward and, if we are likely to lose those in any of the regions, and East Anglia and the West Country seem to be at the greatest risk at the moment, would we consider developing a hub and spoke model between other universities like Bristol for chemistry and the other higher education institutes in that region?

Dr Howells: Yes. This is a fascinating subject, and now we have got regional development agencies and they have got some money I notice that there is a different kind of reaction across the country. The North West Regional Development Agency, for example, seems to be very interested in working with Manchester and Liverpool Universities especially, but also with others, such as the University of Central Lancashire and Lancaster and so on. They seem to be very focused in understanding that universities are amongst the most potent economic drivers of any region. Not only are they in themselves enormously important industries; they put a lot of money into the economy in terms of salaries, but if they have got a good relationship with a region they can make all the difference. I think we are beginning to understand that lesson very well in this country now, but the response of RDAs is still a bit patchy in terms of their willingness to collaborate with the universities in making the most of their expertise and especially of their research strengths. There are simple things as well, Dr Iddon, like, how do you keep your graduates, and especially how do you keep your science and engineering and technology graduates? I can remember that until very recently in my own constituency, Pontypridd, where we have got the University of Glamorgan, which is a very fine institution that grew out of the Treforest School of Mines, it was regarded as a kind of car parking problem by the local authority for years and years. It was a nuisance to the people who lived around there. It is only recently that they have begun to realise, "Hang on. This is something we really ought to value and we ought to try to keep the graduates and the postgraduates", because if we can keep those people the chances are they are going to start their own businesses, they are going to raise the level of skills in an area and it makes that area wealthier.

Q490 Mr McWalter: Just talking about research funding and its distribution, you have just mentioned the need to extend the science base but the UK deans of science have reported 80 closures of science departments with scores of four or less. Is that a good thing, to clear out the rubbish, get rid of the under-performing departments, or have some valuable departments been lost and, if so, what are you going to do about it?

Dr Howells: I am sure some valuable departments have been lost. I was very worried about Exeter's decision and I know that Lord Sainsbury, as he probably told this committee, was very worried about Exeter's decision. Steve Smith, the Vice Chancellor, is one of the outstanding academics and academic administrators that we have got in this country, and I sat at the back of this room this morning and listened to his evidence and it is very difficult to argue against. The university sector has decided in its wisdom that this is the kind of model that they want. They have closed departments other than mathematics and science and engineering. I think they stopped the teaching of Italian at the same time at Exeter and that is a worrying tendency as well, but I can understand why Steve Smith did it. The problem is that I do not think there is a single voice or opinion in the higher education sector about how best to move forward in this respect. They vary from people saying there is over-provision of science and mathematics departments to those who say that we are losing a vital regional asset and we will never make it up.

Q491 Mr McWalter: As, for instance, mathematics at Hull, another example of a place where there is a big impact. Would you not consider changes to the research assessment exercise in time for 2008 to lower the funding differential between departments rated at five or above compared to those at four or lower because after all that would immediately go a long way to resolve this desire that you have correctly identified to broaden the science base?

Dr Howells: Mr McWalter, if I were to tell you that there are Vice Chancellors who have said to me, "Forget giving research money to any but the top four or five research-based universities in this country", I am sure you would not be surprised.

Q492 Mr McWalter: We often think the government is on their side.

Dr Howells: I think if you look at the list of five-rated departments that are around now, there are a lot of them, in chemistry, physics, maths and engineering. I doubt if there is any country on the face of this earth that has got more per head of population than we have got in this country. I do not think we are standing by idly and watching our capacity disappear but I do worry a great deal about the fact that regionally we might be losing some of that capacity.

Q493 Mr McWalter: By saying, "Oh, gosh, we have got all these fives; are we not well off?", you are then having a policy that shoves the fours into the wall. What you have just said gives no succour at all to

those of us who think that some departments rated at four and 3A are actually departments that are often doing new stuff, fledgling departments, younger staff, people with a very considerable amount of dynamism to contribute to the subject but have not yet reached the stage where they are household figures or are featuring in international conferences. What you have just said gives us no succour at all in terms of what you are going to do about them. It sounds like you are saying we have got enough already.
Dr Howells: No, I do not think I am saying we have got enough already. There is one aspect of what you have just said that I agree with entirely and to me it is the central quandary of the research assessment exercise model, and it is this. How do we ensure that for a university that is ambitious, that might be a lot younger than the Russell Group of universities, there is enough money around for a little bit of research like the research conducted at the University of the West of England that I mentioned? How can they start to break into the big time? How can they make the established research universities feel as if they are breathing down their necks? There are universities that have done this. Warwick is one.

Q494 Mr McWalter: Are these questions rhetorical? You know the answer. It is to give those departments rated four and 3A much more money than they currently get.
Dr Howells: The universities themselves do not believe that. The universities themselves, who, after all, have designed this model, believe that the money should be concentrated in those centres of excellence. We have got other pots of money which to some extent help these other universities, these research departments, and HEFCE and the universities themselves have modified the way in which the RAE will work in 2008. I noticed that there was a little flurry with the Vice Chancellors before they left about not knowing how the funding was going to be distributed after the RAE is completed. Remember, a lot of people said that the reason why Exeter and other universities have closed their departments is that they are trying to read the entrails of what is likely to happen in the next RAE and they are cutting their losses now. If that is true then that is extremely disappointing because I do not think any of us knows what the RAE is going to come up with. If the central question you are asking me is whether we should take money away from those five-rated departments and spread it a bit more thinly, well, that is the basic philosophical argument.

Q495 Mr McWalter: Increase the quantum if you really believe that.
Dr Howells: We are increasing the quantum but in a way that it has never been increased by any other government previously. It has a huge amount more money going into research. I know that if I were a Vice Chancellor, and they would never make me a Vice Chancellor, I would be getting my retaliation in first before this RAE and I would be ensuring that everybody believed that I was starved of cash. The universities have never had more cash than they have got now.

Q496 Dr Harris: You said there were 21 five and five-star universities in chemistry and that this was over-provision, and I am not going to argue with 21—
Dr Howells: Nineteen I have counted.

Q497 Dr Harris: But the point you were making was that that was over-provision.
Dr Howells: No, I did not say that. I said the Vice Chancellors have said to me that there is over-provision and before you came into this committee this morning I heard Steve Smith say that there are too many departments and not enough demand. They are not my words. I am reporting to this committee what people have said on the public record.

Q498 Dr Harris: And your view is that that is true in the narrow sense and that that is—I am not sure what you are saying. We need to increase demand?
Dr Howells: Yes.

Q499 Dr Harris: But if we cannot then you recognise that that is still effectively over-provision which is not good value for taxpayers?
Dr Howells: I cannot see how you can sustain university departments if nobody wants to study in them. That would be idiotic. It comes to the point that Mr McWalter was making, which is a very valid one, that, for whatever reason, all kinds of cultural reasons, young people want to study other subjects; they do not want to study these subjects. That is the major problem we have got: inspiring those people to want to read chemistry and physics.

Q500 Dr Harris: And you said earlier that that was the problem. You did not know why but there was plenty of research being done.
Dr Howells: I have got theories as to why.

Q501 Dr Harris: There was plenty of research being done although none of it was listed in the evidence that you submitted to us and you are going to send us the information about what research is being done into what is a key question. You said in answer to Mr McWalter that universities are making a conscious decision to respond to the financial realities in the way they are doing, and it may be that an individual university does make a conscious decision; no-one is suggesting that they are comatose in their governing bodies, but presumably you are not arguing that the university system as a whole is making a conscious decision to close departments to a viable level, that it is a consequence of what is coming out.
Dr Howells: As you know, Dr Harris, universities are incorporated bodies. They are run as businesses. We cannot tell universities, nor can HEFCE or anybody else, what they should or should not teach. They have to make those decisions and they guard that right jealously. If a university decides in its wisdom that it is going to open a new department or

close a department, and universities have always done that throughout their history, then you have to ask yourself, do we direct them to keep a department open or do we close them? That is what HEFCE is looking at at the moment.

Q502 Dr Harris: That is a separate question, is it not? It could be organised by the powers that be, and I am not saying it is necessarily the government or the government alone, but if it is clear why universities are closing and if it is felt that a lot of university departments are closing and that is not a good thing for the economy then a system should be arranged so that it is not each individual university as an island making this decision but that there is at least some strategy behind what is going to happen in individual areas. That is what society is. It is individuals making a decision within the context of thinking about the impact it has overall. Do you accept that there is a role for government to play as part of that wider structure or is it each man for himself?
Dr Howells: No, I do not think it is each man or each woman for themselves. Government plays it role by putting record amounts of money into science and engineering and technology departments of universities, more money than they have ever had previously. The problem, and I think you have heard it enough this morning, Dr Harris, is the decisions that are made by those universities as to how they allocate that money within their own provision, and that is something that we cannot tell them to do. We can make encouraging noises, we can provide the money for university departments, and especially for science departments, but we cannot make universities keep a department open simply because we want them to. It does not work like that in society.

Q503 Dr Harris: How accurately do you think that HEFCE's teaching subject weightings reflect the cost of providing the science, engineering and technology subjects at undergraduate level? Do you think the change that was made was correct or do you recognise what was said in the earlier evidence session, that that evidence is flawed?
Dr Howells: This is quite interesting, because when there was a move by HEFCE to try to be more prescriptive about the base price per student per subject, the universities railed against it and said, "No. We will decide how we are going to spend our money and we do not want you to be prescriptive in terms of deciding what the ratio should be".

Q504 Dr Harris: But given that they now do decide what the ratio is—
Dr Howells: No, they do not decide.

Q505 Dr Harris: Now HEFCE does decide what the ratio is, and I take your point that universities want to have that power themselves, I am asking you about that recent change. Was it rational or not?
Dr Howells: With respect, Dr Harris, they do not do it as prescriptively as a lot of people would like. For example, in the funding formula laboratory based sciences, engineering and technology subjects are in price group B and attract 1.7 times the base price, that is, £5,923 compared with £3,484 for lecture-based courses, but there were some people, when the Royal Society for Chemistry came to see me, for example, who said that it ought to be higher than that for chemistry.

Q506 Mr McWalter: It was lowered to that.
Dr Howells: And it was lowered to that, but the Vice Chancellors themselves did not want the funding formula to be that prescriptive. They wanted some leeway and flexibility in the system.

Q507 Dr Harris: I am asking your opinion. Do you think that the recent change in the weightings was rational and correct or not?
Dr Howells: Yes. It was a peer review. It was discussed extensively inside and outside the universities and they came to this decision and that is a decision for the universities to come to. I agree with it.

Q508 Dr Iddon: But did not the 1.7 figure come out as a result of the biologists having a bit of a row with the people at the hard science end, that they could not come to an agreement?
Dr Howells: Yes, there are arguments, Dr Iddon, and I do not know how you resolve those arguments. We cannot on the one hand hold up the flag for academic freedom and on the other hand say, "No, sorry, mate. We are going to tell you what those arrangements ought to be precisely".

Q509 Dr Harris: The government says it has put science at the heart of its economic agenda. What evidence is there that there is a link between the growth in the number of science graduates now and a healthy economy? Should we be seeking for economic purposes to push this demand, obviously not just keeping university departments open; you have made that clear?
Dr Howells: We talk a great deal to employers about what it is that they want and what demand looks like from employers for undergraduates and for the particular skills that come out of universities. There seems to be a pretty good balance at the moment. There are some sectors that claim that they have got difficulties in recruitment but, in a sense, with any booming economy like the one that we have got you are going to have recruitment difficulties right across the sector. The most obvious recruitment difficulty we have had recently has been plumbers and we are training a lot of them at the moment. In terms of graduates coming out of universities we have not identified specific immediate needs, but people tell us that not very far down the track there will be shortages and I think those are the ones we have to worry about.

Q510 Dr Harris: If there are shortages then how is secondary school education with relatively low wages compared to industry and, indeed, the City, which wants numerate people, going to compete

better when because of your policies, which must have justification, a consequence is that these science graduates are going to have more debt?
Dr Howells: I do not know if you are making a political point here or not but we have got absolutely no declining PGCE students in science subjects, for example. In the year 2000 there were 2,220 PGCE science recruits; this year there are 2,690. It is not a massive increase but I do not think we would expect one. I think they are doing pretty well actually.

Q511 Dr Harris: Let us look forward to an era when science students are doing a three year course and instead of being asked to find £1,000 are going to be asked, for reasons that have been given, to find £3,000 a year in debt, top-up debt because they just pay it back later, so there will be more debt, at least £9,000 plus living costs for a three year course let alone a four year course.
Dr Howells: Dr Iddon, I do not see any point in rearguing the 2004 Higher Education Act, it is an Act. We have seen an almost 9% increase in undergraduates.

Q512 Dr Harris: Just let me ask the question. You may not see any value in it but it may be that this Committee sees value in it because it is a key issue. You have accepted that the supply of teachers is key, the Vice Chancellors have accepted that and other people we have had. I want to ask you, as a Government, not to change your mind over that policy—
Dr Howells: And we will not be.

Q513 Dr Harris: But do you have a Plan B if the policy, and I do not think it is unreasonable, means that there is less attraction to doing PGCE and going into a less well paid public sector job because your debt, by design by the Government, is on average going to be higher? What is your plan to deal with the market pressures the Vice Chancellors talked about of finding it more difficult to recruit into teaching, lecturing and research?
Dr Howells: Your question is full of suppositions and I do not accept any of them. I do not see any evidence whatsoever that there is reluctance amongst young people to go to university, in fact it is increasing. Nobody knows what is going to happen—You can shake your head but nobody knows what is going to happen.

Q514 Dr Harris: You do not know. You come up with a policy and you do not know.
Dr Howells: Do you want me to answer your question or not?

Q515 Dr Harris: I would like you to answer what research you have got to suggest that people are more likely to go into teaching with higher levels of debt.
Dr Howells: I think that people will take out loans from 2006 on knowing that they do not have to repay one penny of those loans until they are earning sufficient money in order to be able to repay them. I think we have done an enormous amount for teachers in order to encourage people into the sector to teach all subjects, including science and mathematics, and we have done it very successfully. I do not believe that anybody is going to be put off as a consequence of the new funding arrangements post-2006; indeed I think it is going to attract people. You cannot tell me any different and I cannot prove that to you because we will have to wait for history to prove us right on that. If we look at the problem and we make a supposition and say there is a catastrophic failure in people to come through the university system to become science teachers then we will have to address that issue very seriously.

Q516 Mr McWalter: Obviously this business of students exercising the main demand does mean that there are problems about whether employers, for instance, have got a sufficient input into the process, and in particular university departments might well end up producing graduates who are not the graduates that employers want at all. Do you think you have got that input broadly right or do you think that maybe you should be going further down the track of consulting employers so that students get a clearer perception of the value their skills would have if they graduated in subject X for the employers' market?
Dr Howells: This is a very important issue. I think we are getting there. We are doing it through Sector Skills Councils. I will give you an example. In the Sector Skills Council that deals with the creative industries, especially the media, we know there are sectors within that skills area like, for example, computer-aided animation, which is very science driven and we are the world leader in it which is why Hollywood comes to Britain to make its movies constantly, that is driven by university educated people. At the University of Bournemouth and other places we have some world centres of excellence in that subject. It is a very science based subject but one that marries science with creativity in a wonderful way. We know that the new Sectors Skills Council for that area would like to see more clarity in terms of how employers might judge the universities and colleges that are producing graduates in that area right across the media. Media Studies is a reviled subject but the problem is the halfwits who revile it forget that this country earns a lot more money out of general media and creativity than they can ever imagine and it is one of our biggest earners of foreign currency and if we do not nurture those roots we have got problems. They are working with us and we are working with the universities and with the Regional Development Agencies and everyone else to try to identify how best we can influence each other and how best we can get the kind of graduates that industry needs out of our institutions of higher education. There is one more thing, if I may. We have got the Langland review of the professions at the moment and Professor Langland is looking very, very closely at the ways in which the professions are served and the way in which they inform the universities and colleges of the kinds of courses that they think they require and the kind of graduates they would like to see come out of the universities.

Q517 Mr McWalter: There is a lot of good work going on there, I agree, but the fact is that not much of that gets into the head of the 18-year old who is making his or her application to go to university. You referred earlier to the real problems in the Careers Service about the information that people have to be able to give to students. Somehow or other there is a big gap between the sort of valuable work we are talking about and what a student does when they apply to university and I find it difficult to know how you are going to bridge that gap but, unless it is done so, students are making demands for courses which are not serving either themselves or the economy and that would seem to be something that Government should be taking an interest in.
Dr Howells: We are taking a great interest in it and a lot of the work that Lord Sainsbury and I are doing is directed precisely at this. We have got organisations out there, and a lot of money is going into them, like Connexions and Aim Higher, which are trying to stimulate much more of an informed discussion within schools. We know that a lot of students are directly accessing website based information that universities put up there for them to read. I notice when I go round the country they do not ask me about tuition fees, they ask me, "What kind of job am I likely to get at the end of a university degree? What about the university, is it any good? Is it going to do this or that for me?" They want to know very practical questions and I think they have got a better chance now of accessing that information than any of us have ever had in history.

Q518 Dr Iddon: Minister, the Government has an excellent ten year strategy for science and innovation but what this Committee is concerned about is that the universities might not be producing an adequate number of high quality graduates to drive that strategy forward. If that is your concern also, if you share that concern, what would you be advising the universities to do to improve the supply of the right quality graduates?
Dr Howells: The first thing is I think they are supplying the right quality of graduates and we have got some wonderful university courses. There are pressures on the system as a consequence of the way in which the RAE works and the way in which the various funding regimes work which it is for the universities themselves to come to decisions about. We have got the task of providing the wherewithal for them to conduct world class research and I think we are doing that, but I am not a believer in Government sticking its fingers into every pie there is. We ought to have, and are having, a public debate about strategy in terms of what our universities teach and where we move from here, but—

Q519 Mr McWalter: Some fingers in the pie would be quite nice.
Dr Howells: The biggest fingers in the pie are the ones holding the pound notes that we hand over to the VCs, via HEFCE of course, and, believe me, that is quite a handful. I would not be in favour of Government making massive strategic decisions about what ought to be taught and what should not be taught. The genius of our universities and of academic life is they come up with things that we would never dream of as politicians. That is the way it has always been. It ought to have an organic relationship with the rest of society which is not prescribed. Fundamental research sometimes literally comes out of the blue and we should not try to prescribe that, I think.
Dr Iddon: Thank you very much, Minister. We detect a passion in you to get it right and hopefully between the universities, this Committee and all the other organisations, HEFCE and the Research Councils, we can get it right for the future and for the benefit of the country. Thank you very much for your time, it is appreciated.

Written evidence

APPENDIX 1

Memorandum from Dr J R Fry, University of Liverpool

The Committee has invited evidence on the following points, addressed in turn:

— The impact of HEFCE's research funding formulae, as applied to RAE ratings, on the financial viability of university science departments;

The teaching of undergraduate science subjects in universities is not adequately funded, and historically it has been subsidised by income from research. Given the recent trend for research income to be sharply focussed on subjects with RAE grades of 5 and above, university managements are increasingly taking a commercial approach to the viability of individual subjects. In the short term this has put at risk science departments with RAE ratings of 4 and below. In the longer term even top-rated science departments may be at risk if they have few students, because of the need for the cross subsidy from research. The most useful form of assessment of the quality of a department, or subject area, would be on the basis of the contribution made by the whole department, both teaching and research—but this assumes adequate funding for both!

— The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend;

There is merit in better resourcing a number of highly-rated departments so that they may compete in research on equal terms with the best in the world—usually in the USA—but this must not be done at the expense of less highly-rated ones; additional money is required. Whilst the RAE rating gives a measure of the international dimension of research, it does not pretend to measure its utility or its importance in a regional setting. If money is switched from low RAE-score departments to high ones, then the danger is that all regionally-useful research will be lost. Moreover, because of the cross-subsidy of teaching from research funds, a reduction in research funding may lead to the loss of a good teaching unit and the very useful graduates produced.

— The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula;

The weighting given to science subjects is woefully inadequate given the high cost of providing and maintaining up-to-date teaching laboratories, and needs to be substantially increased, but an additional concern is the small numbers of students in some science departments. This limits the overall "formula funding" to the department unless the university is prepared to cross subsidise from its other activities. This point is further addressed under "regional capacity".

— The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments;

Research (at university level) and experimentation (at secondary-school level) are of inestimable benefit to the teaching of science. Science is a living, developing subject where progress is made by observing, measuring and trying things out—and making mistakes. It is not just that research know-how and equipment is used in project work at all levels of undergraduate teaching—although this is of great benefit—nor that research at the frontiers of knowledge often gives insight into the understanding of elementary science, but that the pursuit of knowledge through research communicates the inspiration, excitement and motivation to students—and also humility and doggedness—that is an essential part of their ongoing education. A teaching-only university science department would be a sad, moribund affair. If there is a need to teach science to undergraduates as part of a more general education than the traditional single-honours degree, then money should be put into the development of more generalised degrees—but the teaching should be done by research-led faculty.

— The importance of maintaining a regional capacity in university science teaching and research;

Here in Liverpool, local secondary schools rely on staff from the university science departments to keep them up to date, to give special-interest lectures to, and run laboratory projects and science fairs for, their (mainly 6th form) pupils, and to advise and guide them on the more modern and more difficult aspects of A-level work, as well as contributing strongly to (eg Institute of Physics) programmes of talks and lectures. [Others will describe the context in which advice is given to local industry and joint work is done.] An item which you have not mentioned is inter-disciplinary science within a university. If a particular subject is cut—because the international appreciation of research in that area is not high enough—then the contribution of staff to work in other departments may suffer very badly. Here in Liverpool there is growing inter-disciplinary work within the science faculty and between the faculties of science and medicine, with strong regional components. Finally, as the problem of student debt increases there will be financial pressure, particularly on those from poorer backgrounds, to study at a university close to home. It would be unfortunate in very many ways if such students were deterred from studying science because the department of choice at their local university had been closed.

— The extent to which the Government should intervene to ensure continuing provision of subjects of strategic, national, or regional importance; and the mechanisms it should use for this purpose.

Where the subject provision is of "strategic, national, or regional importance" then it is obviously necessary to safeguard it. The problem is to determine the level of importance, the cost, and who will make up the shortfall in funding. What is probably needed is a broad measure of "importance", with some local assessment from schools and industry together with an assessment of the contribution of both research and teaching towards meeting regional and national goals, and some assessment of the damage that might occur (eg deterring students from poorer backgrounds from studying science) if the subject were lost locally through closure of the department. There is also the problem of university autonomy to address if funds are targeted.

January 2005

APPENDIX 2

Memorandum from Dr Michael Bolton, Withington Hospital, Manchester

— The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments;

The present problem resulting from science/engineering department closures is the loss of teaching capability across the university sector. Students will be attracted to departments with a high reputation, which presently means a high research rating. Financial viability depends on both research funding and teaching funding, the latter relating to student numbers. Reduction in research funding will have the "knock on" effect of reducing demand for teaching places. The present RAE and the Roberts proposals do not really address the "critical mass" of combined research and teaching. The whole RAE process and the separation of funding between teaching and research has had a very negative effect on the science/engineering base in the UK particularly in those universities with strength and tradition in engineering. The applied and translational research (useful research) often in collaboration with industry, which is an essential part of engineering, appears to be given less RAE weight than the fundamental sciences.

— The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend;

The establishment or continued support of "centres of research excellence" in specific areas—not necessarily subject based but topic based is to be encouraged. Many research topics, including my own of biomedical engineering are multi-disciplinary. However, if this leads to a concentration of all research in fewer institutions it will be wholly inappropriate. Specialisation by individual universities makes sense and can be based on both traditional strengths and geographic location, eg Marine Science research is appropriate for Plymouth but not for Birmingham. HEFCE should take a strategic view on the location of specialist centres for research to be preferentially funded while ensuring that the host universities have the infrastructure and "science" base to support them.

— The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula;

The upgrading of some science subjects is a step in the right direction. However, I am not convinced that the teaching cost between science subjects (across all universities) is as important as the cost of the same subjects between universities. It is the inter-university difference rather than the inter-subject difference that will lead to closures. Modern universities with a large student number per subject will have a lower cost per student overall irrespective of subject. Funding for teaching should be on a "need" basis rather than a blanket formula. Some universities run more specialised courses within the broad subject headings of the formula including vocational courses. Closure of the main teaching department could lead to loss of specialist courses that cannot be undertaken elsewhere with serious consequences for some professional groups.

— The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments;

The optimal balance will vary between universities. There is no "one size fits all" answer. Until recently, there were many excellent teaching-only science institutions namely the technical colleges/colleges of technology. These have been rebadged as universities. There is certainly a place for teaching-only departments especially in engineering and similar applied technology areas or for "vocational" degrees. The financial viability of a teaching university will depend entirely on how it is funded. If an institution achieves a good reputation for its teaching excellence it will succeed in attracting students. Good research does not necessarily lead to good teaching and a concentration on achieving a high RAE score may even detract from teaching quality. There should be an equivalent assessment scheme for teaching excellence.

— The importance of maintaining a regional capacity in university science teaching and research;

With the introduction of student fees and loans, it is more important than ever that students have local access to universities. More students are going to their local university and living at home than previously, largely for economic reasons. The large expansion of student numbers, the transfer of colleges to universities and the increasing requirement for vocational and part time degrees will make local access essential, even on a sub-regional basis. Again the actual geography and local travel situation must be considered.

— The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose.

It is essential that a strategic overview be taken. The Government should work with employers, including its own departments to predict future requirements for graduate staff in all subject areas where a shortfall would have serious economic, strategic or health/welfare consequences. Professional bodies can also contribute evidence relating to supply/demand and training needs. Planning must have the appropriate timescale as well. A good example is the shortage of medical and nursing graduates to meet the Government's own expansion of the NHS. Within my own professional area, the DoH Chief Scientific Officer (Dr Sue Hill) is introducing the requirement for honours degrees for "Clinical Technologists" in order that they become "State Registered". This is a new requirement for which there are no courses at present (some in development) and no indication of how these are to be funded. If a Government department introduces graduate requirements as a condition of practice within its own organisations like the NHS, there is an obligation to ensure that universities can establish financially viable courses to meet the need and with a realistic timescale.

January 2005

APPENDIX 3

Memorandum from Save British Science Society

Saving Strategic Science

1. Save British Science is pleased to submit this evidence to the committee's inquiry into strategic science provision. SBS is a voluntary organisation campaigning for the health of science and technology throughout UK society, and is supported by over 1,500 individual members, and some 70 institutional members, including universities, learned societies, venture capitalists, financiers, industrial companies and publishers.

2. We deal with each of the Committee's points in turn.

HEFCE's Research Funding Formula

3. Following the Research Assessment Exercise in 2001, HEFCE summarily cut funding for departments rated as nationally excellent. The contract the universities believed they had been promised was broken. It turned out to be untrue that by working hard to improve the rating of a department previously graded 3 in the exercise, a university would be rewarded. It appeared that nationally excellent research is no longer considered worthy of investment.

4. It is no longer possible to sustain a science department on teaching funding alone, as we describe below when dealing with the implications of changing the weightings given to science subjects in the teaching funding formula.

5. This means that, without some research investment, it is practically impossible to sustain a department in a subject such as engineering, chemistry, physics or biology. It is certainly impossible for an individual university to sustain a portfolio of sciences.

6. It is still possible to sustain at least some arts or humanities departments without research funding, so cutting funding for nationally-excellent research in these fields, while just as undesirable in itself as cutting science departments' funding, has not had the same immediate effect on the viability of departments.

7. Although it is too late to change the past, we feel it is important to analyse the events that led to the cutting of funding for nationally-excellent departments. The reason given was that average gradings had increased and that, within finite financial limits, it was not possible to maintain absolute levels of funding for each grade.

8. While this was clearly arithmetically true, it was hardly a secret that ratings were likely to increase on average. Raising standards is, after all, seen as part of the point of the exercise. Moreover, the empirical evidence was that grades increased in every previous assessment. HEFCE could, and should, have planned for this.

9. The tens of millions of pounds that were used on the unsuccessful e-university would have made a good starting point as a source of funds to ensure that nationally-excellent research was preserved.

The Desirability of Increasing the Concentration of Research into Small Number of Universities

10. At a time when the costs of doing some kinds of research are becoming enormous, the concentration of research is to some extent inevitable. Only a small number of institutions can carry out expensive particle physics, for example, and only a small number of institutions will be able to rival the world's best across a broad range of disciplines.

11. However, the current policy appears to be to concentrate all scientific and engineering research in an ever-decreasing number of departments, even though the overall number of higher education institutions is increasing.

12. There will be two main consequences, one concerned with the long-term health of the science base, and the other concerning the quality of educational experience for students.

The effect on research

13. Although there may be short-term gains in concentrating all research in a few hands, in the longer term, the science base will suffer. The system will tend to ossify, with the established agendas of the research giants becoming fixed; there will be little or no possibility of funding novel ideas falling outside the orthodoxy.

14. The Government has chosen to compare the research system with football, describing a scheme to attract good researchers by paying them more as a hunt for "the David Beckhams of science".[1] Leaving aside the fact that Beckham is paid more for each 90-minute football match than a university researcher earns in a year, the analogy had some merit.

15. Beckham had his first professional games in 1994, with Preston North End Football Club, then in the third division of the Football League. Similarly, Les Ferdinand, who played for Queen's Park Rangers, then Newcastle, then Tottenham Hotspur, began his career with the non-league team Hayes. These lower-ranking clubs did not have the wealth of the richer clubs, but they did have the basic resources to allow the future stars to practice their profession.

16. Just as the Premier League in football depends on the lower divisions for new talent, so the research league depends not only on the departments that have already proved themselves to be internationally excellent, but also on those that have the basic resources to allow people to develop, and which may have the potential to be promoted into the research premier league.

17. For this reason, mechanisms for allocating public resources for research need to be allocated selectively, but the degree of selectivity needs to allow for groups with potential as well as groups that are already excellent.

The effect on teaching

18. If research is concentrated into a handful of institutions, it will no longer be possible for many, if not most, students to study science in a research department. It may not be possible for them to study science at all, and there are already large parts of the country that where it is no longer possible to study physics.[2]

19. But even if it proved possible for many institutions to maintain teaching departments in which no research took place, there would still be a problem. It is not possible to learn science without doing serious practical work, which requires appropriate infrastructure. Final year honours projects rely on the availability of active researchers to supervise them, and on the availability of suitable equipment. If research becomes highly concentrated, a large proportion of students will not be taught in an atmosphere of discovery, and will not be familiar with research techniques.

20. Scientific industry, such as the pharmaceutical industry, relies on a supply of well-trained scientists who are not going to be the next Einstein, but who do need proper research training. This workforce cannot be delivered if most universities simply do not undertake scientific research at a significant level.

The Implications for University Science Teaching of Changes in the Subject Weightings

21. The changes in weightings are an unmitigated disaster. There was no justification for them at all, and they are contrary to the Government's stated policy of making the UK one of the best places in the world to do science. Decision-makers at HEFCE should acknowledge that they have made a mistake, and should correct the weightings to reflect some kind of reality.

22. The current situation is that, even when student recruitment is buoyant, teaching many science subjects is not now viable without the back-up of substantial research funding, as the case of chemistry at Exeter shows very starkly. This is not the situation for classroom-based subjects such as law, English literature or business studies, where there are many departments that continue to prosper despite having very little or no research funding.

[1] *Daily Telegraph*, 7 July 2000.

[2] Physics—building a flourishing future, Report of the Inquiry into Undergraduate Physics, Institute of Physics, 2001.

23. With a limited total quantum of money available, and in the certainty that there will never be sufficient resources available to meet all demands, HEFCE has essentially two courses of action available to it.

24. The first is to distribute the pain equally among subjects, so that there is a level playing field among disciplines with no inherent bias in favour of or against any one subject or set of subjects. No hard data exist to say what the relevant ratios would be under this system, which is itself a fault on the part of HEFCE. However, the old weightings (under which students in laboratory-based subjects were funded at twice the level of those in library-based subjects) clearly gave a closer approximation than the current ratios.

25. The second potential model would be to weight funding in favour of subjects of national importance, judged according to the needs of the economy, likely shortages, the desirability of maintaining a presence in a variety of fields, and so on. Under this model, science and engineering subjects would, on average, fair substantially better than other disciplines, as would some languages and vocational degrees.

26. Although there is a clear argument for taxpayers' money being disproportionately focused on subjects of national importance, SBS would not currently advocate this policy.

27. We do not believe science and engineering should be subject to special pleading, but that they should be funded on a level playing field with other disciplines. The recent changes have tipped the balance against science and engineering, with no justification and no obvious benefit.

The Importance of Maintaining Regional Capacity

28. Partly because of changes in the funding model, undergraduate students increasingly need to live with their families while studying. Many are likely to graduate with substantial debts, and the financial saving of living at home makes the difference between being able to go to university or not doing so.

29. For this reason, it is matter of fair access that provision should be made across the whole country for students to study important subjects, including (but not exclusively) science and engineering.

The Extent to Which Government Should Intervene

30. Although the Government chooses to assert that universities are independent bodies and that it has no power to intervene in their affairs, it is patently nonsense that when taxpayers' money is being distributed on an annual basis, the executive branch of government is somehow powerless to exert strong influence on Vice Chancellors and others.

31. That ministers know this to be the case was made clear when a former Secretary of State referred to his "letter of direction" to the Higher Education Funding Council. When the Council's chief executive pointed out that the letter was, in fact, officially called a "letter of guidance," the minister was unrepentant.[3]

32. It is generally accepted that one of the jobs of Government is to intervene to correct failures in the market. It is a bizarre view that Government should not intervene to ensure the continuing provision of subjects of strategic importance. The Government's current attitude appears to be that the future of the nation's economy should be harmed by the foolish cutting of funding for excellent research and a bizarre tipping of the balance against science, or else that future prosperity should be left to the whim of the current cohort of 17-year olds, who are not choosing to study science in adequate numbers.

33. The mechanisms by which the Government could intervene could be relatively simple. It could give the Regional Development Agencies modest funding and specific responsibility for ensuring that each region maintains a competitive capacity across a broad range of disciplines. It could give the Research Councils modest extra funding and specific responsibility for ensuring that no area of research was completely lost without a breathing space to assess whether the costs of doing so would outweigh the financial savings.

34. We hesitate to suggest that HEFCE be given further authority, since it is at least as much to blame for the current predicament as any other organisation, but in fact, it has already been given new responsibilities in the Government's ten-year framework for science. Sadly, it appears not really to understand the problem, as it proved when its representative said in the press that any financial would be only be available to departments rated 5 or 5* in the last Research Assessment Exercise.[4] While the overwhelming majority of research departments are underfunded, it is not the top-rated departments that are currently under greatest pressure. If strategic support cannot be extended to departments that are rated as "nationally excellent," it is a nonsense.

January 2005

[3] quoted in *The Guardian*, Education Section, 5 December 2000.

[4] *Times Higher Education Supplement*, 26 November 2004.

APPENDIX 4

Memorandum from Professor David Walton, Coventry University

Point 1: *The Impact of HEFCE's research funding formula, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments.*

This is having a very damaging effect. My understanding (admittedly at second-hand) of the situation at Exeter is that the Chemistry course achieved its target undergraduate student numbers but it is intended to close the Department because there is insufficient funding via RAE to support the infrastructure. If nothing else this must show a mismatch between target quota numbers, the amount of funding awarded to the university per student for this subject and the costs of maintaining the infrastructure.

There is also an issue about strategic reallocation of funding obtained through the RAE.

In my own situation we are a "new" university, but have an ongoing research effort that has led to a decent number of deliverables: we have only nine chemistry staff (out of 667 teaching staff who could choose to undertake research), and since the last RAE alone we have produced 75 published papers out of 336 total in all MIMAS databases from our entire university, have contributed to 13 new books, are involved with almost half of all university-held patents, and have supervised 34 completed higher degree (Masters/Doctoral) studentships out of 231 from the whole university. Currently we have 31 ongoing higher degree studentships. We also have acceptable external esteem indicators (President of International Society, Chairman of European COST Action, membership of professional committees etc). These efforts have brought Professorships to three of our staff (but with increased financial demands on our cost centre), and we contributed greatly to the award of RAE grade 4 in Unit of Assessment 32 Materials (up from 3A), which was the joint highest grade at our university. This ought to be cause for celebration. Instead we are anticipating job losses (having been warned verbally that these are in the pipeline) because 'chemistry is too expensive'. Despite grade 4 achievements the overall RAE income to our university was less than was expected and as a result of this has had to be used strategically across the university. From my personal situation the HEFCE research funding formula has been nothing short of disastrous.

Point 2: *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend*

The smaller the number of research units, the less chance of making sufficient discoveries. However high the calibre of the few remaining research units, the country will suffer a demonstrable loss of capability. This is because an important part of research is not just the successes, which are what are published and attract attention, but also the failures, which are not published but which guide the next effort in the field. Often partial successes, such as are obtained at a moderate research centre, when published can guide workers at a top-class unit. For example, an organic chemist pursuing studies into a small aspect of synthesis makes a new compound for no other reason than it is in a series in which he or she is interested. This is then published and comes to the attention of a researcher interested in leading-edge research into biological membranes and consequences for disease conditions. This researcher realises that the new compound could be used as a mimic in part of the process and so, using the published synthetic procedure, which may not be obvious, is able to make and study the new compound. If the first researcher at the smaller establishment had not been there, then the leading-edge researcher would have had to think of the novel compound and also come up with a synthetic route to it. In my experience, however high-calibre a researcher may be, they cannot think of everything, and in any case the project at the high-calibre unit would now require a double-level of justification of resources, firstly to attempt to make the new compound (which it may not be possible to make, remember the first worker had to prove it could be done), and then to use it. This may be sufficient administrative hindrance for the work never to be performed.

In addition high-flying research can be quite strongly focussed, while smaller research groups are able to interlink with each other and develop a broad range of expertise to act as an underpinning resource for developing technologies in the country. This can be most useful for small companies (SMEs), and an example at Coventry is the Sonochemistry (ultrasound) Centre, run by colleagues, and its spread of activities.

My experience of "clustering" research at a limited number of units was when British Gas (with whom I collaborated) closed their London Research, Watson House Research and Solihull Research Centres and replaced them with a (now itself closed) single new research unit at Loughborough. The scope of new science and potentially commercially-useful discoveries became quite limited. I do not think that as a country we should restrict the opportunities for discovery (by all means enhance high-calibre units), but if the referees of papers, and the awarding bodies for individual grants (eg EPSRC) think that a particular piece of work at a smaller unit is meritsome then sufficient infrastructure should be provided to support it. It is recognised to be almost impossible to predict what will be a crucial discovery in research, and no-one involved in the early development of lasers would have predicted that one would be part of a storage device in the computer that I am using, or even that a computer of this power and speed would be sitting on the table in my back room at home. Major research discoveries are predicated upon a host of minor ones.

Point 3: *The implications for University Science teaching of changes in the weightings given to science subjects in the teaching funding formula.*

At a recent European COST meeting in Brussels I was interested to hear from an Israeli scientist that the relative weightings in his country are that a university receives for a chemistry undergraduate student four times as much as for a history student. I believe here the ratio is only 1.7 times. Science subjects require laboratories, technicians and infrastructure support, but the trained personnel who come out from these courses are able to bring funding back into the country that has trained them. This is not true of all subjects, and there have been several recent surveys to try to establish the "value-added" of training in chemistry compared to other subjects. I assume the Committee will be made aware of these by Professional Bodies (for example I believe the Royal Society of Chemistry has data from a survey in Germany that confirms the clear value to the country's Gross National Product of Chemistry training). If the country of Britain is concerned about the cost of training its citizens in strategic subjects then it should consider ways of extending the training to include commercial skills so as to maximise financial return to the country of producing these trained personnel. This must be a better strategy than cutting back on training so that one day we may have to rely on importing suitably skilled personnel from outside our country.

It is hard to find out "value-added" data from my own Alumni Office, especially since the value to the country some 5 or 10 years after finishing a BSc is a truer indicator of the worth of the education provided than simple "first destination" data. The ex-student need not still be working in the field of science to be a net earner for the country, and so represent a good "value-added" return on the costs of education. Universities represent only the final stage in the complete education of a person.

As well as the balance between teaching and research there is also an issue about the balance regarding central infrastructure and administration costs. I am not clear how these are factored into calculations about the weightings for subjects, and how they vary for different institutions.

Point 4: *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments.*

The problem here is that a proper undergraduate training in say chemistry involves the teaching of a modicum of research skills. This benefits the student in whatever walk of life they may end up in, even if it is not in chemistry. The idea is to give training in how to approach a problem, devise a means to attempt it, and assess the value of data obtained. At my Institution this involves a final-year project, and to give specific examples I have three of these this year.

One concerns the surface properties of silicon, measured by a wetting measurement technique derived from a collaboration with a university in Poland. Our aim was to check silicon (actually the outside layer is an oxide) as a control, before moving on to more complicated materials such as intrinsically-conducting polymers (we have a research proposal for an extensive higher-degree study on these materials lodged with the EPSRC and would like to give some preliminary data to assist the assessors of the proposal). The student is a French National on a final-year exchange from France. The results from silicon alone are so interesting that these will be sufficient for the project report. Some measurements are performed in the laboratory of a small spin-off company set up by an ex-colleague who was obliged to leave during a reprofiling exercise here two years ago.

The second concerns the possible effects of magnetic fields upon electro-organic reaction mechanisms. This is an old chestnut in electrochemistry. Magnetism certainly affects the corrosion of iron, which is a magnetic material in its own right, but the possible influence of magnetic fields upon transient intermediates in complex organic reaction mechanisms has long been a matter for debate. We have a collaboration with the University of Birmingham to use new magnetic materials that may give sufficient field strength to see an effect. The reaction system we have chosen is one that we are familiar with from our studies within the European COST Action, and we know that the balance of products can be switched by alteration of electrolysis parameters such as by using sound waves. Here we are now investigating the effects of magnetic fields.

The third concerns the use of sound waves to examine an unusual electrochemical reaction in which oxygen inserts unexpectedly into bonds in a carbon-compound. This is a collaboration with Kyushu University in Japan. The results may explain some of the surface effects seen by other workers in carbon nanotubes and similar new materials.

The students have only a few short weeks to study these projects, and as undergraduates unused to problem-solving at research level they do not make great discoveries, nonetheless these contribute to the minor steps forward that underpin major ones and we may have results suitable for publication in the refereed scientific literature from any of these projects. In a recent student project we made a novel compound that was taken to Oxford for further study, and the consequent results jointly published in a high impact-factor journal.

The point is that the projects use research-grade apparatus that is already in the laboratory for research usage, and importantly the undergraduates have practical assistance from postgraduate and postdoctoral researchers who are there to help precisely because of their presence to undertake research. In a "teaching university" (and I am not sure how this type of institution would work) there presumably will not be dedicated research-grade equipment, and such project students as there are must try to fit in on equipment routinely used by groups of students in practical classes. If there were equipment dedicated to undergraduate projects it would sit unused for periods of time, since the project component cannot be a major and continuous part of an undergraduate course. This is a less-effective use of laboratory resources than the current system where overall usage of research equipment is maximised by undergraduate projects.

Point 5: *The importance of maintaining a regional capacity in university science teaching and research.*

To the best of my knowledge my institution is one of only two of its kind (ex-polytechnics) in the whole Midlands of England that delivers a traditional chemistry degree, and we understand we will soon be reprofiled again to offer only a forensic chemistry degree. In the case of Exeter there is now no traditional chemistry offered in most of Devon and Cornwall. If the Government is serious about extending university education to 50% of the eligible population, and "widening access" to those who for whatever reason may not be able to undertake a chemistry degree at a Russell Group University then the current situation does not make sense. At Coventry we tend to take students who do not have a traditional background, and a consequence of this is that we have a higher failure rate early in the course. We do not view this as a waste, because we do not expect everyone who thinks first in life that they want to be chemists should be forced to have a chemistry training if they are not suited to it. If instead the students who leave us early go on to find other useful careers in life then we have given them valuable self-knowledge. This must overall be to the benefit of the country, but failure rates are held as negative factors against us. On the other hand our students who get good honours degrees go on to get higher degrees at many other universities, such as Warwick, Leicester, London, Southampton, and Oxford. A student who earlier obtained an Upper Second Class Honours BSc degree from us has just obtained a DPhil from Oxford and been put forward for a prestigious Royal Society Fellowship. We often have students who have personal and social reasons that distinguish them from "typical" school-leavers and we believe we give them as good a training in the subject as they could receive anywhere.

In respect of variants of the subject, I recently asked chemists from fourteen countries at a European meeting if the word "forensic" meant anything to them. To my surprise none of the attendees (once I had explained the word to non-english speakers) thought that forensic chemistry was an important subject in their country, and they were surprised to hear that many British universities were changing from traditional chemistry to forensic chemistry and other variants of the subject. This is an increasing trend that the Committee must address, in which British higher educational establishments are driven by what they think young people think they want to do. This may not be the best for the country, and other countries do not allow this to happen. Young people are by definition less experienced in life and the country supports their education so that when they are older there will be a mix of skills that is best for society. This may not be apparent to students at the age they leave secondary school and it is necessary to give guidance. By all means offer forensic chemistry as a branch of the subject that exploits existing equipment, laboratories, technicians and infrastructure, but as a subject it is more restrictive than chemistry, and to be taught properly requires additional expertise that is not normally available within a chemistry department. I am personally happy with the analytical chemistry component of forensic chemistry, which I am able to teach, but overall forensic chemistry is a relatively new subject and it is not clear how much the training of increasing numbers in this subject will benefit the country. It would make more sense to run forensic chemistry in parallel with the parent subject, not instead of it, until the benefits are clearer. This is not what is happening, and on top of this the regional mix of whatever variant of chemistry is being taught is such that students from certain backgrounds who may not be able to move just anywhere to learn are no longer able to study the subject at all.

Point 6: *The extent to which government should intervene to ensure continuing provision of subjects of strategic national or regional importance, and the mechanisms it should use for this purpose.*

This is an interesting point since virtually all higher education funding in this country originates from the government in any case. I recently attended a lecture by the Vice-Chancellor of another university who made the point that "since HEFCE controls the quotas of students per subject, and controls the amount of funding per student per subject, then the only sanction open to a Vice-Chancellor is to alter the mix of courses on offer" (which in the current climate amounts to closing courses down). The problem seems that Vice-Chancellors have necessarily a limited view of the overall picture (ie they are charged with the financial probity of their institution and not with any wider issues, such as the good of the country as a whole). It is therefore essential that government intervenes to direct the use of resources. It is surprising that a country of 60 million inhabitants could end up with only 20 (if that becomes the number) of good academic research units in one of the key natural sciences, and that we cannot support the teaching of some 3,000 new students in chemistry per year, yet this appears to be the case. At my university the lecture rooms are not in ideal condition, and these are not just used for chemistry classes. If chemistry is suffering because of poor student numbers, what subjects are doing well and having resources put into them? It is not obvious to me which subjects are, and as I travel around other universities I do not see signs of conspicuous expenditure on teaching resources elsewhere. If it is true that higher education is being effectively funded then why is not the sharp end (ie teaching resources) showing this? Where is the funding going, and is it really there? I cannot say.

How this is rectified is a matter for the Committee to address. One possibility is that an independent panel be set up to adjudicate on course closures and other changes in educational provision. A Vice-Chancellor planning to close courses would need to lay the reasons before this panel. If nothing else this would help to clarify matters for those involved. The panel should also obtain proper "added-value" data from alumni. It is important to obtain accurate figures on which to base decisions. At my institution we are not convinced that the true costs of our chemistry course have been taken into account. There are local issues to debate, including the setting up last year of a centralised undergraduate admissions office, with teething troubles that particularly affected chemistry recruitment. Chemistry staff also bring in research money and were key players in the RAE grade 4 for Materials. We are not sure how the "chemistry is too expensive" view is justified when the whole spread of chemistry activities is considered. The contribution of our chemists to university patents and "third strand" activities is notable and generally chemists are productive in this regard everywhere. No doubt there are other potentially extenuating issues for courses at other institutions.

In any case an independent panel would be able to take a national strategic view. At present it seems to us that Vice-Chancellors are being almost panicked into decisions based on short-term financial considerations, and are not required to consider the longer-term national benefit. This situation ought to be redressed before long-term damage is caused, unless of course the restriction of science provision is actually a national aim.

I have had several industrial jobs in my career, so have experience of both commercial and academic establishments, and cannot say that I have found universities to be places of conspicuous over-expenditure in regard to teaching provision. Given the number of course closures proposed, in the range of subjects at such a spread of institutions, especially offset against a supposed wider access to higher education of students in greater numbers, then the likely explanation is that the funding model is erroneous. I hope the Committee will consider this possibility.

I have produced this document at short notice and in great haste. I am happy to provide further detail if desired. I am very concerned about the future of science education in this country.

January 2005

APPENDIX 5

Memorandum from the University College Lecturers Union (NATFHE)

Introduction

NATFHE members work in the new—post-92—universities and colleges of higher education. Whilst science and engineering course and departmental closures in these institutions often don't receive the same high-profile media attention as those in more research-intensive universities, they represent a vital strand in national teaching and research provision. This submission to the Science and Technology Committee focuses on the relationship between teaching and research, the importance of sustaining regional provision, the negative impact of over-selective research funding, and the dangers of over-hasty and short-term decision making based on fluctuations in student choice.

Teaching and Research

The Committee has invited evidence on the optimal balance between teaching and research provision in universities—and in particular the desirability and financial viability of teaching-only science departments. In NATFHE's view teaching-only departments are in themselves undesirable. NATFHE was pleased to be represented on the Government's Higher Education Research Forum (HERF) last year, under the chairmanship of Sir Graeme Davies. We fully supported the advice produced by the Forum: "The relationship between Research and Teaching in Institutions of Higher Education". This advice clearly states that:

> "This suggests that in each academic department (or within each course team), there needs to be appropriate resources, a reasonable research culture, and sufficient research activity (broadly defined) to enable such programmes of study to be designed, led and taught effectively. It does not imply that every academic member of staff in every department in every institution of higher education will have to be entered for the ARE or should be pursuing Research Council grants."

The HERF advice recognised that the RAE is currently the only mechanism by which basic funding to support research in departments is delivered and that, given the highly selective allocation of research funding via the RAE, departments in some institutions, (primarily the post-92 institutions), lack the levels of funding needed to sustain a research culture and research activity. The HERF solution was to suggest a new funding model that could support research-informed teaching in institutions with low levels of QR funding—at a funding level of around £25 million. Whilst NATFHE, and others represented on the Forum, would not want to see such a funding model being used to exclude any institution from seeking funding for research per se, nonetheless, given the (excessive) level of funding selectivity currently in operation we saw this proposal as a useful way to help channel some additional funding where it is most needed.

Ministers accepted the advice but whilst the funding to the sector announced in December 2004 made some provision for this, it fell far short of expectations. The £25 million envisaged as recurrent funding has been delivered as, apparently, a single allocation spread over three years, with a mere £2.5 million being made available in the first year (£7.5 and 15 million in the two following years). If Ministers accept the principal that the funding of research-informed teaching must be addressed then, although any additional money must be welcomed, it is impossible to see how a single and partial funding allocation can address the on-going needs of departments to support both staff and students In engaging with research and research methodologies, as envisaged by the HERF advice.

Arguably these issues are particularly sharp in the laboratory-based subject areas where the funding demands of research and research-informed teaching are highest. Additionally the fact that opportunities for staff to engage in both teaching and research will further and further reduce in all but a small number of leading research universities will, over time, erode the career motivation of post-graduate and post-doctoral students, and thus the research workforce.

Course Closures

Although it is the closure of whole departments that hit the headlines, of very significant concern is the reduction in provision through course closures that may then leave patchy provision or provision in currently popular areas. For instance at Anglia Polytechnic University it is now likely that the chemistry department will either be closed or cut back so that the only curriculum on offer will be forensic science. Although it is vital that higher education is responsive to student demand there is a danger that short-term decisions are made—especially where subjects are expensive to provide and sustain. Once courses have been closed and staff have left it is not easy to open up provision again. Smaller-scale provision in the post-92 institutions is also likely to be serving different communities of students, employers and other research-users than the major science research departments—communities that are as entitled to their share of public funding for science and engineering as any other.

For instance, at Sheffield Hallam University a suite of courses in civil engineering, physics and chemistry was cut in 2002. It was argued that student numbers were insufficient to justify necessary expenditure on laboratory, staff and support facilities, that there would be further reductions in undergraduate applications in the relevant areas and that there was adequate existing alternative provision at other UK universities. In fact the forecast of student numbers was contested by staff in relation to civil engineering—and indeed there has been a significant rise in UCAS applications for civil engineering in the subsequent two years, and part-time applications were rising at the time. And although there was other provision in all three subject areas in the locality it did not provide the same range of courses as those on offer at Sheffield Hallam. Indeed it was argued that the SHU provision could be viewed as complementary to that on offer at the older, more research-intensive universities—being more oriented to local and regional industry and often offered on a part-time and sandwich basis. This not only points up the dangers of short-termism in closing provision in key subject areas, but also suggests that the needs of part-time, work-based students, local employers and the regional economies can all suffer when strategic planning is over-focused on international research competition and the need to fund a small number of highly competitive research departments at the expense of broader and smaller-scale teaching and applied research.

A similar argument has been made by staff at Coventry University where the chemistry department has been told that their numbers will be reduced by half. As yet the union has not been consulted and the university rationale is unclear. We would argue that although there is neighbouring chemistry provision at the university of Warwick, once again the two departments are working in very different areas, with different students, and the loss of capacity at Coventry will have an impact that will not be compensated for by the Warwick provision.

It is also the case that whilst the widening participation and access debate tends to focus on sub and first degree level provision, some of those institutions that do most to increase participation from under-represented groups in higher education, have the experience of taking students through access routes and seeing them progress through their first degrees onto PhD programmes. Reducing research opportunities in all but the most elite institutions inevitably means reducing access to higher education at all levels.

The Impact of Selective Funding

It is also feared that course closures and departmental reductions are but the preliminaries to the closure of whole departments. There is a critical mass of staffing below which RAE aspirations have to be abandoned, and along with them, hopes for research funding and academic career progression. The recent announcement that the Research Councils will fund 80% of research costs in future is very welcome, and arguably will assist departments in gaining research council funding despite lower levels of QR funding. But in practice success in the RAE makes a hugely significant difference to likely success in gaining Research Council funding. Inexorably: "to they that have shall be given". And of course this pattern has now been intensified by the decision only to fund post-graduate research degree programmes in departments that received a rating of at least 4 in the last RAE (or 3 in those units receiving research capability funding). Once a negative trend has been established in terms of the RAE ladder having been pulled up, and staff begin to leave, it becomes harder and harder to attract students. The viability of whole departments is under threat. The same occurs where redundancy and partial closures take effect. At the University of Greenwich the School of Chemical and Life Sciences has lost about half of its lecturers over the last eight years, with a similar pattern in Engineering. Further cuts are now likely and staff take the view that the School is now getting close to the limit at which course provision can be sustained.

It is also worth noting that the inextricably entwined funding pressures of inadequate research funding and difficulties in student recruitment may have hit the post-92 institutions rather earlier that the better funded pre-92 universities. At Wolverhampton University, for instance, the Physics department was closed 10 years ago, the Chemistry department five years ago, and the School of Engineering has cut manufacturing engineering, materials and quality awards.

Future Students

Any enquiry into strategic science provision also needs to look at the health of teacher education in both primary and secondary science—at University College Chichester, for instance, the Primary ITT science course closed three years ago, although there are now attempts to re-start it. Student demand for science and engineering at higher education will not improve unless science teaching and the science curriculum at primary and secondary level is sufficiently exciting and effective. Another critical issue in relation to the arguments for sustaining provision not only on a geographical basis, but in terms of institutional type and range of provision (that is, industry and local economy focused science and engineering) is the need for universities and colleges to work with local schools, colleges and employers to help stimulate interest in the sciences in the school-age students, and those who might come in through work-based and work-related routes.

Many of the post-92 HE institutions are well-placed in terms of existing partnerships to work to stimulate student demand for new curricula and modes of study in science and engineering—and at the same time to address government targets in terms of widening participation. But they need the funding to deliver it, and that includes research and teaching funding mechanisms that underpin research, and research informed teaching, in all higher education departments.

January 2005

APPENDIX 6

Memorandum from the UK Deans of Science

The UK Deans of Science has members in over 70 Higher Education Institutes across the full range of old and new universities and other higher education institutes. Whilst its core focus is on higher education it has a deep interest in all aspects of science and science education. We therefore welcome the opportunity to respond to the Science and Technology Committee Inquiry into Strategic Science Provision in English Universities.

1. General

It is recognised that the issue of the viability of university science provision is highly complex. Quite apart from the volatility of the undergraduate student demand for subjects there is an interwoven web of issues relating to the overall financial position of the individual university, the various overheads charged by universities for space and other supporting resources, external funding for research and other income outside the RAE allocation, etc It would be inappropriate to argue that any single factor has alone had the effect of closing down so many science courses. However, it needs to be recognised that departments or courses which were already "under notice" from university senior management have been readily put beyond financial viability by a single downward fluctuation in any one of the following factors—student recruitment, RAE funding, the HEFCE weighting for teaching given to the subject or even the move to another institution of a single lead researcher with very large research grants and large research group, equipment support, etc When a department is subject to more than one of these factors there are very few ambitious senior managers who will not decide to close it in favour of areas which may look more promising.

2. The Impact of HEFCE's Research Funding Formulae as Applied to Research Assessment Exercise Ratings, on the Financial Viability of University Science Departments

It is hoped that the Committee will be able to summon witnesses who can speak with authority on the precise reasons for some of the recent, high profile closures of departments, ie members of the universities concerned. However, the figures speak for themselves at a macro level. Since the 1996 RAE there have been at least 80 cases of closure of single subject science degrees in lower (RAE) graded departments. At the micro level the effect of the RAE can be very clearly seen: for example, the change between 2001–02 and 2003–04 for each Quality Research Unit for Biological Sciences was:

for 3b from £8,735 to zero

for 3a from £13,155 to zero

for 4 from £19,869 to £10,018 (ie 50% less)

The effect of this on the budget of a department will be evident to members of the Science and Technology Select Committee and the consequences must have been very obvious to those who made the decisions on the 2001 RAE funding allocations. Note also that these changes even mean that a department with the same number of QR units in 1996 and 2001that increased its rating from 3a to 4 would have seen its income per unit drop by almost 24% and the new settlement means that a department with research quality at "attainable levels of excellence in over two-thirds of the research activity submitted, possible showing evidence of international excellence" (the definition of a 3a grade) will receive no funding at all!

There are other potential knock-on effects of the receipt of a grade less than 5/5* in the RAE. Many would argue that Research Councils and other research funders are less likely to fund grant applications from research groups with lower grades regardless of the merit of the proposed work

3. The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of Such a Trend

Good science can be carried out in small pieces. In many areas of science research is increasingly carried out using computers. In these, and other areas not requiring large-scale experimental facilities, physical proximity of researchers is much less important, especially with modern communications.

Science in the UK needs a lively and broad community. Individual subjects need people in a range and significant number of universities to attend conferences, train students and postdocs, to referee grant proposals and research publications, etc Increasing the concentration in a few universities loses this broad community and subjects will lose their national identity and, eventually, their wider international visibility.

It is self evident that where a local university does not offer a subject at undergraduate level a student who wishes to study it and who cannot (or will not) travel further afield will simply study something else (or not attend university at all). If the local university does not offer a particular science then even those potential students who are willing to leave home to study may also feel that science is not important. (This is not an argument for every university to offer every subject).

The consequences of the increased concentration of research in a small number of universities may well satisfy a cost accountant working for "efficiency savings". It may also make it easier to fund some big science projects though these have been managed in the past when there was much less concentration of research funding than now. It will, however, reduce the opportunities for students (undergraduate or postgraduate) to have an experience of research and will reduce the number and range of opportunities for potential high quality researchers to emerge. As one example, the last three professorial appointments in research-led universities in biomaterials science have been of individuals who obtained PhDs from post-1992 universities.

An obvious drawback to unplanned concentration is the loss in some universities of the core sciences such as Physics, Chemistry or Biology. Without a balanced portfolio of physical and biological sciences, growth in new interdisciplinary areas is likely to be inhibited.

4. The Implications for University Science Teaching of Changes in the Weightings Given to Science Subjects in the Teaching Funding Formula

While universities are entitled to apportion their HEFCE funding as they wish there is a general trend, after the removal of overheads including funding for special projects, for resource allocation methods to pass funding to the area that has earned it. Also, universities are knowledge based businesses, and are well aware of the income associated with different subjects' activities, and of the margins in each area. Even though they are free to vire between areas, this cannot long be sustained against differential external funding constraints. This means that recent (and longer term) teaching funding methods impact directly, immediately and very negatively on nearly all science departments.

Until the recent changes in funding most academic scientists had argued that the unit of resource for teaching science was unsustainably low. 5* departments usually subsidise their teaching directly or indirectly from research funding, particularly by being able to make expensive equipment available to their undergraduates. If the teaching unit of resource is genuinely "for teaching" then it should be sufficient to purchase modern, sophisticated equipment, expensive books and periodicals and support laboratories appropriately.

The recent decision to reduce the relative unit of teaching resource for laboratory-based subjects is incomprehensible and extraordinarily damaging to science. Firstly it shows the lack of connection between the strategies of the DfES with those in the Treasury and DTI who are committed to a future in which science-based innovation drives economic growth. Secondly it does not take account of the long term under funding and the increasing cost of science caused by higher than average inflationary costs, increasing health and safety requirements, more expensive, "cleaner" laboratory facilities for nanotechnology, biotechnology, etc The arguments that the relative weightings reflect the amounts spent by universities is one of the great self-fulfilling statements of recent times and does not take account of the historical under funding of science in universities.

Three universities have supplied estimates of the effect of the recent re-banding and re-weighting of courses. These led to the removal for the 2004–05 session of approximately £750,000 for one Science Faculty and around £1,000,000 each from two others, despite their increasing costs. Where a Faculty includes computing the reduction to Band C is likely to have very extreme consequences on this subject.

5. The Optimal Balance Between Teaching and Research Provision in Universities, Giving Particular Consideration to the Desirability and Financial Viability of Teaching-only Science Departments

As far as science is concerned UKDS simply disagrees with the decision by the Government that universities can exist and offer taught degrees without being active in research. Science is about finding out and applying high level knowledge. It is inconceivable that good science teaching at degree level can be undertaken by those who are not practising researchers (this may be blue skies or more applied, "third stream" work). The increasing numbers of international students, which has helped the financial stability of numerous science departments is at risk if this fact is not grasped by Government.

Teaching only departments will make science provision two tier. In teaching-only departments, scientific understanding will be restricted, with more handed down truths, and such departments will produce students with less understanding of how scientific knowledge is generated. This is self-evidently undesirable.

As scientists, we accept that it would be helpful to be able to put a quantitative figure on the question of the optimal balance between teaching and research provision. We have stated above that there is insufficient money in total for teaching and it is clear that the RAE allocations were affected by a failure adequately to fund increased quality. Subject to a significant increase in the overall budget, across the whole of science the balance of funding between research and teaching could be, in percentage terms, what it is now had it been disbursed differently. However, we would not argue for a further perturbation which now takes money from 5/5* departments but a proper funding of other national and international quality research including much larger third stream funds and an acceptance that some resources must be allocated to ensure that there is research activity in universities offering undergraduate science courses.

6. The Importance of Maintaining a Regional Capacity in University Science Teaching and Research

A diverse regional capacity in university science teaching and research is important, *inter alia*, for the following reasons:

- for the regional economic and cultural agendas and the increasingly regional aspects of our democracy;
- to support the widening participation agenda, particularly for those students who cannot or will not leave home;
- to encourage the study and dissemination of science in all regions;
- to support the supply and the staff development of school science teachers across all regions;
- top rated science departments do not depend (or need to depend) on local recruitment;
- there is a potential for top up fees to increase the numbers of students who wish or need to study at their local university;
- to provide a local technology transfer service;
- some important industries may move or close if there is insufficient relevant higher education support in their locality.

7. The Extent to Which the Government Should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance; and the Mechanisms it Should use for this Purpose

If proper thought had been put into funding of teaching and RAE allocations over the past decade it is very unlikely that this question would have arisen. It is very unfortunate that Professional Bodies have only recently taken a serious interest in what has been happening to science provision in UK universities—as members of these bodies we have been warning them of the consequences for many ears. We are clear that some action may need to be taken to ensure that regional provision is maintained but we are very sceptical, based on previous history, some of which is described above, that any intervention could be relied upon. Indeed, if it were yet another case of change with no additional money it could prove to be counterproductive and is most unlikely to be sustained. Intervention would have to be delivered, following a clear strategy of defining regions considered science deficient, by clearly articulated, sustained, ring-fenced Central Government funds possibly augmented by equivalently sustainable support from Regional Development Agencies.

Science is vital to government policy in every sphere. The UK science base is currently under a real threat, which arises from a mismatch between government policy in general terms, and its expression in real terms in university funding. The mediums of expression of government policy in science are the OST and the research councils, and the DfES and the funding councils. The central problems arise in the UK's university science base arise from RAE-related funding, and from the unit of resource for teaching science. Both of these major factors are controlled by the funding councils. Government should act swiftly to ensure that the dislocation in policy is rapidly corrected, by enforcing changes in both these funding areas, so that UK science can be returned to a sustainable position.

Given the obvious and significant effects negative effects caused by successive decisions impacting on universities, which we believe we have clearly demonstrated above (to which could be added the unpredictable effect of top up fees) a thoughtful observer might wonder whether HEFCE and the Government are carrying out one of the ultimate experiments in Higher Education, that of testing science provision to the point of final destruction.

January 2005

APPENDIX 7

Memorandum from the Russell Group

1. I write on behalf of the English members of the Russell Group of Universities in response to your Committee's invitation for the submission of evidence to its Inquiry into Strategic Science Provision in English Universities. This is an important subject, which is indeed of relevance across the UK, and the Russell Group welcomes this opportunity to contribute. Throughout this response we have used the phrase "science" to refer to the specific subjects referred to by the Committee.

2. At the outset, we feel that the Inquiry should recognise that the matters it is seeking to review are being shaped by four primary considerations operating at the national or international level and as set out below, which have come together to create an environment where some further concentration of provision in science is both inevitable and indeed desirable.

2.1 *Dynamic Changes to the Scale of Research Capability*

In its Science and Innovation Investment Framework 2004–14, Government itself has recognised that research has become intensely competitive at the global level. To be competitive, research needs to be of the highest quality and at the cutting-edge. This in turn requires increasingly sophisticated and diverse staff expertise and facilities, and often also the constructive interaction of cognate disciplines, each capable of performing at the highest level. Success in the face of such international competition requires therefore a proper depth of research expertise and capability, particularly in science subjects. For the UK, these considerations are resulting in processes of greater research concentration.

2.2 *The Relationship between Research and Teaching*

Research concentration also has relevance for teaching provision and for higher-level training in science. Postgraduate research students have always been a very important component of a dynamic research environment in science and it has long been recognised that their successful training can only be assured where vibrant communities of such students can be supported and sustained in sufficient numbers. At the undergraduate level, high quality and up to date teaching also requires access to a range of staff expertise and of facilities which can only be sustained by a successful research community. There is therefore an essential and close link between the sustainability of high quality teaching and the successful prosecution of research activity.

2.3 *Student Demand*

In this symbiotic relationship between teaching and research, there is of course an equivalent reliance upon an adequate supply of students. It is almost impossible to sustain a successful research department that does not also include a healthy range and scale of teaching. However, the demand for teaching in science has shown considerable adverse change over a number of years, with a marked reduction in the proportion of students wishing to pursue undergraduate courses in science. This is particularly so for the State sector, which in recent years has seen a substantial decline in the number of students leaving secondary education with what might be regarded as the minimum of qualification of two science A levels. To counter this trend, universities and the professional bodies have been working very hard to generate interest and aspiration. But the dynamics are such that student demand in these areas is ultimately an issue of national significance which will have to be addressed at the Secondary Education level, and any significant improvements will necessarily have long lead times. In this regard, we look forward to the Government's response to the Tomlinson Report as an opportunity to begin to address these matters substantively.

2.4 *Strategic Planning and Competition*

It is now clear that universities in the United Kingdom are working in competition at both home and abroad. As autonomous bodies, this has required them to think carefully about their strategies, about their priorities and about their strengths and weaknesses. The need to maximise performance and to sustain provision in areas of strength or strategic priority necessarily involves also a careful assessment of the resources that can be directed elsewhere, and in particular the extent to which chronically under-performing or lower-priority activities can or should be sustained.

3. Having set out what we consider to be the primary drivers in the matters under review, we should like to make the following comments about the policy implications for science provision:

3.1 *Rationalisation and Collaboration*

The fall in student demand and the requirements of research competitiveness and concentration together require a policy environment which manages rather than obstructs necessary change. In circumstances where a university considers that its provision in a science subject is weak and no longer properly sustainable or part of its strategic priorities, it should be able to work with HEFCE and with other universities to transfer that funded provision more appropriately elsewhere, while being enabled to retain equivalent resources to reapply to its strategic strengths and priorities. Through such an arrangement, the consequences of large-scale processes can be properly mediated and directed to the benefit of the HE system and to the country as a whole. Only in a very limited number of highly specialised and small-scale subject areas might any greater intervention be required to protect the national interest.

3.2 *National Levels of Provision*

Although of course there are wider societal benefits from ensuring that a good proportion of our HE students graduating from our Universities are educated in scientific subjects, there can be no absolute or "right" figure for the number of students in science subjects that the country needs to meet its skilled manpower requirements. This is in part because some of those manpower requirements will continue to be met by the import of skilled staff from abroad. Although some evidence may be beginning to emerge about skill shortages in some particular subject areas, this of course may be as much the product of the number of graduating students choosing to enter postgraduate or postdoctoral training than a reflection of the absolute members in science education and training. For it will of course be recognised that many graduates in science, and not least in Chemistry, presently choose to go straight into well-remunerated careers outwith science, and career salaries within science show little sign of the upward movement that would reflect any general skill shortage. Furthermore, as set out in paragraph 2.3 above, the right way to address concerns about the number of students coming into science is not by encouraging the provision of unfilled university places but to encourage more students to take relevant subjects at A level or equivalent, by improving the quality of mathematics teaching in schools and by making experimental science in schools more exciting.

3.3 *Patterns of Access*

The factors influencing science provision are national or international in scale. Nevertheless, it does need to be recognised that the overall pattern nationally of that provision will need to be monitored and kept under review. We believe that these considerations can be properly met within the policy processes identified in paragraph 3.1 above and indeed would not envisage that the outcome of such processes would denude any one region of access to one or more sources of high quality expertise and training in the relevant sciences. However, equally we see no merit whatsoever in seeking to preserve uncompetitive and lower quality provision merely to enable its continued availability at the sub-regional or indeed regional level.

3.4 *Resource Allocation*

The Committee has raised in its call for evidence questions concerning the possible impact of various aspects of resource allocation. It is our view that the issues being addressed by the Committee go far beyond the product of any particular aspects of HEFCE's funding arrangements and are therefore generally unsusceptible to tactical readjustment of those arrangements. Nevertheless, some adjustments to resource allocation might help to smooth and mediate the outcomes of the processes we have described. For example, we feel there would be value in reviewing the resources associated with the award of a grade 4 in the last RAE. Following that RAE, the first priority was to provide resources to departments rated 5* and 5 to enable them to continue to compete internationally.

However, the overall level of resources available was such that it proved necessary consequently to reduce the resources attributable to grade 4, and that has led to a very steep funding gradient indeed between grades 4 and 5. Yet grade 4 is intended to represent research work of national importance. The new RAE grading system which will apply in RAE 2008 may come to address this issue if it is properly resourced, but in the meantime a review of the resourcing of grade 4, without detriment to grade 5 and 5* through the allocation of additional resources as necessary, would be of value.

4. In summary, we would contend that the principal issues raised by this Inquiry reflect much wider and longer-term considerations of research competitiveness and student demand. These are primarily matters of national relevance and significance, in some cases mainly requiring attention outwith Higher Education. In response to these changes, processes and policies need to be reinforced in order to permit universities working together and in collaboration with HEFCE to shape science provision constructively and efficiently. The pattern of provision nationally might need to be kept under review, but this cannot justify or sustain the preservation of uncompetitive and lower quality provision at the sub-regional or indeed regional level.

We would of course be delighted to provide further information and clarification as your Committee might require. I should of course remind you that the Russell Group comprises the Vice-Chancellors and Principals of the Universities of Birmingham, Bristol, Cambridge, Cardiff, Edinburgh, Glasgow, Imperial College London, King's College London, Leeds, Liverpool, London School of Economics and Political Science, Manchester, Newcastle, Nottingham, Oxford, Sheffield, Southampton, University College London and Warwick.

January 2005

APPENDIX 8

Memorandum from the Society for Applied Microbiology

The Society for Applied Microbiology is the UK's oldest microbiological society with members in over 73 countries. The society is the voice of applied microbiology in the UK and we are always exploring ways to promote the interests of our members and science. For example, the society was recently selected to handle communications for the EU Network of Excellence called "Med-Vet-Net". This is a network of 16 Institutes in 10 European countries investigating diseases transmitted by animals; these diseases as well as causing considerable suffering and misery are responsible for 14 million deaths worldwide and costs the EU well in excess of €6 billion/yr.

Applied microbiologists play a key role in public health, environmental protection and remediation, as well as in industries such as food, pharmaceuticals and biotechnology. Applied microbiology is a key skill required in human and animal medicine, for example in combating diseases whether emerging (SARS or avian flu) or classical (foot and mouth) and now, regrettably, defence against bioterrorism.

The Society welcomes this opportunity to present evidence to the Committee and to share its concerns about the future direction of teaching and research in our universities.

The responses to the Committee's questions are:

1. *The impact of HEFCE's research funding formulae, as applied to RAE ratings, on the financial viability of university science departments;*

There has been a marked decrease in both the number of microbiology departments and graduates with specific microbiology degrees over the last decade.

There are sound economic arguments for the formation of large departments by merger and rationalisation and for concentrating resources on the less expensive subjects. However, there is a serious risk that with significant funding only allocated to the highest rated research units that other units, many with a considerable quantity of good science which is of strategic importance to the future of the UK, miss out.

Universities have to pursue strategies to maintain their financial viability. Applied microbiology is an expensive subject because of the laboratories, technicians, materials and equipment required, and often jointly used, for teaching as well as research. The cost of maintaining this very specialised equipment is also significant. Our fear is that the trend to concentrate funding into a limited number of units will continue and the teaching of, and research in, applied microbiology will suffer.

2. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend;*

The formation of large departments can result in an increase and rationalisation of teaching and research. There is, however, a concern that if the number of university departments carrying out research becomes too small, much good quality science will be lost and new ideas will not emerge from the UK.

The appropriate number of university departments in a particular subject is a difficult balance to strike. We believe that this balance should not be left solely to market forces as teaching/research in certain subjects is of strategic importance to the country. We believe that applied microbiology should be considered a strategic subject.

3. *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula;*

The most serious implication is that it will continue to be extremely difficult to adequately teach science subjects, such as applied microbiology. Applied microbiology has a high, and therefore, expensive practical element. Unless this need can be financed students will leave English Universities less well equipped for their careers.

4. *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments;*

Overall there has to be balance between the two elements, though this balance will vary between Universities. However, teaching-only departments are of questionable viability in science since there will be a shortage of funds for practical provision. Practical teaching is a key component of courses in subjects such as applied microbiology!

Public health, medicine and many industrial sectors such as food, pharmaceuticals, water and environmental remediation are of crucial importance to the future of the UK. These sectors require knowledgeable, enthusiastic and skilled applied microbiology graduates who have practical skills, insight and experience. We believe that to satisfy this demand the best teaching includes a component of "research-led teaching". Enthusiasm for, and experience of, research by staff is transmitted to undergraduate students and produces the high quality graduates required by employers. We have many examples to support this argument.

5. *The importance of maintaining a regional capacity in university science teaching and research;*

This is important as it is more costly than ever for students to study away from home. This could mean that students will study whatever subject they can at an institution close to home rather than a subject which is of strategic importance to the UK.

Government policy is to encourage the development of SMEs and the existing science based industries. Industry and SMEs often benefit from a local research institution to provide them with the help, knowledge and advice they need. That university will benefit, as will the local community and the country, from this partnership.

6. *The extent to which the Government should intervene to ensure continuing provision of subjects of national or regional importance; and the mechanisms it should use for this purpose.*

The Society for Applied Microbiology believes that a policy based on a blend of market-led forces coupled with a strategy to protect and encourage subjects which are of strategic importance for the UK has to be developed.

This policy needs to identify the strategic science subjects and accept that they are often more expensive to teach but that the result will be quality graduates and a healthy research and industrial base. The policy also needs to recognise that the strategic science subjects, such as chemistry, physics, applied microbiology and biochemistry are essential for the teaching of other disciplines, such as medicine, dentistry, pharmacy and veterinary degrees.

The Government finally needs a rigorous investigation of the complicated reasons for the decline in the number of school and undergraduate students wishing to study these sciences.

26 January 2005

APPENDIX 9

Memorandum from the Higher Education Funding Council for England (HEFCE)

Introduction

1. We welcome the committee's enquiry into this topic. The excellence and vitality of the UK HE and research base, including provision for teaching and research in scientific and technical disciplines, are crucial to maintaining a strong economy and an inclusive society. This is a highly developed, complex system which a number of key players—including schools, higher education, and employers and users of research within the productive economy, as well as government bodies—need to work in close interdependence towards shared aims. Any proposals for change within the system must recognise this complexity and fully reflect the tensions between the needs and priorities of the different stakeholders as well as changing patterns of employer and student demand. Our evidence below is based upon our analysis of the current situation and the evidence available to us, which may change as a result of further work that we still have in hand. In this context we have some reservations about certain assumptions underlying the committee's call for evidence, which we hope that their enquiry will expose to informed debate.

2. The role of the HEFCE is to allocate public funds, and to ensure that these are well used in support of government policy—notably as set out in the recent *Science and innovation investment framework 2004–14.* In reading our evidence it should be borne in mind that the Council is one of several major funding sources for HE; that HEIs are autonomous bodies, and we would consider intervening in their internal decisions only where there was an exceptional case in national policy or gross market failure to do so; and that we do not have planning powers to determine the exact shape and type of HE provision.

3. The issues raised by the committee do not apply only to science; and nor are they peculiar to the UK. (Note: in this evidence we refer to STEM disciplines—science, technology, engineering and mathematics.) Issues of student and employer demand, and the supply of student places and research output, arise in relation to a number of areas including for example modern languages. They can also be seen to arise in other developed countries, including across Europe and North America. Patterns of demand and provision vary over time, and between institutions and disciplines, and it is unlikely that possible action that may help in one area will be equally effective across the sector as a whole.

4. The following paragraphs deal in turn with the six points on which you invited evidence; we have taken the last two of these together.

HEFCE funding for research

5. Some key facts about the Council's allocation of grant for research are given at Annex A. The key aim of our funding for research is to promote the continuing excellence, responsiveness and diversity of the research base within HE.

6. The great majority of HEFCE funding is allocated to HEIs as a single block grant, and it is entirely for the HEIs to decide how to allocate this and the other resources available to them between disciplines and between activities within disciplines. We do not therefore see a direct linkage between our grant allocations and the financial viability of academic departments. In particular:

- Across the sector as a whole and for many HEIs, HEFCE grant is a minority element in their overall income. In 2004–05, HEFCE research grant represented 31% of the total research income for institutions in England (and was around a third of their research income in STEM subjects).
- HEIs at large are undertaking research activities of public benefit at a loss—taking into account their income from all related sources and the full economic cost of the work that this supports. This situation is not sustainable, and is being tackled in a number of ways including the recently announced increases in QR and in the proportion of project costs covered by grants from the research councils; and importantly, through a requirement in our financial memorandum with HEIs that they should ensure that the full cost of all of their activities is covered by their aggregate income stream taking one year with another. But institutions still have to take hard decisions about how best to use the resources available to them, and are generally not able to increase research activity in any field without making reductions in other fields of activity that their stakeholders would probably challenge.
- There is evidence that a somewhat less selective funding regime in other territories within the UK does not necessarily rule out the closure or rationalisation of academic departments; and within England a number of HEIs are able to maintain strong science departments with healthy demand from students (see below).

Concentration

7. HEFCE has no policy aim to increase the concentration of research funding; rather we have a policy of selective funding which rewards and fosters excellence (as judged by the Research Assessment Exercise [RAE]). We aim to ensure that the overall quality of the research that we support, and the competitive position of the UK research effort on the international scene, are maintained and improved. We remain committed to support research of the very highest quality wherever this is being undertaken within the HE sector. In our funding we therefore give the first priority to ensuring that we maintain our level of support to the most highly rated departments in all disciplines, and then support less highly rated work down the scale as far as resources permit.

8. The outcome of the 2001 RAE was a significant increase in the volume and proportion of research in departments awarded the highest ratings. This means that, in order to avoid reducing our unit funding to departments rated 5 and 5*, we no longer count departments rated below 4 in our research funding allocations (except for the "capability" funding noted below). This has not, however, meant that our funding is very significantly more concentrated. There are now 75 HEIs with at least one department rated 5 or 5*. Between 2001–02 (the last round of allocations using the 1996 RAE ratings) and 2004–05 (the current grant year):

- Total HEFCE funding for research in STEM increased by 18%
- Across all disciplines, in 2001–02 75% of our research grant was paid to 24 institutions and in 2004–05 75% was paid to 22 institutions.

9. We see no cause for concern at present about the number or geographical distribution of strong research departments in any of the main STEM disciplines. We do have some concern about the need to develop research capability in certain disciplines that were comparatively recently established—to which we give special support through a "research capability" fund of some £17 million each year, covering departments rated 3b or 3a in 2001. We are also working with the research councils to provide targeted support for research in strategically significant subdisciplines where current provision is judged to be vulnerable. In particular, we have launched jointly with EPSRC a Science and Innovation Awards Scheme to strengthen research provision in fields including chemical engineering and statistics.

10. The RAE panels in 2001 did not apply criteria of critical mass in judging excellence; but it is observable that across SET disciplines the smaller departments tended to get lower ratings. This suggests strongly that there is some connection between the size of a research unit and the capacity to achieve and maintain excellence, possibly related to the cost of maintaining and updating specialised equipment, and it may be that institutions need to find ways to work with this. We would be concerned if these pressures were to lead to many fewer departments than at present being active in research at the highest level in any discipline, or to the attrition of isolated research units of high quality in institutions with lower overall volumes of highly rated research. We are actively considering how best to work with the sector to safeguard such "pockets of excellence" and the diversity and vitality of disciplines overall. The change to quality profiles for the RAE 2008 will assist this; one approach may lie in identifying and supporting new models of collaboration between HEIs.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

11. Although fairly simple in concept, we understand that the teaching funding methodology can appear complex to those unfamiliar with its principles. This has led to unfortunate headlines about reductions in funding to science subjects which are seen to be without foundation once the funding method and outcomes are understood.

12. The change in weighting affects the relativities between subject allocations. Changing the relativities naturally has an effect on the base unit of funding used to calculate grant allocations. When the weighting for SET subjects was changed from 2 to 1.7, this led to only a slight shift in resource for these subjects of −3.4%. Moreover, the allocations made to HEIs included additional funding for teaching, meaning that overall grant for 2004–05 was allocated against a higher base. Taking this into account, the resource for SET subjects actually increased by 5.5%.

13. When considering the specific implications of changes in weightings for science subjects a number of points should be borne in mind:

- No institution had their teaching grant reduced as a result of changes in subject weightings.
- As indicated earlier in this document, we allocate recurrent funding as a block grant and institutions have considerable freedom as to how they distribute their grant internally to support their academic objectives. We do not expect institutions to allocate their teaching grant internally using the same approach that we have adopted for the sector as whole.
- The weightings are based upon our best observation of actual patterns of relative departmental expenditure within the sector, as returned to us through HESA by institutions themselves.

14. In the review of cost weightings which informed the 2004–05 grant allocation, we proposed a "split" in the science price group (price group B), with differential weightings for higher cost subjects and other science and laboratory-based subjects. In responses to the consultation a significant majority of institutions did not favour splitting price group B; and nor was this proposal generally supported by the broad science and engineering subject bodies, who perceived that science and engineering as a whole would lose out even if the high cost subjects gained. We will continue to monitor provision in the SET subject areas in case action to support these subjects, regionally or nationally, proves necessary; this is one of the actions we will take to support our advice to the Secretary of State.

15. Currently our funding method uses expenditure as a proxy for cost in each subject area. This is the best information available, but we are piloting a means of looking more closely at costs based on the TRAC methodology, and may use this information in making future allocations.

16. A description of the funding method and the detail behind decisions to change the price group weightings can be found at www.hefce.ac.uk under publication numbers 2003/42 and 2004/24. A further useful document for reference is publication number 2004/23 which describes the funding methods for teaching and research.

The optimal balance between teaching and research provision

17. In considering the balance between teaching and research provision we understand that the Committee seeks an "optimal" solution. We believe that this must remain a strategic and academic judgement for individual HEIs, and it is unlikely that a balance could be found that would be considered optimal for all partners. We feel it would be unhelpful to try to find a 'one size fits all' solution. The issues relating to STEM subjects are highly complex, and we consider that a flexible approach, enabling HEIs to meet the demands of their various stakeholders, is more likely to lead to a successful outcome.

18. It is possible for departments to remain viable where the majority of income comes through teaching resource. For example, in 2003–04 there were some 42 departments of chemistry with significant student numbers. Sixteen of these do not receive HEFCE research funding, although they do earn research income from other sources.

19. A major factor affecting the viability of a teaching department is student demand. In his report SET for Success,[5] Sir Gareth Roberts makes the point that the primary driver in HE course provision is student choice. The report illustrates that the number of graduates in science and engineering has been increasing, but that this growth has largely been through increases in students choosing to study biosciences and computer science. In contrast, demand for physical sciences, engineering and mathematics is falling.

20. The recent UUK/SCOP report Patters of higher education institutions in the UK: Fourth Report shows that total enrolments in biological sciences have risen by 40% between 1994–95 and 2001–02. In computing science enrolments have increased by 82% over the same period. Enrolments in engineering and technology have fallen overall by 5%, and those to physical sciences by 8%. These percentages, based on large subject groupings, mask a changing profile with the disciplines themselves. For example, aeronautical engineering has seen an increase in enrolments of 67%, whilst metallurgy has dropped by 30%.

21. In attempting to meet these demand patterns and, perhaps more crucially, to stay abreast of the dynamic forces within subject disciplines themselves, HEIs are choosing to reorganise their academic provision to emphasise subjects at the cutting edge of research and to meet perceived changes in demand for teaching and research. A good example of this is the re-alignment of Chemistry within life or environmental sciences in a number of HEIs. For this reason, the closure of a department may not signal complete cessation of work in that area, since elements of existing provision in the discipline may be retained with a related department. This "transdisciplinarity" is vital to the ongoing health of subjects. It is important that the dynamism of subjects is not constrained by artificial single subject constructs, "frozen in time", when evolution is driving them towards greater interdisciplinarity.

22. We will continue our research into these factors to inform our advice to the Secretary of State on HE subjects or courses of strategic importance. It is, however, already clear that student demand is a complex issue bringing together a number of factors. We have recognised some of these in work in hand with the sector—for example, work to increase the science links to schools and colleges from HEIs, industry and scientific societies. We are undertaking a project with the Royal Society of Chemistry to raise the aspiration of school children, and are in discussion with other bodies including the Institute of Physics and the Royal Academy of Engineering about ways in which student demand for science and engineering courses might be stimulated.

[5] SET for success: The supply of people with science, technology, engineering and mathematics skills: the Report of Sir Gareth Roberts' Review published April 2002.

The importance of maintaining regional capacity in teaching and research, and mechanisms to bring this about

(a) *teaching*

23. The Secretary of State's letter of 13 December asked us to advise on where intervention might be required, and in what form, to ensure the continuing availability of higher education subjects and courses of national strategic importance. We are working on this—including through our review of teaching funding—but it will take a little while to assemble and review the relevant evidence and to draw conclusions on possible ways forward.

24. The Secretary of State has also asked us to look at the scope for involving HEIs more closely in regional skills strategies, and to work more closely with sector skills councils to identify both gaps and opportunities to which the sector should respond. We are taking this forward, and indeed are already working with partner bodies on some specific issues where significant localised gaps in provision have been identified.

(b) *research*

25. Excellent and innovative research is increasingly a global business. We see limited value in debating the question how much research HEIs should be funded to undertake, overall and in particular disciplines, at below the national level. The main contribution of research to the economy, and the supply of highly skilled manpower, operate at that level. Moreover there are many fields of research activity in which it is more important to maintain one or two world class units nationally than to increase the number of smaller groups perhaps doing less innovative work, especially where costs are high.

26. We are already taking action to strengthen parts of the research base nationally where there is a clear justification for this and we have identified an appropriate mechanism:

- our funding for capability subjects noted above.
- Working with OST and the research councils to stimulate the health of science disciplines, we have launched the initiative with the EPSRC noted above and are discussing proposals for similar initiatives with other research councils.
- We welcome well framed proposals for projects to strengthen and update research provision—especially in collaboration between HEIs and in consultation with the RDA—for funding from our strategic development fund.
- The Science Research Investment Fund (SRIF), a joint DfES/OST programme, which we manage with input from the Research Councils, is helping HEIs to update their research infrastructure including in response to changing demands from research users and partners. The benefits and impact of SRIF were confirmed in a report on the evaluation carried out by JM Consulting in 2004.

27. There are certain regional elements to be considered in relation to the provision and impact of research within HE, especially in terms of promoting interactions between HE and smaller businesses. We do recognise that particular research units can make a contribution to their regional economy, and are working to encourage joint working between individual HEIs and the Regional Development Agencies in building and planning provision at regional level. But the proposition of a direct linkage between the location of centres of research strength and enhanced regional economic growth (sometimes referred to as "clusters") remains unsupported by clear evidence and requires further investigation. We plan to undertake some work on this. In the mean time we do not see the location of research activity as a key element in ensuring that people wanting to undertake postgraduate research degrees, or wealth creating bodies requiring specialised advice and support, have good access to suitable provision of high quality.

January 2005

Annex A

HEFCE Research Funding Allocations

1. In 2004–05 HEFCE distributed £1,081 million of grant for research to HEIs in England within the overall block grant. The great majority of this was distributed as quality weighted "QR" grant, allocated by reference to

- Institutions' quality ratings for research in 68 subject units of assessment (UOA) in the 2001 Research Assessment Exercise (RAE).
- A composite measure of research volume including eligible staff submitted for assessment in 2001; and annually updated figures for numbers of research assistants, research fellows and research students, and research income from UK based charities, in units counted for funding.
- Cost weightings for academic subjects, in three bands, based upon the pattern of actual observed expenditure. The amount of funding to be allocated in relation to each UOA is calculated by reference to these weights and to the volume of eligible research returned in the UOA.

2. An element within the QR grant (some £75 million) is allocated to support the costs of providing for students undertaking postgraduate degree programmes. In the context of our policy for a closer link between funding for these programmes and the quality of provision, the Council will be changing the way in which this element is calculated, and also taking research student numbers out of the general volume measure above, with effect from 2005–06.

3. QR grant is now allocated by reference only to units rated 4 or above in the 2001 RAE, except for some £17.5 million of "research capability" grant to units rated 3b and 3a in seven subject units of assessment and a small sum allocated in relation to postgraduate research students in units rated 3a (we are phasing this out).

APPENDIX 10

Memorandum from the National Conference of University Professors (NCUP)

STRATEGIC SCIENCE PROVISION IN ENGLISH UNIVERSITIES

I am writing concerning the above. I do so on behalf of the National Conference of University Professors (NCUP). The National Conference of University Professors (*http://www.swan.ac.uk/ncup/*) aims to promote beneficial developments in the UK university system.

The NCUP is dedicated to the impartial communication of information and advice about higher and further education in general. Our organisation has a membership drawn from all disciplines and all UK university institutions.

A recent survey of Members' opinions (see Annex) indicated a great concern about the perceived threat to the UK science base. In particular the following emerges:

1. Members view very negatively the impact that HEFC funding has had, using RAE rankings, on the science-base of university Departments.

Further, it is felt that:

2. It is undesirable to increase the concentration of scientific research into a few departments.

3. Teaching only science departments are both undesirable and non-viable.

4. It is very important to maintain a regional capacity in science teaching and research.

5. It is essential that Government should intervene to ensure a continued provision for those scientific subjects of strategic, national or regional importance.

I would urge the Committee to consider seriously the voice of the NCUP in this matter. Certainly we would want our views to be "factored in" to policy actions taken in the light of the deliberations of the Science and Technology Committee.

I have appended an Appendix of both quantitative (questionnaire based) and qualitative (Members' views that encapsulate the views of many others) evidence to back up the import of points 1 through to 5 above. I am happy to communicate further on this matter.

January 2005

Annex

QUANTITATIVE EVIDENCE: QUESTIONNAIRE RESULTS

The House of Commons Science and Technology Committee is inquiring into actions that will ensure an adequate level of science teaching and research in English universities This inquiry follows several recent high-profile closures of university chemistry, physics, mathematics and engineering departments.

We would appreciate your briefly expressing opinions through the following questions, which cover several of the key points of the enquiry. All questions refer to science departments in the English university system, but they clearly have implications for universities in Scotland, Wales and Northern Ireland.

1. How has HEFCE's research funding, based on RAE ratings, affected the financial viability of science departments?

Very negatively (47%)/negatively (44%)/neutral(7%)/positively(0%)/very positively(0%)

2. How desirable is it to increase the concentration of scientific research into a few departments?

Very desirable(9%)/desirable(9%)/neutral(6%)/undesirable(45%)/very undesirable(39%)

3. How desirable are teaching-only science departments?

Very desirable(0%)/desirable(9%)/neutral(6%)/undesirable(40%)/entirely undesirable(46%)

4. How financially viable are teaching-only science departments?

Completely viable(3%)/viable(9%)/neutral(32%)/non-viable(44%)/utterly non-viable(12%)

5. How important is it to maintain a regional capacity in science teaching and research?

Very important(68%)/important(29%)/neutral(3%)/unimportant(0%)/entirely unimportant(0%)

6. Should the Government intervene to ensure continued provision of scientific subjects of strategic national or regional importance?

Yes(91%)/No(9%)

Qualitative Evidence: Selected Members' Responses

"We desperately need trained science teachers in the schools. Government intervention to SUPPORT science may be necessary but it MUST ONLY be carried out in consultation with the universities and MUST take school provision into account".

"It is entirely wrong to believe that good research can only come from established centres . . . The history of science from Galileo on shows that new ideas and breakthroughs come from those on the edge of convention, not the recognised establishment. Fund diversity, not complacency".

"Many actions of Government have exactly the opposite effects of the ones intended. The RAE exercise is one. Research results are smeared as thinly as possible to produce repetitive publications in journals which university libraries can no longer afford and which few people, none from industry, will ever read. The primary aim of big laboratories is to strangle infant rivals. Many useful activities which are hard to count are treated as valueless".

"As the RAE bites, better qualified scientists will drift to higher rated departments, thus removing teaching competence for honours and for instructional masters from hitherto highly competent departments. Non research departments will be unable to recruit lively staff. The sad thing is that the Government . . . have allowed a handful of old universities to return the national situation to that which applied in the old days—good provision for the few. The impact on science teaching nationally will be exceptionally hard".

"This should not be a consultation of English but of all British Science Faculties . . . Teaching-only should not be considered unless there is a direct arrangement to use them as feeders into high quality, laboratory-based, research-informed Honours courses. All good laboratory science teaching is, in effect, subsidised by research income and so teaching-only science Departments are not only academically undesirable, they have no real chance of being financially viable.

It is very important to link the number of laboratory-trained science graduates to the numbers of jobs available in each part of the country. That does not necessarily mean that the graduates need to have been taught in that part of the country.

The Government should intervene in the sense of funding laboratory-based courses at the correct full economic cost. They should NOT even consider telling individual HEIs what they should and should not teach. There should indeed be figures readily available for the numbers of, say, Honours Chemists that the country (the UK) needs on an annual basis".

"It has been an error in public policy regarding higher education in science to separate teaching from research, particularly as the research funding has been skewed by the RAE rating system . . . The inevitable result is evidenced by recent closures of perfectly sound science departments.

The choice is either (1) to make teaching-only science departments financially viable by assigning large-scale funding to support them; or (2) to abandon the inequitable research funding system and return to the concept of the 'well-found laboratory' that underpinned all university science departments in the past. The first choice will generate an unnecessary and educationally divisive distinction between science degrees from different institutions. The second alternative appears to offer a rational and desirable objective of national science policy in higher education".

"I am an applied mathematician and that mathematics is one of the most fundamental and at the same time one of the cheapest sciences. British science has been very successful in the past, and cheap at the same time. No country has been more successful or cheaper. In science there is a natural pattern of growth which is not well understood . . . read the history of science".

"Issues that I think are important . . . notably to do with the labour market for trained scientists in the UK, their career prospects and wage rates . . . wage rates are not great and career prospects are often very uncertain, given which it is far from irrational for young people to turn away from science. The share of industry, especially chemicals, in our economy continues to fall, and you only need to look at the back pages of New Scientist to get an idea of the poor wage rates on offer for really experienced scientists".

"The separation of teaching and research in a university setting would undoubtedly have a deleterious effect on recruitment of young scientists of the future. Science-only departments or support for only a handful of science departments will undoubtedly lose the exceptionally gifted young scientists who arise. . . in the smaller universities".

"Professor of Applied Mathematics . . . During the last 60 years the world has been turned upside down by the computer, a mathematical device . . . also by the Internet, depending on cryptography, a branch of mathematics. Much of the progress came from the UK. The Committee should consider how the rigid constraints now fashionable would have operated 60 years ago. Clearly these developments would never have come into being . . ."

"the best form of teaching, whatever the subject, is carried out and received in an atmosphere of research . . . it is imperative we maintain if the UK is to produce world-class scientists and engineers who can keep UK plc at the forefront internationally. . . ."

"The Government should take positive steps to stop the current 'brain drain' from academic research as well as promoting science and engineering amongst university graduates through the availability of more government/industry sponsored academic post provisions across the universities. Where such or similar schemes already exist, science and engineering should be given a higher priority . . ."

"Downscaling science at the current rate is strategically dangerous. It is destroying valuable intellectual assets, and indeed a whole 'research ecology', that could take a century to re-build. These assets, and this system, are critical to the performance of an innovative, knowledge intensive economy like the UK".

APPENDIX 11

Memorandum from the Institution of Electrical Engineers (IEE)

The Institution of Electrical Engineers (IEE) is the largest engineering institution in Europe with a membership of some 130,000 professional engineers who represent key sectors including electronics, communications, computing, energy, manufacturing, and transport. Our members are employed in an equally wide range of organisations from multi-national companies through small and medium sized enterprises (SMEs), to sole traders. In addition, many of our members are involved in cutting-edge scientific research, as well as its application, exploitation and knowledge transfer. We therefore welcome the opportunity to submit evidence to the House of Commons Science and Technology Committee inquiry into strategic science provision in universities.

It goes without saying that university science departments provide the seedcorn of the engineering profession of tomorrow in terms of both graduates, and the research output that is vital for wealth creation and quality of life. Whilst it is tempting to try to develop a "supply chain" model for the flow of graduates into industry, government and indeed academia, the output lags the input by at least three years and the behaviour of each stakeholder is influenced by other often competing and conflicting models, and national and international conditions beyond their control.

In submitting our evidence to the inquiry (Annex A) we have where possible provided firm views on the issue involved. However, there are areas where there is valid conflict between different stakeholders. We have not tried to resolve these different views because it is equally important that the Select Committee is aware of these conflicts and alternatives.

January 2005

Annex A

IEE evidence to the House of Commons Science and Technology Committee Inquiry: Strategic Science Provision in Universities

The HEFCE Research Funding Formulae

1. The RAE gradings of departments or subjects do not necessarily provide a true picture of the contribution of the academic community to wealth creation and quality of life. Successful innovations do not flow only from world-class research departments. There are very many significant pockets of excellence in non grade 5 departments, which frequently produce excellent and internationally competitive PhDs as well as exploitable innovation. There are also many pockets of speculative research that go on to achieve great breakthroughs. However, the over emphasis on publication quality and international reputation threatens to significantly disadvantage research that has yet to generate published material or other mechanisms for defining outcomes. In turn this threatens to discourage rather than encourage those "blue skies", "curiosity" and "adventurous" research activities that should be positively encouraged and adequately rewarded. There is a severe risk that the vital work of these groups will be placed in jeopardy by a funding formulae that is biased towards 5/5* departments. Indeed, the cut-off between 4 and 5 is now so great as to potentially jeopardise the financial stability of whole departments. In essence, the current RAE formula places at risk many of the departments which provide opportunities for young/new researchers to develop their skills and confidence and hence threatens to undermine the sustainability of the UK research community.

2. An equally problematic issue is that, not withstanding the headline figures showing real term increases in funding, much of this is associated with special initiatives with hypothecated funding, the consequence being that the core grant is always under pressure. To enable the universities to plan strategically for what is most important for them, their students and their region, it is essential to ensure that the core grant, especially the QR element, is maximised.

Concentration of Research into Fewer Departments

3. Exploitable innovations spring up in a vast range of institutions—the wider the (fertile) field the greater the probability and scale of innovation in the UK. In addition, innovation can arise wherever there are bright people and these might not be concentrated only in 5/5* departments. In fact, so called "lesser" universities and departments are often the breeding ground for elite departments and provide a natural succession for ambitious young researchers. In addition, whilst the larger industrial companies could probably cope with research departments "not on their doorsteps", small and medium sized organisations tend to build relationships with their local universities, often creating local spin-offs that inject wealth creation into local areas. Concentrating research into fewer departments would create deserts of research in many areas of the country, and would adversely impact on local innovation and wealth creation initiatives, and regional development plans. We must maintain a regional and national capacity in university science and engineering teaching and research, providing of course that the research is internationally competitive. On the other hand, in some subjects there are probably too many departments vying for limited funding. Spreading funding too thinly tends only to create mediocrity amongst many whilst we should be aiming for excellence amongst a few. The question to be answered is "how few is few?"

Changes in the Weightings

4. In November 2003 the IEE responded robustly to the HEFCE consultation "Developing the Funding Method for Teaching from 2004–05" which included a proposal to downrate the funding of engineering courses from B (with a multiplying ratio of 2) to B2 (with a ratio of 1.6) on the basis that engineering courses do not need the large traditional labs. This proposal appeared to be based firstly on a view that engineering departments were receiving more funds than actually required and secondly that simulation and modelling can replace high cost equipment.

5. There is clear evidence from the IEE's accreditation visits that the assumptions that have led to the proposal to downrate the funding for engineering course are fundamentally flawed. However, generous cash allocations might seem, they are simply insufficient to equip laboratories with equipment of the type that graduates are likely to be confronted with when they progress into industry.

6. One of the ways in which electrical and electronic engineering departments have responded to the dilemma of teaching with out of date equipment and insufficient resource has been to introduce the use of computer simulations. There are many advantages to simulating activities such as system design using computer software, and of course there is the added advantage that the computers can then be used for a wide range of additional activities, unlike specialist laboratory equipment. However, reports from our accreditation teams provide overwhelming evidence of the value to students of properly equipped hands-on laboratories and adequately resourced practical work, in terms of the potential to gain real-world hands-on practical skills. We are of the opinion that computer simulation should be supplementing practical work and not replacing it.

7. Science, engineering and technology (SET) subjects are already seriously disadvantaged and receive less than 50% of the funding going into medicine. Furthermore what is invariably misunderstood is that design is an essential component of engineering. However, design can only be taught in small groups and hence the staff-student ratios are intensive, and equipment must be available for each group. Indeed, the resource demands of engineering design are as equally intensive as those necessary to cater for the "four around a bed" principal for medicine. The scope and breadth of SET disciplines, and the infrastructure required to support them is certainly no less than that required for medicine. Therefore, if the UK believes that SET is vital to the UK economy then sufficient resources should be made available to see that it is adequately funded. If implemented the HEFCE proposal would have had a very severe adverse impact on computer, electrical and electronic engineering departments. The dire state of the laboratory facilities in many, and some might say the majority, of university engineering departments provides clear evidence that these departments need their funding levels to be uprated.

Optimal Balance—Teaching/Research

8. We have received evidence that supports two schools of thought. The first suggests that research provides dynamism to teaching. Teaching-only units could appear to the students as lacking in involvement with the wider academic community. Postgraduate research students, through laboratory demonstrations and other tutorial activities, contribute significantly to the learning experience of undergraduates. In all departments some research is necessary for curriculum richness, relevance and modernity, and ultimately for credibility and viability. Furthermore, students (particularly those from overseas) will select universities

that provide the best overall learning experience and there is clear evidence that their selection decision is heavily weighted in favour of those departments that have vibrant research activities and access to the most current knowledge. On the other hand it can be argued that provided lecturers keep abreast of research in their areas and ensure their teaching reflects the most recent science, then there is no overwhelming requirement for research to be carried out in every institution. The two models can exist side-by-side and would not only sustain the research base but also allow some universities without research departments to remain viable. For our science and engineering based industry to prosper in a world market place, we need graduates who have the skills and tools to use advanced knowledge to the benefit of their employers and the general economy.

Regional Capacity

9. Regional capacity has two elements. Firstly there are the demands of the RDAs, and secondly the fact that university departments "are where they are". Research departments can contribute enormously to the evolution of regional high technology ventures and to the development of regional policy, providing a dynamic and secure future for the regions. RDAs and Devolved Administrations (DA) need to tackle this in relation to such issues as inward investment and the presence of (and plans for the development of) science or engineering based multinational companies and SMEs. However, whilst RDAs and DAs are well placed to invest in established technologies and industries within their communities of interest, they are not well placed to deal with "new" or strategic science issues. Indeed a lesson was learned in the area of nanotechnology where each RDA wanted its own centre but with no coherent knowledge transfer or exploitation strategy. This was resolved by putting in place a national strategy driven from the Centre. The nanotechnology experience has clearly demonstrated that the national science strategy must be planned and coordinated centrally. However, even here regional requirements must be considered and of course elements of this strategy could be delivered regionally, but again in a planned manner. In essence the RDAs must clearly understand what research they can reasonably influence and fund, and what must be the domain of the research councils or other central funding bodies. Similarly the research councils must be aware of regional capacity needs and these should be addressed in a planned manner rather than the ad hoc process that currently exists.

Government Intervention

10. A two-part approach may be useful. Too often, for example, chemistry is being taught by biology graduates and too often the mathematics tuition is not provided at a sufficient level to support pupils in (for instance) their instruction in physics. Coupled with this, league tables for secondary schools have encouraged schools to direct pupils into areas where high grades will be achieved (at the expense of science). The secondary school/college population needs to be much better encouraged into science and technology—properly qualified teachers, more intellectually exciting syllabus material and less of the entirely practical "CDT" activities. Gripping advertising, such as used by the armed forces in cinemas, could also be a possibility. On the other hand, government intervention in the overall "size and shape" of university departments needs a more careful and coherent approach. What is required is a model that takes a long-term view on the number of graduates and researchers required to maintain and sustain the national science and innovation strategy. Government intervention should therefore be based on measures that ensure its long-term strategy for science and innovation will be delivered. This intervention needs to be timely and involve all stakeholders.

11. Industry also has a role to play, particularly to ensure that critical infrastructure and industrial capabilities can be sustained. An excellent example is the IEE's Power Academy. Under this scheme the electrical power industry has established its long-term requirement for graduates and has put in place arrangements (including incentives) to assure the necessary flow of engineers. Selected universities have agreed to run undergraduate courses to meet these needs. Government should encourage other sectors of industry to establish similar models, and indeed the manufacturing sector is already considering this type of scheme.

APPENDIX 12

Memorandum from the University of Oxford

Q1. *The impact of HEFCE's research funding formulae, as applied to research assessment exercise ratings, on the financial viability of the university's science departments.*

To protect science research, it is essential that research selectivity applied by HEFCE in respect of its QR funding is maintained. This is especially so if the UK is to maintain international competitiveness. If funds are limited, they must be concentrated in the most successful and competitive departments.

The level of overall public funding must cover the full costs of the research it supports, and the relationship between HEFCE QR and other funding from research councils is critical. FEC will help but the transition to full FEC will not be complete until at least 2010.

Q2. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend.*

Maintenance of research selectivity at least at its present level is essential for the reasons stated above. It is likely that funding pressures will require some further increase in the concentration of research, but this is essential if excellence and international competitiveness are to be maintained.

There are downsides: too few departments risk reducing national viability and critical mass, and undermining the ability to train enough graduate students. The highest quality undergraduate teaching also requires a good research interface.

Q3. *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula.*

The squeezing of differentials[6] between clinical medicine and laboratory-intensive sciences on the one hand, and other subjects on the other in the HEFCE teaching funding formula has not been welcomed. It has (in effect) allowed a shift of resource away from experimental science subjects. This does not, in our experience, reflect the increasing complexity and cost of experimental sciences. There are difficulties at the margin in disentangling research related from teaching related costs, but experimental teaching laboratories are expensive to equip and operate, and for example new safety legislation has also increased costs.

Q4. *The optimal balance between teaching and research provision in universities giving particular consideration to the desirability and financial viability of teaching-only science departments.*

There is no single "optimal balance". In this university we see a vital link between teaching on the one hand and the maintenance of high international quality research capacity on the other. This is especially so in postgraduate and doctoral training. HEFCE's new Research Capability Fund will enable the development of research capacity in emerging subjects, and changes to the method for allocating HEIF funding will give less research intensive universities the potential to access this source of funds. Clearly, it is essential that good teaching should be informed by the outcome of good research, but it is impossible to return to a situation where all teaching departments are funded at a similar level to undertake research: as indicated above, the continuance of research selectivity at least at its current level is essential for UK science.

Q5. *The importance of maintaining a regional capacity in university science teaching and research.*

Given the increase in costs to students on first degrees, it is important to maintain good regional capacity in university science teaching. However, it does not follow from this that there needs to be an equally strong regional dimension in research, and the desirability of an even regional spread of high-quality research in universities cannot possibly outweigh the need to maintain national and international excellence through maintenance of research selectivity.

Q6. *The extent to which the Government should intervene to make sure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose.*

Current selectivity in the distribution of QR by HEFCE should at least be maintained. The Government's FEC initiative is also vital, and move from 80% to 100% by Research Councils should take place as soon as possible, so that universities can recover the full costs of the research they undertake and thereby become able to invest responsibly in their faculties and departments. But the Government's role must be to provide the funding and strategic framework to enable HEIs to function effectively. We do not support moves which would lead to the Government directly interfering in the academic and research priorities of individual universities. Government's role is to provide adequate funding, and to enable universities to charge full cost prices for their research. In the case of teaching, Government needs to move as rapidly as possible to enable universities to recover the full costs of their teaching: even with the £3K fee, unit prices for teaching in experimental sciences are seriously inadequate.

[6] The weighting for clinical medicine was reduced from 4.5 to 4.0; and the weighting for laboratory science from 2.0 to 1.7.

General points

We would make four general points about the subjects raised:

(1). To protect science research it is essential that the research selectivity via QR, and the Government's FEC initiative are maintained and funded.

(2). On teaching, the main problem is the continued underfunding of both graduate and undergraduate science programmes for home/EU students; the £3K undergraduate fee will only go a small part of the way to overcoming this. There are particular problems associated with attracting able graduates to remain in research after their first degree, because of the relatively low salaries for postdoctoral workers and contract research workers.

(3). The decline of science in maintained schools, especially single science options, and too few qualified teachers at that level, is a problem which needs careful investigation since it affects recruitment to universities' science degree programmes.

(4). As the Select Committee knows, there are issues concerning rewards and recruitment in university science careers which reduce their attractiveness.

January 2005

APPENDIX 13

Memorandum from EEF, the manufacturers organisation

Introduction

EEF–The manufacturers' organisation, has a membership of 6,000 manufacturing, engineering and technology-based businesses and represents the interests of manufacturing at all levels of government. Comprising 11 regional Associations, the Engineering Construction Industries Association (ECIA) and UK Steel, EEF is one of the UK's leading providers of business services in health, safety and environment, employment relations and employment law, manufacturing performance, education, training and skills.

We believe that the issues surrounding the popularity and success of science, engineering and technology subjects in Higher Education are complex. There are issues relating to the supply of suitable young people to study, which lead to problems of low demand for these courses. Higher Education Institutions (HEI) consequently struggle to maintain facilities and provision. We have examined the causes of departmental closures below, and suggest some ways in which the popularity of these subjects could be improved.

Reasons for HEI Departmental and Course Closures

1. Lack of appropriate applicants—the individuals applying for courses in these subjects are not suitable for high-level study, because they have not achieved the necessary levels of learning in prerequisite subjects such as mathematics and physics.

2. Unpopularity of subjects in school—science, engineering and technology can struggle to attract students at A level, reducing the "pool" of students applying to HE. These subjects are often perceived by students to be more "difficult" than subjects in the arts or social sciences, and therefore less appealing.

3. The relative cost of delivery of these subjects can makes them hard to justify—they are highly resource intensive in terms of facilities, staff and materials.

4. Unattractiveness of the HE "offer" to a diverse cohort—there is not enough part-time and distance learning for people already in work. There is also a lack of understanding of the nature of prior qualifications and eligibility for entry to courses. HEIs therefore exclude a number of individuals who might make excellent students by failing to provide enough flexibility in the access and delivery of courses.

What Will Make These Subjects Thrive at HE Level?

1. Demonstrable good employment prospects for young people who undertake them. With increasing levels of debt from higher education study, young people will expect to see a return on their investment. Employers, professional bodies and HEIs have a responsibility to provide accurate information on employment levels and salaries to help inform the decision-making process.

2. Also key is good careers advice which identifies individuals' strength and finds an HEI and course to match (academic, vocational, large, small, etc). This is an imperative at all levels of education, and one which EEF is actively campaigning to improve. This advice and guidance should be based on factual data, giving the individual all the appropriate information necessary to make informed choices.

3. Government/HEI intervention to make them cheaper to study than other subjects. This could be through fee rebates, or other financial incentives such as free accommodation for students in these departments.

4. Company sponsorship—there is no doubt that employers have a role to play in encouraging appropriate individuals in their workforce to develop their skills to a high level, utilising HE courses if necessary. Many employers do already provide sponsorship and support, both for full and part-time participation.

5. Following from the sponsorship point above, flexible entry criteria to HE courses, and flexible delivery mechanisms are essential to provide high-quality candidates in these subjects. Part-time students, former apprentices, and those with vocational qualifications can boost the intake of science, engineering and technology departments, as well as providing "real world" experience to enrich the learning of all. These subjects are significantly more attractive to prospective students when they can see a wide range of people with different experience taking part.

6. Similarly, attracting and employing tutors with real-world experience who are enthusiastic is extremely important to sustain the popularity of these subjects—young people and prospective students will want to study with people who are at the fore-front of their field, and who also know how to apply their knowledge.

7. High levels of staff/student ratios—personal support and interaction with tutors gives students increased levels of confidence necessary to cope with the demands of these subjects.

8. Facilities that are state of the art and well-maintained, including information resources. This gives young people confidence that their learning will be applicable in the workplace. It also makes the subjects attractive to those who wish to work on the "cutting edge" of new technology.

9. Links between HEIs and companies make these subjects very attractive to students, particularly large global employers. This can lead to high-level, sponsored research within the department, as well as employment opportunities.

Science Subjects and the Teaching Funding Formula

EEF made a response to the recent Higher Education Funding Council for England (HEFCE) consultation on weightings for science, engineering and technology subjects. We were extremely alarmed at the proposed reduction in funding for engineering. Our argument is that reducing funding for engineering subjects is directly contrary to the current Productivity and Innovation agenda, given impetus by the Roberts Review of Supply of Scientists and Engineers, and Baroness Greenfield's report SETFAIR, that science, engineering and technology based subjects make an invaluable contribution to the wealth and well-being of the nation as a whole. The work done by engineers and scientists in their chosen fields keeps Britain at the forefront of research and development in the global economy.

Additionally, a significant proportion of SET students contribute to the wider economy through employment in other occupations following graduation. The high levels of numeracy, problem-solving and analytical skills which these courses develop mean science and engineering graduates are in high demand throughout the economy. The economy as a whole will therefore suffer if there are fewer graduates in engineering and science.

We can see no justification for the selection of these subjects for reduced funding. We do not believe that they have become cheaper to deliver since the existing funding structure was agreed. On the contrary, constant upgrading for new technology, equipment and processes places increasing financial demands on HEIs, who need to be confident that their resources are "leading-edge".

Similarly, the need for those teaching science, engineering and technology degrees to continually update their skills places a financial burden on institutions as they invest in the continuing professional development of staff.

Regional Capacity in University Science Teaching and Research

For engineering employers, one of the key elements to higher education support is its geographical proximity to the employer's premises. This is for a number of reasons:

1. For employees moving beyond apprenticeships, and those already in work, part-time local provision is more likely to be appealing than full-time. Many will want to continue in their workplaces in some capacity, as well as taking the opportunity to maintain some level of earnings during their study.

2. The engineering sector has always had regional strengths. It is therefore essential that HEIs in areas of high industrial concentration are encouraged to develop their engineering and science provision, and that appropriate levels of HEI places are available to the local population.

3. Engineering employers, because of the physical nature of much manufacturing, can build strong links with local education providers. While some companies may link across wider distances, engaging with post-graduate research and desk-based studies, others prefer to build local links which reflect tangible benefits

GOVERNMENT SUPPORT

We strongly believe that Government should intervene to protect subjects of strategic importance, incentivising these subjects through HEFCE. We also believe that public government support, backed by material funding, will underline the value of science, engineering and technology subjects in the UK economy. There is a continuing misapprehension, because some parts of the sector are contracting, that there is no future for either the sector or those who wish to make these subjects their career. Rather, high-level skills in these sectors has never been more valued or more sought after. The Pathfinder Sector Skills Agreements currently being developed by SEMTA (the Sector Skills Council for Science, Engineering and Manufacturing Technologies) strongly support this.

We believe that Government should provide support in two ways:

1. Providing funding to allow HEIs to rebate and reduce fees for science, engineering and technology courses.

2. Supporting this with a public statement about the value of such sectors to the UK economy, and their contribution to its future prosperity. This will raise their profile with prospective students, and improve their understanding of the potential rewards of a career in this area.

January 2005

APPENDIX 14

Memorandum from Professor Grierson, University of Nottingham

— The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments;

The step changes in funding that occur between grades has had a significant impact for those units that did not achieve the highest ratings. We have been particularly concerned that, in the last exercise, the assessment was uneven across different areas of science and engineering. In particular, we consider that the RAE ratings had a damaging effect on key medical areas which are disproportionate to the judgements that were being made about research quality in these areas. There has also been a distorting and harmful effect, especially on areas of research that are applied, interdisciplinary, innovative, or specialised. RAE has driven some Departments towards pure, single-subject, orthodox, mainstream research, to the detriment of other exciting and useful possibilities.

— The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend;

This is a complex issue since greater concentration in fewer departments may in the longer term risk reducing the national science and innovation capacity even though critical mass is often necessary for the UK to have research groups which can sustain world-class competitiveness in an area. It would be valuable for some high-tech disciplines with costly physical resources, but could be a damaging and arbitrary constraint on other subjects which could prevent the strongest seeds from sprouting where they fall. It is vital that concentration is targeted at those universities and departments that can demonstrate enterprise and imagination in developing new research, encourage interdisciplinary working, and are innovative in dissemination, technology transfer and exploiting the outcomes of research. Further concentration in universities or departments that do not have the culture and capacity to innovate, however good the current quality of their research, may be counterproductive.

— The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula;

Any changes which reduce the weightings given to science subjects will have a detrimental effect on these areas. Given that university budgetary models usually reflect the national funding model, it will reduce income levels available for that subject. This means not only less for teaching but also puts pressure on recruitment and promotion budgets leading to a spiral of decline in demand for the subjects. This can be very costly to address at a later stage through special incentives and other schemes, to say nothing of the cost of lost opportunities.

— The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments;

In our view only research active units can credibly reach world class levels of knowledge dissemination. Units will not be recognised for teaching alone at this level. Furthermore, there are synergies between teaching and research when an optimal balance is achieved. Therefore, we believe that teaching-only science departments are not desirable without compromising on quality and if they emerge, should be related to specific roles. Removing research capacity from departments by shutting off funding may mean fewer possibilities for those departments to compete globally.

— The importance of maintaining a regional capacity in university science teaching and research;

We believe that it is important to maintain a regional capacity in university science teaching and research providing that this capacity exceeds a quality threshold. In some areas, specific investment may be required to ensure this happens. The RDAs should be encouraged further to work closely with universities to ensure that this capacity is developed. We see the development of a new vet school at the University as precisely the kind of initiative where a partnership approach can deliver high quality research and teaching capacity. However, we can see no benefit in maintaining sub-standard capacity.

— The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose.

If the market alone dictates how HE is configured, less popular subjects will continue to be at risk (as evidenced by recent closure decisions). Measures to invest in less popular departments, while challenging them to be innovative and imaginative, working with industry and RDA partners, in addressing their lack of popularity, must be considered if the UK is to retain a broad-based science portfolio. In particular, it is vital to support the more fundamental science and engineering disciplines which are essential to tackle the major research challenges of the 21st Century. Mechanisms should range from stimulating staff and student demand through incentives such as "golden hellos" and special allowances to major schemes such as the EPSRC's Science and Innovation Awards which encourage a partnership approach to address the issues in a coordinated and holistic way. The importance of the national profile of science and engineering in public, political, and educational life of the nation should be enhanced and the reward system improved in order for these areas to continue to attract young people. If teaching provision in schools is inadequate and/or uninspired, there is little prospect of achieving this.

January 2005

APPENDIX 15

Memorandum from the Council of Professors and Heads of Computing (CPHC)

Information Technology has become integral to the way countries and companies compete. It has become fundamental to how each of us lives our daily lives. IT skills, therefore, lie at the heart of our success as individuals and as a nation. The scope of the challenge is broad; it goes from the factory floor to the board room, from the corridors of power in government to the hospital ward. IT literacy and digital inclusion are key parts of the government agenda . . . Action is required if the UK is to continue to be one of the beneficiaries rather than one of the casualties of the Information Age. The responsibility for taking this forward lies with business, government, the education sector and the UK's employees themselves.[7]

Success today in a developed nation's industry, education, and commerce seems to depend increasingly on bringing the latest computing technology to bear. Failure to keep up brings the risk of failure in the global marketplace. And with barriers to international commerce falling (especially in western Europe), failure in the global marketplace brings failure in the local marketplace. In addition, we find critical national infrastructures—communication, finance, energy distribution, and transportation, not to mention civil and national defence—also coming to depend more and more on networked computer systems. Thus, at least in developed nations, quality of life is affected by access to computing technology and expertise in deploying it.[8]

Summary

Before answering the specific questions posed by the Committee, we provide the context for our responses. This context:

— Introduces the subject body for Computing that represents all universities in the UK;

— Summarises why IT is vital for the future competitiveness (if not survival) of this country;

— Outlines employers' needs for IT professionals;

— Looks at the role of Computing departments in universities in supplying the needs of employers in private and public sectors;

In answering the Committee's questions, we highlight some serious difficulties that the majority of Computing departments face as a result of decisions that lie outwith our control.

About CPHC

CPHC is the subject body for Computing for all universities in the UK. "Computing" is concerned with the understanding, design and exploitation of Information Technology, perhaps the most significant advance of the twentieth century. The design and the exploitation of computer technologies lie at opposite ends of the spectrum that Computing represents. Some of our members focus on the design of sophisticated, high-performance computer systems, others focus on innovative software technology, while others address the integration of information systems into organisations (such as the NHS) to improve efficiency and customer service. Computing supports the goals of the largest and smallest organisations, and helps individuals in their everyday lives; it is ubiquitous and diversely applied to a range of applications, yet

[7] *IT insights: trends and UK skills implications,* e-skills UK and Gartner Consulting, November 2004, p 7.

[8] *International Review of UK Research in Computer Science,* Fred B Schneider & Mike Rood, Editors, EPSRC, BCS & IEE, 2001.

important components are invisible to the naked eye. Computing, or Information Technology is the infrastructure vital to the knowledge economy. CPHC works very closely with the British Computer Society, the professional body for Computing.

IT and Competitiveness

The IT industry makes a significant and increasing contribution to the UK economy. It represents almost 5% of the total UK GVA and is almost twice as productive as the all-industry benchmark.[9] The UK IT Industry is also a major European player, with the UK IT services sector being the largest by turnover and number of enterprises of all sectors of the EU. Computer Services, with Electrical, Electronic and Instrument Engineering, are also the areas of the UK economy that enjoy the largest international market for their products, measured as a percentage of the business in an industry.[10] It is undoubtedly a subject "at the heart of the UK economy and is a key source of competitiveness for all sectors, opening new markets, increasing performance and driving productivity",[11], underpinning innovation and competitiveness in every sector of the economy. Indeed, IT-intensive industries represent 45% of the total UK GVA, which exceeds the corresponding figure for all other G7 countries save Germany.[12]

IT as an Enabler and Driver of Change

"A series of trends are emerging which cause, and are caused by, greater exploitation of IT by an informed community of interest."[13] Among these trends are mobile computing, which supports remote and collaborative working, while providing new opportunities for organisations (such as the NHS) to communicate effectively with customers and clients. Information Technology has provided new channels to markets. The internet is now used routinely for shopping, banking and other financial services and, increasingly for access to government and its services. Another trend that is enabled by IT but also has an impact on IT-related industries is the offshore outsourcing of services and business processes.

E-Learning

"I see ICT and its potential to transform how we teach, learn and communicate as crucial to our drive to raise standards."[14] IT provides the infrastructure for e-learning, which enables learners to reduce their dependence on the place and time of study. Notwithstanding the spectacular failure of UKeU, government, Hefce and the education sector remain committed to the appropriate use of technology to support learning.

The IT Workforce

1.2 million people are employed in the IT sector in the UK, and the workforce is forecast to grow by between 1.5% and 2.2% per year for the next decade. In addition, it has been forecast that from within the IT industry, there will be a need to replace workers who are moving into non-IT roles, taking career breaks or retiring. The total demand for new staff in the IT workforce has therefore been estimated at 156,000 to 179,000 per year.[15]

Computing in Universities is Crucial

Supply of graduates

Universities have a key role to play in delivering this trained workforce, either as graduates from a spectrum of IT-related courses, or through retraining. Specialist, high-level computing education is essential to the UK's competitive position, especially in areas such as security, maintenance of business critical systems, internet and communications technology, the development of highly complex information systems (particularly in the public services), and healthcare technology. Without an adequate supply of skills in these areas, the UK will suffer a slowdown in economic growth as companies look beyond the UK to supply these skills. This is easy to do given the global market for IT services and the ease of global communication. Further, public services will be squeezed out of the competition for IT talent, as commercial enterprises offer higher salaries.

[9] *IT insights: drivers of demand for skills,* e-skills UK and MRM Solutions Ltd, November 2004.

[10] *21st century skiolls: realising our potential,* HMSO, July 2003.

[11] *IT insights: trends and UK skills implications,* e-skills UK and Gartner Consulting, November 2004, p 18.

[12] *IT insights: trends and UK skills implications,* e-skills UK and Gartner Consulting, November 2004, p 19.

[13] *IT insights: trends and UK skills implications,* e-skills UK and Gartner Consulting, November 2004, p 22.

[14] Ruth Kelly, Secretary of State for Education & Skills, BETT 2005 Keynote Address.

[15] *IT insights: trends and UK skills implications,* e-skills UK and Gartner Consulting, November 2004, pp 34–35.

Research

"In a number of areas, the UK is a world-wide leader, demonstrating an outstanding record of innovation and first-rate science."[16] Since the earliest days of computation, UK research has had a significant impact on the development of and the application of the technologies it has spawned, and it is also key in the majority of research and development activity in industry and universities in the UK. Virtually all science and technology (the genome project, for example) relies on easy access to state-of-the-art computer expertise. Today, industry in the UK, Europe and US benefits directly from research conducted in UK universities. Some of that work is funded directly by the beneficiary (such as Rolls Royce, BAE Systems, BT, Airbus, Daimler Chrysler, NHS, Microsoft, IBM) and some through the dual support system via research councils and the funding councils. Internationally sponsored research is a means of inward investment. PhD students from UK universities are an important source of research capacity for UK-based companies.

Knowledge Transfer

Many universities engage in knowledge transfer activities with (usually local) organisations, ranging from multinational companies, through SMEs to microbusinesses. The Knowledge Transfer Programme is a particularly effective mechanism for supporting businesses.

e-learning

Computing departments have driven innovations in the application of their own technology to support learning. It is important that UK-based academics, through their own research and innovations in learning and teaching technology engage in driving e-learning forward. Or, as the Secretary of State continued in her keynote address to BETT 2005 "We must be sure that we are squeezing every ounce of innovation from new and emerging technology. We should not simply wait for technology to offer solutions. We must also drive technological developments by clearly articulating what it is that learners and teachers need. By combining the forces of supply and demand in this way we can tease out the best that ICT has to offer."

Issues Raised by the Committee

This submission to the Science and Technology Committee from CPHC clearly addresses the concerns the Council has for the ability of universities to respond to the national needs for appropriately skilled graduates and for innovation in the development and innovative application of Information Technology. While the plight of other sciences and technologies is frequently acknowledged, in answering the questions posed by the Committee, we illustrate that the problems we face in our own discipline should be of no less concern to government. We strongly support the Committee's initiative to safeguard the level of science teaching and research across universities in England.

1. *The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments*

The financial returns from RAE 2001 were a great disappointment to many Computing departments (and their Vice-Chancellors), especially in the many cases where a significant improvement in performance yielded a lower income. This has led to some structural changes and re-focussing of effort in some departments, but is not on its own a major cause for concern. However, it becomes highly significant when juxtaposed with shortfalls in income from teaching (see the answer to point 3 below).

2. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend*

The definitions of quality levels in the Guidance to panels for RAE 2008, just published as RAE 01/2005, makes it clear that a broader distribution of research income through QR is not the intent. RAE 2008, coupled with the application of Full Economic Costing from 2005–06, will lead to an even greater concentration of research. While CPHC supports the maintenance of world-class research in Computing in the UK, it does not support the ever-increasing concentration of that research in fewer and fewer institutions. It is a myth that researchers need to be concentrated—most researchers collaborate with colleagues in other institutions across the UK and across the globe, and less frequently with colleagues in the office next door. CPHC believes that there needs to be a broad research base that informs excellent teaching and provides a local source of expertise for businesses and organisations. Students who wish to study Computing should be able to access undergraduate and postgraduate programmes locally.

[16] *International Review of UK Research in Computer Science,* Fred B Schneider and Mike Rodd, Editors, EPSRC, BCS & IEE, 2001.

3. *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula*

Following the "dot com" shake-out of 2001, applications for undergraduate Computing courses have fallen by over one-quarter from 2001 to 2003; simultaneously, HEFCE[17] reduced the level of its funding for Computing by 35%, by moving it from Band B to Band C, which had a much greater impact than for any other subject in science and technology. These two factors have reduced budgets for Computing in universities and led to reductions in staff at a time when, according to the Government's own reports, employers are increasingly demanding higher level skills in this area. (For some universities, the impact has been exacerbated by shortfalls in research income.) For 2005 entry, applications to Computing would appear to be increasing again.

A brief survey of members revealed that almost all universities passed on the funding shortfall to departments. As a result, a number of universities, old and new, are having to shed staff to make up shortfalls of the order of £500,000 per annum. HEFCE's funding decision has had a major impact. See Annex A for CPHC's submission to Sir Howard Newby in response to HEFCE's "consultation" on the funding (not printed). We believe that HEFCE's methodology was fatally flawed.

4. *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments*

CPHC does not support the notion of teaching-only science departments. Science is underpinned by the application of high-level knowledge to the process of discovery, to satisfying curiosity—by research. As noted above, we believe that excellent teaching should be informed by research and we believe that local universities should be drivers of local and regional economies through the application of their knowledge and expertise. There is increasing evidence (see, for example: http://www.economist.com/world/europe/displayStory.cfm?story_id = 3556596) that international students are becoming more selective and have a greater number of choices available to them, especially in continental Europe, where research-active universities offer attractive programmes, all taught in English. A teaching-only institution will have no appeal. This is one of several self-imposed threats to the Prime Minister's Initiative (to recruit international students).

5. *The importance of maintaining a regional capacity in university science teaching and research*

CPHC believes that a number of universities will not be able to respond to an increase in demand, if the attrition is as high as reported. This will have a significant impact on widening access and participation. As our letter to Sir Howard noted, UCAS statistics show that Computing (and Mathematics) have been very successful in widening participation with respect to other areas. In fact, HEFCE's own performance indicators show that Computing and Mathematical Sciences had the second highest proportion of young entrants from social classes IIIM-V between 1998 and 2001, while at the same time, it accounted for the third highest proportion of students from low participation neighbourhoods. We fear that students who are not in a position to travel to study will be denied the opportunity to study Computing at their local university. (See also our response to 2.)

6. *The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose*

While universities are autonomous institutions, vice-chancellors have few reasons to depart from the funding models set down by HEFCE in allocating their internal resources. HEFCE and the Government should understand how its own decisions on funding (not good for any science, but especially bad for Computing) are at odds with the avowed priorities of DfES, Treasury and dti, and that the UK's future competitiveness, on a variety of fronts, is being seriously compromised.

It is difficult to predict the impact of variable fees when they are introduced in 2006. It is possible that there will be a negative impact on recruitment to science and technology programmes. The Government needs to incentivise the study of subjects, including computing, of key strategic importance to the UK economy, through its own system of bursaries to allow students to study subjects of national strategic importance, and to ensure that those subjects are adequately funded by individual higher education institutions.

We believe that the Government should waive fees for Computing graduates (and other science and technology graduates) to pursue a PGCE, so that we counter the vicious circle of decline that seems to be gathering pace.

CPHC believes that the unchecked approval of offshore outsourcing will lead to the erosion of the UK's science (and technology) base, through the increased migration of work overseas. It is not just work requiring low-level skills that is going offshore, jobs requiring graduate-level knowledge, ability and skills are not far behind. See Annex B, a report produced by CPHC.

January 2005

[17] HEFCE circular 2003/42.

APPENDIX 16

Memorandum from Professor Ian Peterson, Coventry University

The Impact of HEFCE's research funding formula, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments.

The research funding formula is proving to be extremely harmful, both in the university at which I held my Chair and in many universities known to me. I was taken on to do research, as a result of my good publication record (now over 120 publications, the vast majority in rated refereed journals, and well cited). In the last RAE, the Unit of Assessment of which I was a part managed to improve its rating by one point, to which improvement I made a major contribution. This improvement was achieved by great effort, in spite of a continuous loss of support staff over the period covered by the exercise. Instead of being a matter for congratulation, the improved research rating led within months to swingeing (40%) cuts, justified by the poor financial position of the school. In fact, in spite of the improved rating, the income brought in by the RAE was substantially reduced compared to the previous one. Other Units of Assessment were even more severely affected. The action taken in 1992 did not stop the rot, and further savage staff cuts are currently on the agenda.

This may appear anecdotal, but I have heard many similar stories from colleagues all over the UK. As a result of the level of research funding provided by the UK Government, many Vice-Chancellors are deciding that research in areas with special equipment needs, particularly the natural sciences, is not financially viable. This situation was highlighted by the recent decision at Exeter University to close the Chemistry Department. The events at Exeter were publicised by the efforts of Prof. Kroto, who as a Nobel prize winner is in a position to go public without prejudicing his employment prospects. However, Exeter is by far from being the only example, and Physics is also severely affected.

Point 2: *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend:*

Incremental scientific advances can be made by large groups following agreed protocols approved by the funding committees. However, I would stress to the Committee that unexpected fundamental discoveries, of the sort for which the UK has in the past had a great reputation, are very often not made in this way. No matter how highly rated by expert panels, fewer research groups means a smaller chance of making discoveries, and the country will suffer a loss of capability.

Over the last few years, we have seen whole departments sacked because their research rating, though good, was not excellent. This is breeding a situation where all research is being conducted on "bandwagon" topics meeting the approval of funding bodies. The Committee must be aware that such topics are not guaranteed of success or significance. Moreover it is breeding an attitude where research is driven by the necessity of bringing in money rather than a love of the subject. Risky research, following up hunches, is being strongly discouraged.

Point 3: *The implications for University Science teaching of changes in the weightings given to science subjects in the teaching funding formula.*

I believe that the capitation weighting in the UK for undergraduate teaching of Physics and Chemistry is 1.7 times that of subjects requiring no special equipment, and that this is considerably lower than that in other European countries. Science subjects require laboratories, technicians and infrastructure support. This is expensive because hands-on training with up-to-date equipment is essential for these subjects with their relevance to manufacturing industry. The trained personnel who come out from these courses are able to contribute to the balance of trade in a way that service industries cannot.

The steady loss of teaching and support personnel in science subjects at my former University has been constantly justified by the poor financial position of the school. The inadequacy of the level of provision by the Government across the board, not necessarily just in science subjects, was also confirmed last year by the debate on top-up fees. There has been a steady trend, away from meaty traditional subjects valid for a whole spectrum of future employments, to lightweight specialist courses chosen for their superficial attractiveness to students, and with no connection to future employment prospects, eg sports science and forensics.

Point 4: *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments.*

There always have been colleges of higher education of this sort, and it is recognised that the quality of their teaching is not as good. Effectively, it is a continuation of secondary schooling. The factors involved are intangible. Some boil down to the fact that the teaching staff are not conversant with the latest state of the art, nor are they aware of subtleties of interpretation. Others concern the consequent lack of training of research skills. Research projects are only possible if there is state-of-the-art apparatus already in the laboratory for research usage, and if the undergraduates can receive practical assistance from postgraduate and postdoctoral researchers who are there to undertake research. Research projects give training in how to approach open-ended problems, devise a means to solve the various unexpected problems which arise, and assess the value of data obtained. The resulting ability to handle real-world problems as well as the usual textbook questions benefits the student in whatever walk of life they may end up in, even if it is not in science.

Point 5: *The importance of maintaining a regional capacity in university science teaching and research.*

This point overlaps Points 2 and 4.

Point 6: *The extent to which government should intervene to ensure continuing provision of subjects of strategic national or regional importance, and the mechanisms it should use for this purpose.*

Virtually all higher education funding in this country originates from the Government. Since HEFCE controls the quotas of students per subject, and controls the amount of funding per student per subject, then the only sanction open to a Vice-Chancellor is to alter the mix of courses on offer, most often by closing courses down. Vice-Chancellors are held responsible for the finances of their institution, but there are no sanctions for failing on any wider intellectual or macroeconomic issues of importance to the country as a whole. It is therefore essential that government intervenes to direct the use of resources. It is surprising that a country of 60 million inhabitants could end up with only 20 (if that becomes the number) of good academic research units in key natural sciences, and that we cannot support the teaching of eg 3,000 new students in chemistry per year, yet this appears to be the case. If it is true that higher education is being effectively funded then why is this not visible on the ground (ie teaching resources)? Where is the funding going? If the provision of higher education is being expanded to give 50% of the population chances for a life-enhancing experience, why are traditional intellectually-challenging courses being closed down and replaced by light-weight ones without realistic employment prospects?

I would be delighted if the Committee could address possible solutions. One possibility is that an independent panel be set up to adjudicate on course closures and other changes in educational provision. A university planning to close courses would need to lay the reasons before this panel. If nothing else this would help to clarify matters for those involved. At my former institution it is not clear that the balance of costs and benefits of science teaching has been properly considered. The contribution of science to university patents and "third strand" activities is notable. No doubt there are other extenuating issues for courses at other institutions.

An independent panel would be able to take a national strategic view. At present it seems that Vice-Chancellors are being encouraged to take decisions based on short-term financial considerations. Decisions as to what is taught are also being put in the hands of people with no experience or overview, and without consideration of long term national benefit. This situation needs urgently to be redressed. Damage is being done, and the longer corrective action is put off, the longer it will take to recover.

January 2005

APPENDIX 17

Memorandum from the University of Surrey

1. The University of Surrey is a medium-sized research-led university with a relatively high concentration of its research and teaching activity in science, engineering and technology. The University's evidence to the Committee grows out of its distinctive mission and experience. In submitting this evidence it is aware of the submissions being made by Universities UK, the Royal Society, the Institute of Physics, and the Biosciences Federation. It notes the high degree of convergence between the positions advanced by these distinguished bodies, and endorses the points being made in common. Its own view is further influenced by its commitment to supporting links between universities and enterprise, which are important not only to its SET subjects but also to the research and teaching in social sciences, humanities, management, and healthcare which constitute the rest of its academic provision.

2. The University has a particular strategy of managed and focused research which paid dividends in the 2001 RAE, with particular effect in Electronic Engineering, Biomedical Sciences and Sociology, which were all graded 5*A. Its basic and applied sciences are grouped into three Schools: Electronics and Physical Sciences (comprising Electronic Engineering, Mathematics, Computing, and Physics); Engineering, and Biomedical and Molecular Sciences (comprising basic and applied Biomedical Sciences and Chemistry). This internal academic organisation reflects an academic philosophy, in which research and teaching capacity in basic sciences (Physics, Chemistry, Biochemistry) is supported for its own sake but also underpins capacity in engineering and applied sciences. Research groups and centres within the Schools frequently combine researchers from different disciplines—thus for example the Advanced Technology Institute within the School of Electronics and Physical Sciences is staffed by solid-state physicists and electronic engineers—and the University has set up a multidisciplinary Materials Institute with membership drawn from Engineering, Electronic Engineering, Physics and Chemistry.

3. In this structure, and with this philosophy, the University has been particularly challenged by the experience of those departments which were not rated at 5 or 5* in the 2001 RAE, but which are nevertheless important to its educational and research provision. With the support of the Higher Education Funding Council for England it has invested heavily in restructuring and refocusing its School of Engineering, which was financially disadvantaged by the fact that three of its four units of assessment were rated at 4 (the fourth, the Centre for Environmental Strategy, was rated 5). It faced an even greater challenge to preserve Chemistry, rated at 3a. In this case without external financial support, the University reorganised the department and made it part of a new School of Biomedical and Molecular Sciences. With development of its research mission to contribute, through analytical and biological chemistry, to the work of research groups in biomedical sciences, and through materials chemists to work undertaken in the Materials Institute, it has been possible to sustain a significant staff group (16 academics) who are able to teach a full undergraduate chemistry syllabus and thus preserve the subject in this part of the South East region. A financial analysis shows that Chemistry is still operating in substantial deficit—hence the continuing need for cross-subsidy from the University—but is increasing its income from research grants and contracts and building up its student numbers.

4. A somewhat different situation faces Physics, rated 5 in the 2001 RAE, which shares with almost every other Physics department in the country a shortage of undergraduate students (and hence a deficit in teaching income) despite its research success. The Surrey department has in this respect been successful relative to most of its neighbours in the region, seeing a small growth in undergraduate numbers over the last five years and enjoying a relatively large cohort of postgraduate taught students. Even so, its income from all sources is significantly less than its full allocated costs. As a highly successful generator of research output in its own right, and an essential contributor to the work of the Advanced Technology Institute and the Materials Institute, it is a discipline which the University needs to preserve, but must cross-subsidise heavily because of the funding methodologies of HEFCE and the research councils.

5. It is with this mission, background and experience and that the University approaches the Select Committee's questions. Its detailed responses are set out below under the Committee's headings. The general themes are as follows:

— The predicament of "strategic subjects"—largely but not exclusively science subjects—comes about because of the failure of the whole educational system, starting in secondary schools, to produce enough scientifically-minded individuals. This is not a problem which can be solved by the universities alone, though it is one in which university action can help.

— The details of university funding formulae allocations for science with respect to other subjects are less significant than the absolute level of funding for university teaching, which is too low.

— Concentration of research, in the form imposed by ministers, is misguided and counter-productive.

Detailed Responses

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments

6. HEFCE's funding formula as applied before the 2001 RAE provided a steep differential between departments with little research of national significance and those whose work was rated as being of national or international quality. The funding was nevertheless just adequate to support a limited research infrastructure for departments which were striving to improve their quality, and thus weaker departments were given both the incentive and some of the means to move towards the general level of excellence which the government claimed to want. Funding decisions taken after 2001 were doubly destructive. The decision to reduce "R" funding to 4-rated departments, which was understood to have been forced by ministers upon the Council despite its reservations, reduced funding faster than fixed costs could easily be removed, thus forcing universities to take on short-term costs from other funding. The coincident inability of the funding council to "fully fund" 5-rated departments in the first year after the RAE further reduced universities' capacity to manage change in their research portfolios.

7. In the (nearly) steady state of funding since 2003 the predicament of science departments rated 4 or below, and even of some rated 5, is still grave. Although universities could theoretically choose whether their science departments should to become "teaching intensive" or "research intensive" according to the level of R funding received, it is not in practice possible to run a science department without some contribution from R funding towards the cost of academic and support salaries and recurrent non-staff costs. The teaching income from a student cohort will not generally support a sufficient number of staff to teach an acceptable academic programme (as defined in QAA benchmarks). Thus the decision about R funding is always a determinant of financial viability.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

8. The UK science base has an enviable and justified reputation for producing more and better research for each pound spent than other national science communities. Given the rising cost of the science infrastructure, there is obviously a concern that limited national resources should be deployed carefully to protect this position. There is no reliable or robust evidence, however, that the productivity of fewer, larger departments would be greater than that of smaller departments. (see Funding Research Diversity: summary report (2003), Evidence Limited for UUK).

9. It is important to distinguish here between the human resources required for big science and the material resources. The case for concentrating expensive instrumentation is very strong, and is based on the argument that it is only cost-effective when intensively used. Major national facilities will be used from researchers from across the country—and indeed across the world. Less expensive instrumentation can be, and often is, concentrated regionally.

10. There is much less justification for concentrating the researchers who use these resources. Scientists work in communities which are not bounded geographically. Their collaborations are habitually conducted remotely, in conferences, over the internet, or by travelling, and no single department, however large, will be enough to provide an active researcher with the research community he or she needs. While there is probably a minimum critical mass of researchers in one place in any subject, it does not follow that once that critical mass is achieved the returns to scale are linear, especially as numbers rise very high. An optimal distribution of scientists will in turn be influenced by the optimal distribution of students. Thus the users of concentrated facilities will generally have other tasks, notably in teaching, which have to be undertaken away from the equipment and this is the norm, for example, in researchers working at Daresbury or CERN. Good communications and proper work planning, and career planning, enables scientists to be productive wherever they are geographically sited in relation to their instruments.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

11. The weightings in the T formula are used by HEFCE council to calculate university block grants, and not every university uses the same weightings to allocate funds to departments because differences in real costs cannot be reflected in the broad weightings used centrally. Most universities are forced to cross-subsidise science teaching from somewhere—often other teaching grant but also from other non-governmental income. However, the assumption that universities will be able to cross-subsidise one subject area's T grant from another only holds good if there is enough slack from subjects allocated more money by the formula than they really need for them to be able to provide for subjects allocated less than they need. Since the funding level for arts and social science subjects (bands D and C in the current formula) is not generous, the effect of cross-subsidy is to squeeze both the classroom-based subjects and the more expensive laboratory-based subjects. The change in weighting was most damaging in that it sent signals to universities to re-arrange their internal allocations against the interests of science. Some universities heeded these signals, some did not. But changing the weighting back to the levels current in 2003–4 would not significantly help universities to support science teaching unless the total sum of money available were increased.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments

12. The TRAC exercise has confirmed that in most British universities most of the time, research activity is conducted at a huge loss and the teaching of publicly-funded students—ie students from the UK and the European Union—is conducted at about break-even or slightly worse. Analysis at a more detailed level suggests that laboratory-based subjects are much more likely to be the ones falling below break-even. The overall business model for a research-based university is that its earnings from endowment, industrial links, and overseas students—very often the latter to a considerable extent—allow it to continue to support publicly-funded research and publicly-funded teaching. A teaching-only science department would not have all, or necessarily any of these resources to call upon. It would get no R income from the funding council. It can by definition have no research grant and contract income, and without a significant research presence it would be unable to attract overseas students. For that reason alone a teaching-only department would have very little chance of financial viability (sustainability in current HEFCE terminology). Nor would it be a desirable environment in which to learn or to teach. Research attracts good teachers at university level, and it then inspires the teachers in the laboratory. Given the shortage of students for science undergraduate courses, a teaching-only department would attract steadily fewer students, its teaching income would go down, and it would face financial ruin rather earlier than a department with research resources upon which to call.

13. Those are the financial arguments for rejecting the concept of a teaching-only science department. The academic argument is that the quality of teaching and of the student experience of science is irremediably diminished if the undergraduate does not have access to the act of research and knowledge-creation.

The importance of maintaining a regional capacity in university science teaching and research

14. Regional capacity for research is relevant insofar as research departments support local and regional businesses. This will vary from region to region and industrial sector to industrial sector, but the existence of significant high-technology clusters in areas well-served with universities (Cambridge, the S.E., central Scotland) strongly suggests that it would be more difficult to launch and nourish effective technology-driven industry in areas without university research capacity. This is at least in part because graduates tend to cluster around their places of study, as well as because of direct knowledge transfer from universities to business.

15. The need to maintain regional capacity for teaching is indicated principally by the increasing trend for students to attend universities within a relatively short distance of home, even if they do not live in the parental home. The lack of a convenient, if not strictly local university teaching science will be a tangible discouragement to some students, and will thus challenge a major strategic objective of raising the number of science graduates.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose.

16. "Strategic subjects" in the sense used in this debate generally refers to subjects in which both the knowledge and the trained manpower is disproportionately important to society. We need both science and scientists, skilled linguists and a scholarly knowledge of different languages and cultures. This is clearly an area in which there has been major market failure, to the extent that the UK science base is insufficiently large to generate enough trained scientists to refresh itself. There are neither the science teachers to educate enough schoolchildren into a sufficient scientific competence to undertake further study, nor enough graduate scientists in the pipeline to fill scientific posts in universities and research establishments when current senior generations retire. In cases of market failure, there is no-one to intervene but government. Mechanisms must be appropriate to each stage of the cycle of regenerating the labour force.

- The school teaching career must be made more attractive to scientists, but the result of putting more scientists into schools will not be seen before two electoral cycles have passed.
- Short-term career prospects for science graduates (which are already quite attractive because of shortages) must be maintained to encourage school-leavers to make the right choices of university course.
- The quality of teaching and teaching equipment in universities must be enhanced, to the same end and also to maintain the quality of graduates. This will require an increase in the unit of resource for science teaching, not merely a redistribution of existing funds through manipulation of the funding formula. This will require immediate intervention and will have an immediate effect, but will on its own produce a less fundamental change in the long term than the first recommendation above.
- Fiscal and other incentives should be developed to encourage employers to promote lifelong learning and professional development among career scientists.

17. There is also a market failure in research, which was highlighted by Lambert. The appropriate responses are more expensive:

- It should be accepted that business will tend not to invest in research or development to the level which government has wished. To expect business to fund the necessary basic or applied research in universities is therefore not realistic in the short term.
- Nor is it realistic to expect universities to make sufficient money out of exploiting scientific IP to support the creation of that IP.
- Government, through the OST, should protect the "responsive mode" funding of basic science research which generates the new understanding on which applications closer to market are built.
- All Government departments should guarantee to pay full economic costs of research for the work they commission (which is almost entirely applied).

January 2005

APPENDIX 18

Memorandum from Sheffield Hallam University

Sheffield Hallam University is consistently ranked as one of the top performing modern universities in the UK for research. The last three research assessment exercises have given ratings of "international and national excellence" in a number of our research areas.

Research is organised into research institutes and centres, of which the Materials and Engineering Research Institute (MERI) and Biomedical Research Centre (BRC) having the strongest science focus.

The research institutes and centres pursue a portfolio of research related activities including research (funded by research councils, EU, charities and through contracts with industry), consultancy, and the provision of postgraduate education and continued professional development (CPD) courses. They are applications focussed and benefit from strong links to regional and national industry, funding bodies and other research organisations.

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments;

Over recent years HEFCE QR research funding has been increasingly focussed on the most highly rated departments, which has resulted in research becoming concentrated in a smaller number of departments. It also focuses research funding according to the criteria of the RAE. It can be argued that in the past sufficient weight has not been given to applied research, particularly research conducted in collaboration with companies who are often concerned about the potential loss of intellectual property resulting from publishing results in academic journals. It is yet to be seen if this will be addressed for the next RAE.

Some applied research is not world-leading in the RAE sense, but highly relevant to UK or regional industry. With HEFCE funding focussing on highly (RAE) rated departments, this research is struggling for support. This is the "funding gap" referred to in the Lambert Review.

The MERI strategy is to pursue a research programme which is high quality in RAE terms but also relevant to market needs. This requires balancing a research portfolio funded by HEFCE research funding, research council and EU framework grants and contract research and encompassing long-term, speculative programmes to shorter term projects with more predictable outcomes. Any reduction in HEFCE research funding would result in the balance moving towards the latter, while it is the former which are more likely to give rise to innovative developments. Over time, the consequences of this shift will be a reduction in the levels of expertise in the institute which will then impact on the effectiveness of other activities including teaching. Long term, high quality research projects ensure that staff, who also engage in contract research, consultancy, training and teaching are at the forefront of their fields and their expertise feeds through directly to the customers and students. Customers benefit from access to novel technology and students are made aware of the most recent developments in the subject.

The move to full economic costs for research council funding will reduce the reliance on QR funding.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend;

As several independent studies have shown, research is already more concentrated in the UK than in other leading industrialised nations. The further concentration of research in a small number of university departments will reduce diversity in terms for research themes and approaches. It will further remove the important link between teaching and research in many universities and in some scenarios will weaken the research capacity in some regions.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula;

Science courses tend to be expensive to deliver because of the requirements of a practical component. Any reduction in funding will lead to the reduction in practical components of courses and thereby the quality of the student experience.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments;

One of the most effective channels by which scientific developments and technical innovation can be channelled from universities into the economy is through well-equipped graduates joining the work force. Students who have been taught by staff actively engaged in research and used state of the art equipment and techniques will take their knowledge into the workplace and potentially strengthen links between companies and their university.

University science departments that do not engage in research will not be able to offer as informed a student experience as those that do. Students in research active departments can be involved in original research as part of a final year project of postgraduate course work, giving them valuable practice experience at the forefront of their discipline. In a teaching-only department the knowledge of teaching staff will tend to be less current, and they will tend to be less engaged in developing their subject.

The importance of maintaining a regional capacity in university science teaching and research;

MERI is a Yorkshire Forward designated Centre of Industrial Collaboration (CIC) as the Materials Analysis and Research Service (MARS). The CIC, provides research and consultancy services to a range of companies in Yorkshire ranging from SMEs to larger companies. Physical proximity and a shared understanding of capabilities and requirements are important aspects of an effective symbiotic relationship between a company and the research institute, with expertise and knowledge passing from research institute to the companies and market-awareness passing the other way. If the regional research capability were to be reduced the consequences would be felt by regional industry.

Approximately 50% of the student population (undergraduate and postgraduate together) at Sheffield Hallam University comes from the Sheffield area and a similar percentage remain in the area after graduation. Increasing regionalisation means that Sheffield Hallam University and other HE providers in the region are playing an increasingly important role in training the region's workforce. Concentration of research into a few universities will inevitably mean that some regions will have lower university research activity, thereby reducing the quality of the science teaching available in the region and also the research capacity available to regional industry. Reducing the provision of science and engineering teaching and research in the region will have a direct impact on the regional skills base and thereby the regional economy.

At Sheffield Hallam University, the Solutions Centre offers companies in South Yorkshire the opportunity to employ a sandwich student who receives additional training that is relevant to the company's requirements, and potentially augmented by the universities research resources. CASE studentships, whereby PhD students engage in collaborative research programme involving the research institute and a local company, represent other opportunities of effective technology transfer between the university and regional industry.

The BRC provides undergraduate and postgraduate training and CPD for NHS pathology services in the region, and that training benefits from the strong coupling that exists in the BRC between research and training. Any reduction in either will have an impact on the provision of a skilled workforce in this area.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose.

Science departments throughout the country are under significant financial pressure which has resulted in the reduction of teaching provision in strategic subjects and the well-publicised closure of departments. Once a course has been stopped it becomes very difficult to restart it because staff, expertise and reputation quickly leave the university. Government intervention is required to maintain science teaching provision and research capability.

We have stressed the consequences of increased concentration of research and science teaching provision in the context of increasing regionalisation; this should be borne in mind when a mechanism for Government intervention is considered. Specifically, any intervention should recognise institutional autonomy and the need for institutions to make academically and financially rational solutions. Intervention should take place in an agreed regional economic framework (not necessarily an RDA region), and focus on finding creative ways of maintaining provision using a range of mechanisms including collaboration.

January 2005

APPENDIX 19

Memorandum from Senior Scientists and Research and Development Managers representing several UK Pharmaceutical Companies

The authors of this document have a broad experience of the interface between academia and the UK Pharmaceutical industry. In our opinion the rapidly diminishing provision of chemistry as a subject in many universities will severely compromise the development of the UK pharmaceutical and biotech industries. The key issues that Government must address quickly are:

— As a matter of urgency universities must be provided with the full per-capita cost of undergraduate chemistry teaching, without the necessity to subsidise teaching from research income.

— There must be a Government backed national strategy for the provision of chemistry teaching in England, which will ensure that provision meets the needs of industry and also regional demands.

— Any further rationalisation of those departments that teach chemistry must be carried out within a well-considered national strategy for the provision of graduate chemists.

The Committee has invited evidence to be given on the following points:

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments.

There is no other country where, only by achieving the highest standard in research, can a university afford to provide undergraduate training. In the US for example, universities derive enough income from teaching to fund undergraduate activities and as well as this, even in the smallest departments, academics can normally pursue some independent research activities. Many of the smaller colleges are renowned for producing high quality graduates who often transfer to major research departments (eg Harvard, Columbia, Stanford, MIT etc.) to pursue doctorate-level work. In the UK, as well, there has traditionally been a symbiotic relationship between the smaller departments, who have provided well-trained, well-motivated graduates who have stepped-up to have successful research careers at larger departments. It is well known that leading research departments such as, IC, Cambridge and Oxford have relied heavily on a graduate intake from smaller departments.

It should also be recognised that the majority of science graduates leave university at graduate level and the majority of jobs for scientists (including teaching) are also at this level. It follows that provision of very well-trained science graduates is a vital activity, which must not simply be a by-product from the major research schools.

The research funding formula was intended to direct research funding towards those departments that are the leaders in research. However, the under-funding of science teaching has meant that only those departments that have very high research funding can afford to teach undergraduates. This is clearly illustrated by the example of Chemistry at Exeter, which had nearly 100 undergraduates in each year with high A-level scores, and was a very good (RAE 4) research department, but could not run chemistry without losing money.

Many of the highly rated research departments (eg Cambridge, Bristol, Durham) take high numbers of undergraduates, but do not produce a high proportion of graduates that become practicing scientists. Many of the smaller research departments, including some of those that have closed (eg Salford) had a reputation for producing graduates that were attractive both to industry and to the bigger research departments, as PhD students. The supply of these research-oriented graduates is diminishing with the uncoordinated closure of Chemistry Departments. This has severe consequences for both industry and the major research universities. Major pharmaceutical companies are now collecting data to predict the impact on the industry.

There needs to be adequate funding for universities that provide high quality teaching for group sizes of 50-100 students/yr, but research output at $<5/5$*.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend.

In many fields of scientific research that are of current importance, the highest level of equipment and infrastructure is required in order to compete at the highest level—this is very expensive. It is important that UK academics are able to compete at the highest level, and concentration of key, large items of equipment must take place for economic and critical mass reasons. However, this DOES NOT imply that other research centres are unnecessary—a wide diversity of research active universities is essential for the academic health of the nation. The research activities of many young academics has been nurtured in small departments, where they have had the opportunity to grow as scientists. Many internationally renowned scientists at the leading universities started their careers in this way. Indeed, the diversity and independence academic institutions has stimulated competition between research groups and been a catalyst for new ideas and innovations. A parallel has also been seen in the start-up of research-based companies, in areas such as biotechnology.

It would not be possible or reasonable to provide all chemistry departments with the highest level research facilities. However, any rationalisation of research provision needs to be better managed and co-ordinated within England. We must not allow the closure of departments ONLY on the grounds that they cannot achieve the highest standard in terms of research. In many universities committed academics have made significant research contributions without having the most expensive top-level instrumentation. As well as the finite impact of such research, it also stimulates advanced undergraduate programmes, providing students with first-hand research experience. Such experience is a necessary requirement of training at MChem level, which has become the standard recruitment level for graduate research jobs. In assessing the research productivity (volume) of a department, account should be taken of the other demands on staff, particularly departments with low staff numbers, where teaching loads are high.

For the reasons above, we need a funding system that allows the maintenance of good teaching departments throughout the country, not all of which should be expected to engage in research at the highest level.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula.

For undergraduate chemistry teaching, the single most important problem is that the funding weighting given to the subject is totally inadequate and in no way reflects the cost of providing good education and training in the subject and complying with modern standards of safety.

It is now relatively more expensive to teach science subjects in university than it was in the past. Nearly all Chemistry Departments conduct undergraduate teaching at a loss, and back-fund the shortfall through research funding. In chemistry, more stringent requirements for chemical handling, exposure and disposal have been particularly significant. New chemical handling requirements have also meant that the standard of many university teaching laboratories is totally inadequate. The expense of refurbishment of labs is considerable.

A significant and immediate increase in the per-capita funding of chemistry undergraduates is required to avoid the risk of severe curtailment of chemistry provision in the UK!

Recently HEFCE were asked to address this issue, but failed to restructure undergraduate funding in a way that would have given sufficient funding to cover the cost of teaching laboratory-based subjects. It has been agreed that chemistry is under-funded and that HEFCE should move to "real-cost" funding. However, during a 4 year review period, the situation is set to remain as it is now until 2008. This could be too late for a significant number of good chemistry departments, that may be faced with the same fate as Exeter, Kings, Swansea, QMC, Salford.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments.

A mixture of Research led departments, Research/Teaching and some Teaching only departments is required, with departments being able to gain credibility and financial security from high quality teaching as well as from research. We certainly need a small number of top world-class Research led departments, but these need to be backed by a larger number of well-resourced Research/Teaching departments. The balance of teaching and research for any department could depend on many factors, with the value of each activity being regarded equally. A few departments might choose to be Teaching only, as were many former technical colleges and polytechnics. Departments of this type would mainly teach at Foundation or BSc level and ideally would have close links to research active departments and/or to local industries, who are often key recipients of their graduates. The important drivers are that the quality of the teaching is high and the content of science courses is not diluted or compromised, and that the UK continues to be a leader in chemical/medicinal/scientific research. We cannot have word-leading research and at the same time neglect the importance of undergraduate teaching.

Departments that can attract a significant number of students, produce high quality science graduates that are well regarded by employers and by research universities, should be financially viable on income from teaching. However, some universities now run "diluted' science courses, which are cheaper to teach and sound more appealing than "straight' chemistry to the uninformed sixth form student (and to many of their teachers). However, such courses (despite their branding), do not provide graduates with the skills or depth of understanding that employers demand—it is these courses that should be targeted for consolidation, because they mislead students about their vocational value, but the present funding policy encourages universities to develop such courses, even after chemistry departments have been closed.

Smaller departments that provide good teaching as well as doing some research and/or provide support for industry should be encouraged and should be judged on the overall value of their provision, not just on research and in particular not just on the level of research income. Such departments do provide a valuable stepping-stone for talented researchers who later move to be successful 5/5* departments. Chemistry departments such as Bath, Exeter, Salford, have typically provided this function. Sadly, of these departments, only Bath still survives.

It is somewhat ironic that many of our current leading chemists in industry and academia came from poorer backgrounds and started university with modest A-levels, but found genuine opportunities through the high quality teaching and encouragement that was once provided by many English chemistry departments, that no longer exist, or may not exist for much longer.

Sadly, at a time when much is made of widening participation and improving access, it is those universities that provided genuine opportunities for students from less privileged backgrounds, who were less well prepared for university, that are losing their chemistry departments. If this continues chemistry degree courses will only be accessible to the students with the highest A-level scores and will only be taught at a small number of "elite' universities. Chemistry will be inaccessible to students that have not fully developed their academic skills at age 18. As a consequence there will also be inadequate provision of chemists that are appropriately educated for the wide range of technical and research jobs that the economy demands.

Recognising teaching excellence as a key output of universities alongside research, may be profitable over the short term. The majority of academics compete for research funding *a priori*, as this is their core purpose. Teaching excellence is perceived as secondary to research success. By providing recognition of teaching excellence (and a career structure in line with this), academics would chose to become research leaders or teaching leaders, and help to meet the primary drivers above.

The importance of maintaining a regional capacity in university science teaching and research.

Students increasingly attend universities in their own region and, if we are not to deny them the opportunity to study chemistry (as well as other science and engineering subjects), there must be provision for sciences throughout the country. Departments that concentrate on teaching could play a big part in encouraging young people into science. If there is not local provision they will study other subjects that are less beneficial to the economy. So it is an imperative that regional capacity in science teaching exists in the UK. Because of the insular nature of universities, we have often lost more than one institution in the same region, because neither was considered viable in its own right, by its governing body. This was the case in London when QMC and Kings closed chemistry departments in close succession. Surely, in that case, there was an opportunity for local rationalisation, instead of losing both institutes. There are now other regions of England where there is a clear risk of losing two or more chemistry departments, because VCs may make independent decisions on the their viability. A policy is required, driven by the Government and HEFCE that will lead to co-operation between universities to ensure the regional demand for chemistry provision is met. In the Manchester area, at least 15 years before the merger of Manchester University and UMIST academics at Manchester UMIST and Salford recognised the local supply and demand issues and were calling for a merged Greater Manchester Chemistry Institute. However, the management of the three universities opposed this. In the intervening years: chemistry at Salford closed; a significant number of leading researchers reluctantly left each of the universities for better prospects elsewhere; and a lot of money was wasted refurbishing laboratories at UMIST; before Manchester and UMIST ultimately merged. Finally, with a lot of investment, there is the prospect of one leading university in the region, but it is difficult to bring back staff of the same calibre as those that have left individual departments over the years. Also, the provision of high quality chemistry education for those without the highest A-level grades has been lost. There has to be a better way to ensure appropriate provision in each region, but individual VCs will not act in the interest of their region, they will only take measures that have a positive short-term impact on their balance sheets.

The issue of access is an important one for science degrees. Science has traditionally provided a route whereby people from less well-off backgrounds find success. In the past, many students obtained science degrees (and HND/HNC) by studying (often part-time), at FE colleges and polytechnics. These institutions used to offer rigorous chemistry courses, which were ratified by RSC (eg GRSC) or CNAA. The provision of such courses at local colleges has essentially disappeared and universities are the only institutions that can take their place, but at present there are relatively few courses that satisfy this void.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose.

Government is the major funder of universities and therefore on behalf of the tax-payer is a major "customer". Industry is another important "customer" of the university system and the Government, as the sponsor of the universities must make sure they deliver the type of students required by industry. Government should exercise its influence as a customer and sponsor in directing which products the nation needs to produce through the university system.

VCs now run universities to meet arbitrary financial targets, rather than the needs of employers and students in the region. We would prefer Government to take direct action in order to ensure that there is adequate provision of capable graduates in key subject areas like chemistry. Government are clearly uncomfortable about taking away autonomy from universities. However, there seem to be certain obvious ways for government to encourage VCs to continue to run science courses: firstly to make it financially viable for them to do so by improving the weighting of science subjects; and secondly to have Chemistry, Physics, Maths departments as defining points for what constitutes a "top-rated" university. They could also provide regional incentives and objectives for Universities in certain parts of the country to provide science provision. If universities, (unlike Exeter which demonstrated 115 good chemistry applicants in 2004), are not meeting regional demands, then they could face penalties. The question must be asked, why have a university in a position of regional importance like Exeter, if it does not meet a regional need for provision of a broad range of subjects, including core science disciplines?

As argued under the section on regional provision, it seems obvious that government /HEFCE should strive to enable and encourage universities in a region to collaborate together and where appropriate merge facilities, so that they can provide effective provision of science teaching, that is in accord with regional needs. If universities in a region collaborate to share a successful and cost effective chemistry (or other science) department, they should be rewarded for this by generous government funding. Mechanisms should be put in place to make it easier for two or more universities to share a chemistry (or other science) department and each gain the kudos from its success.

Some other points that we think are of key importance:

- Science (chemistry) graduates are attractive to a range of employers, there is very little unemployment amongst chemists and it has been shown that chemistry graduates make a bigger overall contribution to wealth creation in the economy than those from most other disciplines.
- Chemistry is a key discipline in many areas that are targeted by government for the future prosperity of a country driven by a high-tech economy:
- It is the core discipline in drug discovery and development.
- Research based pharmaceutical and biotechnology industries cannot survive in the UK without the provision of well-trained graduates.
- It is a core discipline in other industries that Pharmaceutical and Biotech companies are also reliant upon.
- Many other vital industries and public organisations cannot operate without well-trained chemists
    - examples are: electronics (semiconductors, displays, LEDs, memory etc.)
    - the food industry
    - agriculture
    - polymers and coatings
    - environmental industries
    - water industries, and many more..
- We need well-trained chemistry graduates to become capable school science teachers. The provision of well-trained and motivated graduates for science teaching represents a significant challenge for the future if we are to attract good students into science. Taking chemistry as an example, only 40% of students taking A-level chemistry are taught by teachers with a chemistry degree. The fact that chemistry graduates are attractive to a range of employers, and can benefit from well-paid careers, has for several decades pulled chemists away from teaching as a primary career option. The same is not necessarily true of graduates from other disciplines for whom teaching may be the major opportunity for employment.
- Many university chemistry facilities are well below the required standard. Better funding is needed to provide a range of well-equipped chemistry departments.
- The Government is spending a significant amount of money on schemes, such as the chemistry AimHigher, to encourage young people into university, but this will not be effective for chemistry when the overall provision is being reduced dramatically.
- It has been said that new courses are replacing those that are closing. However, courses purporting to be relevant to the pharmaceutical industry need to be scrutinised carefully. Many of them are diluted pseudo-science courses that are cheaper to run than "real" science courses and do not provide the type of training required by employers. Some universities that have closed their chemistry departments are now advertising such courses—See for example Biomolecular and Pharmaceutical Sciences at the University of Salford. This course sounds attractive to potential students, but would not provide the rigorous science training required by the pharmaceutical industry—in short, such courses are cheating the students that take them. This is what will continue to happen if good science courses are not funded properly.

This statement was prepared by Senior Scientists and Research and Development Managers at AstraZeneca and Pfizer, with significant contributions from people of similar stature at GlaxoSmithKline and Organon. The statement has also been endorsed by SEMTA (Sector Skills Council for Scientific Engineering and Manufacturing Technologies). We believe that the points made here are widely endorsed within the pharmaceutical and biotech R&D sector in the UK.

January 2005

APPENDIX 20

Memorandum from Nottingham Trent University

INTRODUCTION

Nottingham Trent University Provision

Nottingham Trent University is a large University with a breadth of teaching provision in Science, rare within UK Universities.

- Programmes are provided in the more traditional core sciences of Biology, Chemistry and Physics and also within the modern interdisciplinary subjects of Sports Science, Forensic Science, Environmental Sciences and Biomedical Sciences.

- — Uniqueness exists in the variety of levels of qualifications and modes of study (full-time, sandwich and part-time) which offer a multiplicity of entry and exit points for both traditional and non-traditional applicants, all the way from Foundation Degrees to PhDs.
- — Many programmes have professional placement routes.
- — Level one entry to Science programmes in 2004–05 is around 500 FTEs and total enrolments over all years and levels of taught provision are around 1,500.

Our comprehensive teaching provision offers an ideal "one-stop shop" for candidates and schools searching for science in Higher Education.

The Science provision at NTU is highly rated for both teaching and for research.

- — Teaching was awarded the top grade in HEFCE/QAA subject reviews for all traditional subject areas: Chemistry, Physics and Molecular/Organismal Biosciences, plus an excellent grade for Sports Science (22/24 points).
- — The university has just been awarded maximum funding under the HEFCE Centre for Excellence in Teaching and Learning to develop the Centre for Effective Learning in Science.
- — Research in RAE 2001 was awarded a grade 5 in "Other Professions and Subjects Allied to Medicine" and a grade 3A in "Chemistry"; a submission which included physicists.

A key feature of our provision in both research and teaching is its interdisciplinary nature.

Submission Evidence

"The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments"

The extreme selectivity and lack of knowledge of changes to funding weightings before RAE 2001 has resulted in a total loss of HEFCE second stream income to the Physical Sciences part of our science base. The loss of HEFCE RAE income is despite a significant growth in our third stream activity over both the 1996–2001 and post-2001 periods.

Based on a grade 5 post-RAE 2001 income of around £70k per member of staff entered in RAE 2001 and an undergraduate income of around £5.5k per student, the grade 5 award in our Biosciences equates to approximately an effective reduction in student-to-academic staff ratio (SSR) of 13 per member of staff submitted to RAE2001.

It is clear that the differential in total HEFCE research and teaching income between a department submitting 100% of its academic staff and receiving an RAE grade 5, compared to a department receiving only HEFCE teaching income, when measured in terms of SSR is extreme.

It is our belief that our grade 3A, which was one of very few two-grade increases, compared to RAE 1996, awarded within chemistry, was equivalent to grade 4 in many other units. However, this grade 3A has no associated income and the differential in income to our grade 5 is therefore very significant. Juxtaposing the greater difficulty in recruiting undergraduates to the Physical Sciences, an equivalent to 13 SSR is an extreme multiplier for RAE.

"The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend."

NTU strategy is to provide a full complement of science provision, although the size of such a base in each sub-area reflects relative strengths in student recruitment.

Our past experience is that a core of traditional science expertise is important in retaining flexibility and being able to respond when a new subject area develops. Thus, our new science degrees are fully underpinned with experience and facilities from the Physical and Biological Sciences. Examples include Sports Science and Forensic Science rather than less rigorous Sport Studies or Crime Scene Study. This approach retains scientific competency within graduates and reduces the loss of scientific competency from the overall graduate output. Focusing research in a small number of departments may lead to a downward spiral in which new subjects are offered in non-research departments offering predominantly "science studies" rather than "science".

Further concentration of research is likely to reduce the ability of departments such as ours to recruit high quality staff across the full range of disciplines to support existing teaching and retain future flexibility.

NTU research strategy supports cross-discipline approaches and this has underpinned our use of SRIF funding to construct interdisciplinary research spanning the Biological and Physical Sciences. An over-focussing of research on a smaller number of departments nationally is likely to reinforce a single-subject mentality within the UK.

"The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula."

Recent proposals by HEFCE to increase the relative weight given to science were overturned and eventually the formula resulted in a cut in funding per student. This appeared to indicate confusion in policy similar to RAE2001 when it initially appeared that HEFCE would retain funding of grade 3A departments. The overall effect is to signal a lack of commitment to science.

"The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments".

It appears unlikely that teaching-only science departments will be either desirable or financially viable, but we would not wish to use RAE outcomes, which have been reportedly subject to "games-playing", solely as a measure of, or to determine, research activity or provision. NTU practice in this area is that undergraduate teaching is underpinned by staff who undertake research.

At present NTU science works on a student-to-academic staff ratio of around 20:1 and, whilst RAE 2001 income to physical sciences does not exist, there is a significant level of research funding from other sources, such as research councils and the EU. Forthcoming changes to research council funded projects, which are moving towards full economic costing, should reinforce our ability to maintain a small core of highest quality research within the Physical Sciences irrespective of RAE funding.

An overall consequence of current HEFCE policy is that major provision in physical sciences now exists in less than 50% of universities. The loss of science and engineering from the majority of universities is likely to result in a lack of scientists and engineers within senior management teams and certain universities could become scientifically illiterate.

"The importance of maintaining a regional capacity in university science teaching and research."

If financial pressures, due to higher undergraduate fees, result in less student mobility from their home, then regional provision becomes increasingly important. Full provision of science within a geographical region is unlikely be delivered unless that provision includes all levels from foundation degree to postgraduate and all modes from full-time to part-time. Also increasing prevalence of local students should encourage more cooperation and collaboration between HE institutions to ensure optimal regional capacity.

"The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose"

Universities are autonomous institutions but the Government is able to exert strong national influences collectively via HEFCE on the funding available to support such subjects, as well as at more local level through the Regional Development Agencies. Government should not intervene directly in the affairs of institutions such as the viability of individual departments but it should ensure that the funding councils have mechanisms to support key subjects at regional and local level, particularly by encouraging breadth of provision and interdisciplinarity in the sciences.

A threat to the provision of physical science within interdisciplinary structures is the tendency for universities with long established high RAE grades in core physical sciences to recruit large undergraduate student numbers in these areas. These high RAE grades coupled with high undergraduate intakes reinforce the trend to single-subject departments. Marginally reducing undergraduate intakes in such departments.

January 2005

APPENDIX 21

Memorandum from AstraZeneca

1. The UK economy is dependent for its success upon the innovations made, predominately, by the pharmaceutical and aerospace sectors. Companies within these sectors rely on the UK science base for supply of trained scientists and engineers and the dynamic interactions with academia that engender the creation of ideas and promote innovation. In order to sustain a vibrant and flourishing environment for economic growth it is imperative that the teaching of SET subjects and provision for sustainable research in universities, to international standards, is given high priority and pursued rigorously.

2. We strongly recommend that the Government takes a holistic approach to science education from primary level, through secondary and higher education and develops a cohesive strategy that delivers the quality outputs required by companies operating in the UK, namely excellent scientists and engineers. Focus

on one part of the education system may lead to imbalance in other parts and not produce the solution initially expected. It is critically important that teaching and research are not disconnected as it is only through research-informed teaching that the UK can continue to develop gifted scientists for the future.

3. AstraZeneca is pleased to make a contribution to this important inquiry and welcomes the opportunity to discuss this topic with you in greater detail than this brief response allows.

Impact of HEFCE's Research Funding Formulae, as Applied to Research Assessment Exercise Ratings, on the Financial Viability of University Science Departments.

4. The recent changes in HEFCE's research funding formulae are unhelpful. They have directed funding towards the 5 and 5* rated departments at the expense of those departments rated 4 and to the detriment of scientific research in the UK. The amount of funding is inadequate to sustain an internationally competitive science base. In most fields of scientific research that are of current importance, the highest level of equipment and infrastructure is required in order to compete at an international level: this is very expensive. The changes in the funding formulae have already resulted in closure of a number of university physical science departments notably at Newcastle and Exeter universities. If this trend continues, we will face a situation where we lose critical mass in many of the physical sciences subjects, a situation from which it would be extremely difficult to recover.

5. The Research Assessment Exercise (RAE) provides a measure of research quality that is useful when determining where to place research collaborations in the absence of any other knowledge. However, we question the value of the RAE when it becomes disconnected from the overall university education process. We are resolute in our belief that the RAE should recognise industry-sponsored research and industry outputs such as patents in addition to joint publications. It is our view that the RAE has resulted in teaching in universities becoming downgraded in importance. One example of this is Salford University. Although not strongly rated for its research capability, Salford has excellent chemistry teaching departments and has provided AstraZeneca with many excellent students and graduates.

The Desirability of Increasing the Concentration of Research in a Small Number of University Departments

6. Concentrating research within a reduced number of university departments would be to the detriment of SET teaching and research in the UK. However, we do recognise that it would be both inefficient and unreasonable to have a large number of very expensive departments, each with a relatively low volume of research output.

A small number of large departments would not provide a suitable career structure for UK scientists compared to that which exists today. One consequence of this is likely to be that scientists leave the UK to pursue careers overseas and that the UK becomes a less attractive place in which to conduct research. This would lead to a lack of investment in the UK by companies due to the reduction in the quality of the UK science base.

7. It is important to maintain both sufficient critical mass and quality teaching and research in SET subjects, in order to provide the calibre of scientist required to pursue research that is of international standard. A range of skills across all disciplines is required to produce a vibrant and sustainable research environment. This is unlikely to be the case if there a fewer universities.

Any rationalisation of research provision needs to be better managed and co-ordinated within England and Wales. For the reasons above, it is imperative that we also have a funding system that enables the UK to maintain good teaching departments throughout the country.

8. In addition, there is a danger in focussing funding too sharply. To have only five or six research departments in one subject, for example, chemistry, runs the risk of developing too narrow an academic resource pool, which would be unhealthy.

9. We do believe that there is merit in encouraging universities to collaborate in order to capitalise on their relative strengths. The concept of regional universities collaborating in chemistry or physics for example may offer a genuine solution, eg the East Midlands. The Government's recent announcement to create "science cities' is an ideal platform on which to promote collaboration between universities using "science councils' as the conduit. In the North West region the NW science council has been particularly successful in this respect.

The Implications for University Science Teaching of Changes in the Weightings Given to Science in the Teaching Funding Formulae

10. We are very disappointed that HEFCE has chosen to reduce the multiplier for clinical subjects from 4.5 to 4 and laboratory-based science, engineering and technology from 2 to 1.7. The consequence of this is a reduction in funding relative to the arts and humanities. We appreciate the requirement to broaden participation but feel that the multiplier for SET subjects should not have been eroded. Clinical and

laboratory based subjects are obviously more costly than classroom based subjects, but practical experience is a key requirement of the science education process. Too often the practical component of degree courses is minimised in order to save costs to the detriment of the education received by the student.

11. It is now relatively more expensive to teach science subjects in university than it was in the past. Nearly all Chemistry Departments conduct undergraduate teaching at a loss, and recoup the shortfall through HEFCE research funding. In chemistry, more stringent requirements for chemical handling, exposure and disposal have been particularly significant. New chemical handling requirements have also meant that the standard of many university teaching laboratories is totally inadequate. The expense of refurbishment of labs is considerable.

12. A significant and immediate increase in the per-capita funding of chemistry undergraduates is required to avoid the risk of severe curtailment of chemistry provision in the UK. Recently HEFCE were asked to address this issue, but failed to restructure undergraduate funding in a way that would have given sufficient funding to cover the cost of teaching science subjects. Real-cost funding is required now.

13. Teaching undergraduate science has to be made profitable in order to encourage Vice-Chancellors to support it in the long-term. The resource provided by HEFCE is inadequate to cover the full cost of providing sciences courses and results in pressure on universities to abandon subjects such as chemistry and/or close departments. One result of which is a decrease in the number of talented and enthusiastic scientists and teachers. If this trend continues and culminates in a downward spiral then the ability of companies to recruit highly talented employees from the UK will be severely affected.

Optimal Balance Between Teaching and Research Provision in Universities

14. It is vitally important that science teaching is not separated from research since if left unchecked this will result in a further decline in the standards of teaching of SET subjects in the UK and a decline in the number of students entering the system, to the severe detriment the UK science base.

15. A SET policy framework needs to be developed which has good quality metrics and measures of assessment for the balance of research and teaching, both of which are important to the higher education SET base.

16. There is a clear interdependence between teaching and research. Research-informed teaching is instrumental in driving forward the boundaries of science and developing motivated scientists who will in turn enthuse the next generation of scientists and teachers. Learning from research projects is also an important part of the undergraduate curriculum. Teachers who continue their professional development through involvement in research, keep up to date and provide enthusiasm and relevance in their teaching and will continue to inspire young people.

In addition to further financial resource, lecturers should be allowed more time for teaching and curriculum development.

17. We suggest that consideration is given to a change in the composition of departments to include Research led departments, Research/Teaching and Teaching only departments, with a select number of world-class Research led departments, and a higher number of Research/Teaching and Teaching only departments. The important drivers are the quality of the teaching, the content of science course and that the UK continues to be a leader in biomedical research.

18. Departments that provide good teaching in addition to some research should be encouraged. These departments should be judged on the overall value of their provision, not just on research quality or the level of research income. Such departments can provide a valuable stepping-stone for talented researchers who later move on to be successful in bigger research departments. Chemistry departments such as Bath, Exeter, Salford, have typically provided this function. Sadly, of these departments, only Bath still survives.

19. Departments that can attract a significant number of students and show that they produce high quality science graduates, who are well regarded by employers and by research universities should be rewarded. However, some universities now run "diluted" science courses, which are cheaper to teach and sound more appealing to the uninformed student than straight chemistry. In our opinion, such courses (despite their branding), do not provide graduates with the skills or depth of understanding that employers demand. These courses should be targeted for consolidation as they lack value and relevance for industry.

20. The research led departments will continue to be major providers of chemistry graduates. However, their teaching tends to be geared towards high-calibre students who start university with strong academic backgrounds and good preparation.

21. Unfortunately, at a time when much is made of widening participation and improving access, it is those universities that provided genuine opportunities for students from less privileged backgrounds, who were less well prepared for university, that are losing their chemistry departments. If this continues Chemistry will become an "elite" subject, only taught in the universities that are virtually inaccessible to students that have not fully developed their academic skills at age 18.

22. Recognising teaching excellence as a key output of universities alongside research, may be profitable over the short term. The majority of academics compete for research funding *a priori*, as this is a core purpose. Teaching excellence is too often perceived as secondary to research success. By providing recognition of teaching excellence (and a career structure in line with this), academics would chose to become research leaders or teaching leaders, and help to meet the primary drivers above.

23. It should be remembered that departments within universities and/or institutes may have excellent teaching capabilities although the universities may not be 5 or 5* rated in terms of research. It is crucial to the UK science community and the UK science base as a whole that such departments receive funding appropriate to their international standing in teaching. Moreover, there must be strong discouragement to those institutions that achieve a high RAE ranking at the expense of neglect of teaching.

The Importance of Maintaining Regional Capacity in University Science and Teaching

24. This point has been addressed to some extent in item 2 above.

Regional universities play an important part in the local economy providing employment and associated benefits in addition to fulfilling their primary purpose of teaching and research.

25. It is important to retain teaching and research capacity in regional universities and to ensure that such universities are strong and well funded. A good geographic spread of institutions will act as focal points and attract able students into science. If we move to a situation where financial considerations mean that more students live at home, we must ensure that each region has a share of quality universities. The funding system should reward collaboration between universities in order to ensure that financial resources are used optimally.

26. Many students increasingly attend universities in their region and, if we are not to deny them the opportunity to study SET subjects, there must be provision for sciences throughout the country. Departments that concentrate on teaching could play a big part in encouraging young people into science. If there is not local provision they will study other subjects that are less beneficial to the UK economy. Therefore, it is an imperative that regional capacity in science teaching continues.

27. In the past, many students obtained science degrees by studying (often part-time), at Further Education colleges and polytechnics. These institutions used to offer rigorous chemistry courses, which were ratified by RSC (eg GRSC *inter alia*) or CNAA. The provision of such courses at these local colleges has essentially disappeared and universities are the only institutions that can take this place, but at present there are relatively few courses that satisfy this void.

The Extent to Which Government Should Intervene—Ensure Continuing Provision of Subjects of Strategic National or Regional Importance and the Mechanism it Should Use

28. The biomedical research base underpins future drug discovery and development. The ability to sustain and develop the UK biomedical research base will bring positive benefits to the UK economy.

In order to sustain a world-class organisation of scientific excellence AstraZeneca has an absolute requirement for creative and innovative individuals with extensive scientific knowledge. In some disease areas, we struggle to find graduates and PhDs of the required standard and in sufficient number to provide us with a choice.

29. It is important to recognise that the demands of the pharmaceutical industry for new graduates and PhDs does fluctuate. Consequently it is difficult to plan for a constantly changing recruitment scenario. Communication of our skills requirement to academia in a realistic time frame to enable courses to be developed (BSc, MSc) to address any shortages, coupled with the requirement for experienced tutors in such areas is a difficult process. The demands of our business require both innovative experts in new/emerging areas in addition to those core or mature fields eg pharmacology, enzymology. Reconciling such supply and demand for new recruits is not straightforward.

30. In particular we are experiencing a deficit in the number of individuals who are willing to work with animals, an acute lack of graduate and PhD in vivo pharmacologists, a paucity of scientists in areas of integrative science such as drug metabolism and pharmocokinetics and diminishing numbers of suitably qualified chemists, toxicologists, post-graduate pharmacists and pathologists. Furthermore we are concerned that the level of numeracy displayed by an increasing number of graduates over the last 10 years has decreased. As a consequence many graduates do not possess the level of mathematical ability required to pursue a scientific career in the pharmaceutical industry. The pharmaceutical industry routinely uses in silico prediction, cellular and pathway modelling which require extensive theoretical appreciation of biochemical mechanisms. However, bioscience students are not equipped with sufficient mathematical and physical knowledge and skills necessary to perform effectively in these key areas. This pressing weakness within the UK system must be addressed urgently by government.

31. The impoverished mathematics training in the UK is of great concern to us. This problem appears to begin early in the education process at primary and secondary levels, such that degree course candidates are less well equipped with mathematical skills on entry into university. Consequently, they graduate poorly

prepared for theoretical problem solving required by the pharmaceutical industry. This situation will be further exacerbated as the pharmaceutical industry moves towards an increasing "in silico"/predictive era. This situation is not sustainable and the ability of the pharmaceutical industry to remain competitive will be affected. The paucity of excellent mathematics teachers coupled with a lack of recognition of the value of applied mathematics in the school curriculum are key contributory factors. Mathematics is critical to scientific performance and should be a cornerstone of the education system. To rectify this position requires urgent government action in training, recruiting and rewarding appropriately good mathematicians.

32. It is our firm view that the Government should provide both the funding framework and strategic direction in order to maintain the science capability critically required for biomedical research in the UK. Government should not direct individual universities, but should create the framework and provide the infrastructure and funding such that the Vice-Chancellors, supported by Council can lead their university in pursuit of a comprehensive science and education strategy. Graduate courses curriculum should be based on national needs linked to a clear strategy and not on market forces driven by students as "customers" rather than "products" of higher education.

33. We recommend that government encourages Vice-Chancellors to continue to run science courses by making it financially viable for them to do so by improving the weighting of science subjects. Furthermore, development of criteria for what constitutes a "top-rated" university department in Chemistry, Physics, Maths should be developed. The government could also provide regional incentives and objectives for universities in certain parts of the country to provide science provision. If universities, (unlike Exeter which demonstrated 115 good chemistry applicants in 2004), are not meeting regional demands, then they could face penalties.

34. The Government should work with industry and academia to review the entire science education system in the UK and ensure that it is "fit for purpose". A holistic analysis of the many changes affecting science education from schools through to graduate and postgraduate education needs to be undertaken. This should be related to a government strategy for UK science education and biomedical research. Following this, measures need to be put in place within schools and universities (with assistance from industry) to ensure that relevant and quality teaching and research in biomedical science is maintained.

35. Specifically, greater funding should be made available for core disciplines such as chemistry, physical sciences, mathematics and the biomedical sciences. Science teaching and research must be conducted in well equipped schools and universities.

36. Focussed investment in science education at all levels, primary, secondary, graduate and post-graduate, against a clear set of objectives is required. Coupled with greater involvement of industry in curriculum design, course content and application, this should create an exceptional education system and vibrant research environment for young people and reinvigorate interest in science subjects.

37. Incentives, rewards and continuous professional development for SET teachers need to be developed. We strongly recommend that the government substantially increase the salary and other benefits of properly trained mathematics and science teachers even if this leads to a differential of teachers' salary. Improving opportunities for continuous professional development, coupled with greater pay and benefits of SET teaching are some of the most fundamental ways of promoting SET education and inspiring young people to enter into SET careers.

38. Industry, academia and Government must continue to work together to ensure that the biomedical research base in the UK is well funded, produces excellent research and superior teaching, is sustainable and an attractive place to conduct biomedical research.

We hope that this brief response is helpful to you in your aspiration to create a world-class science base in the UK.

January 2005

APPENDIX 22

Memorandum from the School of Ocean and Earth Science, University of Southampton

The School undertakes teaching and research training in geology and in all fields of marine science. An RAE 2001 Grade 5 department, we are based at the Southampton Oceanography Centre, Europe's largest centre for research and education in ocean and earth science and currently have 500 undergraduate students, 170 postgraduates with 46 academic staff and 80 research and support staff. Oceanography involves the application of the core disciplines of physics, chemistry and biology to the marine environment. Our students must learn these subjects through a balanced education involving an appropriate mix of theory, laboratory experiment and practical work and field work on land and at sea. Our graduates form a key pool of trained scientists with expertise in the marine environment ranging from our estuaries and coasts, coastal seas and fisheries, to the open ocean that is a key component of our climate system and the deep sea floor. (Two of our staff are currently with HMS Scott leading the survey of the seabed rupture caused by the Indonesian Earthquake).

While a letter from the Russell Group Vice-Chancellors to your Committee deals with many of the strategic issues, we wish to address the issue that has put the most recent and immediate financial pressure on science subjects, the change in the HEFCE subject weightings.

The implications for University science teaching of changes in the weightings given to science subjects in the teaching funding formula.

The change in HEFCE's relative weighting of laboratory subjects to classroom subjects, last year, from 2 to 1.7 has had a serious effect on our financial sustainability. Our situation is different from Chemistry and Physics departments in that we have buoyant undergraduate student numbers (relatively fewer University Departments teach marine science and there is a "Jacques Cousteau" effect in attracting recruits). Nevertheless, with the reduction in funding that the weighting change has brought, we are now struggling to make ends meet. We cannot compromise the delivery of our teaching, and would be unable to do so since our degrees are accredited by professional bodies who rightly monitor the quality and appropriateness of our programmes. For example, training students to sample and monitor pollution in estuaries involves sampling from inshore vessels and chemical analysis with expensive equipment housed in "clean" laboratories. The enforced solution therefore, has been to continue with student:staff ratios that are unsustainably high for a research-led University delivering research-led education. The upshot is a severe and unsustainable pressure on existing staff.

We believe that the decision to reduce the relative resource weighting for laboratory (Band B) subjects before implementing the review of the full costs of teaching using the TRAC methodology has significantly increased the pressures on science and engineering subjects all of which depend on laboratory training and some of which (like oceanography, ecology and geology) also depend on fieldwork.

The extent of Government intervention should include an urgent implementation of a TRAC methodology review of the true costs of teaching these subjects at sustainable levels of student numbers.

January 2005

APPENDIX 23

Memorandum from the London Metropolitan University

1. General

1.1 This response has been prepared by the Director of the Graduate School at London Metropolitan University. He is also Chair of the UK Deans of Science (UKDS) and prepared the UKDS submission to the Select Committee. The University broadly supports the evidence contained in the UKDS statement. This submission will therefore attempt not to repeat all the points expressed therein.

1.2 London Metropolitan University was formed on 1 August 2002 by the merger of London Guildhall University with the University of North London. The new university continues the missions of the two previous institutions. It intends to be much more than the sum of the two previous universities. It aims to provide education and training which will help students to achieve their potential and London to succeed as a world city. It is, and intends to continue to be, the major provider of vocational and business education for the City and north and east regions of London. The university is committed to promote personal development and social justice.

1.3 We note that the Science and Technology Committee is investigating what is being done "to safeguard an adequate level of science teaching and research across universities in England". This presupposes that there is a single clear view of the meaning of "adequate". Without wishing to be pedantic we would wish to propose that the Committee agree that an adequate level of provision would include:

- taught undergraduate and postgraduate science courses available within reasonable travelling distance for the vast majority of potential students
- all institutions offering science courses having high quality facilities and staff, with at least a proportion of the staff involved in scientific research
- within each region some variation in the type of university at which a student can study to ensure an appropriate diversity of provision.

1.4 London Metropolitan University has a well-defined research policy which recognises a full spectrum of research from the most fundamental experimental or theoretical study to near market research/consultancy, creative work and advanced pedagogic research acceptable in a national assessment exercise. If there is to be a diversity of provision in London, local students, usually the first in their families to enter higher education and who are often from some of the most deprived boroughs in the UK, have a right to receive their higher education delivered by staff who understand the frontiers of their subject and in a learning environment enriched by real research as well as "scholarship". To these ends, we have found, and will endeavour to continue to find, ways of supporting research in a wide range of strategic areas. This has partly been achieved by the creation of nine Research Institutes that are funded following competitive internal bidding to support research which is based on the study of real world, interdisciplinary solutions to the real world problems of society be they local, regional, national or international.

2. THE IMPACT OF HEFCE'S RESEARCH FUNDING FORMULAE AS APPLIED TO RESEARCH ASSESSMENT EXERCISE RATINGS, ON THE FINANCIAL VIABILITY OF UNIVERSITY SCIENCE DEPARTMENTS

2.1 We shall use the term "department" as a description of an organisational unit but it will be clear to the Committee that university staff (academic, administrative and technical) are organised in many different configurations, not necessarily in recognisable, subject-based departments.

2.2 It is obvious that the financial viability of a science department (or subject) is dependent on many factors, the most significant being income from teaching (and its recruitment of students), income from research, other major external income (eg consultancy, short courses, etc) the nature of its assets (eg the age of its equipment and laboratories). Each of these will impact on the financial position and a department's ability to balance its income against its costs. It is therefore recognised that the RAE is only one of the factors that affect the viability of a discipline. However, we offer one example where an analysis of the RAE results in 1996 strongly indicates a serious effect on the availability of one subject—Chemistry.

2.3 In 1996 the Royal Society of Chemistry published a list of courses accredited for its Graduateship or Licentiateship (Accredited Courses, The Royal Society of Chemistry, August 1996). Such accreditation required the submission of significant paperwork and explanatory text, a task not to be entered into lightly. If one takes the 56 English universities listed in this document as having a "Chemistry"[18] honours degree the following facts emerge:

> For the 21 post-1992 universities, 13 (61%) do not offer a Chemistry degree in UCAS for 2005 entry. For those not entered in UoA 18, six out of eight (75%) no longer offer Chemistry, for those who received a Grade 1 the figure is four out of six (67%), for Grade 2, two out of six (33%). The one department achieving at 3b has also stopped offering Chemistry.
>
> For the pre-1992 universities the numbers no longer offering Chemistry are[19]

Grade 2:	100% (2 out of 2)
Grade 3b:	75% (3 out of 4)
Grade 3a:	29% (2 out of 7)
Grade 4 and above:	5% (1, Exeter, out of 20; note that King's obtained 3a in 1996)

Note that two universities chose not to enter their chemists under UoA 18; one of those still offers Chemistry the other does not.

The data for the both groups of universities clearly indicate an effect of RAE grade on continuation of Chemistry. It is accepted that this may be a very complex issue with low RAE scores generating poorer recruitment even to undergraduate courses and/or the lower scores reflecting a malaise within a department (though a detailed consideration of individual departments would not necessarily bear this out).

The overall reduction in the percentage of universities offering Chemistry is quite different for the two groups of universities: for post-1992 61% (13 out of 21) no longer offer the subject, for pre-1992 the figure is 26% (nine out of 35). The median RAE score for the former was around (lower) two and was four for the latter. We consider that these data are a clear indication of a real effect of RAE results and their subsequent funding of one important science discipline.

Note that the 1996 results are chosen for this comparison as the full effects of the 2001 RAE settlements will not be seen for three or more years. We believe that an equivalent analysis of some other basic science disciplines would show a similar trend. Where this may not yet be so apparent (eg in the biological sciences) it will happen over the next 10 years unless a different approach is taken to funding for research and teaching.

2.4. A graphic illustration of the impact of the change in HEFCE's RAE funding formula is available from looking at the changes in the allocation per RAE Quality Research Unit between 1996 and 2001 in a selection of sciences given in the Table below. Of course, the changes for 3b and 3a Grades are even more extreme with no funding being available except in the small number of "emerging disciplines".

[18] "Chemistry" is used to describe an essentially single subject degree in the subject which may be titled Chemistry, Applied Chemistry or possible Chemical Sciences. It deliberately excludes eg Environmental Chemistry, Chemistry and Forensic Science, etc.

[19] Note that for the purpose of the calculations Manchester/UMIST have been combined.

Zero Sum Game—Percentage Changes in value of RAE Quality Research Unit, 2001–02 and 2003–04.

	4	5	5*
Biological Sciences	– 50	– 7	– 11
Chemistry	– 46	+ 1	+ 1
Physics	– 42	+ 7	+ 7
Earth Science	– 49	– 5	– 5
Environmental Sc	– 38	+ 17	+ 16
Pure Mathematics	– 39	+ 15	+ 14
Applied Maths	– 44	+ 3	+ 3
Stats and OR	– 49	– 5	– 4
Computer Science	– 38	– 16	+ 16

3. The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of Such a Trend.

3.1 The concentration of science research funding into the fewer universities has been at the cost of reducing the number of departments offering science (see above) and the failure to resource nationally excellent, and some internationally excellent, research in submissions rated 3a and 3b[20] where there is much work of national importance which is now unfunded. We believe this is wholly undesirable.

3.2 The concentration of research as measured by the RAE has potential effects elsewhere. There is at least some indirect evidence of this in, for example, the first tranche of the Laboratory Infrastructure Fund based on 1996 ratings not 2001: where 32 awards went to 5/5* departments, only 9 to 4 rated (all but one of which were in the most research intensive universities) and 2 to those with a 3 rating (both in research intensive universities).

4. The Implications for University Science Teaching of Changes in the Weightings Given to Science Subjects in the Teaching Funding Formula

4.1 This is almost a rhetorical question. Any change in relative weighting for a subject from 2.0 to 1.7 has to have a negative effect on that subject. It makes the retention of science more problematic for all universities and is insufficient to deliver appropriate courses in the long term.

5. The Optimal Balance Between Teaching and Research Provision in Universities, Giving Particular Consideration to the Desirability and Financial Viability of Teaching–Only Science Departments

5.1 The University is convinced that having a significant proportion of its staff active in research is critical to the vibrancy and attractiveness of its courses and its ability to attract and retain high quality staff. This is essential if, as an institution which is recognised for its leading role in widening participation, we are to give our students an appropriate educational experience.

5.2 If one takes as a proxy for research funding the ranking generated by the Times Higher Educational Supplement from the 2001 Research Assessment Exercise, the "top 10" and "bottom 10" universities show the following characteristics:

	Students from Private School	*Students from Social Class IIIM, IV, V*
Top 10	32%	14%
Bottom 10	15%	34%

All the lower 10 are post-1992 universities, the upper 10 are all pre-1992. If there is to be any science teaching in the post-1992 universities it is essential that there is adequate funding for research so that those from social classes IIIM, IV and V, already often disadvantaged before reaching university are not further disadvantaged by being taught in a higher education wasteland devoid of staff able to challenge and stimulate them and in an atmosphere lacking in research, be it basic or applied. It will follow from this that this University does not accept the concept of a teaching-only science department.

[20] 3b equates to attainable levels of excellence in more than half the research activity submitted, 3a to national excellence in over two-thirds possibly showing evidence of international excellence.

6. The Importance of Maintaining a Regional Capacity in University Science Teaching and Research

6.1 There are clear data to indicate that an increasing percentage of students wish to, or have to, study at their local university. If this is to include the opportunity to study science it will almost certainly require some consideration of regional availability. We would remind the Committee, however, that if this is to reach all potential students who might wish to study science, it will need to ensure a diversity of provision.

7. The Extent to Which the Government Should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance; and the Mechanisms it Should Use for this Purpose

7.1 We are somewhat ambivalent as to whether direct intervention in the form of support for so called strategic subjects is practical or desirable. London Metropolitan University has, through extremely careful planning and use of resources committed itself to supporting scientific research and endeavour to maintain a quality experience for our students and staff. It has also begun the development of a major new science building, total cost ca £26 million. Of this figure only £4 million is available as a capital grant and £4 million in a loan from HEFCE, the remainder has to be found by the University. We are doing this because we are utterly committed to being able to offer access to higher education science for all in London and (elsewhere) who could benefit from it—not just those who can gain entry to a research-rich university. We believe that we are the only university in the inner part of London to make such a commitment. We would be very concerned if our commitment were to receive no resources from a regional support fund while other universities who may have already cut and run are rewarded with extra resources.

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APPENDIX 24

Memorandum from the Centre for Bioscience, part of the Higher Education Academy

By way of introduction, the Centre for Bioscience promotes and supports high quality learning, teaching and assessment in UK higher education as part of The Higher Education Academy network. The aim of the Centre is to support learning and teaching at a discipline level recognising that for many staff in higher education it is at this level where networking and exchange takes place.

In principle, this response covers issues in the teaching of bioscience in higher education but specifically refers to examples within Biochemistry and Pharmacology.

(1) The previous suggestions about changes in the weightings given to science subjects in the teaching funding formula would have been disastrous for Biochemistry and Pharmacology departments. The equipment (mass spec, DNA sequencing etc) and running expenses (eg for cell culture and molecular biology) costs are similar to those for Chemistry.

(2) The mechanism by which Chemistry (and Physics) Departments [whether teaching only or not] might be supported should be by encouraging students to take these courses rather than funding the departments directly. This is a difficult problem. Students might be encouraged by bursaries as is done for PGCE, but they also need encouragement from their schools to apply to take degrees in Chemistry and Physics. Public relations and outreach activities are also important in informing school students about science, and children need to see role models. This latter has clearly happened with respect to forensics and TV programmes.

(3) With respect to teaching-only departments, the material taught needs to be up to date and cutting edge. Teaching needs to be linked with research in some sort of way, even if the university teachers themselves are not actually doing active research at the time (but have done it in the past). We have collaborated recently in the Higher Education Academy project Linking Teaching and Research which suggests ways of doing this, and which also features a number of case-studies [http://www.bioscience.heacademy.ac.uk/projects/ltr]. Engagement with research and with how research is carried out is important in the training of university science students. The QAA Benchmark statements for Bioscience and for Agriculture, Forestry, Agricultural Sciences, Food Sciences and Consumer Sciences, stress that an understanding of how research is carried out is vital, and specifically mention the value of the final-year research project, which is offered by practically all bioscience departments, as a way of achieving this.

(4) With respect to students reading for bioscience degrees (especially Biochemistry and Pharmacology) rather than Chemistry or Physics degrees, a knowledge of Chemistry (and some Physics) is vital in order to comprehend the subjects and to progress. The techniques of analysis, etc, used by biochemists and pharmacologists are principally chemical ones (see below). Our contacts in the pharmaceutical industry regard students' present knowledge as inadequate, for example. There is requirement for imaginative service teaching by Chemistry departments, and the importance of this should be recognised (financially). Chemistry departments have in the past not been good at teaching Chemistry to bioscience students in an imaginative way: teaching "Chemistry for Biologists" requires different emphases than for straight Chemistry or indeed for "Chemistry for Engineers". The provision of service courses is of course recognised by universities by a distribution of financial resource, but the total financial cake is the same: it is simply divided in different ways under the present system.

(5) It is noticeable that students leaving school take Biology courses (including Biochemistry and Pharmacology, but also Forensic Science) because they think that these are "easier" and are actually more interesting subjects than Chemistry. Students think that by taking "easier", less rigorous subjects they will more readily achieve higher grades. However, although they may indeed achieve better grades at "A" level, chemical knowledge is vital to their studies in Biochemistry and Pharmacology. Here again more information at the school level is what is needed to get them to understand this. This will not come about while Physics and some Chemistry in schools are taught in a way which students find difficult to relate to their everyday experiences, often by Biology graduates with little chemical background, or by Physics and Chemistry graduates of low ability. The PGCE scheme should go some way to correcting this, and the Royal Society of Chemistry is also helping, but there is a long way to go.

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Annex

SOME EXAMPLES OF THE USE OF CHEMICAL AND PHYSICAL TECHNIQUES IN BIOCHEMISTRY AND PHARMACOLOGY

(1) Structure-activity relationships and drug design are at the heart of Pharmacology—and are based on Chemistry.

(2) The synthesis of DNA primers for the polymerase chain reaction (PCR) is not trivial chemistry, and the separation of optical isomers is vital in modern-day pharmacology requires a wide knowledge of both Chemistry and Physics—to give just a couple of examples.

(3) The development of commercial "kits" for all sorts of analyses in both the clinical chemistry laboratory and also in molecular biology needs a high level of chemical understanding.

(4) Similarly the development of biosensors for all sorts of uses requires a good knowledge of physics and chemistry.

(5) A great deal of biochemical and pharmacological analysis these days is done by mass spectrometry which demands knowledge of both chemistry and physics.

APPENDIX 25

Memorandum from Professor Sir John Cadogan

I begin by observing that England is fortunate that the Select Committee for Science and Technology exists, thus providing a mechanism whereby the Executive can be challenged. We are much deprived in this connection in Wales. There is there no such mechanism of challenge to the Welsh Assembly Government nor do we have a Chief Scientific Adviser or a Minister for Science (indeed the word Science does not appear in the job description of any member of the WAG Cabinet). However it does appear that, for the moment, HEFCW follows the lead of HEFCE in financial allocation policy, so, if there is an improvement in England following the deliberations of the Committee, there is a possibility that Wales may follow suit.

My submission bears only on Chemistry, although in general my comments are valid for Physics and Engineering.

There are two main mechanisms whereby VCs presently receive money from the Funding Councils. The first is by way of the capitation fee and the second is via the bonuses flowing from the RAE. In future they will also receive much increased contributions to overheads form the Research Councils. Having received this money they are then free to spend it as they please. In this connection it is important to remember that if Government were to instruct HEFCE to increase the capitation fee for the hard sciences, as I argue below, VCs would still be free to commit it as they wished. So David Sainsbury's belief that Government does not believe in getting involved with an individual university's sovereign right to run its own affairs would not be threatened.

The evidence is that a major cause of the problem lies in the size of the capitation allocation per student. The latest capitation figures which I have for Wales (which I am told closely follow those for England) are as follows:

	£
Science (no differentiation between subjects)	5,617
Engineering	6,182
Maths IT	4,674
Social Sciences	3,096
Humanities	3,917
Medicine non clinical	6,827
Medicine clinical	13,380

The figure for Chemistry is simply too small. Chemistry is an expensive subject, just like Medicine. It consumes expensive chemicals, it needs expensive equipment and technical support, its library and information costs are massive in these days of near exponential growth in scientific progress world wide. Importantly it also needs lots of laboratory space, space which is much more expensive than tutorial rooms for Law, say, particularly to meet today's standards of health and safety. Many Universities have a costing procedure which exacerbates the Chemistry problem by charging for total space (which includes everything such as recreational facilities, upkeep of gardens, administration, Vice Chancellor's accommodation etc as well as the space actually occupied by particular departments. Some Universities include the costs of loans for capital projects). So Chemistry departments not only carry a large charge for the space they actually occupy they also pay a big proportion (if not the biggest) of the very large cost of the of the overheads exemplified in parenthesis above which is charged in direct ratio of the space they actually occupy. The experimental evidence is there for all to see, the axe is falling on Chemistry because this is an expensive subject. If it was not Chemistry would not be dumped.

Professor Graham Richards is Head of the Department of Chemistry of Oxford University, the biggest in the UK (no shortage of students there!) and in my view one of top three Chemistry Departments in Europe. He is on record as reporting that his Department is in deficit on the current funding model! Far from there being anything wrong with this Department everything is right, so the bean counters must have the wrong model.

I now turn to the widespread canard that the reason Chemistry departments are closing is that there are not enough student applications. This was not the case at King's, London, Queen Mary, Exeter or Swansea for example. The VC at Exeter was honest enough to say that the reason was entirely based on unit of resource and not on student numbers. The VC at Swansea said to me "I don't want any Chemistry students , they are too expensive" echoing his pro-VC who said "Law is cheap". In this connection it is particularly of concern that the CEO of HEFCE, Sir Howard Newby, said (THES 10 September 2004).

> "Mr Clarke has said that there is no extra money, and, in any case, throwing more resources to address a demand side problem will achieve little: increasing the unit of resource will not, on its own, produce a single extra chemistry student".

This is misleading, whether intentional or not, and is to seriously miss the point. The issue is that the unit of resource is too small causing VCs to close down departments where there is no shortage of students. It is more profitable to go for cheap students.

Double the unit of resource for Chemistry and VCs would soon clamour for Chemistry students (whose numbers are on the increase by the way). Of course Sir Howard and his colleagues would have to cut the resource for others and that would open the flood gates of wrath but I would expect them to be able to handle that. Lest HEFCE should be tempted to stick to the line taken by its CEO, the Secretary of State should step in now with a strong Letter of Guidance. There are many precedents for such; I was on the receiving end of several during my time at OST (Letters of Instruction would be a better description). David Sainsbury has said that he is very concerned about what is happening to Chemistry but he doesn't control this budget. What about some joined up action rather than words from Government? Some, with me, may think it impossible to reconcile the fine words in The Ten Year Investment in Science with what is happening on the ground in some of our Universities. The future of the hard sciences and engineering in this country is at the mercy of local bookkeeping sheltering under the mantle of university autonomy. National and regional needs are being ignored.

Apart from false arguments based on so called lack of demand and the sound arguments based on the central enabling role of Chemistry research, it is essential to remember that Chemistry teaching is vital to many other disciplines now that Biology Medicine and Materials are becoming molecularly based. It is no solution to let these disciplines teach their own Chemistry—just look at what has happened in the schools where so much Chemistry, Physics and Mathematics are being taught by Biologists. Take away Chemistry, the main language of so much of the NEW FRONTIER science, from a University and other disciplines also crucial to the future of the nation will suffer. This is in marked contrast to others that we can all name, some of which are not disciplines at all but are beloved of some VCs for their low cost.

And what is the message to the young in the schools when they see Chemistry being dumped—that Chemistry is important?

Rarely has there been such a serious national problem for which there is so simple a solution—instruct HEFCE to significantly increase the unit of resource for the hard sciences, particularly Chemistry.

January 2005

APPENDIX 26

Memorandum from the Institute of Mathematics and its Applications

INTRODUCTION

The Institute of Mathematics and its Applications (IMA) is the professional and learned society for qualified and practising mathematicians. Its mission is to promote mathematics in industry, business, the public sector, education and research. Founded in 1964, the Institute now has over 5,000 members. In 1990 the Institute was incorporated by Royal Charter and was subsequently granted the right to award chartered mathematician status.

The IMA welcomes the opportunity to put forward its views, concerning the actions being taken to safeguard an adequate level of mathematics teaching and research across universities in England. By logical, exact, quantitative, structural analyses, and by powerful techniques of abstraction and modelling, mathematics provides the underpinning for all other scientific study. Its role in the physical and technological sciences is well-known; there is a welcome growing awareness that it plays the same fundamental part in the life sciences, in the economic and financial sciences, and in the social and health sciences.

The mathematical sciences do not remain static in a world of change, but constantly evolve. New applications bring new challenges, and new problems, which require the development of new tools, new methods, new theories. (The successful part played by the UK mathematics community in such fundamental developments is highlighted in the recent IRM, International Review of Mathematics Research in UK—commissioned by the Engineering and Physical Sciences Research Council.)

Mathematics, with its wide-ranging applications, is nevertheless a fundamental discipline in its own right. It is a coherent subject, and one where connections are of crucial importance; in practice new ideas and understandings grow and flourish through cross-fertilisation. It is a subject where theory and practice are inextricably combined; doing mathematics is an integral part of learning mathematics.

Mathematical talent is widely dispersed; successful students of mathematics in universities and schools come from a wide range of backgrounds, and the widening access agenda poses no special problem for the subject. The completion of mathematics A-levels and degrees with a significant mathematical component are demonstrably life-enhancing; it is a challenge for us all to convey that message to potential students and their families. (The mathematical societies have collaborated in a new careers website, www.mathscareers.org.uk, but that alone is insufficient.)

The IMA has very close links with the London Mathematical Society (LMS) and has worked collaboratively on numerous occasions. The two societies make up two thirds of the Council for the Mathematical Sciences (CMS) which was established in 2001. Along with the Royal Statistical Society, the CMS provides a forum for the three mathematical societies. Taking this into consideration, and reviewing the LMS's submission (Annex 1) (published as Appendix 68), the IMA would like the Science and Technology committee to acknowledge our endorsement of the LMS submission. We strongly agree with the opinions of the LMS, to the points set by the committee. The IMA has, however, provided additional comments that we feel the committee needs to be advised of.

POINT 1—THE IMPACT OF HEFCE'S RESEARCH FUNDING FORMULAE, AS APPLIED TO RESEARCH ASSESSMENT EXERCISE RATINGS, ON THE FINANCIAL VIABILITY OF UNIVERSITY SCIENCE DEPARTMENTS

No additional comments.

POINT 2—THE DESIRABILITY OF INCREASING THE CONCENTRATION OF RESEARCH IN A SMALL NUMBER OF UNIVERSITY DEPARTMENTS, AND THE CONSEQUENCES OF SUCH A TREND

Until recently, the previous pattern of provision of mathematics courses at undergraduate and at postgraduate levels, which functioned well and had a stable existence, were made up of a number of key elements. One of these was a number of internationally-renowned departments attracting the best researchers and offering outstanding opportunities for research training. Another element was those departments whose main focus was on applications of mathematics, and these were often highly committed to teaching mathematics as a supporting study in engineering, science etc Several such departments also developed "practice-based" mathematics courses. However, in addition to modest recruitment to these courses, internal funding considerations have rendered these departments vulnerable. The continuing process of closure is contributing to the erosion of the mathematics base, the presence of which is an essential element in any attempt to deal with the identified problems with school mathematics.

POINT 3—THE IMPLICATIONS FOR UNIVERSITY SCIENCE TEACHING OF CHANGES IN THE WEIGHTINGS GIVEN TO SCIENCE SUBJECTS IN THE TEACHING FUNDING FORMULA

No additional comments.

Point 4—The Optimal Balance Between Teaching and Research Provision in Universities, Giving Particular Consideration to the Desirability and Financial Viability of Teaching-only Science Departments

Mathematics degree courses are best taught in research active departments, by staff who are actively in engaged in doing mathematics and not just talking about it; students of other disciplines benefit from being taught by staff active in mathematics as well as actively engaged in collaborative work.

Point 5—The Importance of Maintaining a Regional Capacity in University Science Teaching and Research

Every University needs a group of mathematicians developing their field, since research underpins and informs teaching in this all-pervasive subject. Small "critical masses" of specialists should come together to form a subject-focussed department. Whilst there are higher education institutions overseas, where mathematics academics are embedded in other departments, these are usually much larger departments than exist in UK universities and the mathematicians form a self-sufficient, often self-managing subset. It is often the case that those mathematicians in one such department rarely, if ever, interact with those in another department, leading to a loss of opportunity for cross-fertilisation of ideas, sharing experience and so on.

To be meaningful a "mathematical presence" in an institution must imply the existence of a coherent group of mathematically-trained academics whose specialisms cover the mathematics needs of the courses (including post-graduate courses) on offer. Their specialisms should also be appropriate for supporting the research being carried out in an institution, and thus needs may vary from one institution to another.

At the HE teaching level, there needs to be a group of people who are well qualified in mathematics and who can be called upon to deliver structured courses in mathematics to support this vital part of these other disciplines. In addition, in schools, teachers need to have time and resources for subject-specific professional development, so that their contact with the living subject can inform and enthuse their pupils. We believe that there is a great need for improved linkage between maths school teachers and their local university maths department. This will aid the provision of enrichment materials to local school maths teachers.

Inter-alia, data on salaries indicates that nationally there is an undersupply of graduates with high mathematical ability; this undersupply could be met through widened participation. It is firmly believed that action based on local provision can make the most significant contribution to recruitment from non-traditional applicant categories. "Practice-based" mathematics courses, with an appropriate focus, could well prove attractive to these groups, supporting the case for good national provision. Furthermore, in any geographical region, especially an isolated one, reasonable alternatives should be available to prospective students who cannot travel far so that they are not compelled to live away from home in the event the only local university does not accept them.

Efforts need to be made to attract applicants from non-traditional backgrounds, perhaps to "practice-based" courses, where the immediate employment possibilities will be apparent. Undergraduates working in schools can help in this but, as Smith was at pains to point out, financial incentives can also play a part.

Finally, the Smith report on mathematics 14–19, and the government's response to it, has placed emphasis on the need to provide a strong subject-specific element to programmes of CPD for mathematics teachers. University-based mathematicians clearly have an important role to play here, and since CPD will largely be delivered through local networks, this is a further argument for taking measures to stop the continuing erosion of the mathematics base through departmental closure.

Point 6—The Extent to Which the Government Should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance; and the Mechanisms it Should Use for This Purpose

This aim would be supported by the recognition that financial incentives, through fee waivers for example, could provide the necessary motivation. In the short term, universities need to maintain, and indeed increase, their contact with schools, through visits or through the Undergraduate Ambassador scheme etc In this connection, a defined role for university departments in "the sustainable local networks", as envisaged in the DfES response to the Inquiry report, could serve to raise the importance of this work in the minds of vice-chancellors.

The Government may wish to consider a public demonstration of concern for the subject. This might serve to convince pupils and teachers that the prospects of employment are good following a study of mathematics.

However, in the LMS submission, they recommend that "only through Government intervention can the aims set out in these responses can be achieved." The IMA are fully aware that this situation is very unlikely to occur, and is in favour of the Government "shadowing", as Clarke advised in the DfES Press Release, dated 1st December 2004, "Charles Clarke Seeks Protection for Courses of National Strategic Importance". A copy of this press release can be found attached (annex 2) (not printed).

Conclusion

Mathematics exists as a fundamental discipline in its own right. In addition, through the application of mathematical methods and techniques, it has developed into an essential tool for logical investigations and development in science (including the biological sciences), the social sciences (including health sciences), engineering, technology, economics, finance and business. The list of areas of applications continues to grow.

Whilst the numbers of those who contribute significantly to the advancement of the fundamental discipline will be relatively small, very many will produce greater understanding or advancement in the areas of application. Yet still more people will use mathematics as part of their everyday life and work and they need a firm grasp of the basic tools of mathematics and the strengths and weaknesses of its applications in their areas of activity. For perhaps the majority, a mathematical training helps to discipline the mind, it develops critical and logical reasoning, and it strengthens both analytical and problem-solving skills.

References

Making Mathematics Count, the report of Professor Adrian Smith's inquiry into mathematics 14–19 (2004).

DfES Press Release, 1 December 2004—"Charles Clarke Seeks Protection for Courses of National Strategic Importance." (http://www.dfes.gov.uk/pns/DisplayPN.cgi?pn_id = 2004_0209)

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APPENDIX 27

Memorandum from the Institute of Physics

The Institute of Physics is a leading international professional body and learned society, with over 37,000 members, which promotes the advancement and dissemination of a knowledge of and education in the science of physics, pure and applied.

The Institute welcomes the Committee's Inquiry, as we are extremely concerned about the future viability of a number of university physics departments in England. Recent high profile announcements about the Universities of Newcastle and Keele discontinuing their core undergraduate physics degree programmes have done little to allay fears of the Institute and its community.

As the Committee may well be aware, since the turn of the new Millennium the Institute has been active in highlighting the emergence of 'physics deserts', regions in the country where there is no university provision for undergraduate physics. It was reported in the Institute's report of 2001, the Undergraduate Physics Inquiry, that since the removal of the binary divide, the economics of university physics departments has led to over 30% of them having either merged or closed. The current figure, following the merger of Manchester, and not accounting for Newcastle and Keele, is 48 in the UK, of which 36 are in England. If this pattern continues, we could be left in a position where many potential physics students are unable to study physics at their local institutions.

We are in the process of talking to HEFCE with regards to the demand side problem of getting more students interested in physics at A-level and undergraduate degrees. But this is a long-term solution, by which time the "desert" could be encroaching into further regions of the country.

The attached annex details the key issues of concern to the Institute, in response to the main points issued in the call for evidence.

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Annex

Strategic science provision in English universities

Recommendations

The following issues need to be addressed as a matter of urgency in order to safeguard the provision of undergraduate physics in English universities:

— The HE market must take into account the needs of employers and the strategic need for more scientists and engineers. There is already capping of course entry in some subject areas, such as medicine or teacher training; it is not unreasonable that this level of control should be introduced elsewhere.

- The HEFCE funding model must be adjusted to provide appropriate funding for physics, as their teaching funding method from 2004–05 will lead to a 1% cut in funding for university physics teaching. If the Government is serious about its commitment to world-class research, more money needs to go into physics departments. Physics is a subject that links with industry on a long time scale; it is difficult to attract direct industrial funding, since companies are usually interested in a 3-5 year payback. However, the equipment and staff costs for running a physics department are as high as for any engineering department.
- A realistic solution to the problem of the missing part of FEC for charity and EU funding is required. The principle of transparency in use of funds argues against using funding from one area to subsidise work in other areas. Charity support is not equally distributed over all sciences, but is concentrated in medical areas. It is good that universities have some freedom in deciding how to use their HEFCE income for strategic developments, but it should not be the norm that QR income "earned" by research excellence for example in a physics department could be used to fund the missing FEC for charity-funded medical research. The logical consequence of transparency is that if the Government wants to get the benefit of charity and EU funding, it should either work with those bodies to get them to pay the full FEC, or it should decide to provide explicit funds to top-up charity and EU grants.
- Schoolchildren must be provided with accurate careers advice at a sufficiently early age to allow them to make informed choices. Currently, careers advice tends to be reactive. For example, advisors will respond to a pupil's request on, say, how to become a doctor but they do not provide information on the relative career opportunities of different subject choices. If we are serious about persuading more students into science, we have to tell them explicitly that their career prospects will be better if they do. The Connexions initiative is useful in many ways, but does not provide any subject-specific information.
- We need more specialist teachers of physics. With only around 2,500 UK graduates in physics and astronomy each year, the shortage cannot be rectified from that source in the short to medium term. One small change that could help a little would be to allow physicists to teach mathematics as a second subject. However, we are faced with the situation that much of the teaching of physics will be done by people who do not have a background in the subject. There should be a subject-based, professional development obligation on all teachers of science operating outside their level of specialisation.
- The physics curriculum needs to be reviewed to ensure it is attractive and exciting, reflecting modern applications and advances. The Institute has developed an A-level, Advancing Physics, with this aim in mind (there are others). Although it is the second most popular A-level, many non-physicists find it too demanding to teach, due to the subject knowledge it requires.
- The solutions to the problems facing physics departments are of a medium- to long-term nature. However, if the situation worsens, then there may be a need for the Government to intervene with a short-term fix, by providing funds (possibly with strings attached to encourage change) to prevent several more struggling physics departments from closing.

The Impact of HEFCE's Research Funding Formulae, as Applied to Research Assessment Exercise Ratings, on the Financial Viability of University Science Departments

The Institute is extremely concerned about the level of funding for 4-rated physics departments in the RAE 2001, of which there are a significant number.

The Institute notes that HEFCE has recently announced that they will increase the average unit of funding by approximately 4% for 5 and 5* rated departments, and maintain funding in real terms for 4-rated departments. This is pleasing, as the Institute understands that the £118 million allocated by HEFCE through their present formula for 4-rated departments was not initially linked to inflation. However, 4-rated physics departments in England received only a little more than half of the QR funding they had anticipated from HEFCE for 2003–04, with the threat of even less in subsequent years. As a consequence, the Institute is concerned about their future viability and the marginalising impact this would have on physics if 4-rated departments were unable to continue to teach and produce distinct physics courses. Despite HEFCE's announcement, additional funds are needed for 4-rated departments; otherwise, by the time RAE 2008 is underway, it may be too late to prevent a number of 4-rated physics departments from closing, or at least cutting back severely on their research activity. The position of 3a-rated physics departments of which there are a few, is even more precarious.

HEFCE stated in its review of research funding consultation in 2003 that they propose to review the basis for subject weightings and to calculate new weightings to be used after the next RAE. This is something that the Institute would welcome, if it leads to an increase in the subject weighting for physics. The QR allocation per active staff member in physics in 2004–05 is: Grade 4, £10,376; 5, £28,981; and 5*, £34,886. Interestingly the QR allocations for physics are only marginally above the averages for all UoAs of £9,980, £26,346, £31,498, respectively.

The disparity in QR funds available to 4-rated departments relative to 5 and 5* means that 4-rated departments have been scrutinised closely by university managements with a view to either closure or investment to improve their grade. This was certainly the case with the University of Newcastle, which was constantly reminded of the strong correlation between their RAE grade and the size of its physics department. The average number of staff submitted by physics departments achieving a 5* grade in 2001 was 104, grade 5, 39 and grade 4, 19. We understand that it was then argued that with a Newcastle physics department submission of 14.5 staff achieving a 4B grade (which fell further following restructuring), the university could not afford the investment in physics staff and facilities required to achieve a 5 or 5* grade.

Physics is a research- and capital-intensive subject that is dependent upon up-to-date laboratories and new pieces of equipment, and has suffered from under-investment and a lack of sufficient infrastructure funding for some considerable time. This is demonstrated by the fact that, despite their success in the RAE 2001, even 5-rated departments (especially the smaller ones) are experiencing difficulties and are facing tough decisions with regards to the number of permanent staff they can retain. One of the reasons for this is that physics members of staff in 5-rated departments are being funded from the QR associated with their RAE rating at much lower levels than chemists, and up until recently biologists, in departments with grade 5 ratings. This state of affairs is a direct consequence of the closure of the smaller and, in some cases, weaker departments over the last decade or so. Other subjects have much longer "tails" in their distribution of RAE grades. Paradoxically, the presence of a large number of weaker departments actually increases the funds given to the best, because it increases the size of the overall pot for the subject. Equivalently, even the strong physics departments are suffering from the closure of the weaker ones.

The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of Such a Trend

There is no doubt that HEFCE believes that there are too many research-based physics departments. However, the much quoted "autonomy" of universities (the Government itself has created the environment that influences the decision making of many vice-chancellors) and the absence of any clear strategy in this area have meant that closures have occurred haphazardly, often resulting in regional deserts. It follows that there should be rational planning, identifying the number and location of the research departments. Undoubtedly, this will be a painful exercise but it should be done as openly and as fairly as possible.

The Implications for University Science Teaching of Changes in the Weightings given to Science Subjects in the Teaching Funding Formula

Recent changes in the weightings given to laboratory based science subjects in HEFCE's teaching funding formula have been disastrous; the funding provided was already seriously deficient, as a consequence of the overall support per science student having steadily decreased in real terms over many years.

Having continually argued for HEFCE to monitor and review the price groups allocated to the laboratory sciences, in order to maintain the existing high standards in undergraduate physics, the Institute believes that physics, as well as many other science and engineering disciplines, will suffer further under the new weightings. As of 2004–05, the weighting of 1.7 for price band B, which includes physics, will lead to a reduction in real terms of 1% in the teaching resource (confirmed in a response to the Institute from HEFCE, February 2004).

The rationale behind the new weightings is not clear. HEFCE initially recommended a split of price band B, to give five bands. The Institute understands that a decision was made not to split price band B, because the high unit costs of some laboratory-based sciences, including physics, were perceived to be a result of under recruitment. But this is far from obvious because:

- physics undergraduate numbers have not fallen (acceptances to undergraduate physics and astronomy were 3,102 in 1994, and 3,068 in 2003 (UCAS));
- departments have closed and large departments have become even larger leading to efficiency of costing; and
- deficit departments have severe limits on spending and so their spending will possibly have been lower than one might expect.

At a time when the Government is trying to encourage more students into science and when several physics departments are struggling to survive, it is hard to see why there should be an incentive for universities to recruit yet more students into arts and humanities degrees. The potential impact of top-up fees appears not to have been taken into account—the broadly "flat" increase from fees could mean that HEFCE will need steeper bandings.

Physics is by its nature a resource-intensive subject to teach, in terms of both teaching staff and laboratory provision. As industry's demands for graduates with a high degree of technical knowledge and expertise increases, it is incumbent upon universities to have modern facilities and equipment. The cost of providing such equipment has risen at a faster rate than inflation. Universities are under pressure for resources for undergraduate teaching, and in the Institute's experience over the past few years, the majority of physics departments have been operating at a deficit.

The Optimal Balance between Teaching and Research Provision in Universities, Giving Particular Consideration to the Desirability and Financial Viability of Teaching-only Science Departments

The Government's HE white paper hinted of the establishment of a two-tier university system, where research would be concentrated in a few centres of excellence. This would undoubtedly boost research effort, but at the expense of separating more strongly than at present those universities with a strong research base from others that might become teaching only universities. Any such move would have to be planned in an organised manner, and it needs to be understood that this approach may not provide the undergraduates that the country so clearly needs.

However, assuming that the Government decides to limit the number of research departments, there could be two models for producing the graduates. One would be simply to increase the intake for the remaining universities. This approach has several problems. It may not be possible to accommodate the students in laboratories and classrooms without substantial new build. In addition, it does not address the problem of regional deserts. The alternative is to create a new class of physics departments that do not carry out research competitive in the RAE but that can teach physics at the undergraduate level. The problem then would be to find a way of sustaining such departments. One way would be to make them teaching only, possible as part of a larger, multidisciplinary unit. Another would be to give them a role working with regional or national industry, with the support of the RDAs. In either case, these departments could offer three year Bachelors degrees in their own right, while acting as feeders for the students who wished to complete 4-year MPhys/MSci degrees at the research departments. Such students could spend the final two years of their programmes at the research departments. But, this model (and any other model that requires teaching-led departments) will have to be adequately sustained.

The US is an example of a successful mixture of types of institutions. There are several highly esteemed undergraduate colleges (eg Dartmouth, Swarthmore) where faculty may conduct some research in the summer months, but the emphasis is on teaching. Most universities do both teaching and research, with a range of weightings. The US example leads us to think that there is no one "optimum" and it is preferable to let each institution determine its own balance. The current funding system in England doesn't seem to allow such a choice, with departments dependent on research income for survival.

The importance of maintaining a regional capacity in university science teaching and research

Large areas of the population and industry now have no convenient access to a local university physics department offering teaching or research. As the proportion of students living at home increases (a THES survey undertaken in April 2004, revealed that a quarter of students live at home while studying, a higher proportion than estimated for previous years), and as industry becomes more dependent upon high-technology knowledge, these regions will suffer from a lack of proximity to university physics. The Government, rightly, is keen on increasing the number of women, ethnic minorities, lower social classes in science and engineering. Among these groups there is a greater likelihood of students wanting to live at home. But, if they live in the East Anglia region, where will they go to study physics? There is no undergraduate provision for physics at the Universities of East Anglia or Essex, and the University of Cambridge would not be a realistic proposition for many.

As another example, in the North East, there are substantial distinctions between the physics intake to the Universities of Newcastle and Durham, for example, in terms of geographical and social backgrounds. Newcastle has more locally-based students, many of whom perceive that they would feel socially less comfortable in Durham. Through a foundation year, Newcastle's access has also been substantially broadened by admitting students whose background has contributed to entry grades that would prohibit direct entry to the first year. The withdrawal of Newcastle physics programmes will lead to a net loss of physics students in the region. It will send out a negative message to schools regarding physics and serve to degrade further the already weak science base in most regional schools.

The Extent to Which the Government Should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance; and the Mechanisms it Should Use for This Purpose

To state the problem, physics departments are closing principally as a result of an inability to attract sufficient students to make ends meet, exacerbated by cuts in research funding in some cases. There are two reasons why some departments have found it difficult to attract enough students. One is that, although the number of physics entrants has not fallen dramatically in recent years, there has been no increase to match that of the total number of students in all subjects. The *relative* number of physics entrants, therefore, has fallen by around 40% in the last decade; the expansion in HE has largely been in subjects that do not require a specific skill or knowledge base on entry (eg psychology, drama, media studies etc). The second reason is that, without doubt, the HEFCE unit of teaching resource for physics is too low, as previously discussed. As a result, to maintain the level of their funding, the more popular departments have increased their student intake, sometimes by huge amounts, squeezing the smaller units, in many cases causing them to close.

One of the worst aspects of the closures is that they are occurring just at the time when analysts are predicting that the country will need an increase in science, particularly physical science, graduates. There is a need to stimulate a higher demand for physics degrees. Note that there is no shortage of demand from employers; indeed, that is part of the problem because so few of the graduates enter the teaching profession. In 2003, only 8% of the PGCE entrants covering science had physics degrees. But the HE market is not driven by employers, it is driven by student choice and there is no evidence to suggest that the choice is being made rationally. Somehow, careers advice to school students has to be made much more pro-active. The Institute would never want to prevent students from taking, say, history or media studies degrees, but it must be made clear to them that, by doing so, they will be severely hampering their career opportunities, both in terms of flexibility and pay. It would help enormously if the Government were to track graduates of various disciplines, possible via devices such as the census, to provide valuable, independent data on career prospects.

A recent report commissioned by the Institute and the Royal Society of Chemistry, *The economic benefits of higher education qualifications*, reported that the return of public investment for physics and chemistry graduates, and their earning potential was significantly greater than for a number of other, more popular subjects, and that only medics and lawyers are financially better off. The monetary value[21] of completing a degree level qualification in today's money terms stands at approximately £129,000. At the higher end of the scale, physics and chemistry graduates achieve additional lifetime earnings benefit (in today's money terms) of between £185,000 and £190,000. In addition, it currently costs the state approximately £21,000 to provide education to degree level for the average graduate. However, the value to the state in terms of tax and national insurance associated with earnings following qualification for an average degree is approximately £93,000—for physics and chemistry, this figure is between £130,000–£135,000. Despite the fact that they are more expensive to teach (between £4,000–£6,000), the net income to the Exchequer is still much higher than for arts or humanities degrees. This message needs to be spread far and wide.

The shortage of physics teachers is undoubtedly already a matter of great concern and the situation will only get worse in the short-term. The situation certainly won't be helped by the recent announcement that trainee teachers will be charged up to £3,000 a year in variable top-up fees from 2006, which will effectively reduce the £7,000 bursaries being offered to graduates who become teachers in physics, mathematics, etc The Government should consider increasing the bursaries on offer to take account of the extra cost of training to become a teacher once variable fees are introduced, or give teachers help with their (tuition fee) loan repayments while they remain in teaching, so that the bursaries on offer remain as effective as possible in recruiting teachers into subjects, such as physics, that urgently need them.

Anyway, the number of trained physicists entering teaching will not be large enough to repair the damage for the foreseeable future. We have to live with the fact that the vast majority of people teaching physics at GCSE levels and below do not have physics degrees and need subject support.

The Government has recently introduced a number of initiatives to try to improve the situation with regard to the teaching of physics and the take up of university places in science and engineering. In the, *Science & innovation investment framework 2004–2014*, plans were unveiled for an increase to the aforementioned teacher training bursaries and golden hellos and, encouragingly, an intention to instigate a series of surveys to find out exactly who is teaching science in our schools. As the Smith Report, *Making Mathematics Count*, pointed out in the context of mathematics, this is an absolutely essential first step. One needs to know the full extent of the problem before one can solve it. Also on the teacher education front, the Teacher Training Agency, in collaboration with the Gatsby Foundation, has financed a scheme designed to encourage more teachers into certain shortage areas, including physics, mathematics and chemistry, by offering subject support to those who have the potential to teach but who do not have sufficient subject knowledge. In the physics scheme, the Institute is also involved, offering tutorial support and mentoring to the participants. In addition, there are various other schemes to help them, not least the Institute's own SPT Project, and the National Network of Science Learning Centres has put the infrastructure in place. What is now required is either a very effective carrot or an equally effective stick to ensure that the people most in need of this support actually take advantage of it. It is our experience, and that of comparable organisations in cognate disciplines, that the teachers most in need of help are the slowest coming forward. There is also a profound reluctance on behalf of head teachers to release staff for subject-specific INSET. Further Government intervention is absolutely necessary if we are to make a significant difference to the skills, knowledge and confidence of teachers of physics.

Finally, it is worth noting that, despite the recent decline, physics is still the third most popular A-level for boys. However, only one in five A-level students are female. Were we able to increase the number of female applicants to physics degrees, we would solve most of our problems immediately. Not least, it is known that women are more likely than men to become schoolteachers. On the other hand, an awful lot of

[21] The monetary value of a degree is defined as the difference in the present value of the after tax employment adjusted lifetime earnings of representative degree level holders compared to representative individuals in possession of two or more A-Levels. The monetary value incorporates earnings and employment effects in a five-year age band across the entire working life of graduates (as opposed to an overall snapshot). The monetary estimate is also discounted to provide an estimate of the value of a degree in today's money terms.

people have tried to solve this problem; what is required is a hard-headed look at the problem based on solid research. The Institute is going some way along the road in this area but our limited resources place restrictions on the impact we can make.

The Institute of Physics is a leading international professional body and learned society, with over 37,000 members, which promotes the advancement and dissemination of a knowledge of and education in the science of physics, pure and applied.

January 2005

APPENDIX 28

Memorandum from the 1994 Group

The 1994 Group comprises the Vice-Chancellors and Principals of the Universities of Bath, Birkbeck College London, Durham, East Anglia, Essex, Exeter, Goldsmith's College London, Lancaster, London School of Economics & Political Science, Reading, Royal Holloway College London, St Andrews, Surrey, Sussex, Warwick and York.

1. This is the response to the invitation to submit evidence to the Inquiry into Strategic Science Provision in English Universities. This is an important subject, which is indeed of relevance across the UK, and the 1994 Group welcomes this opportunity to contribute. Throughout this response we have used the phrase "science" to refer to the specific subjects referred to by the Committee.

2. At the outset, we feel that the Inquiry should recognise that the matters it is seeking to review are being shaped by four primary considerations operating at the national or international level and as set out below, which have come together to create an environment where some further concentration of provision in science is both inevitable and indeed desirable.

2.1 Dynamic Changes to the Scale of Research Capability: In its Science and Innovation Investment Framework 2004–2014, Government itself has recognised that research has become intensely competitive at the global level. To be competitive, research needs to be of the highest quality and at the cutting-edge. This in turn requires increasingly sophisticated and diverse staff expertise and facilities, and often also the constructive interaction of cognate disciplines, each capable of performing at the highest level. Success in the face of such international competition requires therefore a proper depth of research expertise and capability, particularly in science subjects. For the UK, these considerations require a continued concentration of research resources.

2.2 The Relationship Between Research and Teaching: Research concentration also has relevance for teaching provision and for higher-level training in science. Postgraduate research students have always been a very important component of a dynamic research environment in science and it has long been recognised that their successful training can only be assured where vibrant communities of such students can be supported and sustained in sufficient numbers. At the undergraduate level, high quality and up to date teaching also requires access to a range of staff expertise and of facilities which can only be sustained by a successful research community. There is therefore an essential and close link between the sustainability of high quality teaching and the successful prosecution of research activity.

2.3 Student Demand: In this symbiotic relationship between teaching and research, there is of course an equivalent reliance upon an adequate supply of students. It is almost impossible to sustain a successful research department that does not also include a healthy range and scale of teaching. However, the demand for teaching in science has shown considerable adverse change over a number of years, with a marked reduction in the proportion of students wishing to pursue undergraduate courses in science. This is particularly so for the State sector, which in recent years has seen a substantial decline in the number of students leaving secondary education with what might be regarded as the minimum of qualification of two science A levels. To counter this trend, universities and the professional bodies have been working very hard to generate interest and aspiration. But the dynamics are such that student demand in these areas is ultimately an issue of national significance which will have to be addressed at the Secondary Education level, and any significant improvements will necessarily have long lead times. In this regard, we look forward to the Government's response to the Tomlinson Report as an opportunity to begin to address these matters substantively.

2.4 Strategic Planning and Competition: It is now clear that universities in the United Kingdom are working in competition at both home and abroad. As autonomous bodies, this has required them to think carefully about their strategies, about their priorities and about their strengths and weaknesses. The need to maximise performance and to sustain provision in areas of strength or strategic priority necessarily involves also a careful assessment of the resources that can be directed elsewhere, and in particular the extent to which chronically under-performing or lower-priority activities can or should be sustained.

3. Having set out what we consider to be the primary drivers in the matters under review, we should like to make the following comments about the policy implications for science provision:

3.1 Rationalisation and Collaboration: The fall in student demand and the requirements of research competitiveness and concentration together require a policy environment which manages rather than obstructs necessary change. In circumstances where a university considers that its provision in a science subject is weak and no longer properly sustainable or part of its strategic priorities, it should be able to work with HEFCE and with other universities to transfer that funded provision more appropriately elsewhere, while being enabled to retain equivalent resources to reapply to its strategic strengths and priorities. Through such an arrangement, the consequences of large-scale processes can be properly mediated and directed to the benefit of the HE system and to the country as a whole. Only in a very limited number of highly specialised and small-scale subject areas might any greater intervention be required to protect the national interest.

3.2 National Levels of Provision: Although of course there are wider societal benefits from ensuring that a good proportion of our HE students graduating from our Universities are educated in scientific subjects, there can be no absolute or "right" figure for the number of students in science subjects that the country needs to meet its skilled manpower requirements. This is in part because some of those manpower requirements will continue to be met by the import of skilled staff from abroad. Although some evidence may be beginning to emerge about skill shortages in some particular subject areas, this of course may be as much the product of the number of graduating students choosing to enter postgraduate or postdoctoral training than a reflection of the absolute members in science education and training. For it will of course be recognised that many graduates in science, and not least in Chemistry, presently choose to go straight into well-remunerated careers outwith science, and career salaries within science show little sign of the upward movement that would reflect any general skill shortage. Furthermore, as set out in paragraph 2.3 above, the right way to address concerns about the number of students coming into science is not by encouraging the provision of unfilled university places but to encourage more students to take relevant subjects at A level or equivalent, by improving the quality of mathematics teaching in schools and by making experimental science in schools more exciting.

3.3 Patterns of Access: The factors influencing science provision are national or international in scale. Nevertheless, it does need to be recognised that the overall pattern nationally of that provision will need to be monitored and kept under review. We believe that these considerations can be properly met within the policy processes identified in paragraph 3.1 above and indeed would not envisage that the outcome of such processes would denude any one region of access to one or more sources of high quality expertise and training in the relevant sciences. However, equally we see no merit whatsoever in seeking to preserve uncompetitive and lower quality provision merely to enable its continued availability at the sub-regional or indeed regional level.

3.4 Resource Allocation: The Committee has raised in its call for evidence questions concerning the possible impact of various aspects of resource allocation. It is our view that the issues being addressed by the Committee go far beyond the product of any particular aspects of HEFCE's funding arrangements and are therefore generally unsusceptible to tactical readjustment of those arrangements. Nevertheless, some adjustments to resource allocation might help to smooth and mediate the outcomes of the processes we have described. For example, we feel there would be value in reviewing the resources associated with the award of a grade 4 in the last RAE. Following that RAE, the first priority was to provide resources to departments rated 5* and 5 to enable them to continue to compete internationally. However, the overall level of resources available was such that it proved necessary consequently to reduce the resources attributable to grade 4, and that has led to a very steep funding gradient indeed between grades 4 and 5. Yet grade 4 is intended to represent research work of national importance. The new RAE grading system which will apply in RAE 2008 may come to address this issue if it is properly resourced, but in the meantime a review of the resourcing of grade 4, without detriment to grade 5 and 5* through the allocation of additional resources as necessary, would be of value.

4. In summary, we would contend that the principal issues raised by this Inquiry reflect much wider and longer-term considerations of research competitiveness and student demand. These are primarily matters of national relevance and significance, in some cases mainly requiring attention out with Higher Education. In response to these changes, processes and policies need to be reinforced in order to permit universities working together and in collaboration with HEFCE to shape science provision constructively and efficiently. The pattern of provision nationally might need to be kept under review, but this cannot justify or sustain the preservation of uncompetitive and lower quality provision at the sub-regional or indeed regional level.

January 2005

APPENDIX 29

Memorandum from the Institute of Biology

1. The Institute of Biology (IOB) is the independent and charitable body charged by Royal Charter to further the study and application of the UK's biology and allied biosciences. It has 14,000 members and over 45 specialist learned Affiliated Societies (see www.iob.org). The IOB is a member society of the Biosciences

Federation. The IOB contributed to, and fully supports the Biosciences Federation's response to this inquiry. However, we would like some additional relevant points to be considered regarding the provision of applied sciences in HE institutions.

2. HEFCE research funding formulae rate research primarily on the basis of the individual's grant income, and the impact factor of the journals in which they are published. Research grant income is determined by the policy of the funding bodies and their wealth. Applied areas of biology such as agriculture, horticulture and ecology are often expensive both in terms of research and teaching costs and so are vulnerable to closure for strategic reasons. Additionally, applied biology research tends to be published in specialist journals that have a low impact factor. If the viability of science departments is based on publication impact factors and grant incomes, funding will be determined by factors unrelated to the quality of the research.

3. In applied "whole organism" and field-based disciplines such as agriculture, environmental science and forestry, student numbers have been declining for the past decade. Add to this the cost of animal husbandry and expensive machinery. This has reduced the viability of such courses and has led to closures of entire departments in these disciplines. The capacity of the UK to turn basic scientific discoveries into practical and environmentally sustainable processes, and to fulfil its commitment towards climate change is in jeopardy. These disciplines must be strengthened by subsidising student fees and/or selective funding of universities.

4. There is a very real danger that many of the applied biosciences will only exist within predominantly single discipline institutions. Students of such institutions will not be exposed to the full academic rigours of the basic biological, chemical, geological, mathematical and physical sciences allied to studies of agricultural sciences and economics. While these graduates may be competent in rural production and land management we are concerned that they will be incapable of identifying and capitalising on nascent innovations. This poses the risk that the UK will fail to identify and exploit opportunities for sustainable rural development and conservation of biodiversity at considerable financial and social cost to our population. The UK also risks failing to foresee and guard against the increasing likelihood of biological and agricultural disasters, for example the effects of climate change on crop production, the spread of diseases such as FMDV, and the potential risks posed by use of GM organisms.

5. The Institute, in line with Government policy on openness and Science and Society Select Committee recommendations, are pleased for this response to be publicly available and, with permission, will be placing a version on www.iob.org. Should the House of Commons Science and Technology Committee have any queries regarding this response then they should in the first instance address them to Dr Caroline Wallace, Science Policy Advisor, Institute of Biology, 20-22 Queensberry Place, London, SW7 2DZ, email: c.wallace@iob.org

January 2005

APPENDIX 30

Memorandum from British Nuclear Fuels Limited (BNFL)

Background and Introduction

1. British Nuclear Fuels Ltd (BNFL) welcomes the Committee's inquiry into the steps that need to be taken to safeguard an adequate level of science teaching and research across universities in England. We rely heavily on a strong university science and engineering base for the recruitment of graduates and research staff. This is also vital in the development of new knowledge and technologies to deliver competitive products and services to our customers, both within the UK and internationally. We acknowledge that the Government's 10 Year Science and Innovation Framework signals a substantial funding commitment to provide the UK with a world class science infrastructure. However, we were surprised that the Framework made little reference to the sustainability of science and engineering departments in the UK's universities, particularly as a key policy is to increase the number of graduates to 50% of all school leavers. This target is fundamental to the "upskilling" of the UK's workforce at a faster rate than the developing countries, but the mechanisms to achieve it need to be given greater transparency in the Higher Education strategy.

2. BNFL does not have a detailed knowledge of the funding complexities of university funding. However, we do have strong links with a number of universities. Nuclear sciences were, perhaps, an early example of what has now become a broader trend, with a progressive reduction in the science teaching and research capability at the UK's universities. The privatisation of the United Kingdom Atomic Energy Authority and the Central Electricity Generating Board, together with the cancellation of the Fast Breeder programme, prompted the closure of most of the nuclear degree courses and university nuclear research programmes. In the late 1990's we responded by establishing our University Research Alliances (URAs) at Leeds University, Sheffield University and the University of Manchester, to rebuild a nuclear research capability. More recently we have contributed to the creation of the Dalton Nuclear Institute at the University of Manchester, in partnership with the North West Development Agency and the university. The objective is to rebuild critically important nuclear research skills identified by industry and Government.

3. BNFL, together with the Dalton Institute and the URAs are the custodians of what now remains of the UK's nuclear skill base. However, the ageing profile within the nuclear industry, and the progressive loss of commissioning experience with Light Water Reactors threatens to undermine the Government's strategy of "Keeping the Nuclear Option Open".

4. The UK needs to identify similar strategic threats across the science and technology base. The problems of ever fewer students enrolling onto science degree courses and increasing numbers of university science departments closing must be tackled by new Government initiatives.

Detailed Responses to the Committee's Questions

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments

5. Our main concern is that the Research Assessment Exercise (RAE) fails to recognise research that is of value to industry. University departments are being financially penalised for concentrating their efforts on successfully collaborating with industry and are increasingly threatened with closure. Moreover, industrial staff who transfer to academia do not have their credentials recognised because they do not have a track record of publications in the scientific journals.

6. The RAE of 2001 introduced a greater degree of selectivity in the allocation of funding, focusing it at a smaller number of higher graded departments. We support the strategy of creating a limited number of "centres of excellence" that will be able to compete globally, attracting the very best researchers and delivering research of the highest standards.

7. However, this has, effectively, created a "winner takes all" situation.

8. It had long been accepted that research budgets effectively subsidise the cost of teaching due to the inadequate allowance in the HEFCE formula for the higher costs of teaching science subjects. The loss or reduction of a research budget across many science departments has been accommodated by universities running these departments at a loss, effectively subsidising them from other lower cost facilities. This is unlikely to be sustained for much longer. The expectation of even greater selectivity in RAE2008 is inevitably forcing Vice Chancellors to focus funding on those departments that can compete successfully in RAE2008 and closing those departments that make a loss.

The RAE is focussed on creating "centres of excellence", but industry's needs are being ignored. The departments on which industry depends are threatened with closure due to the loss of RAE research income.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

9. It is necessary to create a limited number of national "prestige" universities to act as centres of excellence and provide the means of competing with the likes of Harvard and MIT. These would carry out the "cutting edge" research and act as flagships for the UK. However, this should not be at the expense of losing the breadth of teaching and research that is currently needed by industry in the UK. Many departments provide a wide range of "niche" expertise at both national and local level. It is unrealistic to expect this to be provided from the envisaged few centres of excellence. The UK needs to retain a good spectrum of science departments, both to compete at the international level and to provide technical support to local companies. Without this the "premier league" of centres of excellence will soon be operating in a vacuum with no "feeder leagues".

10. Competition and striving for high performance must be encouraged at all levels. But it is unrealistic to expect smaller or more specialised departments providing a niche expertise to a high-tech company, or technical support to local industry, to compete with these centres of excellence for research funding.

11. The UK needs to define what level of teaching and research support is required across this broad spectrum of science departments and allocate funding across this spectrum appropriately. The use of the RAE to single-mindedly create the centres of excellence, at the expense of all else, will ultimately undermine the science base in the UK.

Centres of excellence are essential if the UK is to successfully compete in the global R&D market, but a broader spectrum of facilities must be supported to maintain a viable science base.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

12. HEFCE's formula and factors that derive the funding allocation for each department do not properly reflect the additional present cost of teaching science and technology subjects. This is particularly true in respect of Health and Safety requirements and the cost of modern experimental facilities.

13. HEFCE's factor of 1.6 to compensate for high cost laboratory and clinical subjects needs to be re-evaluated against the real costs. We believe this will show significant under-funding. The financial stringency imposed from this under-funding may also be reducing the attractiveness of the facilities and curriculum to

potential students. This is a possible contributory factor in the falling number of science graduates. We also believe that the introduction of variable fees will exacerbate this trend. Science departments will attempt to pass on the higher cost of teaching science subjects and so further discourage take-up.

14. HEFCE provides additional funding support for a wide range of supplementary factors, such as old and historic buildings, the size of the establishment, London weighting and specialist institutions. It seems reasonable to question the weighting of such factors against the need for additional support for subjects of national strategic importance.

15. The under-funding of science teaching has traditionally been overcome through subsidy from research income. However, the increasing selectivity of the RAE is rapidly reducing this option for the majority of science departments and they increasingly facing closure. We are moving to a position where industry, the RDAs and the Research Councils are combining to overcome the failings of the HEFCE funding formula. The Dalton Nuclear Institute has recently received a grant from the EPSRC with industry support that will provide funding for a range of nuclear MSc modules. This will put nuclear teaching at this level back on the map in the UK.

HEFCE is failing both to fund the full cost of teaching science subjects and to recognise the strategic importance of these subjects to the prosperity of the UK.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments

16. We believe that teaching at the highest academic level can flourish in a vibrant research environment. Much of the early stages of the honours and foundation degree curricula are fairly generic. The value is added by quality of the teaching. The need to base the funding criteria on the interaction between teaching and research is therefore limited, being essential at the highest levels of academic achievement and reducing down the scale. We see no fundamental reason to always link research and teaching. We believe a funding model could be constructed to make teaching only departments financially viable.

Research only contributes to the quality of teaching at the highest academic levels. Teaching must be properly funded on its own merits.

The importance of maintaining a regional capacity in university science teaching and research

17. Teaching at the foundation degree level is probably best delivered at the regional level. Such universities would provide a valuable source of technical support to local industry. Teaching at honours degree level is probably best considered at the national level in terms of the national requirement for numbers of places and the range of subjects on offer.

18. However, each region also needs one or two larger universities of the Russell type to attract and retain the medium to larger sized companies. This is reinforced by the view of the RDAs, who argue that students tend to seek employment close to where they graduate. This is a particular problem for rural economies where school leavers select a university away from their home and rarely return, making it difficult for the region to attract and retain "high-tech" companies.

19. The more applied the research, the greater the working level involvement and, therefore, the greater the need for local or regional research facilities.

Each region needs science research and teaching facilities to attract and support locally based companies which then provide employment for indigenous students.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose

20. The autonomy of the UK's universities is a cherished cornerstone of their constitution. However, we believe this derives from an era when the link between knowledge and wealth creation was more diffuse. Universities now occupy a crucial position in the prosperity of the nation. The UK is increasingly dependent on technological developments for our health, security and lifestyle. The university science base from which these evolve must be sustained. If the Government relies on market mechanisms to eventually bring home the importance of scientists to our economy, the protracted timescales for this to occur may result in irreparable damage.

21. A list of strategic skills that are essential to the health, security and prosperity of the nation and an estimate of the minimum viable size of the skill base is urgently needed. If it is not defined it can not be managed. The well-being of this expertise and skill base can then be monitored and managed in a proactive manner, with single point accountability for delivery.

22. The alternative is to persist with what the UK does now—attempting a recovery action when the symptom of demise becomes all too apparent. We believe the UK's nuclear expertise was historically a "crown jewel" in its technology strengths and yet its gradual decline was only recognised when, as the industry regulator, following an OECD publication, reported "if the nuclear skills was a hospital patient, it would be in intensive care".

23. The on-going reduction in the number and quality of science graduates leaving our universities is the greatest threat to the UK's future competitiveness. Post-graduates are an essential lifeline in the links between university research, business R&D departments and the process of developing future technologies.

24. The dual funding of university research must be better integrated, with HEFCE and the Research Councils developing common goals and performance targets. Delivery against these goals and targets should be monitored and measured.

25. A larger proportion of the increased science budget should be dedicated to the funding of key skills with a commitment, over extended timescales, to encourage long term planning.

The university science base is vital to the UK's future competitiveness. Increased funding must be targeted at the strategically important skills.

January 2005

APPENDIX 31

Memorandum from the Physiological Society

The Physiological Society is one of the larger member organisations of the Biosciences Federation, which has already submitted a detailed response to the Commons Science and Technology Committee Enquiry. The Biosciences Federation and Institute of Biology represent a total of $\sim$65,000 bioscientists interested in maintaining excellence in research-led teaching in English universities. The Physiological Society endorses the issues raised in the response from the Biosciences Federation.

The major concerns in our discipline are related to recruitment of talented and motivated A-level science students. School children, who later take up university courses in Physiology and related sciences, are usually enticed into a science curriculum by the practical experiences they have conducting hands-on experiments. We concur with the Biosciences Federation statement that students need to be targeted to elect science options. However, we would advise that students are targeted prior to selection of GCSE courses. This requires placement of highly motivated and qualified science teachers at an early stage in secondary education, and preferably in primary schools. In this context, The Physiological Society has undertaken to train young affiliate members (PhD, postdoc) in Communication Skills so that they can visit both primary and secondary schools to share their enthusiasm for science.

Universities need to advertise the benefits for PhDs seeking a career in teaching science. This may necessitate continued advertising by government and a clearer statement that highly qualified science PhDs will be well rewarded financially as teachers of science curricula.

As Physiology is an experimental discipline, training in this field is best served by research-led universities. We agree with the Biosciences Federation response that today's physiology/biomedical students at university do not always receive sufficient transferable laboratory skills. This is largely due to the marked increase in student numbers without increased resourcing from government. The inevitable outcome is that our science BSc graduates are often not well-equipped for laboratory-based PhD research, and often need to spend a 1 year placement in industry or undertake MRes or MSc courses.

January 2005

APPENDIX 32

Memorandum from the Society for General Microbiology

Introduction

The Society for General Microbiology, founded in 1945, is an independent, scientific, learned society dedicated to promoting the "art and science" of microbiology. It has now established itself as one of the two major societies in the world in its field, with some 5,500 members in the UK and abroad.

General Comments

The UK has a science-based economy and these are important issues. Any reduction in science departments impacts badly on the others and sends out the message that science is not important. We will not redress the problem of falling applications to science departments by closing them. Once a core science department closes, the University loses credibility in its whole science performance. Closing departments has to be fought at all levels if the United Kingdom is to continue its lead position in science. So much would be lost if we cannot bring good science to all areas of the country.

Specific Comments

On the impact of HEFCE s research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science department

Clearly, lower rated departments find it difficult to keep going, especially where the cost of putting on courses is high. Chemistry courses are a prime example, exacerbated by the decreasing interest from students. The funding formulae have had a detrimental impact on laboratory subjects in general, but in particular on smaller units in regional universities where it is difficult to transfer or buy in expertise. For example, Northern Ireland has lost its only Department of Geology. The region is geologically important and faces significant environmental issues that require geological knowledge, eg lignite mining. Students leaving Northern Ireland to take geology in mainland universities are unlikely to return. Hence, the region will suffer a lack of relevant expertise in the future.

Funding of other subjects has been reduced such that the research base is founded largely on external income that is subject to fads and fashions and could undermine important broad subjects such as biology, biochemistry and chemistry. There is little difference between the outputs of grade 4 and 5 departments ı the definitions used are very similar and the error with which they were applied in RAE 96 and RAE 2001 very great. Hence, grade 4 units have suffered disproportionately. The RAE has created a culture in which accountability is high but in which resource allocation models are somewhat blindly applied. This has had a bad effect on funding available especially for core science areas that are expensive and suffer in some cases from falling student interest.

RAE measures outputs from individuals irrespective of their input—ie asking for the top four papers from a group irrespective of the level of funding, or number of grants that group has received. This has created a culture in which quality is sometimes sacrificed for quantity within individual departments, such that, the groups that get bigger and bigger and less and less efficient are rewarded, while those trying to run 'lean and mean' operations suffer considerably. The effect is actually counter to what was desired from the design of the RAE metrics. There is more wastage within groups that are deemed to be successful and departments that are actually doing a very good job of converting input to output look as if they are doing a very bad job in comparison to the big operations in favoured institutes. This has made a difficult situation nigh on impossible in some departments.

On the desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

By concentrating research in fewer departments the diversity of research in the UK will decrease. Productivity is likely to decrease as well. Larger units often tend to be less productive per person, compared to a smaller one. Increasing the concentration of research in a small number of university departments is not desirable since it would lead to scientific deserts in many parts of the UK. Not all students would be able to attend the remaining research-led universities and many would lose the opportunity to benefit from a practical-based degree in a laboratory science. This would undermine the reputation of the higher education system of the UK as a whole. The loss of research from regions would lead to an even greater tendency to concentrate high tech industries and government scientific laboratories in a few places with a further fragmentation of the UK economy into "richer" and "poorer" parts. Regional universities provide the major portion of the local research base. Physics, chemistry and biology are all vulnerable to changing finances of universities and concentration of research in more central parts of the UK. The effect of this would be disastrous on local intellectual opportunities, challenges in health and environment and economic development.

On the implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

The process affected by Higher Education Funding Council for England is very damaging to all areas of laboratory sciences. For example, Queen's University Belfast has already seen nearly £2 million transferred from the budgets of science and engineering subjects to social sciences and humanities. Should appointments and recurrent expenditure follow these allocations, the result will be decimation of the sciences with physics, chemistry and biology all suffering from unworkable staff-to-student ratios and under-funding. A spiral of decline would lead inevitably to their closure. There must be immediate steps to address this imbalance between subject rations and subject needs, because these are having an extraordinarily unfavourable impact on the intellectual opportunities, health, environment and economic development of the UK. Already, courses are cancelled and practical schedules changed in order to keep within constrained budgets.

On the optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments

A good balance between teaching and research is essential to provide good quality projects, and thus, both enthuse students and give them up to date skills. A science degree taught in a university without relevant research activity would be valueless as far as potential employers and international comparisons are concerned. No student with a choice would choose to go to such a university. This is because of the limited opportunities that such a degree would afford students with respect to practical work and diminished quality of teaching staff that are not contributing to the development of their subject. Both teaching and research elements of funding of science-based departments should be increased in real terms. A ratio within the range of 50:50 to 70:30 teaching:research income is an appropriate, viable target. A teaching only department might be financially viable only in very high demand subjects but in physics, chemistry and biology they would be unlikely to be able to recruit sufficient students of any calibre and turnover of good staff would be very high.

On the importance of maintaining a regional capacity in university science teaching and research

This is essential as outlined above. It is arguable that the process of centralisation of scientific expertise in the UK has already gone too far. Students should have as diverse and high quality opportunities at a regional level, as offered centrally. Widening access for students from disadvantage backgrounds and disabilities is important; it would be inconsistent to create a situation where only students with no barrier to movement could study at a higher level subjects that are only available in a few central locations. Economic development in the regions requires support from HE research and production of skilled graduates at least as much as the more central parts of the UK. Destroying the research and therefore the HE base of the regions will undermine the UK economy as a whole and most certainly and immediately the international reputation of both HE and research in the UK.

On the extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance and the mechanisms it should use for this purpose

Special scholarships for undergraduate courses for students who are committed to go into teaching in core subjects would be useful. The government, on the one hand, is placing emphasis on science and science development and teaching and on the other hand has apparently not evaluated the impact of some of its decisions or those of Non-departmental public bodies, such as HEFCE. The government expects science to develop against a background of falling numbers of secondary school leavers with appropriate scientific background qualifications; against increased competition for these students from vocational schools (pharmacy, medicine) and against the back drop of a perceived lack of sufficient and attractive career options. It needs to join up some of its policies. Given that there is potential for Research & Development in each region, there should be at least one centre of R&D combined with teaching per region.

Final Comments

Most Microbiology degrees are delivered within Biological Sciences Departments and if these departments have a 5 or 5* rating then Microbiology will survive. Otherwise, it would be far more exposed, as it is a 'small numbers' degree programme.

Sources

This evidence has been prepared on behalf of SGM by Professor Lorna Casselton, University of Oxford, Dr Ulrich Desselberger, Virologie Moleculaire et Structurale (General Secretary, SGM), Professor Iain Hagan, Paterson Institute for Cancer Research, Manchester, Dr Pauline Handley, University of Manchester, Professor Bertus Rima, Queen's University Belfast, and Professor Christopher Thomas, University of Birmingham.

About the SGM

Society membership is largely from universities, research institutions, health and veterinary services, government bodies and industry. The Society has a strong international following, with 25% of membership coming from some 60 countries outside the UK.

The Society is a "broad church"; its members are active in a wide range of aspects of microbiology, including medical and veterinary fields, environmental, agricultural and plant microbiology, food, water and industrial microbiology. Many members have specialised expertise in fields allied to microbiology, including biochemistry, molecular biology and genetics. The Society's membership includes distinguished, internationally-recognised experts in almost all fields of microbiology.

Among its activities the Society publishes four quality, widely-read, research journals (*Microbiology, Journal of Medical Microbiology, Journal of General Virology and International Journal of Systematic and Evolutionary Microbiology*). It also publishes a respected quarterly magazine, *Microbiology Today*, of considerable general educational value. Each year the Society holds two major scientific meetings attended by up to 1,500 microbiologists and covering a wide range of aspects of microbiology and virology research. The governing Council of the SGM has a commitment to improving awareness of the critically important role of microbiology in many aspects of human health, wealth and welfare. It has in this connection recently initiated a "Microbiology Awareness Campaign" aimed at providing information to the government, decision makers, education authorities, media and the public of the major contribution of microbiology to society.

An issue of major concern to the Society is the national shortage of experienced microbiologists, particularly in the field of clinical microbiology and in industry. To attempt to improve this situation long-term, the Society runs an active educational programme focused on encouraging the teaching of microbiology in university and college courses and in the school curriculum, including primary schools. Some 320 schools are corporate members of SGM.

January 2005

APPENDIX 33

Memorandum from the School of Civil Engineering and the Environment, University of Southampton

CONTEXT

The School of Civil Engineering and the Environment at the University of Southampton comprises some 30 members of academic staff, 50 research staff, 250 postgraduate and 300 undergraduate students. It was rated 5* for civil engineering in the 2001 Research Assessment Exercise, and has one of the highest per capita research grant and contract incomes in this unit of assessment in the UK.

The philosophy of education and research in Civil and Environmental Engineering at Southampton is to use our strengths in core engineering science disciplines such as solid, soil and fluid mechanics to address the key problems facing society today. Areas of research include transportation, infrastructure, sustainable urban environments, waste and resource management, coastal and marine engineering and sustainable energy. The problems we address are interdisciplinary in nature. While they often do not lend themselves to traditional technical investigation, the challenge we address is to apply the high standards and analytical rigour associated with our core disciplines to their solution. We aim to work with industry and other disciplines to help define and solve problems in a way that advances fundamental scientific knowledge and understanding, benefits society and protects and enhances the environment. This mission is reflected in the range and extent of our educational programmes and our research collaborators and outputs.

All senior staff have a broad experience of civil and environmental engineering research and education through their activities as external examiners, reviewers and members of senior appointments committees at other leading civil engineering schools and departments in the UK and internationally. The following observations relating directly or indirectly to the points on which the Committee has invited evidence are based on that broad experience.

GENERAL COMMENTS

The fundamental problem is not necessarily a lack of overall funding, but that the funding attached to each and every individual activity is insufficient. This results in a department or school being apparently financially viable, but only because the resources (particularly academic staff) are overstretched. The loss of even the marginal funding makes it very difficult to reduce levels of activity without jeopardising the overall financial balance.

A vibrant 5* School with healthy taught programmes is at least superficially financially viable under the previous weightings given to science subjects under the teaching funding formula. However, this requires extremely high levels of output from academic staff: on average, each established lecturer must teach 3 x 15 credit modules per annum (equivalent to 6 hours contact time per week); supervise 4 MSc and 7 undergraduate projects; obtain funding for and supervise three current research students (PhD, EngD or MSc by research); hold current research grants and contracts to the value of at least £300,000; contribute significantly to School and University administration (see below); and engage in all the high-visibility activities such as external committee and review work that contribute to a 5* research rating. Even the most efficient and effective academics find it difficult to deliver what is expected of them in less than 50 hours per week.

The Implications for University Science Teaching of Changes in the Weightings given to Science Subjects in the Teaching Funding Formula

The reduction in per capita student funding resulting from HEFCE's recent adjustment of subject band weightings will either damage the financial viability of a department of school or increase the already excessive productivity requirements of its academic staff.

The reduction in per capita student costs over the past 20 years or so has been achieved by expecting staff to deliver more, and reducing the amount of practical and experimental work in science and engineering curricula. In both respects, we believe that the UK has already gone too far and the recent reduction in per capita teaching funding will worsen an already difficult situation.

The changes in weightings for science and engineering subjects do not seem to take account of the fact that the number of student contact hours is typically higher (about 15 hours/week) than in most other subjects.

Reduced funding seems certain to result in the closure of expensive laboratory facilities unless universities decide to subsidies the teaching of engineering and sciences. This is unlikely and in any case unfair on other disciplines. The danger is that teaching of science and engineering subjects will cease or be reduced to the level of a third world country where they are taught as theoretical subjects only. This is not sensible if the UK is to remain a technologically driven nation.

The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of such a Trend

A degree of focus and concentration is desirable as it enables critical mass to be achieved in certain centres equipped with excellent facilities having a high level of utilisation. This is only possible if we concentrate research funds to some extent into a strategic number of centres. However, an overconcentration of activity into too small a number of institutions would be damaging, because:

1. While the best institutions will be attractive to the best people later in their careers, it would prevent many individuals from even starting on a scientific research career. The location of a first or even subsequent academic appointments is to some extent a matter of luck and personal circumstances.

2. It is essential for the health of both individual disciplines nationally and the university system as a whole that people move between institutions at various stages of their careers. In some North American and European institutions, this is a requirement and internal promotions are not possible.

3. If an activity becomes too small nationally, it ceases to be relevant to the national interest no matter how high its quality. The UK motor car and rail vehicle building industries are examples of this.

The Optimal Balance between Teaching and Research Provision in Universities, giving particular consideration to the Desirability and Financial Viability of Teaching-only Science Departments

In our view, both are essential to the vibrancy and health of a learning environment seeking to deliver at the highest level. Both should be fully financially supported. There is no doubt that the brightest students benefit immensely from the atmosphere of creativity that exists in a leading research department, although weaker students are less able to benefit.

The Extent to which the Government should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance; and the Mechanisms it should use for this Purpose

Continuing provision of subjects of strategic importance is essential. The developing countries with rapidly growing economies (India, Malaysia, China) are characterised by education systems that have been designed to produce graduates with science and engineering skills that can lead the economy. However, what is needed to address this is that the full range of activities is fully funded and properly resourced rather than any artificial Government intervention.

Other Points

Considerable further pressures are placed on staff by the increasing QA and legislative requirements of Government. Not only does a university have to allocate some resource centrally to deal with these matters (thus taking resource away from the delivery of education and research), but staff within the academic schools have to be involved in compliance. Nearly all of our academic staff have at least one major administrative responsibility, and many have two or three.

Academic staff are increasingly called on for (generally unpaid) review and advisory work, for the Research Councils and Government departments such as Defra, DTI and DfT etc.

Many recent research initiatives by the Research Councils and Government have been application focussed, addressing areas that are not necessarily amenable to scientific research. It is often difficult for basic science projects to compete successfully for funding in such an environment as it is not seen as sufficiently exciting; even though without a sound underlying science base, little if anything of real value or practical use is likely to be achieved.

It is becoming increasingly difficult to attract really top quality graduates to an academic research career in many branches of engineering owing to the combined effects of low earnings, unfeasible expectations in terms of workload and quality/quantity of output, and excessive bureaucracy.

January 2005

APPENDIX 34

Memorandum from the University of Leeds

INTRODUCTION

This University takes the view that engineering and physical sciences are core disciplines and that closure of the core science departments, particularly in the light of current emphasis on interdisciplinary research (and postgraduate teaching), is not an option. The problem facing UK science/engineering is a complex one. The subject areas, as in the countries that made up the EU before it was joined by a number from the former eastern block, are unpopular with potential undergraduates; the science teacher base at the secondary level of education has been decimated; for good or bad the university sector is run on a business footing and is thus subject to market forces as we are seeing.

The underlying reason that Sciences and Engineering Teaching is in difficulty is that the pool of students wishing to take these subjects has been decreasing for a long time, at least since the 1970s. In the Sciences this trend is to be observed throughout Europe, leading to the suspicion that there are cultural causes which may not be so easy to remedy. We could identify a number of factors which exacerbate this trend in the UK; one is the comparative lack of competent and enthusiastic mathematics and science teachers in schools, a consequence both of the declining number of students in the physical sciences and, paradoxically, of the enormously increased employment prospects for such students, particularly in the well-paid financial sector. Another is the perception of the physical science and mathematics as "hard" subjects, fuelled by data on A-level results. It is vital that Universities engage more closely with local schools so as to promote science and mathematics through schemes such as Rothschild.

Turning to the situation within Universities, if we are to correct this situation, there is a need to both attract more students into the sciences and mathematics and to inspire them to become teachers. Having a good regional spread is important here: though some of the outreach work we do (particularly in mathematics) can be delivered in Schools, for laboratory experience it is crucial that students should be able to come to the Universities themselves.

Failure to grow our intake when funded student numbers were available meant that our subject areas have been particularly defenceless during a period of 40% drop in funding unit of resource. The teaching unit of resource for physical science at Leeds, even on non-full economic cost (fEC) basis, is at least 40% too low and on a fEC basis is possibly of the order of 1–200% under-funded. Equipment is old and infrastructure failing.

Laboratory-based subjects have high overhead costs and so are significantly disadvantaged by funding regimes that are simply proportional to fte numbers (ie linear growth of funding with fte and with a zero intercept)—small departments cannot recruit and manage a volume necessary to cover the fixed costs. This is true irrespective of whether Universities internally operate space charging explicitly. The speed of increase in expectations of a well-found and Health and Safety compliant laboratory in physical sciences requires regular and expensive infrastructure investment, providing further management challenges to Universities. A welcome move to modernising laboratory classes is allowing reductions in laboratory space required, but again implies refurbishment costs. Moreover, once closed, physical science departments are prohibitively expensive to re-start.

Graduates of UK maths and physical science departments are highly valued and readily employable and contribute significantly to UK GDP (estimates of £200k pa per person working in the chemical industry). This comes from having teaching aligned to research; teaching-only departments are a poor substitute. Exactly similar comments apply to biological science and engineering; funding one subgroup at the expense of the other does not address the fundamental problem.

Given the social aspect of the problem of attracting good students, concerted national (not simply governmental) effort is needed. A model of good practice might be the Finnish government's underpinning of music tuition at all levels. Such a policy is expensive, but, in the long term will pay off in both expected and unexpected ways. But if the problem of attracting students is not addressed, whatever is done within the University system to counteract the difficulties in the physical sciences will fail in about two generations.

1. The Impact of HEFCE's Research Funding Formulae, as Applied to Research Assessment Exercise Ratings, on the Financial Viability of University Science Departments

HEFCE QR funding is a zero sum game so the RAE is all about the distribution (or re-distribution) of the available funding. If the available money is distributed more uniformly, then with increasing costs the excellent departments will see a reduction in real terms. If the funding is distributed even more selectively than in 2001, then all the grade 4 departments and most of the grade 5 ones will see a reduction in funding which could be disastrous and would probably result in closures or amalgamations.

We are not convinced that the funding really takes account of the laboratory space required to undertake leading edge research. All laboratory subjects have fixed overheads and thus are peculiarly vulnerable to reductions in income, be it from a reduction in student numbers or in the QR funding formula or from a poor RAE result. Typically, if space is charged for, there is no cheap way of reducing this charge in the light of reduced income. Reconfiguration of teaching laboratories on that kind of scale costs millions of pounds: there is a limit to the frequency of a University's doing this, if it chooses to do it at all. So, unless we return to the generous funding regime of the 1960s, or special measures are taken for all laboratory sciences, Universities will always be faced, from time to time, with the choice between cross-subsidising or closure. Nationally, this points to the inevitability of continuing closure of laboratory-based departments.

A Civil Engineering Perspective:

The RAE leads to a distortion in relation to staffing—engineering departments now cannot afford to recruit excellent teaching staff who do not have a research pedigree. If a department is struggling, there is a temptation to make appointments with the RAE in mind, ie to appoint academics who will meet the requirement for a minimum of 4 academic papers per year. These are unlikely to be practitioners from industry, who would bring the full breadth of knowledge about civil engineering. Increasingly, university civil engineering staff lack any industrial experience. The long-term consequence on the education of future civil engineers is serious: students are less likely to interact on a regular basis with practitioners.

In response to the hostile funding environment, civil engineering departments have closed in a number of Universities and in others merged into schools/faculties of engineering or built environment. This led to a decrease in the number of departments submitting under the civil engineering unit of assessment in the RAE from 40 in 1996 to 29 in 2001, a 37% decline. The outcome is that the civil engineering influence has declined, and this will create damage to the civil engineering profession, industry and UK plc. The strength of civil engineering research in the UK is its diversity, and this is because of broadly-based civil engineering departments.

The RAE can also affect the choice of research topics, and this may be detrimental to the education of future engineers. The HSE Research Report 275 "Identification and management of risk in undergraduate construction courses" (Supplementary report—April 2004) made the following specific conclusion that may be relevant to the Inquiry:

> The Research Assessment Exercise (RAE) continues to exert a negative influence upon this topic, particularly at Centres where it is seen as a diversion from the main declared focus of maintaining or improving research standards.

This is coming at a time when the numbers entering civil engineering first degree programmes has increased for the third year in a row, and by 15% in 2004 over 2003. Therefore some reports of government attributing the plight of science in HE to the lack of demand are disappointing and certainly not the case for civil engineering. More could and should be done to communicate the facts—that a degree in engineering will equip young people to pursue an exciting, well-paid career where they can help to build a sustainable environment.

A Mathematics Perspective:

The cause of closure of mathematics departments, which has been much less marked, is the consequence of a static or diminishing pool of students, the decline of mathematics service teaching and the very significant expansion of the more prestigious mathematics departments. In other words, we are seeing the result of the operation of both external and internal markets for students. There has been some evidence that mathematics within Universities has been systematically under-funded by comparison with the amounts allocated in the HEFCE formula. If it is the case that money intended for maths teaching is going to other subjects, then it would need to be established whether this was a significant factor in closures.

2. The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of such a Trend

Increasing the concentration of research in a small number of departments under the present system enables continuity and quality to be maintained. There is recognition of the need for a critical mass of staff necessary to sustain research in a particular discipline and to ensure impact. Wide dilution and equal funding for each university would not be practicable or useful.

However, no university has a monopoly on innovation and there must be serious competition in key areas. Concentrating research tends to maintain the status quo, makes it difficult for new departments to join the "research club", with a danger of perpetuating former divides (Russell Group and new Universities). In the best English tradition, teaching in an environment of research is optimal and indeed desirable from a health of the discipline point of view. The consequence of such a trend in the short term would be to improve the lot of a few; longer term this would not arrest the current decline in the popularity of the subjects concerned.

A Mathematics Perspective:

It is not desirable that mathematics research is concentrated in a small number of departments: this has been authoritatively stated in the recent International Review of Mathematics. Once a department is above a critical mass (so that you can have a reasonable seminar programme and train research students) modern physical and electronic communication means that mathematicians can flourish. For the laboratory subjects you need a certain amount of physical infrastructure, so the "critical mass" is larger. It only follows that you need concentrate if you have a fixed pot of money or a limited supply of scientists.

3. The Implications for University Science Teaching of Changes in the Weightings given to Science Subjects in the Teaching Funding Formula

The changes in the funding of teaching are potentially disastrous for science and engineering. It needs to be understood that laboratory-based subjects (including computing) have high standing costs and thus small numbers of students make the cost per student appear high and vice-versa. Engineering departments tend to be more dependent on teaching than on research. Thus not resourcing teaching at a sustainable level is a central problem for engineering departments. Years ago, the weightings were similar to those for medicine; in 2004, HEFCE changed the price group weightings for science and engineering students from 2.0 in 2003 to 1.7 in 2004, a 15% fall. In this regard there is a disconnect between government policy, with its strong and realistic emphasis on science and technology as a basis for economic well-being and growth, and the HEFCE formula.

There is then a tendency for Universities to target the recruitment of overseas (non-EU) students instead of home students, thus attracting higher fees, in order to become financially viable without excessive student: staff ratios. If high, these ratios have a significant impact on an engineering department's ability to remain at the leading edge of research.

In addition, it is a temptation in cash starved Universities to distribute this money to other disciplines through the internal accounting models. For example, the imposition of a "space tax" transfers funds from engineering and science (where more space is needed) to other disciplines, thus the engineers then subsidise the arts and humanities. In some Universities, the HEFCE weightings increases have tended to favour the humanities anyway, and the HEFCE model has put at risk the industrially relevant science and engineering base in the UK.

Either the weightings given to the teaching funding need to incorporate the total, not just the marginal, costs of teaching laboratory subjects, or there need to be separate formula-based capital grants to deal with the necessity to regularly refurbish and reconfigure labs. This is not only to deal with changes in the volume of students, but to keep the labs up to date with current developments in the theory and practice of the subject, and of course, to ensure compliance with Health and Safety regulations. However, because of the instability of income streams, this will not of itself guarantee against closures. If HEFCE wants to provide a hedge against closure, it needs to pay a premium on science subjects so that all the other subjects will lose if a science subject closes (or even if it fails to recruit adequately).

4. The Optimal Balance between Teaching and Research Provision in Universities, giving particular consideration to the Desirability and Financial Viability of Teaching-only Science Departments

Educationally, having teaching only science/engineering departments would be a retrograde step and not desirable. Research activity generates the state of the art that is fed back into the curriculum—very importantly through project work and specialist courses. We are not convinced that teaching—only departments are financially viable or will prove at all attractive to potential students, however, they do play an essential part in the education of incorporated engineers.

The optimal balance between teaching and research provision is all about maintaining a critical mass. There is little point in having too many departments competing for limited funds—the UK will not be able to carry out world-class research or teaching. Graduates in science and engineering are crucial for the future of the UK economy and that implies increasing the numbers of well-qualified students entering university courses and sustaining healthy departments to take them. There is little purpose in "propping up"" departments that are not academically viable (ie comprised of research-active staff) and struggle to recruit adequately qualified students. However, for a research-led university the SSR needs to be reasonably low (about 1:10 or 12) so that staff can have the time to undertake research.

The balance between teaching and research in University departments changes over the years and it is probably not worth trying to find a theoretical optimal balance, as long as both teaching and research are done well. (The basis for the original division of the grant into different proportions of teaching and research for different subjects by the then University Grants Committee, was never explained and the division itself led to significant problems for some departments.) For this University, it is important that teaching be research-led; that teaching be carried out in a research environment, so that, for example, final year projects in laboratory subjects will interact with, and maybe contribute to, the research taking place. Indeed, the MChem degree, now accredited by the Royal Society of Chemistry as the professional grade for Chartered Chemist status would not be viable without a good research base to support fourth year projects. Full economic costing of research may well sharpen the trend for front-line researchers to do very little teaching. As to the financial viability of teaching-only departments, it is necessary, with full economic costing of research activities that the teaching of all departments be separately financially viable.

5. The Importance of Maintaining a Regional Capacity in University Science Teaching and Research

Centres of research excellence are likely to continue to develop and a regional capacity is important not just for the university but also for the professions and industry. However, it is important to recognise that science and engineering research is national and international activity. However, it is likely that, with increased tuition fees and mounting student debt, a higher proportion of students will wish to attend a local university and live at home.

A research (and teaching) presence is also important to support and help develop local SMEs (as exemplified in Leeds by the interaction between Colour Chemistry and printing firms in the region) as well as to create spin-offs which impact on the regional economy.

6. The Extent to which the Government should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance; and the Mechanisms it should use for this Purpose

On government intervention, there are different views: it is supported, for example where the numbers of graduate scientists and engineers falls below a pre-agreed level. Some argue that the advent of fees from 2006 may force students to concentrate on disciplines which have a revenue stream attached, and hence engineering may benefit; others believe it may make students consider degrees with less contact time so they can undertake part-time work, and numbers will fall.

Science and engineering innovation is paramount to the UK remaining internationally competitive in the market place. The question the government and the general public should ask themselves is "Does the UK wish to remain a technologically advanced nation providing the high tech jobs for its population or does it prefer the alternative scenario of seeing the necessity for future generations having to emigrate to China, etc to seek the high tech jobs that will no longer exist at home" This is a very real prospect in the next 20 years or so for children now entering primary education.

How should the Government intervene? One option is to do nothing and let market forces dictate the outcome on the basis that sufficient engineers and scientists are being produced worldwide to satisfy demand—after all, China graduate more engineering students in a year than the total number of students who graduate in a year in all subject areas across the entire higher education sector! The alternative is to contemplate direct intervention by increasing funding for both research and teaching provision in Universities—research, QR, bursaries, scholarships, golden hellos or fee re-imbursement to ensure the number and quality of future graduates in subjects of strategic national importance.

Consistency across government's own departments is needed, for example across Construction (where skills shortages are acknowledged and the Minister aims to address) and DfES (in respect of funding models). Government decision-making in relation to policy such as HE funding, would benefit from the inclusion of more scientists and engineers. Training, identifying and encouraging the engagement of leading scientists and engineers in political discussions on such policy issues, is urgently required.

A Computer Science Perspective:

We note that many Computing departments around the country are in serious difficulty as a result of a fall in student numbers; facts and many reports suggest this is a blip. The recent Gartner report [e-Skills] makes clear that the demand for computing/IT staff exceeds supply, and this gap will worsen. In many Universities, Computing departments are suffering seriously as a result of the "money following the student" system. This is badly exacerbated by the recent misguided rebanding of Computing from B to C.

The country may well lose departments, or at least see them emasculated, in an area which the nation will find indispensable. It is essential for Government to see the merit in ironing out bumps in supply and demand. We are convinced of the long-term need for qualified computer scientists; this is over and above the country's need for wide-based "IT expertise". We are similarly convinced that such qualification comes from studying with those at the edge of the subject—engaged in quality research. It is possible that regional provision could allow such specialist provision to live alongside more vocational provision that goes beyond "IT".

January 2005

APPENDIX 35

Memorandum from the Royal Academy of Engineering

1. The Impact of HEFCE's Research Funding Formulae, as Applied to Research Assessment Exercise Ratings, on the Financial Viability of University Science Departments

1.1 University science departments receive their funding from several sources including the monies allocated through the RAE assessment process and project based research funded by the Research Councils. It is now recognised that these funds in total have been inadequate to cover the overheads and therefore it is an over simplification to put the blame for the closure of departments solely at the door of the RAE process.

1.2 Whilst the RAE process has been beneficial in encouraging UK Universities to take research activity seriously and improve its quality, there are several issues with the funding formulae that require greater attention.

1.3 One issue is that the funding formulae are currently unable to reward pockets of excellence within departments. Such pockets certainly enhance the knowledge base and wealth generation in the UK but are often only recognised at an international level. Because they are part of a larger department which might not be of the same research standing, but classified at the same grading, they are subject to lower funding. As the financial stability of the whole department is reliant on a good RAE grading, an unsatisfactory performance can ultimately lead to closure. Proposals for RAE 2008 to replace the single rating with a Quality profile enabling a small high quality group to score more highly are welcome and should be endorsed.

1.4 Even higher rated departments are not immune from closures. Reading University, for example, was forced to close its undergraduate degree programmes in mechanical engineering despite receiving an RAE grade 5 in 2001. Budget reallocations have not helped to ease this situation. In the 2001 RAE, for example, one department rated 5 lost £0.25 million from its annual income due to a budget reallocation between grades. Clearly the funding formulae need to ensure consistency in funding streams so that departments can plan for their own financial stability.

1.5 The impact of HEFCE's research funding formulae is just one of a number of factors which influence the financial viability of science departments. The other major factors are the teaching grant and demand for undergraduate and post-graduate teaching places and decisions taken by the Vice Chancellor on how to allocate the money. There are cases where departments have been forced to close due to fluctuations in demand for teaching places and a lack of research funding due to a lower RAE score. What is needed is a funded safety net to allow departments to restructure to meet new demands rather than forcing them to use their own resources.

2. The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of Such a Trend

2.1 Views on this subject, even within the Royal Academy, are somewhat polarised. Whilst from a purely research perspective there are some strong arguments for encouraging further concentration, there are also significant negative implications. Greater analysis of the costs and benefits of concentration needs to be taken into consideration before pursuing such a strategy.

2.2 The benefits of concentration are that it prevents resources from being spread too thinly and brings high quality expertise together in better funded facilities. This approach can work as can be seen in the United States where only a handful of top engineering schools carry out the majority of the research. Concentration of research has also been occurring in computer science departments in the UK. There are over 100 departments across the country and uniform research funding across all of these could potentially weaken the research and remove the financial motivation for the best to stay at the top. Whilst concentration of funding has had some success, it is the view of many that it has gone far enough and further concentration would adversely impact on the long-term capacity of the system to produce top-quality researchers. In other subjects such as materials there are already too few departments of significant size to satisfy future needs.

2.3 One consequence of further concentrating research is that a two tier system could be created where the highest ranked departments carried out most of the research and the remainder focused on teaching. As cutting edge research is invariably the basis for cutting edge teaching there are quality implications for those departments which find themselves suddenly without research funding. In addition, the departments which do not qualify for the top tier will be condemned by implication as not providing the best teaching.

2.4 Innovation can arise wherever there are talented individuals which may not necessarily be in the areas of concentration. It is often the case that new initiatives come from other than the big "world class" departments and often smaller departments act as breeding grounds for ambitious young researchers. A concentration policy, too crudely applied, could damage the ability of young researchers in less favoured institutions to win funding and affect the flow of talent.

3. The Implications for University Science Teaching of Changes in the Weightings Given to Science Subjects in the Teaching Funding Formula

3.1 Currently, SET subjects are seriously disadvantaged in the weightings considering the scope and breadth that they are required to cover. They receive less than 50% of the funding for medicine despite being equally, if not more, expensive in terms of resources for equipment and laboratory staff and the cost of industrial projects and design. The weightings used in the current funding model do not reflect this adequately and this is another reason for lack of financial robustness in these departments. If the UK believes that SET is vital to the economy then sufficient resources should be made available to see that it is adequately funded.

3.2 In addition, the funding per student for teaching is too low for many science and engineering departments. As a general trend, for every home or EU student in the physical sciences and engineering, the amount received per student for teaching is less than the amount the department spends. For example, the recent press coverage of the implications of the Oxford University deficit indicates a gap of about £10k per student per annum. Even with £3k per annum in additional student fees, the funding gap will be significant, and there are real concerns about the impact that such additional fees will have on student uptake of four year courses in science and engineering.

3.3 Many departments are therefore being forced to subsidise teaching from overseas student fees and research income. However, without sufficient numbers of oversea students or a high research rating they cannot do this, potentially resulting in department closures. The weightings given to science and engineering subjects in the teaching funding formula need to be substantially increased in order to effectively tackle this problem.

3.4 The weightings have had a particularly adverse implication for computer science, where the primary classification of teaching has been re-banded to a lower funding level at a time when recruitment to computing courses has become very difficult. The viability of many of the UK's computing departments, particularly those most dependent on teaching for income, is now being called into question.

4. The Optimal Balance between Teaching and Research Provision in Universities, Giving Particular Consideration to the Desirability and Financial Viability of Teaching-only Science Departments

4.1 As highlighted in question two, there is a mutually reinforcing relationship between teaching and research which should be maintained. If the UK is to remain competitive at the industrial level then it must have access to the best trained graduates who in turn need to have access to up to date SET knowledge and this can only come from vibrant research. Also, if UK universities are to attract the best overseas students in sufficient numbers then they have to prove that the education system, especially higher education, is at the cutting edge. It cannot do so without a sound and broad research base.

4.2 In terms of an optimal balance, all universities should be encouraged to engage in some research, from close-to-market commercial research to more "blue-sky" work. The Royal Academy of Engineering received one suggestion that leading research departments should aim to achieve about 2:1 research to teaching income whilst those with less of a research focus should still aim to achieve 1:2. However, it must be recognised that the balance depends strongly in the nature of the research—computing is very different from civil engineering which is very different from materials. However, maintaining some sort of balance between research and teaching is the key to achieving overall financial robustness.

5. The Importance of Maintaining a Regional Capacity in University Science Teaching and Research

5.1 Maintaining regional capacity is a highly important issue in the context of increasing science and engineering department closures and rising tuition fees. Students are being forced either to travel to university or not study at all. Clearly this has implications for the already low numbers of SET graduates but also for future generations of students who will be disadvantaged by lack of provision.

5.2 Allowing the loss of regional capacity is currently encouraging the concentration of university capacity in the south east. This is undesirable as it generates instability in national demographics and also has implications for local economic development as many students who attend university in their region are likely, at least initially, to take up employment in that region. The solution is to establish world-class universities in the regions rather than diverting funding from and weakening those already strong in the south-east.

5.3 A national strategy for SET would provide much needed context for the development of regional capacity. Regional capacity in core subjects could be part of a national research strategy in science and engineering. Such a strategy should also recognise that there are certain areas where the UK needs to maintain an international presence, for example in ship design or nuclear power plant design, and the concentration of teaching and research in a national centre may be justified.

6. The Extent to which the Government Should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance; and the Mechanisms it Should use for this Purpose

6.1 It is widely recognized that the UK currently faces a serious shortage in the number of physical science and engineering graduates needed to support industry and academia. The core problem originates in schools where an insufficient proportion of the population are being trained in science and maths. This trend is compounded at university level by a lack of government support for SET subjects and the increasing number of departments under threat of closure.

6.2 Significant government intervention is needed to reverse this trend and there are several mechanisms government can employ to achieve this. As a priority a strategy should be established to encourage better teaching of physical sciences and maths in schools, with appropriately qualified graduates going into these teaching positions. Incentives also need to be given to students to take science and engineering disciplines at university.

6.3 Offering differential "top-up" fees, or developing a national scheme to award government-funded science scholarships in preference to other disciplines are some examples of such incentives. Top graduates could also be retained in engineering and research by waiving fees which only have to be repaid in the event of the graduate accepting a non-engineering or research related position. Tax incentives could also be given to industry to sponsor scholarships in science and engineering.

6.4 Whilst government intervention is to be welcomed it is imperative that is it based on good advice. A good example of such advice would be the "Roberts Report" on SET. Such in-depth reviews need to be encouraged and their recommendations acted upon.

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APPENDIX 36

Memorandum from Cranfield University

1. As the UK's only wholly postgraduate, technological specialist institution we welcome the UK government's commitment to diversity in the mission of UK HEIs. However, there is no doubt that the RAE and its impact on HEFCE's research funding currently runs counter to such a position. The mode 1 "blue-skies" focus of RAE to date, impacts significantly on institutions such as Cranfield, whose mission includes substantial mode 2 research with the aim of transferring knowledge into real and viable applications. The inevitable consequence is impact on the financial viability of departments which play a key role in the future wealth creation of our nation. Such institutions can respond to this by either distorting their institutional mission, to "play" the RAE academic game, or maintain mission and suffer significant financial and potentially reputational losses due to middle RAE gradings. HEFCE has made public undertakings that mode 2 research will be more highly valued in RAE2008, however there is still disquiet regarding how this will be achieved. Major bodies such as the Royal Academy of Engineering have offered intelligent ways forward for RAE2008, and we welcome in particular, the RAEng approach as it will enhance the mission of research intensive "Lambert" institutions, such as Cranfield, who choose to support the future economy of the UK, rather than simply carry out "blue sky" mode 1 research. A reconfigured RAE2008 and its impact on HEFCE's research funding method will result in financial recognition of such distinctive missions and support the financial viability of these institution's departments.

2. Whilst recognising that financial support for research in HEIs is limited, we see serious issues concerning any move to planned research concentration and the basis on which decisions on concentration are made. The challenge for policymakers is that the ground-breaking science and technology we need for the future UK economy is simply not just an evolution from that in current highly funded institutions. The UK therefore needs to maintain a breadth and diversity of mission in its research intensive HEIs. Equally, any move to concentration seems focussed entirely on mode 1/RAE metrics which miss key elements of the UK's research base (as discussed in point one above).

3. We have no comment to make on weightings in the HEFCE funding formula.

4. As a wholly postgraduate institution we recognise the imperative of research informing education at this level and cannot envisage substantial science/technology PG education being conducted in 'teaching only' departments.

5. The regional context of HEIs is diverse and complex. Our view is that regional outreach is not independent of leading-edge research, but that these elements are interdependent. It is therefore imperative that regions have access to HEIs with leading-edge research departments which in a complimentary manner can provide technological outreach to regional commerce, as well as high class education to their communities. The issue of maintaining regional capacity as far as Cranfield sees it is much more one of unevenness of funding between regions, rather than one of lack of capacity or will to engage.

6. As a market-led specialist institution we wish to make no response on the subject of government intervention.

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APPENDIX 37

Memorandum from the Association for the Study of Animal Behaviour (ASAB)

ASAB was founded in 1936 to promote the study of animal behaviour, and membership is open to all who share this interest. It has approximately 2,000 members from Britain, Europe and many other countries outside North America (where it has close links with its sister society The Animal Behavior Society [ABS]). Many members are professional biologists in Universities, Research Institutes or schools. ASAB owns the leading international subject journal *Animal Behaviour,* which it co-edits with the ABS, promotes the study of animal behaviour by holding conferences and supports research by offering members research and travel grants, sponsorship for workshops and vacation scholarships for undergraduates. It promotes the ethical treatment and conservation of the animals through its Ethical Committee and the teaching of animal behaviour in schools through the activities of its Education Committee. It also convenes a joint coordinating committee of European animal behaviour societies. ASAB is a registered charity (no 268494).

Responses to points requested by the Committee:

1. The Impact of HEFCE's Research Funding Formulae, as Applied to RAE Ratings, on the Financial Viability of University Science Departments

While the need for some objective basis on which to distribute support is acknowledged, the RAE as a mechanism is unsustainable in the long term: (a) it is too vulnerable to game-playing and has become an end in itself, (b) it focuses on only one function of universities: research, with the result that staffing priorities have been seriously distorted and the integrated relationship between teaching and research fractured, (c) it parochialises subjects into ephemeral research specialisms and undermines the sustainability of subjects *sensu lato* within institutions, (d) the funding consequences of underperforming in the RAE make it very difficult, if not impossible for "failing" institutions to recover. While the forthcoming RAE exercise promises to be somewhat less formulaic, it still suffers from the limited focus of its predecessors. A more rounded set of criteria, integrating the different functions and outputs of HEIs, is required for a balanced assessment of an institution's contribution to the economic and intellectual health of the UK.

2. The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of Such a Trend

Increased concentration of research in fewer institutions would undermine intellectual competition, impoverish research by reducing the capacity for innovation and the ability of institutions to respond flexibly to new opportunities, and impact on the sustainability of high quality teaching within the sector.

3. The Implications for University Science Teaching of Changes in the Weightings Given to Science Subjects in the Teaching Funding Formula

It is widely acknowledged that the existing level of support for science teaching is inadequate. There is a particular problem with supporting practical work, which has dwindled dramatically in some areas, especially the biological sciences. At a time when the predominant focus of higher education funding is on research, it is a matter of serious concern that opportunities for practical training and independent project work are such notable casualties of the shortfall. There has been a similarly worrying decline in support for fundamental systematic biology, which is crucial to any understanding of the natural world. As a society concerned with whole organism animal biology, we are also concerned about the increasing unsustainability of animal-based teaching and research training in UK institutions as a result of the constraints of Home Office and Health & Safety legislation and the soaring costs of animal maintenance as institutional charges become centralised and geared to full cost recovery research. In saying this, ASAB regards the ethical regulation of animal-based research and teaching, and the principle of the 3Rs, as of paramount importance, and would draw attention to its own ethical guidelines and review processes in this respect (www.asab.org). The issue is one of sufficient resourcing to embrace these needs within the demands of high level teaching.

4. The Optimal Balance Between Teaching and Research Provision in Universities, Giving Particular Consideration to the Desirability and Financial Viability of Teaching-only Science Departments

Teaching and research are mutually reinforcing within a higher education context. Research informs high quality teaching and provides the "added value" of university courses to bright students, while teaching enthuses, and begins to train, the next generation of researchers. Teaching would inevitably take on an impoverished, second-hand quality in teaching-only institutions and should remain in partnership with research throughout the sector.

5. The Importance of Maintaining a Regional Capacity in University Science Teaching and Research

Useful where naturally appropriate, but should not be a required goal of any institution.

6. The Extent to Which the Government Should Intervene to Ensure Continuing Provision of Subjects of National or Regional Importance; and the Mechanisms it Should Use for This Purpose

Ensuring strategic subject provision across the sector is vital. One way of encouraging this is to reward institutions for the rounded scholarship (integrated teaching and research profile) of their provision, rather than focusing narrowly on research performance, which has a disruptive effect on the balance and sustainability of subject areas. Specific financial incentives to attract students or fund new posts in strategic areas are also likely to be effective

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APPENDIX 38

Memorandum from the Committee of Heads of University Geoscience Departments (CHUGD)

The Impact of HEFCE's Research Funding Formulae, as Applied to Research Assessment Exercise Ratings, on the Financial Viability of University Science Departments

Overall, universities are driven by two things—money and league tables. The league tables include the RAE grade and teaching quality assessment as well as such factors as student A level scores. Due to the strong gearing of RAE grade in the funding formula, Universities look to those departments with lower grades and instigate a departmental plan to improve the grade at the next RAE. The most straightforward way to do that is to evaluate all the academic staff, look at those with the weakest research record and take action. Almost inevitably those individuals will be the people with the highest teaching loads, and who are running the undergraduate and postgraduate teaching—lectures, practicals and fieldwork—programmes. Their loss reduces the teaching effectiveness of the department and results in a decline in the student experience and achievements. This feeds through negatively into student recruitment in subsequent years. The new RAE system is designed to avoid the "cliffs" between the grades, and will mean that all academic staff can be submitted with no loss of income. However, it is inevitable that the results will be used to form league tables, and the pressures to lose the essential academic coordinators who will inevitably be lowly-rated for research will continue.

A significant problem with RAE ratings in the Earth Sciences is that commissioned research was largely discounted from the RAE exercise. This had a heavy negative impact on many departments (especially, but not exclusively, in post-1992 Universities) working closely with industry, and does not seem to be compatible with the Government's S&T 10 year framework, viz:

"The strategy will provide a framework for a successful and competitive science and innovation system in the UK, based on:

- a financially robust network of universities and public research laboratories across the UK;
- world class research;
- a continuing step-change in the responsiveness of the research base to the needs of the economy;
- raising business investment in R&D and innovation and encouraging stronger business engagement with the ideas and talent of the UK research base;
- making the supply of science and technology skills more responsive to demand;
- greater flexibility within schools and universities to attract the skills they need; and

— greater public understanding of, engagement with and confidence in UK scientific research and its innovative applications.

The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of Such a Trend

Since Earth Sciences is only taught and researched in a small proportion of UK Universities (compared with Physics, Chemistry, Mathematics and Engineering), the impact of further increased concentration would be a marked reduction of choice. It would reduce the opportunities for industry, businesses, SMEs etc to work with their local University, and they are less inclined to invest in R&D with an institution with which they perforce have a more distant physical relation. One of the strengths of earth science departments over the years has been their diversity, with a few large, high profile departments with prominent research schools, but also a number of smaller, mainly post-1992 Universities, concentrating on teaching and applied geology research linked to local industry. The former are being decimated, while the latter are simply disappearing altogether. This is a largely unplanned activity—Universities are simply responding *ad hoc* to "market forces". In contrast, the Oxburgh Review of Earth Sciences in the late 1980s resulted in major structured reorganisation of the subject within UK Universities, with significant injections of money for equipment and facilities, and to enable mobility of academics. Our understanding is that the proposed follow-up reviews of other subjects (eg Sam Edwards' review of Physics) were shelved because of the high cost of implementing the Oxburgh Review. A case can be made to reorganise to concentrate existing effort into a smaller number of University departments, but it is not cheap. What is happening instead is that capacity and output are falling as departments close. The consequences of this are that we are unable to produce the workforce, and undertake the R&D, that the country needs.

The Implications for University Science Teaching of Changes in the Weightings Given to Science Subjects in the Teaching Funding Formula

We reproduce below our response to the previous consultation on this matter. The tables of supporting data are missing, but the conclusions are clear. We can provide the tables if requested by the Committee. "CHUGD emphatically disagrees with the proposal to split the price group (Question 1 of the Response Document) and specifically with the proposed assignment of Geosciences to price group B2 (Question 2).

Comment on HEFCE methodology

The proposed category of Earth, Marine and Environmental Sciences embraces very different levels of high cost laboratory and field-based activities. The bench mark statements (Quality Assurance Agency for HE) clearly recognise this distinction:

The grouping of Earth, Marine and Environmental Sciences (Annexe A, Graph 14) has one of the largest standard deviations, and differences between mean and median, for the group size (as judged by FTE). The table of underlying data provided by Thom Brain shows extraordinary variability, even for a given institution, the figure can change by a factor of two over the five-year period studied by HEFCE, ie the data are particularly non-robust. HEFCE's choice of measures and treatment of the data are therefore inappropriate. We are also unclear as to whether the regressions are weighted by number of students, which we feel is important in this instance, as there are many institutions teaching small numbers of students.

Modern Earth Sciences departments provide laboratory-based training in chemical and physical techniques in precisely the same way as do Chemistry and Physics departments. It is these scientific skills which are highly valued by industry and other employers, eg our resource industries from water through to the extractive and the energy industries. Earth Science departments therefore have the same equipment and resource needs as Chemistry and Physics departments.

Since the university sector spends most, if not all, of its HEFCE income each year, crudely speaking, at institutional level those cost centres showing costs below the price group average must be cross subsidising those above it. It is highly likely that those cost centres that have been able to recruit strongly in many universities have been subsidising those that have found it increasingly difficult to recruit. In Cost Band B Physics and Chemistry have been under considerable recruitment pressures in recent years whereas student numbers in Earth, Marine and Environmental Sciences have remained buoyant. To subdivide the cost centre into two different sub-bands will only serve to support subjects performing poorly at recruitment and retention at the expense of the rest. To expect universities (Review, para 18) to allocate HEFCE funding using a methodology which fails to echo the HEFCE original is unrealistic.

Fieldwork

Earth Sciences programmes are highly field intensive, and must meet extensive fieldwork requirements to obtain professional accreditation by the Geological Society of London, the professional body for UK geologists. Most earth sciences departments spend a considerable amount (5–10%) of their "T" income supporting fieldwork programmes and this generally falls well short of the full costs, typically covering only

50–70% of total fieldwork expenditure. Students have to contribute the difference. In most cases this is a considerable sum, typically three figures per annum. Loss of "V" income to Earth (and Environmental) Science Departments will inevitably lead either to significant increase in fieldwork costs for students or to reductions in fieldwork. We cannot identify any other ways of reducing costs or increasing "teaching efficiency".

In the majority of our institutions, the fieldwork costs passed on to students have increased significantly during the past decade. If they increase any more, we anticipate that the financial burden imposed on students will result in a substantial reduction in Earth Science admissions. This, coupled with increased drop-outs for financial reasons, will lead to major reductions in Earth Science graduates. Arguments that students will simply have to generate additional income during vacations are unrealistic for our students. Because of timetabling and other restrictions, our fieldwork programmes usually take place outside normal University teaching times, particularly vacations and weekends or during extended terms. Thus Earth Science students are doubly penalised having to contribute to the cost of field courses, and being unable to undertake paid work while they take place.

If we adopt the alternative policy of reducing fieldwork activities, we will not be able to mount degree programmes that satisfy the accreditation requirements of the Geological Society. In addition, industry already complains of a reduction in fieldwork and practical experience in graduates. Any further reduction in fieldwork would lead to major concerns about the viability of UK Earth Science degrees.

Fieldwork programmes tie up significant amounts of staff time, in part to ensure that we operate within the Health and Safety Executive framework. This reduces the time available for applying for and conducting paid research; thus, there is a double financial penalty for Earth Science departments.

Recognition of this essential fieldwork component must therefore be reflected in the price group to which Earth Science is assigned.

Other costs

Fieldwork is not the only significant financial outlay for Earth Science departments. Our teaching necessarily includes the physical, chemical and biological properties of earth materials. We therefore have high costs associated with expensive equipment, dedicated laboratories, and IT facilities, to at least the extent required by physics and chemistry departments. Many disciplines are highly specialised, meaning that a large staff complement is required (including technical and other support staff) to teach and train students effectively. We find it hard to believe that the difference in costs for earth science compared to physics and chemistry in the HEFCE figures is due to a genuine greater expense for physics and chemistry teaching, and is more likely to be due to higher staff, laboratory space and equipment costs than is now justified by their diminishing student numbers.

Further comments

The UK needs well-trained geoscientists. They are essential for hydrocarbon and mineral exploration and exploitation; groundwater resources (where the UK has responded well to EU directives), brown field site studies, monitoring and remediation and a variety of other industries. They are also highly-valued by a number of other employers of science graduates for which the specialisation is less important, in particular for their well-roundedness, ability to apply their knowledge to new situations and problems, capacity to think "out of the box", and the transferable skills they bring. We take our teaching seriously, a fact which is reflected by LTSN-GEES (the Learning and Teaching Support Network in Geography, Earth and Environmental Sciences) being judged the top learning centre.

Proposing to divide up, and reduce the funding for part of price group B is divisive. We cannot afford to divert the efforts and energy of scientists and engineers from teaching and research into change management at a time when attracting science and engineering students is so difficult, and when the country needs well-trained and numerate scientists more than ever. We argue that, reducing T income from Earth and Environmental Science and related subjects will do nothing to increase recruitment to those Band Bi subjects that recruit low student numbers. It will, however, lead to a reduction in Earth and Environmental students, thereby significantly reducing the total number of science graduates. Science and engineering need more money to train the 21st century workforce, not less. The increasing demand for scientific and engineering-based skills, and demographic changes, threatens the UK's productivity, competitive position and level of innovation through a shortage of appropriately-qualified people."

Note that this response touches on the issue of recruitment of science undergraduate students, and science teaching in schools. CHUGD in convinced that poor science and mathematics teaching is reducing the pool of students willing to contemplate science and engineering degrees, either because they feel they don't have the necessary skills ("I'm not clever enough to do a science degree"), or because they have found science boring at school (or both). Many individual members expend considerable effort to help school teachers, by giving talks (the recent Asian earthquake and tsunami disaster has provided a sad but popular topical theme), and providing exciting teaching materials using earth science examples to convey basic physics, mathematics and chemistry, hoping that such examples will make basic concepts more accessible to students. But the impact of such measures does not extend much beyond local schools. CHUGD is a member of the Earth Sciences Education Forum (England and Wales), which includes such other interested bodies as the Earth Sciences Teachers Association and the recently opened Earth Science Education Unit at the University of Keele. Well-coordinated and well-focussed efforts provided by bodies such as these can have greater impact, but they are invariably run on a shoestring by dedicated people in their "spare time" (as is the schools liaison activity of most academics). Additional finance to establish and run science-based workshops, talks, and activities with local schools would assist in raising the profile of science in the teenage community. These activities should be required of each university and department and funded by HEFCE. Increased funding isn't sufficient to ensure better provision, but it is necessary.

The Optimal Balance Between Teaching and Research Provision in Universities, Giving Particular Consideration to the Desirability and Financial Viability of Teaching-only Science Departments

Teaching-only science departments are undesirable. They would automatically become second-rate with the best students preferentially attending departments with better RAE grades. Students benefit enormously from being taught by staff engaged hands-on in research; staff like the opportunity to do research, and therefore have greater job fulfilment which students sense, research results and methodologies are often brought into teaching material, research contacts can lead to cutting-edge student projects, and being an active researcher means keeping up-to-date with the subject. The move to full economic costing is likely to change the current balance (whether optimal or not) in that it is widely anticipated to lead to further concentration of research in fewer, larger institutions with high RAE grades.

The Importance of Maintaining a Regional Capacity in University Science Teaching and Research

CHUGD represents something of a "niche" subject in which there has never been regional capacity. However, for basic science, we strongly support the provision of regional capacity in both teaching and research, given the decreasing mobility of students with the increasing debt burden they face. Top schools will always send pupils to university, but generally there must be local provision so that there is no postcode discrimination in opportunities at degree level. Science must not become a niche set of subjects. For all science, technology and engineering subjects, there are occasional "strategic" reasons for having a particular department in a given location, for example, to take advantage of local industry (for both site visits as part of student coursework, and liaison over student projects and research activity), or local sites of special scientific interest, or other field locations (in our case, quarries, coastlines, and particular geological features). In addition, Universities provide a focus for local further and continuing education, and public understanding of science, activities.

The Extent to Which the Government Should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance; and the Mechanisms it Should Use for This Purpose

A technological society as we are has a long-term strategic need for science, engineering, technology and medical graduates. They are required not just to fill the high-profile top level positions, but at all levels, since the system cannot function without technicians, chemistry teachers, etc Provision could be achieved and assured by raising the subject cost factor so that the universities are able to keep science departments open instead of their current practice of trading science students for students who can be crammed into large lecture theatres and do not need the laboratory space or the long contact hours of teaching each week.

To stimulate demand, additional financial provision for students on all science degree courses (probably paid year-by-year on completion or upon graduation) would encourage teenagers to consider science more seriously at AS and A level and at university. A write-off of some part of the student loan upon graduation with a science degree would be another option, similar to the golden handshake system.

CHUGD is concerned that the UK is not producing adequate numbers of earth sciences graduates. Over recent years, the number of vocational MSc courses and places, as well as the number of PhD places, in Earth Science, have reduced drastically. The country is facing a serious skills shortage in key subjects such as hydrogeology, mining engineering, exploration geophysics, environmental geoscience (especially where health matters are concerned) and engineering geology; these shortages have been well documented by the Natural Environment Research Council (eg NERC Training Review, 2004). At a recent meeting organised in the Houses of Parliament by the Earth Sciences Education Forum (England and Wales), the Environment Agency (with statutory responsibility for fulfilling the European Union Water Directive) said that it was trying to train people in-house to MSc level because they are unable to recruit staff at the necessary level and there are no Universities in the UK able to offer the course they need. Many traditional employers of UK earth scientists, particularly in the hydrocarbon sector and supporting exploration industries, are seeking to recruit significant numbers over the next decade to replace a "bulge" in staff reaching retirement age. At the same time, there is a huge expansion in the extractive industries. The UK is currently not training enough earth scientists to satisfy demand, either at BSc or MSc level—some members are reporting that even BSc students without specialist training are walking into jobs at the moment. Earlier, NERC argued that the companies in need of the MSc graduates should be funding places on courses; the companies retort that they already pay taxes to cover this. Furthermore, more skilled earth science jobs associated with these industries, and with environmental monitoring, protection and remediation, are transferring into SMEs. Although collectively SMEs recruit a significant fraction of MSc "output", individually they only recruit rarely because by their very nature they employ small numbers. They are not in a position to provide regular and continuing support to MSc courses to maintain their viability. Last year (NERC Training Review 2004), NERC accepted that companies can contribute by supporting MSc courses "in kind", but in the meantime, many MSc courses have closed without NERC support. It seems inconceivable to CHUGD that Government should not feel it necessary to intervene to ensure an adequate provision of earth science graduates, particularly at MSc level in subjects of strategic national importance. The exact mechanisms should be determined by a proper analysis of future need, followed by implementation of a policy to achieve the required provision, in stark contrast to the "market" (ie student preference) led, short-term "planning strategies" currently adopted by Universities and Government.

January 2005

APPENDIX 39

Memorandum from the University of Durham

1. The Impact of HEFCE's Research Funding Formulae, as Applied to Research Assessment Exercise Ratings, on the Financial Viability of University Science Departments

The research funding formulae have had a strong effect on the financial viability of science departments. Since it has been acknowledged by the Government that research has been systematically under-funded in recent years, it follows that the most expensive research, mostly that in Science, has frequently required some form of subsidy. Whether this has been provided by neglecting infrastructure and maintenance or by cross-funding from other non-science research activities within universities, the effect of reducing significantly the QR funding for RAE grade 4 departments (nationally excellent) has been to call their viability into question. There is a multiplier effect in that the general under-funding of Science, even in 5* departments, produces pressures within universities which seek to protect the top-rated departments at the expense of lower graded subjects. Even SRIF funding, that was designed to compensate for the decay of the scientific infrastructure via a formulaic allocation, was not automatic for bids led by RAE grade 4 departments.

Attractive additional sources of income might appear to be the recruitment of extra postgraduate and overseas students and from commercial contracts. It is of course difficult to do either of these if a research reputation is low but it is not impossible. It is those science departments that are unable to tap into these alternative sources of income and whose research rating is currently at 4 or below which are most badly affected by HEFCE's funding formulae.

2. The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of Such a Trend

It is acknowledged that concentration is needed in certain research areas. Of course concentration is useful and economically necessary for research relying on expensive facilities, not just mega-pound scanners but specialist libraries. Other benefits of concentration include the relative ease of ensuring a good "research culture" within a subject and of fostering inter-disciplinary work between subjects. But if a good research culture at subject level were not possible in smaller departments, the RAE exercises would have explicitly penalised them and very small 5* departments would not have emerged. We therefore do not believe that concentration is automatically good for all subjects for all time.

Those areas of research that require large teams and a strong "research culture" involve research students, visitors, research workers and academic staff interacting frequently. Some other areas do not. An example of the former is "big" science such as Particle Physics or Astronomy. An example of the latter is that many areas of Pure Mathematics might require only one individual or a very small team in order to be world-leading and would derive little benefit from concentration. However, developments in communications such as of the Access Grid mean that in future many of the benefits of concentration might be available without physical co-location. This may be particularly true in areas of research which depend mainly on computers, for example Computational Chemistry, Theoretical Physics and Bioinformatics.

One drawback to unplanned concentration is the loss in some universities or regions of one or more of the core sciences such as Physics, Chemistry or Biology. Without a balanced portfolio of physical and biological sciences, growth in new interdisciplinary areas could be inhibited in that university or region. Such work by its nature frequently grows from contacts between different specialists and so can be facilitated by their physical proximity.

Another drawback is the possibility that a regional group of universities cannot offer core science subjects to local students from which WP candidates are frequently drawn, cannot participate in outreach to schools in those subjects and cannot offer a technology transfer service to the local community and industry.

In summary, concentration must not be allowed to be a consequence of other drivers such as purely financial ones but its desirability must be looked at on a case-by-case basis, allowing not only for the good of a subject at present but also future trends and emerging interdisciplinary fields.

3. The Implications for University Science Teaching of Changes in the Weightings Given to Science Subjects in the Teaching Funding Formula

This is difficult to quantify because it happened at a time when Rewarding and Developing Staff money was included in mainstream T funds for the first time. The previous year large changes were also made to the way Widening Access and Improving Retention money was distributed which adds further complications.

We estimate that the net effect of re-banding in Durham was a reduction in the income attributed to our Science Faculty of approximately £1 million. Inevitably, there is pressure internally to direct funding to those departments which appear from the HEFCE formula to make a net contribution to the University. Since the Price Band changes were made these departments are increasingly found in Arts and the Humanities. There would be a significant impact on Science teaching in the University if this were to happen and we were merely to pass on the income as it was "earned" with the new price banding.

Another consequence of strict subject banding is the under-funding of some teaching arising from the significant differences in costs within subjects depending on the nature of the research base and hence in some respects the emphasis in teaching. As an example, Psychology departments can be largely laboratory-based neuroscience with expensive scanners at one end of a spectrum to a department similar in its needs to Sociology at the other. Physics departments can contain many large experimental facilities or be full of theoreticians. Through the research in a subject informing the teaching and because science undergraduates are exposed, especially in their later years, to the research of their teachers, the banding structure for teaching resource does not make sufficient allowance for these factors.

4. The Optimal Balance Between Teaching and Research Provision in Universities, Giving Particular Consideration to the Desirability and Financial Viability of Teaching-only Science Departments

At Durham it would be unthinkable that we should have teaching-only science departments. We believe that high quality science teaching at university level must be informed by active engagement in research. Especially in the final year of an undergraduate programme, the material offered should be directly informed by the latest research and scholarship rather than rely on yesterday's knowledge via textbooks.

In the case of four-year undergraduate Masters programmes, active research is strictly necessary in the teaching departments. The fourth year of these programmes generally contains a large element (usually half of the year's activity) of research in an established research group or with a research-active academic. It would not be practical and neither would it be permitted by the various accrediting bodies to offer these programmes without a vigorous research base. In Durham 40% of all science students are enrolled on such four-year programmes, and this will be likely to increase when some subjects without four-year programmes offer them.

Finally, the close engagement of undergraduates with active, often young, researchers plays no small part in Durham's extremely low drop-out rate.

The direct answer to your question is that teaching-only science departments are highly undesirable and probably unworkable, at least those that teach subjects to a level required for progression either to research or a professional qualification.

5. The Importance of Maintaining a Regional Capacity in University Science Teaching and Research

We agree that there should be a regional capacity in university science teaching and research. This capacity will inevitably vary from one region to another. For example, the North East of England has a very strong presence in the chemical and pharmaceutical industries. Its RDA has placed the universities of the region at the heart of its regeneration strategy. It is essential to the regional economy that the Universities of Newcastle and Durham have the capacity to provide research that brings tangible benefits to these industries via our departments of Chemical Engineering and Chemistry, respectively. The same can be said for the five regional Centres of Excellence in which we play vital roles.

The proportion of school-leavers who stay in post-16 education and enter higher education is smaller in the North East than in any other English region. This poor take-up is particularly marked in science subjects in which there is a correlation between school type and the achievement of the good grades at science A levels which are needed for entry into the core science subjects at university. A significant role in the region for universities like Durham is to foster links with schools and with teachers, across the science subjects. Durham University hosts the North East Regional Science Learning Centre which engages with professional development of science teachers in the region, in part through creating partnerships between teachers and active researchers.

6. The Extent to Which the Government Should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance; and the Mechanisms it Should Use for This Purpose.

At regional level the RDA might take a view on the desirability of maintaining subjects of local importance, as the North East RDA has effectively done. Nationally the problem is not new and no consensus has emerged over the years about even the desirability of explicit national planning by Government. However, implicit national planning has been and is being carried out through the decisions that have been taken in the relative funding of subjects by HEFCE (teaching and QR), the relative funding of the Research Councils and by the DTI and other ministries. Market forces have been modified frequently, for example by supplying the same teaching resource for a Chemistry student despite significant variations in costs at different localities. A clear example of dealing with shortages in strategically important subjects is in the teaching arena where there have been special measures for some years, aimed at individuals, which aim to make a teaching career in some sciences more attractive. These measures have not had any impact on the supply of potential recruits but on the proportion going into teaching.

One thing is clear, any attempt to tinker any more must start with a clear strategy that most players are signed up to. The system has been blown one way then another in the last decade or more and some clarity of purpose would be preferable to sporadic panic measures and challenge funding to deal with discovered deficiencies. The problem is that any clearly articulated strategy might well involve sums that would inevitably cause the Treasury to blink and the issues would be fudged. On the other hand it might not.

January 2005

APPENDIX 40

Memorandum from the Royal Astrological Society

Executive Summary

1. There is a national problem in both teaching and research in science, engineering and technology (SET). This is not simply special pleading by academics, as Sir Gareth Roberts' (2002) Review and others make clear.

2. Physics education at degree level must be regarded as of strategic national importance. Astronomy and geophysics provide a stimulating context in which to teach physics. They also have important roles in the public understanding of science. In particular, astronomy has a key role in attracting young people into science.

3. The impact of changing funding formulae are marginal to the national (though clearly not individual) provision—Universities are underfunded, leading Vice Chancellors to rationalise provision by reference to the costs of supplying lower demand subjects. This poses a threat to SET in many Universities.

4. The long term solution is a) better resourced/managed Universities and b) attracting more undergraduate students to SET through better school teaching and careers advice. The latter should trigger a feedback loop of attracting more scientists to teaching and more pupils to sciences.

5. Short-term intervention is almost certainly necessary to protect SET provision. This could be targeted towards "key departments" (using criteria such as regional distribution, RAE rankings, QA reports), but the most important aspect is that it needs to be "new" money, for example, from the Chancellor's promised extra cash for SET. However, we know and understand the Government's reluctance to interfere in the running of Universities, which are autonomous bodies, and we are acutely aware of the negative impact on academics of further paperwork, performance targets, and league tables.

The Royal Astronomical Society is the learned Society representing astronomers (both professional and amateur) in the UK. It also represents a significant number of professional geophysicists, particularly those interested in the solid earth (and comparative planetology)—those with primarily interests in the shallow sub-surface are more likely to belong to the Geological Society of London. A significant number of the Society's members are employed in physics, astronomy and earth sciences departments of UK Universities. The Society is very concerned about the state in which science departments in UK Universities find themselves. We have recently commissioned two studies of UK undergraduate education, in astronomy and geophysics, to try to understand some of the causes of the decline, particularly in the numbers of undergraduate students studying these subjects, and to make recommendations to stem it. The outcome of these studies will be reported later this year, and we are happy to share the results with the Science and Technology Committee. In conjunction with EPSRC, PPARC and the Institute of Physics, we have commissioned a follow-up (to compare with the first in 2000) International Review of UK Physics in the UK; the panel will visit the UK in November this year and report early next. Again, the results will be publicly available should the Committee wish to study them.

We suggest that a sensible starting point for the Committee's enquiry is to revisit the 2002 Sir Gareth Roberts' Review. In his covering letter, Sir Gareth states:

> "The Review has identified a number of serious problems in the supply of people with the requisite high quality skills. They are not equally spread across science and engineering; indeed, the aggregate numbers of students with broadly scientific and technical degrees has risen in the last decade. However, there have been significant falls in the numbers taking physics, mathematics, chemistry and engineering qualifications. These downward trends, combined with deficiencies in transferable skills among graduates, could undermine the Government's attempts to improve the UK's productivity and competitiveness. Furthermore, these discipline related problems will have negative implications for research in key areas such as the biological and medical sciences, which are increasingly reliant on people who are highly numerate and who have a background in physical sciences."

The trends identified in that report have continued, and there is therefore a continued, increasingly serious, threat to the nation's productivity and competitiveness. Thus the issue is not simply science teaching and research across Universities. The Roberts review made a number of recommendations, from schools level (since schools provide the "raw material" for higher education) through to employment via the Universities. Implementation of these recommendations would have a significant positive impact on the situation, both in terms of the scope of the enquiry, but also more broadly in terms of the "health" and wealth of the nation.

The Government's own 10 year Science and Technology Framework has a number of key guiding principles:

"The strategy will provide a framework for a successful and competitive science and innovation system in the UK, based on:

— a financially robust network of universities and public research laboratories across the UK;

— world class research;

— a continuing step-change in the responsiveness of the research base to the needs of the economy;

— raising business investment in R&D and innovation and encouraging stronger business engagement with the ideas and talent of the UK research base;

— making the supply of science and technology skills more responsive to demand;

— greater flexibility within schools and universities to attract the skills they need; and

— greater public understanding of, engagement with and confidence in UK scientific research and its innovative applications"

We will refer back to some of these principles below. They are not all covered by the points raised in the invitation to give evidence, so we comment further at the end of this document. We now address the specific issues on which we were invited to give evidence; some of our remarks cover more than one issue within a specific response, since they are to some extent linked. For the same reason, we do not address them in the order in which they were posed.

The Impact of HEFCE's Research Funding Formulae, as Applied to Research Assessment Exercise Ratings, on the Financial Viability of University Science Departments

The main reason that University science and engineering departments are closing is the fall in numbers of students wishing to study these subjects, whether measured as a proportion of the total higher education student population (which is increasing) or even in terms of actual numbers. "Tinkering" through formulae associated with RAE grades, weightings given to different science and engineering subjects in the teaching funding formula, and other manipulations of income merely help determine which departments in which institutions close, ie those judged by management to be weakest. A far more significant impact is expected through the change to full economic costing on research grants (ie the destruction of the dual-funding formula), which is likely to stimulate many more closures. This is not to say that the RAE formulae and teaching subject weighting changes do/will not have any effect on viability of individual departments in individual institutions—of course they do/would. Management of Universities look at how their "cost centres" (often departments) function within the funding model used by that institution. Those that are consistently in deficit tend to be (depending on whether those staff the institution wishes to keep can be re-deployed elsewhere within it, redundancy costs, whether it hosts a high-profile externally-funded facility, and the like) the ones closed down to keep the institution viable, regardless of arguments related to strategic need, uniqueness, quality of the staff, amount of recent investment etc It sets departments against departments, and colleague against colleague. Since funding comes into the institution formulaically, it is hard to argue that the money should not be spent formulaically—members of a more successful department would not be happy providing a long-term subsidy to a "falling" department, when they see plenty of uses for the money within their own. Appeals higher up the line for changes in the formulae used are met with the response that, although money is earnt formulaically, there is no need for the institution to disburse it through the same formula. Of course, each institution has its own cost model, so a "failing" department in one might be successful in another, through something as simple as the way space was costed, for example. Thus we have a scenario of closures simply due to Universities responding to short-term market forces. There is no real budget policy beyond this: fiddling with formulae is a marginal activity. Does the Government wish to ensure a long-term supply of qualified scientists and engineers for the UK beyond that which the present market will supply? If so, it needs to put a policy in place and reflect that in the way budgets are set—budgets need to be the tools of policy, not a substitute for policy. Ideally, this policy would surely include stimulating supply and demand, but in the short term, it is almost inevitable that a significant element of pure subsidy will be required even to maintain the status quo. We make some suggests below concerning stimulating growth.

The Implications for University Science Teaching of Changes in the Weightings Given to Science Subjects in the Teaching Funding Formula

With high costs associated with both teaching and research, and falling student numbers, science and engineering departments are the most vulnerable. The current teaching weightings are insufficient to compensate for the additional costs of educating a science or engineering student, but the money Universities receive for educating undergraduates is insufficient anyway—it's just that the gap is larger in these subjects. (Witness the recent statement by Oxford University that they are to reduce their numbers of "home" students in favour of full fee paying students to cut the amount by which they subsidise teaching.) Re-adjusting the weightings within the science and engineering subjects is no solution. The earlier proposals were seen by those in science and engineering departments that would have lost out as compensating subjects that had done a poor job of undergraduate recruitment—their costs are higher per student simply because the overall cost of, for example, maintaining a piece of laboratory equipment is divided by the smaller number of students it was servicing. A further effect of the shrinking science and engineering population is that each department teaches its students more "in house". There are two reasons for this. The first is to retain a higher proportion of student FIFE income—for example, whereas physics students would have been taught mathematics by colleagues from the mathematics department, they are now far more likely to be taught mathematics by physicists. The second is that they have no choice if the "partner" department has closed down. Neither enhances the educational experience of students.

The Importance of Maintaining a Regional Capacity in University Science Teaching and Research

Astronomy and geophysics are subjects taught and researched in only a small number of institutions and it is unrealistic to expect regional capacity in these subjects. Few undergraduates specialise in them—Society members who are UK University academics tend to spend most of their undergraduate teaching time with physics or geology students. However, we have a hard time understanding how a University can claim to teach physical science if it doesn't have the fundamental building blocks of physics, chemistry and mathematics departments. Since, as the Roberts review, the DTI "SET Fair" (Greenfield) report, and numerous other studies, have noted, the UK needs more physical scientists, it makes sense to provide/maintain regional capacity in these subjects, if only because increasing numbers of students are studying from home, or in places where living costs are lower, to reduce the debt they (or their parents) build up during their undergraduate studies. What we are seeing instead is an increasing concentration of both teaching and research in the physical sciences in fewer institutions. Universities are becoming unbalanced—they might have a big physics department, but no chemistry department. This is detrimental to teaching, and also makes the departments that survive more vulnerable—a small tweak in funding formulae (teaching or research), a couple of failed large grants applications, or a need to replace a major facility, and they can be struggling.

The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of Such a Trend

We have argued that the concentration of both teaching and research is happening *de facto* through closures, which themselves are governed by "market forces" affecting where and what students choose to study, and how research monies are distributed (both as a result of the RAE formula and through research grant and commissioned research income). There is no policy or strategy associated with it. There is no attempt to assess how the losses affect the responsiveness of the research base to the needs of the economy, business investment in R&D and innovation, business engagement with the ideas and talent of the UK research base, and the ability to respond to demand in the supply of science and technology skills. Even if the assessment were made, there is no mechanism for using it to intervene to protect a department, since Universities are autonomous bodies. Thus the pattern of closures and concentration of research is haphazard. This cannot be healthy.

The Optimal Balance between Teaching and Research provision in Universities, Giving Particular Consideration to the Desirability and Financial Viability of Teaching-only Science Departments

Teaching is best done in Universities with a substantial research effort in the relevant subjects, both main and subsidiary, relevant to the course a student is taking. Having, say, a physicist teaching chemistry because the chemistry department has closed, or having chemistry taught by a chemist in an essentially teaching-only department (or by the "tame" chemist kept on in the physics department to satisfy the teaching need after the chemistry department closed) is a poor second. Many of us can provide examples of our research informing our teaching, and the "extra" this brings to teaching is frequently favourably commented upon by external reviewers during quality assurance assessment. There is an unfortunate assumption in some quarters that departments with strong research records do this at the expense of their teaching. In most cases, the contrary is the case—teaching is better in departments where the majority of staff are involved in high quality research. However, for many academics, most of their research is undertaken in their "spare" time, with greater than 60 hour working weeks being the norm. For most, it is not the balance between what we see as our "core" activities of teaching and research that is the issue, but the increase in time spent on (largely pointless and irrelevant) administration and paperwork. Increasing student-staff ratios have an impact, too, as does the extra time most of us find we have to spend on "welfare" and pastoral care aspects of having students eg worried about debt, and undertaking more paid work to the detriment of their studies and health.

Further Comments

The S&T 10 year Framework's guiding principles mention the need for "greater flexibility within schools and universities to attract the skills they need". Unless or until the UK reverses the decline in numbers of students studying science and engineering at undergraduate level, the situation can only deteriorate, and more and more departments will close. We have already argued that Government must intervene—the UK's continuing prosperity depends on having a numerate, scientifically trained workforce to sustain high technology industries and the like. However, Universities are just one area where change is urgently needed. At the same time, Government needs to improve the teaching of science and mathematics in schools. Most of us working in science departments in Universities see the poor quality of school science and mathematics education, and the lack of good careers guidance, as the main reason why students do not wish to study them at University. There are too few teachers who are trained in relevant subjects (eg physics is often taught by a teacher without any post-school physics education), and school science laboratories are not well funded/equipped. Other problems exacerbate the situation, such as the perception of science as non-trendy, and not leading to a high earning career, and of scientists as old, grey haired men with beards in white coats. How are we going to persuade young people to study science if they believe that the salaries associated with likely career paths are such that they will never be able to afford to buy a house? Perception thus applies to the subject itself, and its career prospects.

We are privileged, being involved in astronomy, space science and geophysics, in studying subjects that attract enormous public interest and are stimulating contexts in which to convey and teach basic mathematics and science, especially physics (geophysics interest sadly boosted significantly by the Sumatran earthquake and tsunami). The Society takes its "promotion" role seriously, putting considerable resources and effort into media activities (eg press releases, speaking and appearing on radio and television, lending our support to other bodies involved in public understanding of science) and education. Ours and other relevant learned Societies, other interested groups, and individuals, all put significant effort into supporting school science teachers, through training courses, providing teaching materials, and speaking in schools. However, this tends to consist of a plethora of uncoordinated activity, which therefore is somewhat piecemeal and does not have the impact it might. We also have difficulty in finding working teachers willing and able to belong to and participate in our Education Committee, due to conflicts with their teaching commitments. The situation would be alleviated if such activity were viewed as part of their CPD and commitment to the strategic development of education.

January 2005

APPENDIX 41

Memorandum from the Association of Civil Engineering Departments (ACED)

The Committee invited evidence on the following points:

The Impact of HEFCE's Research Funding Formulae, as applied to Research Assessment Exercise ratings, on the Financial Viability of University Science Departments

At present UK has a marginal costing system which does not cover full costs. The introduction of Full Economic Costing of Research will help research active universities to become financially sustainable, however the impact of a drop in research grade, particularly from a 5 to a 4 creates serious financial problems. Ultimately it will lead to the closure of more departments of civil engineering.

This has resulted in viable research teams/units who gained respectable 3s or 4s and who were on track to better things to lose funding. Research activity has thus stopped as active research individuals have sought appointments in grade 5 universities. This has had a negative effect on the delivery of specialist courses, especially at Masters level.

The Desirability of Increasing the concentration of Research in a Small Number of University Departments, and the Consequences of Such a Trend

There is a recognition of the need for a "critical mass" of staff necessary to sustain research in a particular discipline or area and widespread dilution and equal funding for each university would not be practicable or useful.

No university has a Monopoly on innovation and there must be some serious competition in key areas.

The Implications for University Science Teaching of Changes in the Weightings given to Science Subjects in the Teaching Funding Formula;

The reduction of Fee Band B from x2 to x1.7 has encouraged cash hungry VCs to re-examine "resource intensive" engineering provision. The freeing up of lab space and the ending of regular requirements to update or replace expensive specialist IT and equipment are financially attractive options; especially when applications (and associated UCAS scores) for engineering (although rising nationally) are low when compared with other subject provision. At the very least, the decrease in direct funding puts further pressure on a dwindling (and aging) staff base.

The teaching is intensive 20-25 contact hours /week and makes heavy use of laboratories, IT, fieldtrips etc, consequently any reduction in fee puts further pressure on civil engineering departments and universities are increasingly likely to cap the numbers of students admitted to study science and engineering.

The Optimal Balance between Teaching and Research Provision in Universities, giving particular consideration to the Desirability and Financial Viability of Teaching-only Science Departments;

Scientists and Engineers destined to play a leading role in industry and the public sector should be educated in a research-led university.

The Importance of 1maintaining a 1regional 1capacity in 1university 1science 1teaching and 1research

It is vital for the staff development roles of all the Regional Development Agencies in the UK that there are local universities with the knowledge and expertise which can be transferred by using appropriate mechanisms.

The Extent to Which the Government Should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance; and the Mechanisms It Should Use for This Purpose.

The effect of fees in 2006 (£3,000 pa is anticipated for most research-led universities) is unknown. Some argue it may force students to concentrate on studies which have a revenue stream attached and hence Engineering degrees may benefit, whilst others believe that it may make students consider degrees with sufficient "free/study" time to undertake part-time work.

Civil Engineering infrastructure is necessary to keep the country going. Government investment in infrastructure is significant but our national capacity (transport, water etc) is in doubt if we lack the people to run and maintain everything. People complain about railways—but society will be devastated if water, sewage etc start collapsing. Civil Engineering is of national strategic importance—it must be a Government function to support it by direct measures (as they have done with teaching). Government could exempt civil engineering students from fees, could give the title Engineer the same protection as Architect, could restore (or improve) fee band weighting, could direct that school qualifications focus on core subjects (eg maths, English, science, modern language, history, geography) with specialist topics being dealt with at FE and HE.

January 2005

APPENDIX 42

Memorandum from Helen Ayers, Biochemistry Student, Brunel University

I am currently a student in the last year of a four year BSc (Hons) Medical Biochemistry degree at Brunel University. I am submitting this letter as evidence for your enquiry into the strategic science provision in English universities.

My course was originally run in the department of Biological Sciences and the HEFCE's formulae has led to being merged with Nursing and Social Care departments to become the School of Health Sciences and Social Care. The eventual aim of the new school is to teach similar modules (eg physiology) to students across the school. This worries bioscience students as the approach required for the subject content will be very different from that of students studying nursing. As bioscience students are a minority in the new school there is already the opinion that the teaching needs of courses with more students (eg nursing) will be put before those of bioscience students in modules with shared content.

Brunel University is currently in the process of making 60 staff redundancies based on the volume of research undertaken, frequency of publication and revenue generated. The university recently released a list and sent out letters on the voluntary redundancies and only three out of approximately 20 bioscience lectures have not been asked to volunteer for redundancy. If enough lectures fail to volunteer for redundancy, there are going to be compulsory redundancies. It is obvious that this will have a significant influence over the bioscience teaching ability of the school. In its defence the University says that the 60 lecturers made redundant will be replaced by 90 research active staff. However, the University holds the opinion that this will not have an affect on the quality of teaching, although these new staff will have less time to teach (and prepare for teaching) because of their research. The University also does not want to commit to replacing staff from the same areas they will be lost from. This will have a huge effect on bioscience if they lose a significant proportion of staff by causing a teaching staff shortage.

Another concern is that the teaching ability of the replacement staff may not be as high as that of the current teaching staff, since they are researchers not lecturers. It is vital that the teaching received throughout science degrees reaches a high level of quality as this is the foundation of principles essential for the continued learning required throughout a scientific career.

The University is also unwilling to commit to keeping the bioscience courses running in the long term and are only willing to say they will complete their contractual obligation to enrolled students allowing them to complete their degree. They also have stopped bioscience students extending their course by a year by blocking the integration of industrial placements into all the Bioscience courses, but no other courses across the university. This will have a direct effect on the ability of bioscience students to perform once they reach the workplace as they will require a higher level of training.

If the Bioscience courses at Brunel were to close I do not believe it would have much effect on the regional capacity as there are many other universities offering similar courses in central London, however there are few universities offering these courses on the outskirts of London and this may deter potential science students. Unfortunately I do not have any suggestions on how to maintain the science provision in English universities but it is obvious something needs to be done before too many departments close down as Universities are unlikely to invest in setting up new science departments due to the high set up and running costs, which may not provide a quick return or increase revenue.

January 2005

APPENDIX 43

Memorandum from Professor Alastair Fitter, University of York

1. EXECUTIVE SUMMARY

1.1. The activities undertaken by the University demonstrate the benefits that accrue by having a HEI with a strong research profile within a region.

1.2. Further concentration of research resources would have a negative impact on the regions, particularly those in the North of England

1.3. Whilst additional funding to Grade 4 departments would be welcomed, funding for Grade 5 and 5* departments must be protected.

1.4. The introduction of teaching only departments would be wholly inappropriate and would not be implemented at a research intensive institution such as York.

2. BACKGROUND

2.1. The University of York is a research intensive institution. Its ratio of research to teaching income is amongst the highest in the sector, as is the level of research grants and contracts that it attracts per member of academic staff. At the same time, it has also demonstrated its ability to engage actively with the region, and it works closely with both the RDA (Yorkshire Forward) and the City of York Council. This engagement, particularly in the area of science and technology, has been recognised as an example of good practice by government, in both the White Paper on "The Future of Higher Education" and the Lambert Review of Business-University Collaboration. It is these two roles, of international research and engagement in the region, which give a particular insight into the difficulties of science provision in the English Higher Education environment.

3. The Impact of HEFCE's Research Funding Formula on the Financial Viability of University Science Departments

3.1. The result of the HEFCE formula for funding research has been increased concentration of funding towards departments graded 5 or above. Whilst there has been some additional funding for exceptional 5* (6*) departments, funding for 5 and 5* has remained essentially constant in real terms. However, the unit of resource for Grade 4 departments fell by 42% between pre-RAE 2001 and 2003–04; for Grade 3a departments funding has now disappeared. Research in these departments is not 'poor'; Grade 4's undertake research which is nationally excellent, with some excellence at international level. Moreover, at the same time as the changes to the unit of resource have been implemented, the weighting given to high cost science subjects was reduced from 1.7 to 1.6.

3.2. The impact of this reduction in QR funding has been particularly acute for science departments due to fixed infrastructure costs. The Transparency Review has already identified that external research funding does not cover the full economic costs; the implementation of Full Economic Costing (FeC) is therefore very welcome, especially for Science departments.

3.3. TRAC has successfully identified to government that the current research grant methodology is unsustainable, and has also highlighted to institutions that research is being supported from teaching and other income, particularly in science. This is a long-standing problem that has been exacerbated by the HEFCE research formula changes, and has led in some institutions to the closure or realignment of departments. The University of York made a strategic decision to maintain and build all its Departments, irrespective of RAE2001 performance, and has successfully implemented this strategy in this challenging financial environment.

3.4. The new grading methodology may alleviate some problems, but will not apply until 2008–09; until then, many institutions will be subsidising their most badly affected departments, making strategies such as that implemented at York very costly. The new assessment methodology will remove the cliff edge effect, but we do not know how it will be applied to funding. This uncertainty is unhelpful when trying to develop long-term strategies.

4. The Desirability of Increasing the Concentration of Research in a Small Number of University Departments and the Consequences of Such a Trend

4.1. Research funding is already highly concentrated with 40% of HEFCE R funds going into the Oxford/Cambridge/London triangle, and the top four institutions attracting 30% of entire QR funding available. Research funding could not be further concentrated without adverse impact on other regions, notably in the north, potentially removing research active science from some. Further concentration of research funding would make it more difficult for an institution to develop new research areas, due to the lead time required to establish a research profile, gain RAE recognition and hence attract QR funding. Institutions may also be unwilling to participate in regional activities that may not contribute to RAE success.

4.2. Further concentration would also inevitably lead to more closures of science departments for the reasons noted earlier. Loss of science provision within a region is a cause for serious concern: in terms of regional development, the presence of an institution actively undertaking research into science and technology is a key driver of success. The engagement of such an institution with the region, as demonstrated by the Science City York, a collaboration between the University and the City Council which supports the Regional Economic Strategy, shows the benefits that a strong presence in the region can have.

5. The Implications for University Science Teaching of Changes in the Weightings given to Science Subjects in the Teaching Funding Formula

5.1. HEFCE teaching income is essentially a block grant, so technically changing the teaching weightings should not automatically increase or decrease the overall grant. However, when looking at the long term sustainability of a department, the HEFCE funding model is invariably used within institutions to determine a department's income generating capacity.

5.2. The recent consultation on teaching funding formula was in the context of no additional funding. In this context, it would be unacceptable for weightings for those science subjects currently under review to be increased to the detriment of funding for other areas. This was the situation that arose following the recent HEFCE rebanding exercise for Computer Science and Psychology at York, who have suffered a significant decrease in their HEFCE T funding. Both of these 6* departments are highly science-orientated and it would be unfortunate for such changes in teaching funding to impact on their teaching and research performance.

5.3. It should be remembered that HEFCE significantly reduced the teaching unit of resource, in order to set up funding for the retention of students associated with its Widening Participation initiatives. Though welcoming HEFCE recognition of the additional costs of widening participation, it is disappointing that such costs have been funded from mainstream teaching income. The reduction in the unit of resource will have had a larger effect on the income for science departments, due to their higher proportion of income derived from the funding council.

6. The Optimal Balance between Teaching and Research Provision and the Desirability and Financial Viability of Teaching-only Science Departments

6.1. Teaching-only departments would be inappropriate at a University such as York, which submitted 93% of its academic staff in the last RAE and which also has an outstanding teaching record. There are benefits to students of a diverse mix of postgraduate and undergraduate students, and a strong link between the quality of research and the quality of teaching, particularly at advanced levels such as 3rd and 4th year teaching and in Masters' courses. A strong research profile allows the institution to attract excellent staff, who undertake cutting-edge research and can engage students in their subjects. This in turn produces well qualified and highly motivated graduates. The University of York has set the optimal balance of teaching to research so that all staff are able to dedicate at least 40% of their time to research, the rest being for teaching and administrative duties. We believe that 40% is a necessary minimum for staff to be able to produce internationally excellent research. However, even (perhaps especially) within top research departments, there is an important role for individual staff whose primary focus is teaching; these staff make a crucial contribution to such departments.

6.2. Research-active departments have other benefits for students. They allow student access to equipment that would not be available in teaching-only departments. This is particular useful for students undertaking final year projects and allows students to familiarise themselves with equipment and new techniques. Models may need to be considered whereby students in less research-intensive institutions can gain experience of more research-led teaching at more research intensive institutions.

7. The Importance of Maintaining Regional Capacity in University Science Teaching and Research

7.1. The important role that a research-active higher education institution can play in the development of a region has already been mentioned briefly above. It is recognised in the Yorkshire and Humber Regional Economic Strategy and the Sub-Regional Investment Plan. As highlighted in the Chancellor's Pre-Budget Report, the need to invest in Science in the regions is vital. The University of York, together with Yorkshire Forward and York City Council, has already developed a successful model of engagement via Science City York. It welcomes the further investment that the Chancellor has foreshadowed in identifying York as one of three "Science Cities" to be promoted in the north. Science City York has already created over 1,600 new jobs between 1998 and 2002, over 250 new high technology companies and substantial indirect employment. In a region with below average industrial R&D investment and a significant number of SMEs, this achievement demonstrates the advantages of a strong HEI science presence in order to support SMEs, expand knowledge transfer and develop new ideas. Without a strong regional HEI capacity there will neither be the expert knowledge base nor skilled graduates with which to encourage further business development. It should not be expected that all institutions would offer all science disciplines, but there is a need for at least some science and technology provision in the region.

7.2. The University of York is also active in other regional initiatives including the White Rose University Consortium (Leeds, Sheffield and York) and the Northern Way (North of England Science Initiative: Universities of Durham, Newcastle; Leeds, Sheffield, York; Lancaster, Liverpool, Manchester). These broader alliances have further potential to drive economic regeneration, but are only achievable among research-active University partners.

8. The Extent to Which the Government Should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance and the Mechanisms it Should Use for This Purpose

8.1. Government cannot directly intervene, without seriously compromising the autonomy of institutions. In order to encourage institutions to continue with science provision, the government needs to ensure that the funding available is sufficient to ensure financial viability. This must be additional funding and not a reallocation from other activities. To penalise Grade 5 and 5* departments in order to support those with lower research grades would put the international standing of UK science at risk.

8.2. The Funding Council has previously allowed institutions to bid for additional funding for other minority subjects, most notably languages. However, such funding tends to be for a limited period and it is not clear that it has significantly halted the reduction in provision in the long term. It is suggested that one key element might be the acceptance that for certain subjects, there are underlying infrastructure costs that apply, regardless of the level of research activity. This would improve the financial viability of such departments.

8.3. Aside from financial support, government can support a healthy research base in three ways:

(i) by ensuring that science is more actively promoted within schools. Institutions will struggle to recruit science undergraduates unless there is a flow of students undertaking science subjects at GCSE and A level in school, or via other more vocational routes;

(ii) by ensuring that Government-funded science is appropriately located in the country. Interactions between Universities and major research institutes can offer an important environment for new developments;

(iii) by encouraging industrial R&D and interactions between business and universities, especially on a regional basis.

January 2005

APPENDIX 44

Memorandum from the Association of the British Pharmaceutical Industry (ABPI)

Introduction

The pharmaceutical sector is the leading industrial funder of the research base in the UK. The industry provides the third highest trade surplus of all sectors with a trade balance of £3.6 billion in 2003[22]. The industry employed 83,000 direct employees in the UK in 2002, GDP per employee being £80,843[23].

The pharmaceutical industry welcomes this inquiry and the opportunity it provides to highlight the importance of strategic disciplines to an industry which, in 2003 invested nearly £9 million per day (£3.2 billion per annum) in research and development (R&D) in the UK, equating to a quarter of UK industrial R&D funding. This figure is substantially greater than pharmaceutical company investments in any other European country.

The pharmaceutical sector is also a significant supporter of academic research, hosting nearly 700 PhD students in laboratories and funding over 400 separate collaborative research projects. This equates to funding over £70 million on collaborative research (excluding contract and clinical research) and provides access to new compounds, technologies and resources that students and universities would not otherwise have.

The chemical and biological sciences are core disciplines in drug discovery and development. Research based pharmaceutical companies have major facilities in the UK in order to interact with the excellent academic research base and to recruit well trained graduates, postgraduates and post docs from its Higher Education Institutions.

Four factors are critical to the success of the UK in retaining R&D investment: access to skills and knowledge; a good regulatory climate; competitive cost base for collaborative research and a market that supports innovation. Unless the UK is able to sustain and improve the environment in relation to these four issues it is difficult to see how the Government vision of a science and innovation-led economy can be realised.

This inquiry is timely for implementation of the Government's 10 year Science and Innovation Investment Framework and the continuing news of closure of university chemistry departments.

Key Points

— ABPI members are finding it increasingly difficult to source certain types of graduates and skills within the UK—especially those individuals with good quality chemistry degrees and in vivo pharmacologists.

— The industry seeks to employ graduates who have received high quality teaching, have had the opportunity to develop excellent practical skills and have studied a single subject in depth, rather than taken a science course in which the science has been diluted by study of other subjects.

— University science departments which have been rated 5 or 5* for the quality of their research do not always produce high numbers of graduates who wish to pursue a career in science. Industry is most likely to value the skills and knowledge developed during a four year MChem/MSci "sandwich" course.

— Supply of clinical pharmacologists is also a major concern as they have a unique role to play in the safety and efficacy testing of medicines.

— The Government and HEFCE should act now to prevent the current random closure of good departments by Vice Chancellors.

[22] HM Customs and Excise.

[23] Annual Business Inquiry, Office for National Statistics.

— Government must ensure that high quality teaching for undergraduate science degrees is maintained and should seek ways of encouraging students to take science degree courses, especially in chemistry, physics and mathematics. A pool of quality science talent should be created not just to enter industry, but to sustain academe and provide the science teachers who can encourage pupils to pursue science in Higher Education.

The Committee has invited evidence to be given on the following points:

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments

The research funding formula was intended to support and reward high quality research by directing funding to leading departments to enable them to strive towards world class research status. However inadequate funding of science teaching in universities has resulted in departments subsidising their teaching from this funding. Changes in the allocation of funds based on Research Assessment ratings since the 2001 Research Assessment Exercise (RAE), has resulted in nationally excellent research departments (rated 4) losing significant funding. It appears that in some instances this has led to Vice Chancellors deciding to close departments, even in institutions with a high level of demand for its undergraduate chemistry course from well qualified applicants, and a record of providing high quality undergraduate teaching. It is possible that all science departments with scores below 5, and which require expensive laboratory facilities, may be vulnerable to closure in an uncoordinated fashion as Vice Chancellors struggle to meet financial targets.

Closure of chemistry departments will, of course, affect other departments within a university. We share the concerns of the Bioscience Federation that, since physical sciences underpin much bioscience research, any loss of departments of physics and chemistry would threaten the current excellence of UK bioscience research. Some universities appear to be planning to increase their commitment to biosciences and medicine, at the same time as closing chemistry departments; this appears a bizarre decision considering that bioscience and organic chemistry are intrinsically linked.

We agree that the status quo is probably not viable, or desirable, if universities are to support well equipped departments with high calibre research and teaching staff. We do not believe that the random decisions being made to close departments, which result in large areas of the country with no high quality chemistry department, for instance, is a satisfactory solution.

Those universities rated highly for research do not all produce high numbers of graduates who wish to follow a career as practising scientists. A number of lower rated departments, however, through provision of courses which include an industrial placement, encourage students to pursue a career where they will use their degree in a research or manufacturing environment.

Many of our member companies provide opportunities for students to spend their Industrial Placement (IP) year in their laboratories. In recent years 11 chemistry undergraduates from Exeter have spent their IP with one large pharmaceutical company, the second highest number from a single university. A number of these students have become full time employees. Other pharmaceutical companies have also commented on the high quality of IP students from Exeter.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

Many areas of scientific research require access to state of the art equipment and facilities. It would not be feasible for all universities to invest in the infrastructure required to support research at the highest level, hence a method for ensuring that top departments remain world class is required. However the rationalisation of top quality research provision needs to be better managed and co-ordinated. We do not believe that the current RAE process is the best method for doing this.

Despite substantial consultation on the conduct of the RAE, the ABPI has concerns that the programme proposed for 2008 will not fully recognise collaborative and cross-discipline work, and hence may understate the importance of applied research, particularly that done in collaboration with industry.

Pharmaceutical companies fund substantial programmes of collaborative work with UK universities. In deciding where to set up collaborations, companies identify those departments with top quality facilities and research expertise. A recent survey of its members by ABPI has revealed that there are at least 8 university departments rated less than 5 where more than one company funds collaborative work, with many more being supported by one company[24]. Reasons for funding these collaborations include high quality teaching, the department being a centre of excellence nationally or internationally in a specific area, an academic group with a strong focus on a relevant research area, and good links with innovative start-up companies.

[24] ABPI Survey of member company collaborations with UK Higher Education Institutions, unpublished data, December 2004.

The solution would be to focus on excellence not just at institution level, but also recognised high quality research teams that may be embedded in otherwise non-research intensive departments.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

Over the last five years pharmaceutical companies have increasingly raised the supply of students as an issue of concern. The concerns are not simply with whether they have good qualifications or not, rather it is with their practical skills and depth of knowledge.

While difficult to quantify, the consistent and regular anecdotal evidence is that quality of graduates is deteriorating from all but the leading universities. Indeed this decline is highlighted by UK R&D facilities taking an increasing number of students for sandwich courses and industrial placements from universities in mainland Europe. Such a trend is not necessarily negative, improving inflow of new ideas and people, yet it reduces the recruitment from UK courses.

The decline in science graduates can only accelerate in the future, following a decision by the Higher Education Funding Council for England to reduce the qualifier for laboratory-based courses from its previous level of 2 to 1.7 (Table 1). While the unit cost for student courses was increased by 20%; because of the drop in funding qualifier, this meant an increase of only 2% for laboratory based courses. It is therefore difficult for universities to justify further investment in expensive laboratory based courses, or indeed refurbishment of existing facilities, rather than expand lecture-based courses to meet Government expansion demands.

Of particular concern is the supply of chemists and, of specific interest to the industry, in vivo pharmacologists. Although numbers following biological degrees have held up well, the relevance of the training has not. There are very few universities providing in vivo skills training at undergraduate/postgraduate level. A major factor is the costs of running such courses which the funding formula does not currently recognise. The few courses still running remain just about viable because of contributions from the British Pharmacological Society supported by industry.

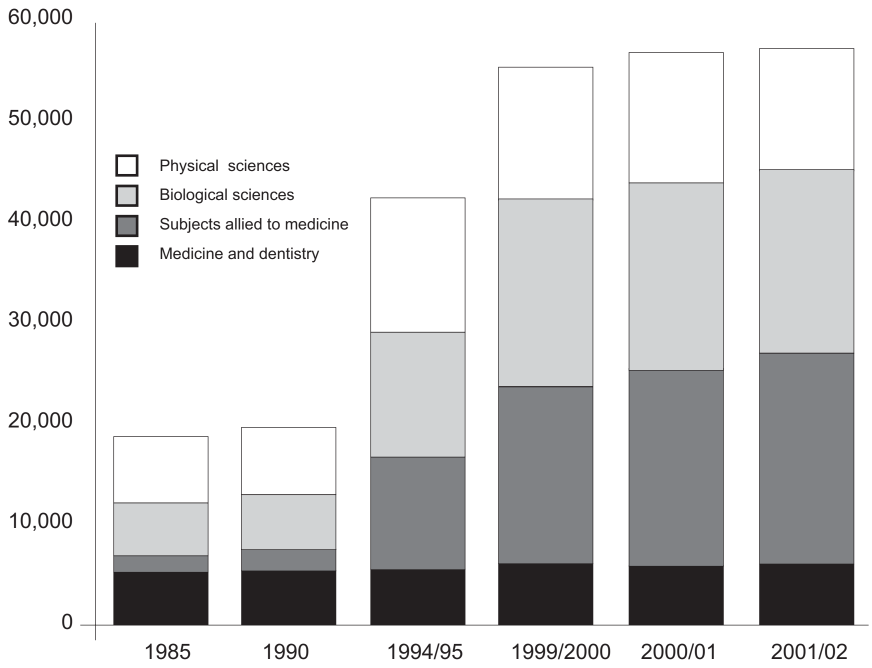
For chemists, despite the expansion of Higher Education intake, we have seen a reduction in chemistry graduates from 4,110 in 1994–05 to 3,215 in 2001–02 (table 2). Nearly all the increase in degrees of relevance to the industry have been in medicine and allied disciplines—the supply of physical science graduates has largely stagnated (Figure 1).

Table 1:

CHANGE IN FUNDING OF UNIVERSITY COURSES ANNOUNCED BY HEFCE ON 23 DECEMBER 2003

	Old funding		*Proposed funding*		
Price group	*Weighting*	*Funding unit (£)*	*Weighting*	*Funding unit (£)*	% rise in funding
Clinical studies	4.5	12,750	4	13,600	6.67%
Laboratory courses	2	5,667	1.7	5,780	2.00%
Intermediate cost subjects	1.5	4,250	1.3	4,420	4.00%
Lecture-based courses	1	2,833	1	3,400	20.00%

Figure 1: Number of people graduating with first degrees relevant to the pharmaceutical industry in the UK (taken from Pharmaceutical Industry Competitiveness Task Force: competitiveness and performance indicators 2003)



Source: HESA Student Record 1994–95 and 1999–2000 to 2002–03

From 2002–03, HESA moved over to a new method of apportioning students to subjects and uses a new subject coding system (JACS). This means that data for 2002–03 is not strictly comparable with earlier years.

Table 2:

NUMBER OF FIRST DEGREE QUALIFICATIONS OBTAINED BY UNIVERSITY STUDENTS IN THE SCIENCES AND MATHEMATICS (SOURCE: HIGHER EDUCATION STATISTICS AGENCY)

Year	*Physics*	*Mathematics*	*Chemistry*	*Biology*
1994–95	2,551	3,435	4,110	3,712
1995–96	2,070	3,383	4,144	4,066
1996–97	2,530	3,114	3,753	4,398
1997–98	2,428	3,372	3,393	4,104
1998–99	2,439	3,638	3,624	4,035
1990–2000	2,400	3,550	3,420	4,230
2000–01	2,600	3,720	3,285	4,405
2001–02	2,330	3,725	3,215	3,915

The decline in chemistry graduates is of particular concern as this reduces the pool of talent from which industry can draw, and reduces the number that might progress to a teaching career.

Despite the continued relatively high funding for medical science it has been reported that a 36% reduction in lecturer posts has taken place in medical schools since 2000. As a result it is likely that certain aspects of medicine will no longer be taught in all medical schools putting patient care at risk[25].

[25] Professor Michael Rees, Head of BMA's Academic Committee, reported in The Times, 20.1.2005.

New medicines only reach the market if their safety and efficacy has been proven through clinical testing. Clinical pharmacologists are essential members of the team which investigates safety in man in early stage trials. In recent years teaching in clinical pharmacology as part of a medical degree has reduced as this speciality has become less important to the NHS, and those undertaking training in clinical pharmacology tend to do this in order to become a specialist in an area such as oncology or infectious diseases. Hence the supply of clinical pharmacologists for the pharmaceutical industry and contract research organisations is not being met.

The pharmaceutical industry has for a number of years provided substantial financial support for a programme for specialist training of registrars in academia and encouraging industry/academic links. This programme has had some success in meeting the needs of the pharmaceutical industry.

The human genome project has an enormous potential to improve human health and quality of life. The development of new treatments based on genomic discoveries will require many in vivo (whole animal) studies to understand the function of novel genes and to discover and develop new drugs that interact with them. The pharmaceutical industry is very concerned that integrative in vivo expertise is rapidly being lost from the academic sector and is taking a lead in generating the in vivo pharmacologists of tomorrow. The three largest R&D investors in the UK—AstraZeneca, GlaxoSmithKline and Pfizer—will be providing funds of over £1 million per annum, with other companies joining. The objective of the initiative is:

— to enhance the academic research and training base for in vivo pharmacology, physiology and toxicology so industry has:
— a pool of well trained scientists to recruit from; and
— a vibrant research base to collaborate with.

For this programme to result in long term success additional funding will be necessary. A significant increase in funding for integrative systems and organism biology is now needed to allow the potential of the human genome project to be realised and we look to Government to provide this increased funding via the Research Councils.

It is vital that the UK Funding Councils sustain graduate science courses—if we are to develop the life science and physical science PhDs of tomorrow we need a quality supply of first degree science graduates.

Effect on science teaching in schools

The number of teachers employed to teach a single science subject has more than halved since 1984, the vast majority of science teachers are expected to teach all three subjects as part of a "combined" science course, often up to GCSE level.

For chemistry, the number of teachers who have a degree in the subject has also decreased, from 6,490 in 1984 to 3,744 in 2002. On the assumption that there should be a balance of expertise in science teaching at GCSE (Key Stage 4), it was calculated that, in 2002, approximately 8,350 chemistry teachers were required to cover teaching at GCSE and A level, whereas only 4,680 teachers in maintained schools had a degree, PGCE or BEd in chemistry. The estimated shortfall of 3,670 teachers must mean that large numbers of students are being taught chemistry by teachers without a qualification in the subject[26].

Science teachers, particularly those teaching chemistry and physics, tend to be older than their counterparts in other subjects. Only 16% of chemistry teachers, and 17% of physics teachers, are under 30, compared with 23% for non science subjects. In contrast 30% of chemistry teachers, and 29% of physics teachers, are over 50, indicating a potential shortage in teachers of these subjects in the next 10 years.

The dearth of chemistry and physics teachers and the aging cohort remaining in schools will inevitably lead to a further decline in the number of pupils progressing from 16-19 education into physical science courses at university.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments

The current model of a university as an institution which strives to carry out world class research and high quality undergraduate teaching in all departments is unsustainable and unrealistic. As participation in Higher Education is widened towards the target of 50%, it is inevitable a large number of students will embark on Higher Education courses without having appropriate study skills and self motivation to complete the course. Currently all universities market themselves on the same model, the needs of students would be better met if institutions were to become distinctive in their methods and in the opportunities they provide.

The ABPI would welcome the establishment of teaching only departments in all regions to satisfy local needs. These should work closely with RDAs and be well resourced and assessed on the quality of teaching they provide. High quality teaching and research departments are clearly also needed to provide well educated science graduates and PhDs to meet the needs of academic and industrial sectors.

[26] "Chemistry teachers" Smithers and Robinson, March 2004.

The importance of maintaining a regional capacity in university science teaching and research

Applications from UK students to study chemistry have been declining steadily over the last 10 years. In 1993 4,110 applications were made to study chemistry as a single subject, this had fallen to 2,434 by 2003[27]. Indications are that there was a slight increase in applications for 2004, but numbers are not yet available. As a percentage of students applying for HE courses, the percentage has fallen from 1.7% in 1994 to 0.68% in 2003.[28]

In the past 18 months Kings College and Queen Mary in London, Swansea, Exeter and Anglia Polytechnic University have announced closure of their chemistry departments. Others are known to be contemplating closure. In addition De Montford University, Leicester took their last intake of students in 2002 and Kent in 2003.

For chemistry research and development the pharmaceutical industry generally recruits first degree graduates who have completed an MChem or MSci in the Chemical Sciences. In 2002 there were 1,150 graduates from these courses[29]. Geographical distribution of these courses is not uniform. In 2003, whereas 10 universities in the Midlands offered MChem/MSci courses in chemical sciences, in Eastern Counties and the South, only 2 did[30]. With the recently announced closure of Swansea's department of chemistry, Wales will also only have two institutions offering these courses.

The lack of regional provision for science teaching in Higher Education has two major effects. Firstly, those students who do not wish to live away from home have a reduced selection of courses to study and, secondly, industry hoping to provide degree level training for employees may not be able to do so. The introduction of tuition fees for students and the anticipated increase in charges once variable fees are introduced has prompted some pharmaceutical companies to take on students with A levels or non-traditional post-16 qualifications with the aim of supporting them to attain higher qualifications through part time study. At one member company, where this scheme has been running for four4 years in both biology and chemistry departments, the employees study biology at the University of Brighton and chemistry at Greenwich. In other parts of the country such an arrangement would not be possible as the travelling times involved would be too great. The biology students have the opportunity to train in in vivo pharmacology as part of this course.

A policy is required, driven by Government and by HEFCE that will lead to co-operation between universities to ensure that regional needs are met within a framework of national provision for subjects of strategic importance.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose

It is very important that the Government intervenes to ensure that subjects of strategic scientific importance are supported.

The life sciences are clearly an area of strength that must be developed. But to sustain UK investment by pharmaceutical companies, there must also be excellence in chemistry and a supply of quality graduates.

Our concerns for the UK science base are:

— dwindling supply of scientists, especially chemists;

— lack of investment in science teaching infrastructure owing to pressures of expansion of HE and the recent reduction in funding qualifier for laboratory-based courses; and

— loss of capability in animal research owing to underfunding, over-regulation and the threat of animal extremists.

Pharmaceutical R&D is a long term strategic investment. The major pharmaceutical companies are global and have plenty of options as to which countries to invest in. Confidence in the UK continuing to have a world-class, diverse talent pool is a prerequisite for such long term investment in the UK and chemists are a key part of this scientific talent pool. Conversely, uncertainty about the future talent pool will undermine such strategic investment.

Pharmaceutical companies can also choose where to recruit from. The enlarged EU provides an opportunity to increase the available talent pool for recruitment and will make it a more competitive environment for UK trained scientists.

To achieve the aims set out above it is essential that Government provides incentives to universities to increase in supply of science graduates, particularly chemistry graduates. They are vital both for the sustainability of the industry and that of other professions such as teaching.

[27] Digest of statistics of chemistry Education 2004, Royal Society of Chemistry. Source Universities and Colleges Admissions Service www.ucas.com

[28] Digest of statistics of chemistry Education 2004, Royal Society of Chemistry. Source Higher Education Statistics Agency www.hesa.ac.uk

[29] Source HECC (74 institutions). Reported in "University chemical sciences provision" Royal Society of Chemistry November 2003 www.rsc.org

[30] "University chemical sciences provision" Royal Society of Chemistry November 2003 www.rsc.org

A national strategy for key subjects must replace the current situation where local university finance determines the future of education.

January 2005

APPENDIX 45

Memorandum from The Royal Society

1. The Committee's inquiry into strategic science provision in English universities addresses a vital subject, and one that has implications wider than the current well-publicised problems. Issues that the inquiry needs to address include:

- better coordination of education policy for the primary, secondary and tertiary sectors;
- building capacity in the science teaching profession; and
- the development of the UK undergraduate degree system within the evolving overall mission of universities to meet Britain's needs in the next few decades of the 21st Century, as the UK, along with the rest of the EU, strives to become a major knowledge-based economy.

It is essential to consider the overall science and education systems and the many complex interrelationships within them. Furthermore, while some of the immediate problems are most obvious in England, the Society believes the more general issues have to be seen at least on a UK basis and often within the context of the European Union and the Bologna arrangements.

2. The structure of individual universities is not immutable, and the Society is not necessarily opposed to the closure or merger of science departments provided the welfare of existing students is safeguarded and the change can be justified in terms of improving the overall science provision locally, regionally and nationally. However it is concerned that some recent examples of closures did not apparently fulfil these conditions. Certainly, HEFCE's claim that they are merely a demand side problem is far too simplistic at the local level, although there is clearly a wider issue of whether sufficient young people are being attracted to university physical science, mathematics and engineering courses. It should be observed that enrolments on some science and engineering courses, particularly in the biological sciences, have increased and are to be welcomed. However, such rises do not necessarily offset the significance of the falls in other subjects, such as physics and chemistry.

3. Because of the interrelated nature of the issues underlying the Committee's specific questions, this response sets out some of the wider issues in the remaining paragraphs. The links to the questions in the Committee's press release are set out in paragraph 24. Some of the issues and their relationships are the subject of ongoing and planned Royal Society studies and so this input to the Committee is to that extent subject to refinement over the coming year.

University Autonomy and Government Direction

4. Ensuring that the education system as a whole will provide the educated and trained individuals to maintain economic and social well-being in the UK into the future is clearly the responsibility of Government. Equally, it is the responsibility of individual universities to determine their own future development, taking into account inter alia: the general and financial policies of the Government; and universities' responsibilities for maintaining the highest standards in equal opportunities and for contributing to local, regional and wider economic development. There must be no question, except in the very direst circumstances, of Government intervening directly with a university, or taking over powers given to it within its Royal Charter or other governance document. Government is the single largest funder of universities and it is essential that when developing its policies, it and its funding bodies (primarily the Funding Councils and Research Councils) consider very carefully whether there may be perverse incentives or other unintended consequences of their action.

Demand for Science and Engineering Graduates

5. Determining the future requirement for trained staff in any area in the extended timescales relevant to education policy is fraught with difficulties, bearing in mind the problems of determining the likely business structure in the second decade of the 21st century. Determining the demands for specialists in the public services and in education may well be easier. The EU has set an aspirational, perhaps unrealistic, target of increasing the Community's gross expenditure on R&D to 3% of GDP by 2010. This would require a significant increase in research staff (possibly 700,000 over the EU (Gago 2004), largely in the business sector). More realistically, but nevertheless still very ambitiously, the UK Government target in its 10-year strategy (HMT 2004) is for 2.5% of GDP by 2014. Even that would require about 50,000 additional research staff and, since many of these posts will be in applied research, there will also be a requirement for many other staff with S&T qualifications to exploit this activity.

6. Although it is difficult to estimate the overall numbers of researchers that will be required, and even more difficult to estimate the number in specific disciplines, the Society believes that the development of the UK as a major knowledge-based economy will require:

— an excellent and vibrant university research base;

— an adequate supply of specialist scientists, engineers and technicians; and

— a good mix of discipline backgrounds, crucially including science and engineering, within the general graduate work-force.

It is therefore essential to inform young people, especially the more able students, of the value of a science, mathematics or engineering degree within the labour market.

The Supply Network

7. The future of university science departments depends on the success of schools in supplying a sufficient quantity and quality of science students. While the traditional supply chain into universities has become a complex network of schools, Further Education Colleges, universities and employers, we are facing a long-term decline in the popularity of A-level subjects that provide young people with the most common route into the physical sciences, mathematics and engineering at university. For example, A-level entries in 2004 in Physics, Chemistry and Mathematics were respectively 34%, 16% and 22% lower than in 1991. Some schools and colleges may be facing the same dilemma as universities; where demand is falling, costs are high, and suitably qualified teachers are in short supply, they may find it increasingly difficult to continue offering physics A-level to their students. Therefore it is important that, as well as monitoring trends in numbers taking A-levels in science and maths, we also monitor numbers of institutions offering them.

8. Research has established that there are many influences on young people's post-16 educational choices (reviewed in the Ready SET Go report (ETB 2003)). For example, the complex questions of whether science is harder than some other subjects and whether it is more difficult to gain a good A-level grade in a science subject than in some other subjects have long been a focus for research at the Curriculum, Evaluation and Management Centre at the University of Durham. Their research indicates that while the proportions of students achieving A-grades in the physical sciences exceeds those gaining A-grades in many arts subjects, fewer physical science students achieve a grade A at A-level than would be expected from their average GCSE scores. Many factors could be responsible for this, and there is a need for research to be undertaken into the underlying causes and their relative effects.

9. The gulf between education at the 16–19 stage and that at university is already a wide one for some students, and risks becoming wider in the sciences as concerns increase over financial pressures and the lack of necessary skills being developed in the average school experience, particularly in mathematics and practical experimentation. In its response to the White Paper on the future of HE (RS 2003), the Society warned about the possibility of science and engineering subjects being disadvantaged by top-up fees, and this needs to be monitored. Even if the more expensive subjects are not disadvantaged through differential fees, their students might find it relatively more difficult to minimise debt and supplement their income because of the content and length of degree courses. For example, questions of how universities will apply bursaries, and whether the four-year MChem/Phys/Eng courses will remain attractive when the full impact on student debt is clearer, need to be explored as a matter of urgency.

10. The priority for increasing capacity in the school/college sector is to ensure science teachers with appropriate backgrounds are recruited, retained and given access and entitlement to professional development throughout their careers. A skilled, enthused and appropriately deployed teaching profession will be able to tackle some of the weak points in the supply network: maintaining interest in science through the notoriously difficult transition from the end of Primary school into Secondary school; raising the profile of vocational science and engineering courses; and motivating students to continue with physics, chemistry and maths post-16 despite perceptions of their relative difficulty or relevance. A recent report for the Royal Society of Chemistry (RSC 2004) notes that in the past two decades, targets for recruitment to science teacher training have only been met in the three years 1991–1993 when the country was in deep economic recession. The proportions of trainees with a chemistry or physics background have dropped significantly since 1984. The likely outcome of this pattern of recruitment, and associated losses from the profession, is that the balance of expertise is skewed towards biology at Key Stage 4 when most pupils are studying balanced science. However, the authors admit that drawing conclusions from 'inadequate official data' was difficult, and the Society eagerly awaits the results from new DfES research into: the motivation, deployment and development of science and mathematics teachers in secondary schools, as reported to the Education and Skills Committee (HoC 2004); and the flow of SET teachers in and out of the post-16 learning and skills sector (HMT 2004). Moreover, as the Society recommended last year (RS 2004), the Government must commit to the long-term survival and development of the newly-established national network of science learning centres, and the analogous structure for mathematics, currently under consideration.

11. Schools and colleges have a fundamental role to play in preparing the next generation of scientists, but so do universities, funders and employers by supporting outreach programmes and work-based learning, and careers advisors and parents in ensuring young people are making their choices based on the best possible information about science and the prospects and challenges it offers. A stream of reports over

the past three years[31] has made recommendations and promises, with notable reference to: science and mathematics teachers' entitlement to Continuing Professional Development; improvements in performance in science GCSEs; and increases in numbers taking SET subjects at A-level and equivalent. DfES will shortly be announcing its plans for 14–19 education, following the recent report from Mike Tomlinson (Tomlinson 2004), which gave no prominence to science during this key phase in the preparation of future scientists. The Society expects to see evidence of co-ordination and communication between the Treasury, DTI and DfES, and a commitment to delivering success for science.

Academic Staff

12. Just as it is important for good science graduates to be attracted into school science teaching, it is essential to ensure that sufficient high quality staff are retained within universities. The Society has a range of programmes designed to help some of the highest quality scientists and engineers at key transitional stages (see paragraph 23), but it has major concerns that academic careers are no longer sufficiently attractive to secure the future faculty of the university system. While the Government's response to the Roberts recommendations (HMT 2002) has gone some way to improving the situation at post-doctoral levels, more needs to be done to improve the attractiveness of permanent academic teaching posts.

Financing of University Teaching

13. It is the Society's view that there needs to be a full investigation of the level of funding provided for teaching in science and engineering subjects. There is evidence that teaching has had to be subsidised from other income in at least some universities, especially in laboratory-based projects in the final year of an honours BSc course, and that this causes problems when for example research income from the Funding Council is cut. The situation has been exacerbated by the revision of the formula for calculating the block-teaching grant for laboratory-based subjects, reducing the weighting from 2 to 1.7 from 2004 to 2005 (HEFCE 2004). Furthermore, it seems that the attempts to encourage wider participation, which the Society fully supports, were not resourced with sufficient additional money. This apparently required HEFCE from 2003 to reduce the funding base for teaching students with more than 17 A-level points, which has hit funding for honours degree courses where it is necessary to recruit well qualified students. Both of these changes send a clear negative message about science and engineering courses to university senates and councils.

14. A key feature of higher education teaching is the high level of scholarship[32] required, and the necessary staff time for this activity is insufficiently taken account of in central funding, exacerbating the shortfall on the funding of teaching. The issue is complicated by the relationship of scholarship with other activities that enhance it, such as: active research; and professional development, including close interaction with innovative employers of relevant graduates, attendance at international meetings, and collaboration with professional colleagues in the public services and business sectors. Research is an important factor in science disciplines and has also featured in the discussions on recent closures, and the relationship between teaching and research is considered further in the next section.

Teaching, Research and the Development, Maintenance and Transfer of Knowledge

15. The prime responsibilities of a university are to teach, to maintain and develop the corpus of knowledge relevant to their activities and to transfer this knowledge, not only though teaching, but also other activities targeted for example at business and the public services. These are all interconnected activities and there are obvious dangers in trying to make policies in one area without understanding the interdependence on other areas. The treatment of teaching and research and the application of research in the HE White Paper (DfES 2003) was a good example of this over simplification.

16. Too often the interdependence of teaching and research has been discussed at an individual teacher level, with attempts to see if there is a correlation between excellence in teaching and in research on the basis of individual members of faculty. Rather, as the Society explained in its response to the White Paper (RS 2003), while all teachers should undertake scholarship, the linkage between teaching and research should be made at the departmental level, and be in terms of its value in contributing to a stimulating learning environment, not least through the attraction and retention of faculty, and the exposure of students to the frontiers of knowledge. This view has been supported by the Higher Education Research Forum's report of June 2004 (HERF 2004) on the relationship between Research and Teaching in Institutions of HE, which received a positive response from Ministers.

17. There is a wide range of research activity at varying costs. The country needs research stars who make a major international impact, and this work can be expensive and demands selective funding. But not all research needs to be expensive in terms of local facilities. For example: it may be conducted at regional, national or international scientific facilities; undertaken via broadband links to major computing or

[31] Roberts 2002, HMT 2002, Smith 2004, DfES 2004, HMT 2004.

[32] There are many definitions of scholarship. For the purpose of this submission it is defined as "a deep understanding and ongoing engagement with the concepts, ideas, methodology and analysis being taught".

database centres; or through collaboration with another university or research institute. The key requirement is staff time, and this has to be resourced from the HEFCE QR research block grant (a unique UK arrangement) or cross-subsidised from elsewhere. It is not clear that the shape of the current HEFCE selectivity is optimal. Arguably, in England, after the 2001 RAE, instead of cutting grants severely or completely at the lowest ratings, the burden of any additional funding for 5*, and the large increase in 5 rated departments, should have been shared more equally across the 5, 4 and 3a departments. Certainly it is difficult to defend the huge gap in funding between 5 and 4 rated departments, since, in reality, there is a continuum in the quality scale across the two grades. The RAE 2008 arrangements address this issue, but the funding based on that exercise is some way off for institutions and departments facing major financial problems, and the Government should consider some short-term interim arrangements to ease such difficulties. Furthermore, it is essential that funding policies should encourage, rather than deter, research collaboration between institutions.

18. The selectivity of the 1990s led to some helpful rationalisations in the system, but there are important limits to the optimal degree of concentration of research in UK universities. The recent demise of some departments rated 4 in the 2001 RAE has meant the loss of good units with high reputations for their undergraduate courses where the demand had kept up well. Furthermore, some members of faculty in these departments had international standing and had received significant Research Council grants. The departments themselves were amongst those that had been chosen as a base by the Society's University Research Fellows. Many 4 rated departments are relatively small and have established important and innovative niche research programmes. Some of the EPSRC international reviews of UK research disciplines have highlighted the important role of small departments.

Geographical Provision

19. Science provision can be considered at a range of levels—EU wide, UK, country or region. To some students and large firms the location of a particularly attractive university course or research programme is irrelevant. However, the advent of a mass higher education system, the reduction in individual student support, and the imperative to provide equal opportunity of access to higher education mean that local teaching provision is very important. The formation of regional "deserts" created by closures of university departments increases the risk of discrimination against those who may need to stay near home because of family commitments, cultural or financial pressures. Furthermore, without local university departments in the physical sciences and engineering, the opportunities for increasing university-school links in these subjects, as promised in the science and innovation investment framework (HMT 2004), will be severely reduced in some areas.

20. While larger companies can access information on a world-wide basis, SMEs can be very dependent on their local universities. Hence, it is still relevant to consider what provision is required at least to the level of the English regions.

Relevant Current and Ongoing Royal Society Activities

21. The Society's ongoing policy work has already been mentioned, and we will keep the Committee informed of progress. The Society also has a number of activities and schemes that are highly relevant to the issues underlying this inquiry.

22. Concerning the need to make science and mathematics more attractive to school pupils, the Society is committed to excellence in science and maths education, and has a range of projects aiming to support effective teaching and learning in schools and colleges. These include: supporting collaborations between scientists, engineers, teachers and their pupils through our Partnership Grants scheme and recent good practice guide for SET role model schemes; production of unique resources, such as the Acclaim pack and sc1 website, that help teachers bring the work of real scientists into the classroom; offering opportunities for post-16 students to meet some of today's leading researchers at our annual Summer Science Exhibition; encouraging and supporting partnership projects throughout the science community, for example the development of the Science Council's careers website, the work of the Advisory Committee on Mathematics Education, and the Nuffield School Science Bursary scheme; and engaging with the Government and professional and learned societies on key science education policy issues such as 14-19 education.

23. The Society also has a number of schemes, funded both from the Science Budget and from its own resources, to support academic research careers. The Society believes that the key to the highest scientific achievement lies in the recognition and fostering of individual quality. The Society's largest funding programme, the University Research Fellowships, aims to provide stability for promising researchers and the freedom to build independent research careers. The scheme has been running since 1994 and during this time just over 800 researchers have been funded. Currently the scheme offers up to 10 years' support in the form of salary and research expenses. The Society also aims to provide schemes to retain scientists within academic research at different points during their careers:

- Dorothy Hodgkin Fellowships provide a first step into an independent research career for excellent scientists and engineers for whom career flexibility is essential.

— UK Relocation Fellowships aim to help researchers who wish to move to follow a partner who has changed place of work and moved a significant distance.
— Professorships provide long-term support for world-class scientists, allowing them to focus on research and collaboration.
— Royal Society/Wolfson Research Merit Awards aims to attract key researchers, with great potential or outstanding achievement, to this country or to retain those who might seek to gain higher salaries overseas. The awards provide funding for salary enhancement and some research expenses.

Links to the Questions Posed in the Committee's Press Release

24. The Society believes that the issues connected with strategic provision of science disciplines go wider than the questions posed in the press release, especially in the area of student demand. The paragraphs of this submission relevant to the Committee's questions are:

— The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments; paragraphs 17 and 18.
— The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend; paragraphs 15–20.
— The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula; paragraph 13.
— The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments; paragraphs 14–20.
— The importance of maintaining a regional capacity in university science teaching and research; paragraphs 19 and 20.
— The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose; paragraph 4.

January 2005

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APPENDIX 46

Memorandum from the British Medical Association (BMA)

The British Medical Association (BMA) is a voluntary, professional association that represents all doctors from all branches of medicine across the UK. About 80% of practising doctors are members, as are nearly 14,000 medical students and over 3,000 members overseas.

Executive Summary

- Co-operation between departments of science and medicine has led to many advances in healthcare (paragraphs 2-6);
- Sustaining and developing student capacity in English science departments, particularly chemistry, is vital to support medical research capability and an expansion of doctor numbers (paragraphs 7-9); we are also concerned about reducing capacity in microbiology, anatomy and physiology (10 -11);
- Maintaining regional capacity in scientific subjects would promote medicine departments' abilities to pioneer collaborative research and better facilitate quality teaching in the sciences for medical undergraduates (12-14).

Main Submission

1. The BMA welcomes the Select Committee's inquiry into strategic science provision in English Universities. We are particularly pleased to note the emphasis on the need for a strategic approach; we believe there is a need for something more than a reliance on market forces alone.

2. There is an intrinsic link between an academic science sector that is in robust health and a successful and world-leading medical research base in the UK. The fortunes of scientific and medical research and application are in many ways inter-dependent, and we would urge the Select Committee to consider this key issue as part of their investigation and recommendations.

Collaborations Between Departments of Science and Medicine

3. Medical breakthroughs often flow from collaboration between departments of science and medicine. Closures of science departments will cut off access to the range of knowledge vital for ground-breaking medical research.

4. By way of illustration, one such example of a current collaboration is at Imperial College, where a team is currently investigating the mechanisms of anaesthesia, one team member working on the physical principles of molecular systems and the other on the clinical effects.

5. Another is at Liverpool University, where physicists and other scientists have provided expert advice to medical academic staff in solving issues of joint wear in prosthetics. Without this expertise in metal interactions and alloys, tendon reconstruction and joint replacement being available, the consequent advances in healthcare would not have been possible.

6. Similar examples of collaboration underpin much of the expansion of the UK and international medical knowledge base, which has delivered many of the improvements to healthcare (both in terms of cost and effectiveness) which today are taken for granted; the development and implementation of imaging technology, such as MRI scanners and laser treatments would not have been possible without strong university departments of physics. Exploring the potential benefits of nanotechnologies for healthcare will rely on collaboration between medical academic staff and experts in the material and pharmaceutical sciences, amongst others.

Chemistry

7. The Association is concerned about the potentially negative impact the closure of chemistry departments will have on the numbers of chemistry graduates.

8. Chemistry graduates are vital to medicine for many reasons, but perhaps most notably:

- They teach chemistry at secondary schools to the next generation of medical students; Chemistry "A" level is still a requirement for entry to most medical undergraduate courses.
- They are essential partners in supporting medical research capability, particularly in laboratory based research.

9. We are therefore anxious about the closures or reconfigurations of chemistry departments; in *The Times Higher Education Supplement* (28 January), it was reported that Leicester was to make significant cuts to its staff numbers in Chemistry, with concerns raised about the long-term viability of the subject.

Biology

10. Applied microbiology is an area of key importance to medicine, be it in combating MRSA or developing vaccines; there are a whole host of other public health applications. Yet the training of microbiologists is under threat. We are informed by colleagues in the Society for Applied Microbiology for example that the pressure on university budgets has meant that less and less practical teaching is taking place in what is a relatively expensive subject, and that as a result there are increasing numbers of graduates who do not have the basic skills to become microbiologists. This will undoubtedly impact on the practice of pathology and important research into disease.

11. Anatomy and physiology are also being lost. In some cases this is because of curriculum redesign, but the intended alternative method of teaching anatomy, radiology, is also facing cuts due to funding pressures, often the consequence of the Research Assessment Exercise.

Regional Capacity

12. The BMA is in favour of a strong regional capacity in medical teaching and research, to facilitate expansion in doctor numbers and extend the boundaries of knowledge and inquiry amongst greater numbers of medics. We are also aware of public health research projects being run at medical schools which are tailored to serving the needs of the people in their immediate vicinity, such as a recent study into the incidence of diabetes amongst the Asian community, which is of clear benefit to the local populations. By extension, not least because of the importance of collaborative and mutually beneficial work outlined above, we also support regional capacity in the sciences.

13. Because much collaboration is still done through physical meetings, either by formal or informal networking, a regional capacity in science is necessary to support the strength of medical research and teaching in the local medical school, and vice versa.

14. A striking example in respect of the importance of regional capacity is again provided by anaesthesia. The vast majority of academic departments of anaesthesia in London have been closed within the last decade; three remain, from 12 in 1997. In a recent case, when a coroner wanted an opinion regarding an aspect of anaesthesia, he had only one academic expert which he could call upon to provide advice. Academic experts in science and medicine are undoubtedly required every day by both the public services and private concerns.

January 2005

APPENDIX 47

Memorandum from the Royal Society of Chemistry

The Strategic Importance of Science

- UK chemical science provision is at a critical point in its history.
- Chemistry and its practical applications are the key to understanding the natural world and to economic and social development, health care and environmental improvement.
- Chemistry is also the key to future scientific developments in areas such as novel energy sources, new materials, nanotechnology, conservation of natural resources and new medicines.
- Industries based on the application of chemistry make a huge contribution to national wealth of over £5 billion/year to the balance of payments, £5 billion/year to taxation and provide over 250,000 highly skilled jobs in the high technology sectors of the economy.

The Need for Action

- The current numbers applying to study chemical science courses in universities are around the long-term average of 3,000/year and reflect the continuing popularity of the subject.
- Inadequate support for teaching chemistry has led to the cost-driven closure of a number of University Chemistry Departments without regard for regional and national needs.
- If allowed to continue the national and local infrastructure will be irretrievably damaged due to short-term, cash-flow driven decisions forced upon many Vice-Chancellors to focus on low cost subjects.

— A clear national and regional strategy for research and education in chemistry is essential for the success of the Government's 10-year Investment Strategy for Science and Innovation. the development of new businesses and employment, and the sustenance of our industrial base.

The Failure of the Current Funding Formulae

— The current funding formula applied by HEFCE is at the heart of the problem.

— Figures from HEFCE show that funding provided for teaching chemistry, an expensive laboratory based does not meet the costs incurred.

— The QR funding for a moderately sized chemistry department rated 5* would be over £1 million higher than a department rated 4—yet teaching is required in both institutions.

— Preliminary data from an RSC study into the costs of chemistry departments indicate that the majority are operating at substantial deficits of up to 60% of gross income. Precious research funds are being used to subsidise teaching.

Increasing Access to Higher Education

— We support the Government's "Access Agenda" to increase participation in Higher Education.

— Science and engineering are a key part of providing the diversity of subject provision that responds to student choice and employer needs.

— Without course provision in centres of international and national excellence distributed geographically to provide access to students, many potential entrants to HE will be denied places or be forced to study courses which are neither their first choice nor area of talent.

The Economic Case for Investing in Science Graduates

— The RSC supports the Government in striving towards a high added-value economy with the well paid jobs that this will bring.

— The value to the individual of completing a degree is £129,000 more that non-graduates with similar backgrounds which translates into a 12.1% annual rate of return over a life-time of earnings. The rate of return for chemistry graduates is 25% higher.

— It follows that fully funding science courses will lead to considerable additional returns to the state and the individual. Considering only the short-term cash costs neglects the long-term cash and other economic gains for the Government and society.

Working With Government to Support Strategic Science

— Well-informed sources have told the RSC to expect further closures of science departments even before HEFCE gives its advice to the Secretary of State on the need to support strategic subjects in 2006. A broader-based HEFCE review of the funding of teaching will not be available before 2008. Long-term regional and national damage to our chemistry infrastructure, the appearance of regional "chemistry deserts", will result during this time if nothing is done immediately.

— The RSC is willing to work with Government to develop a considered and structured national and regional approach for chemistry.

No Time To Lose

— In the next three years £300 million is needed to preserve our current science infrastructure.

— Action is needed now. We cannot afford to wait.

SOCIETY SUBMISSION

Introduction

Chemistry is a premier intellectual pursuit that makes a distinctive contribution to knowledge and to culture. It is also a key strategic subject in UK universities.

Chemistry is the key to understanding the natural world and a key to economic and social development, health care and environmental improvement. Through a study of chemistry we are educating the leading citizens of tomorrow as well as providing the skills for a subset of them to become future practitioners.

Chemistry stands on its own merit in the university curriculum, and underpins many other science disciplines, as well as being vital to the country.

A high quality education in chemistry may be expensive relative to some other disciplines, but the economic returns from chemistry graduates more than exceeds the increased cost to the state of the initial education. The cost of provision of university chemistry education is an investment in the true sense of the word.

Chemistry is vital for future scientific developments.

For example, the human genome has now been sequenced using techniques developed by chemists and we are now just beginning to realise that genomic information, controlled by subtle and complex molecular processes, is stored, expressed and utilised in ways that are barely understood. Thus it will continue to be advances in understanding how molecular processes control fundamental cellular pathways that will lead, for example, to new medicines that will treat and cure many diseases. Chemical sciences will be at the forefront in translating this priceless information into an understanding of the molecular mechanisms that regulate complex biological pathways. Similarly, better understanding of natural phenomena coupled with novel synthetic procedures will improve our environment, conserve precious natural resources and help generate new energy sources. Advanced materials and new insights into molecular processes will stimulate commercial exploitation of new technologies, including nanotechnologies, with significant savings in energy, consumables and side products.

Against this background, our concerns remain those which we set out in our submission to the 2004 Comprehensive Spending Review [CSR] and are reproduced in Appendix 1. When the outcome from that exercise was published, we believed that the Government had accepted our points and that urgent action would follow. The CSR promised that science and innovation would have priority:

— it promised more money for science and education, and accepted the urgent need to secure the future of UK university science and technology;

— it provided foundations from which the UK could meet the global challenges and proposed plans to secure the scientific building blocks, including chemical sciences.

We are now six months further on. While the RSC welcomes the recent announcement that research councils will pay 80 percent of the full economic cost of projects, we are still waiting for the promised help for strategically important subjects. It appears that there will be no genuinely new money until at least 2008: this will be too late.

In our submission to the CSR we set out why the UK needs a strong base in the chemical sciences:

— the chemical sciences provide the core expertise for scientific, technological development, and are key to underpinning industrial sectors;

— the chemical and pharmaceutical industries are one of the UK's largest manufacturing sectors;

— together, chemical and pharmaceutical industries contribute £5 billion to the balance of payments, £5 billion tax revenue each year and provide over 250,000 jobs in the high tech sector;

— the chemical sciences are a vital component of a vast variety of downstream businesses such as the food industry, consumer products, energy, mining, high technology and protecting the environment.

Neither England, nor the UK as a whole, can afford to lose more teaching or research capacity if it is to have a viable long-term chemical sciences component in its innovation plans, or to have sustainable activities in related areas such as biological sciences, the food industry, energy and the environment.

The timing of this inquiry is especially important as the Government seeks to establish its Science and Innovation Investment Framework against an apparently accelerating pattern of university science department closures.

The UK produces about 3000 graduate chemists annually—around the long term average—of which about 80% are from English universities. As the 2002 "SET for Success" report[33] states:

> ". . . graduates and postgraduates in these strongly numerical subjects [including chemistry] are in increasing demand in the economy—to work in R&D, but also to work in other sectors (such as financial services or ICT) where there is a strong demand for their skills. Many areas of biological science research increasingly rely on the supply of these skills."

However, since the publication of the Science and Innovation Investment Framework in July, another two universities have announced that they are to stop teaching chemistry (Exeter University and Anglia Polytechnic University), with the loss of the Exeter degree course alone potentially resulting in a 2% cut in the annual number of places for chemistry undergraduates.

[33] "SET for Success: the supply of people with science, technology, engineering and mathematical skills", the report of Sir Gareth Roberts' Review, Department of Trade and Industry, April 2002.

This rate of loss leads us to the conclusion that unless action is taken now, the success of the Government's Science and Innovation agenda will be seriously undermined.

Continued closures also call into question the Funding Councils' and universities' commitment to the implementation of the Investment Framework, particularly when the reason behind these closures was not lack of student demand for places, but short-term financial pressures within the individual universities.

The RSC was disappointed that it took until December 2004 for the Government to ask HEFCE to review the provision of strategic subjects across Higher Education—and disheartened that this review will not be completed until Spring 2006. The RSC is now pressing for an accurate, speedy review, resulting in strategy development and its urgent implementation and will help in anyway possible.

Action Needed Now

Action is needed now before the UK loses its leading position in research and teaching in science.

The RSC:

- asserts that the UK needs a long-term strategy for provision of science and technology in universities so that it can at least maintain current capacity to meet national and regional skills capability, and research and innovation needs;
- reiterates the urgent need for investment of £300 million to secure the short-term viability of science teaching and research in universities;
- considers that regional accessibility and diversity of science courses must be explicitly accommodated as part of the overall contribution to meeting the wider UK needs.

Action is particularly pressing because:

- a strong university science base is essential for the success of the Science and Innovation Investment Framework and to make the UK the partner of choice for investment in R&D;
- if SET teaching and research in universities is to be sustainable, they cannot be run on short-term business models—they must be developed strategically to provide the necessary longer term capacity for training and research;
- SET needs new money now. The "new" money cannot merely be a redistribution of existing funds—these are already insufficient—but must be a strategic deployment to underpin national research capacity and guarantee the facilities needed to educate the UK's future scientists;
- the UK continues to suffer delays in the effective implementation of the Comprehensive Spending Review/Science and Innovation Investment Framework. These delays are forcing universities to close departments of strategic UK importance.

Science Department Closures are "Fire Fighting"

The RSC respects the autonomy of the universities. The case for strategic science provision is not an attack on the doctrines of university autonomy or academic freedom.

However, we do believe that the recent decisions to close departments have been "fire fighting" decisions by Vice-Chancellors in a bid to meet their short-term financial targets rather than decisions based on a considered structured approach to ensure the longer-term viability for science within the university structure. Our evidence shows that recent decisions to close university chemistry departments have not been based on reduced student demand. Indeed, the overall application figures for chemistry 2004 show an increase of 6.5% in the numbers of students applying to study at the undergraduate level. Student demand for chemistry was buoyant at Kings College London, Queen Mary College, University of London, and Exeter University—at all of which recent closures have been announced—and yet the decisions to close their departments were made despite this buoyancy.

Chemistry is Not Properly Funded

There is no dispute that teaching and research in chemical sciences are more expensive than some other subjects. Student numbers are limited by access to available laboratory space, and laboratories can only be used for practical work. The real costs of science provision are simply not accounted for in current HEFCE funding models and this is a very serious issue.

HEFCE recognises that within its funding model the allocation for teaching does not provide sufficient monies to cover the full costs for teaching laboratory-based subjects such as the chemical sciences. In fact, HEFCE undertook a major consultation exercise to explore how the funding model might be changed to reflect better the real costs of teaching chemistry during 2003. The proposed changes were rejected by the HEFCE Board because of the impact that redistribution of funds would have on other subjects. Instead HEFCE did agree to a review of the full cost of teaching but this is unlikely to report before 2008, but clearly severe damage will be done in the meantime.

The Society's Study on the Costs of Chemistry

The RSC is currently undertaking its own study to establish income and expenditure on chemistry in universities. Data supplied to the RSC in confidence indicate that the majority of chemistry departments are operating at substantial deficits. The pilot phase of the study identified deficits of between 24% and 60% of gross income. The RSC hopes that when the study is complete the income and expenditure data will go some way to quantify the deficit that chemical sciences within UK universities face. [This is an area on which we could perhaps expand in giving oral evidence.]

Damaging Effects of the RAE

The Research Assessment Exercise has seriously affected longer-term science provision.

Despite only focusing on research activities, the RAE continues to be seen as "the only game in town" by many Vice-Chancellors when assessing the credibility and quality of academic units regardless of student numbers or the quality of teaching (eg Chemistry closure at University of Wales, Swansea).

The outcome following the RAE 2001 was disastrous for those departments graded 4 or below in England and Wales. Managing the financial consequences has led Vice-Chancellors to redeploy funds from grade 4 departments to "reward" their more highly graded activities. This approach appears to be a major component of planning exercises currently under way to position institutions ahead of the RAE in 2008. Universities are looking at a limited pot of government money designed—but which fails—to meet the demands of a strong portfolio of academic research. Coupled with the high costs of running adequate laboratory facilities, a grade 4 or below physical science department is highly problematic for universities when there are other departments which are cheaper to run that are also making demands on limited resources.

All Grade 4 Departments Are Potentially at Risk

The RSC is also becoming increasingly concerned that while financial worries are used to justify individual closures, there appears to be a growing culture amongst universities of not allowing a grade 4 or below science department to remain for reasons of overall academic credibility. And this is despite the fact that a research grade of 4 reflects national excellence in virtually all of the research activity submitted, and some evidence of international excellence.

The Economic Return from Studying Science

The RSC, in partnership with the Institute of Physics [IoP], has commissioned an independent and pioneering report from PricewaterhouseCoopers on the economic returns to both the individual and to the state from studying various degree subjects. The full report is included in Appendix 2.

The report shows that, in today's terms, the value to the individual of completing a degree is £129,000 more that for non-graduates with similar backgrounds—which translates into a 12.1% annual rate of return over a life-time of earnings. The rate of return for chemistry graduates is higher at 15.0%; as is the case for physics (14.9%) and engineering (15.5%). The rate of return (based upon increased tax revenues) to the State for the investment in providing these courses is 12.1% for chemistry graduates; 13.0%; for physics, and 13.1% for engineering.

Therefore, on this basis, the directed allocation of increased resources to science courses would lead to increased returns to the State and the individual: consideration of only the short-term cash cost neglects the long-term gains that the Government will receive and neglects our future economic needs. For the first time this study has produced clear evidence of the economic benefits from studying science and engineering in Higher Education: while the short term cash costs are high the overall cash return to the individual and to the state more than repay the initial investment. This evidence must be used to guide how Government and the Funding Councils allocate resources.

Despite some additional monies, even the Government has acknowledged that it is still not fully supporting the science it already has underway.[34] More worryingly, it has taken almost six months following the publication of the settlement for the Department of Education and Skills to task the Funding Councils to address strategic science provision in universities. In the summer there was not the luxury of time for review and debate when the science and innovation framework was first published. But the recent spate of closures shows that the area is in even worse health now. We look to Government and HECFE to work with us to promote science in a co-ordinated and effective way.

[34] "Science and innovation investment framework 2004–14", HM Treasury, July 2004.

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments

The RSC appreciates that the HEFCE funding formula for teaching and QR funds is used to calculate each individual university's block grant, and that these are distributed to universities for them to spend as they see fit in order to fulfil their various missions. However, the monies made available for QR funding are inadequate especially given that funds distributed through the research councils have significantly increased in the last few years. Whilst the introduction of the full economic cost model for research will provide more research funds, QR money should allow institutions to invest money strategically and to support the development of young staff. Currently it does not.

It is increasingly the case that the HEFCE funding formula affects the way in which individual universities distribute monies to individual departments. Many Vice-Chancellors feel that they are under pressure from their staff to follow HEFCE's lead in respect of subject weightings and use these in their internal financial models. Consequently, subjects which are under funded in the institutional block grant have inadequate funds passed to them through university systems.

The weighting used for different RAE grades are well known but it is worth reflecting on the impact that these grades have on individual departments. In England, 3a and 3b rated units of assessment no longer receive any QR funds, and 4-rated departments receive considerably less funding than they did following the 1996 RAE. The two reasons for this are the increasing proportion of units of assessments rated 5 and 5*, and changes in the grade weighting to give more funds to higher rated units of assessment.

To look at some typical figures: a 4-rated chemistry department with 25 category A staff might receive QR funding of £450,000. The same size department rated 5 or 5* would receive £1,255,500 or £1,512,900 respectively. In other words QR funding of £18,000 per academic member of staff might be earned in a 4-rated chemistry department in contrast to £60,516 in a 5* rated department (similar figures were used by Exeter University in contrasting the QR monies earned by Biological and Chemical Sciences with Physics). Or put another way, for a moderate sized chemistry department the difference between a 4-grade and a 5*-grade is over £1 million in QR income.

The impact of QR funding on the viability of science departments cannot, however, be looked at separately from teaching funding. Chemistry is significantly under-funded by the subject weighting applied to teaching (and research). In consequence, income lost by obtaining a 4 research rating serves further to worsen the deficit from teaching and tempts Vice-Chancellors to cut their losses through closure. In the current climate, every 4-rated chemistry department must be regarded as vulnerable.

The RSC knows that a number of science departments use research funds to subsidise their teaching activities and believes that the introduction of TRAC could exacerbate financial problems in under resourced science departments.

Even Departments which are apparently financially healthy are under pressure from management to increase the number of overseas students, since the fees paid by these students are much higher and compensate for under-funding of home students.

A HEFCE consultation in 2003[35] looked at the funding method for allocating teaching funds. As part of the supporting data for that consultation, HEFCE reported that the money universities spend on chemistry is 37% per student more than pharmacy, 19% more than the biosciences, 17% more than earth and environmental sciences and 12% more than with engineering, to take four examples, yet all are in the same band and therefore funded equally through the HEFCE funding formula. HEFCE proposed that more expensive band B subjects, including chemistry, should be allocated more funds in the funding formula than those that are less expensive. In the event the proposal was not implemented but rather a fundamental review of the cost of teaching was called for and this is unlikely to report before 2008.

The HEFCE data call into question the practice of funding according to a small number of very broad bands. A more granular approach would, within the same overall cost, more closely match subject income to expenditure, reducing the under-funding (or, indeed, in some cases over-funding) of subjects. The ability, and willingness, of universities to provide teaching in a particular discipline would not be dependent on cross-subsidy from other subject areas.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

Concentration of research in a small number of universities is likely to have a number of undesirable consequences:

— Further reduction in HEFCE funding to 4-rated departments in order to fund higher rated departments is likely to lead to the closure of both the teaching and research functions. Closure of teaching and research in chemistry at Kings College, London; Queen Mary, University of London; University of Wales, Swansea; and University of Exeter, was essentially due to financial pressures from their research ratings;

[35] Developing the funding method for teaching from 2004–05.

- — Closures of teaching will lead to a net reduction in the number of places available to study chemistry at undergraduate level. It is unlikely that a smaller number of universities would have sufficient laboratory space and other facilities to make up for the loss in capacity, and there would be strong resistance to new buildings. A chemistry department that is closed and staff dispersed is unlikely to be reopened: the capacity is lost for ever;
- — Closure of provision could lead to "regional deserts" which will affect the ability of students to study chemistry locally. In particular the closure of chemistry at Queen Mary, University of London affected members of ethnic minorities groups who by tradition live at home and study at their local university. These individuals are now unlikely to study chemistry but will probably find another subject at Queen Mary. In an era of increased student debt, the financial attraction of living at home will be strong for many students and their subsequent choice of subject will be determined by what is on offer at their local university.

The RSC fully accepts that to compete on the world stage in research requires expensive equipment and infrastructure which means that there must be selectivity in funding research. However, research selectivity must not be the sole driver for undergraduate teaching policy.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

The detail on this point has been given above. The teaching funding formulae are fatally flawed.

The RSC believes that science and engineering teaching in universities is under-funded in general and that subjects such as chemistry are more under-funded than some others. Even if HEFCE's 2003 proposals on a differential band B had been implemented, although the position of chemistry would have improved relative to other subjects, chemistry would still have been under-funded though it would have been in a better position than now.

Chemistry is relatively expensive for a number of reasons. The education of high quality chemistry graduates requires that students spend a considerable time in a laboratory, space that is inflexible in the sense that it cannot be used for other activities out of term time. Chemistry makes demands on consumable budgets, for example the purchase and disposal of solvents, as well as requiring capital items such as glassware, small scale stirring systems, and routine spectrometers. However, as indicated above these increased costs are more than repaid over a life time of earnings from the students on consequent tax receipts by the State: the raw cash cost is a poor indicator of relative economic cost.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments

The vast majority of chemistry departments remaining in the UK are in pre-1992 universities. The majority of these institutions regard themselves as research and teaching institutions. However, the same institutions appear to place a premium on their overall research profile as judged by the RAE grades of their research schools and, as we have already been pointed out, recent closures of chemistry departments have occurred in spite of healthy undergraduate numbers.

STRUCTURAL UNDER-FUNDING OF SCIENCE SUBJECTS

The key issue here is that by the current funding model science and engineering is under-funded for teaching and research.

In the case of the more expensive subjects like chemistry and physics, the resulting larger teaching and research deficits mean that closure is more likely than for some other departments. RSC evidence suggests that it is unlikely that a teaching only chemistry department would be viable under current funding models because in most chemistry departments there is cross-subsidy of teaching by research.

For a teaching only department to be viable significantly higher student-staff ratios than is the norm would be required and this would bring into question the quality of teaching provision given the high contact hours required. The RSC is concerned at the reduction in the diversity of chemistry provision as witnessed by the loss of courses at HND and HNC level. This loss has occurred at least in part because the traditionally teaching orientated institutions have found that it is not viable to provide such courses despite the demand from industry for the students—the well trained technicians—from these courses.

The importance of maintaining a regional capacity in university science teaching and research

Planning for the RAE in 2008 is affecting regional provision and the diversity of courses offered in all institutions, hence the current impact on chemistry.

Regional Deserts

One serious consequence is the risk of the appearance of "regional deserts"—regions where those students who, for whatever reason, wish to study from home, are prevented from doing so. Students who wish to study chemistry locally in East London can no longer use Queen Mary, University of London; students in Penzance who do not wish to move 200 miles away to study chemistry find that they must nevertheless do so.

Damage to the Lambert Review Principles

The "regional deserts" affect industry. Those businesses and industries who wish to use their local universities to develop specific skills or undertake focused research or innovation activities may find that their local institution does not have chemistry teaching or research.

Such a development is in total contrast to that recommended in the Lambert Review.[36] For example, companies based in East Anglia who wish to train employees locally [part-time] in chemical techniques are no longer able to do so. It is vital that regional capacity is maintained in university science to allow access for students to subjects like chemistry and to allow local industry to interact with a local university.

The Uncertain Effect of Higher Education Fees

Increasing student debt, and stories in the media about that debt, means that increasing numbers of students will look to their local university and their subject choices will be determined by what is on offer in that institution. Furthermore, it is difficult to predict how the introduction of higher fees in 2006 will affect student behaviour.

Whilst the RSC recognises that, from 2006, fees will no longer be required to be paid upfront, the fact that the fees will be higher than currently may result in increasing numbers of students being forced to minimise their costs by living at home. Additionally, among some ethnic groups it is preferred that students live at home while studying, so once again among these groups subject choice will be determined by what is on offer locally.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose

The UK cannot afford to see subjects like chemistry die largely due to a university financial system that inadequately funds subjects of key strategic importance.

Proper financial support for the chemical sciences is essential if the 10-Year Investment Strategy for Science and Innovation is to be realised and if we are to combat the real challenges of climate change, improved energy efficiency, the need to discover new medicines and achieve sustainable development.

The RSC believes that the UK needs a national strategy for science and part of this should be the comprehensive regional provision of teaching in chemistry.

The key determinant here should be that a potential student should be able to study chemistry at a "local" university—not necessarily the nearest university but one which is accessible in a reasonable commuting time. Industry should also have access to chemical science research expertise at a local university, again not necessarily the nearest university but one that is reasonably close.

University research and teaching in chemistry is under-funded—even departments where student numbers are healthy suffer financially—and this situation is exacerbated if the departments in question have RAE research grades of 4 or lower.

The RSC contends that Government should ensure that a set number of chemistry departments are adequately funded for teaching and research at a world-class standard across the whole of the UK, and that any gaps in local provision for chemistry teaching are filled by adequately funded chemistry departments whose mission is predominantly, but not exclusively, teaching. Action is needed now.

January 2005

[36] "Lambert review of business—university collaboration" Final Report, HM Treasury, December 2003.

APPENDIX 48

Memorandum from the School of Physics and Astronomy, University of Nottingham

Please find below a statement on the factors determining the sustainability of university departments in the physical sciences. The views expressed are based on my experience as Head of Physics and Astronomy at the University of Nottingham, and on consultations with academic colleagues.

Members of the School are keenly aware of the current controversy and public debate surrounding the closure of university departments in the physical sciences. However, we question the prevailing explanation for such closures which is based principally on a "supply side" problem—ie a consequence of reduced student demand. On the basis of our experience the problem is essentially a financial one, arising from the low level of funding provided per physics student. This undermines the financial sustainability of the physical sciences regardless of the level of student demand.

These views are based on the following experience:

(i) We have an annual intake of about 170 first year undergraduates and have successfully filled our HEFCE quota with high quality applicants for many years.

(ii) We have one of the highest number of students per staff member amongst iUK Physics departments.

(iii) We were awarded Grade 5 in RAE 2001. A recent notable recognition of the School's research was the award of a Nobel prize to Professor Sir Peter Mansfield. This is the first time in over a quarter of a century that research undertaken in a UK physics department has been so recognised.

Despite our successful long term performance, the School has run at a deficit for many years. Since we are achieving our targets in student recruitment, operate with fewer staff members than other UK departments with comparable student numbers, and benefit from HEFCE Research support commensurate with our Grade 5 rating, it follows that our financial deficit is a consequence of the low unit of resource for laboratory-based science subjects. We were particularly disappointed that HEFCE considered raising the unit of resource for Physics last summer, but then decided at a late stage not to take this step. Clearly this decision will have impacted on the sustainability of physics departments at some universities and has almost certainly contributed to recent closures.

We fully acknowledge that more suitably qualified and motivated school leavers should be encouraged to take degrees in physics and that, for some Universities, falling numbers of applicants leads to difficulties in filling HEFCE quotas. However, we emphasise that even when quotas are filled, physics departments generally run in deficit.

In Response to the Questions Posed by the Committee

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments;

It is clear that the HEFCE funding formula does not provide sufficient funding to sustain financial viability of physics departments. Even departments which are successful both in terms of research and undergraduate recruitment find themselves under-resourced.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

We believe it would be disastrous to concentrate research in a small number of departments. This is not only because of the loss of many world leading, and potentially Nobel-prize winning, groups outside of Cambridge, London and Oxford, but also because of the close and important relationship between teaching and research.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula;

As stated above, the unit of resource for science-based subjects is clearly too small to enable many of them to be financially viable.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments;

Teaching-only science departments do not make good sense educationally in the university sector, nor would they be financially viable. This is especially true in science and technology where our knowledge base is rapidly growing and evolving, driven mainly by university-based researchers. It is most unlikely that such departments would attract staff of the necessary calibre to provide world-class university education and equip the country with the scientists it needs for the future. The main reason why UK Universities compete so successfully at international level in science and technology is due to the quality of their staff.

The importance of maintaining a regional capacity in university science teaching and research;

It is clearly necessary to maintain a regional balance in science teaching and research. At present there are many world-class science departments spread across the regions. Concentration on a few research-led departments would cause serious regional imbalance. Furthermore, the link between regional centres of excellence and the ability to attract a new generation of students into physics should not be underestimated. In recent months, we have had many requests for lectures, for EPSRC researchers in residence and for the establishment of other links with schools both locally from Nottingham and right across the East of England in locations up to 150 miles away. If there were only a handful of Physics departments in the country, very few school children would have the opportunity to visit a department, or meet a research physicist in their school.

In addition, we are aware that many pupils taking physics in the leading 6th form colleges in Nottingham do not wish to leave the city to attend university. It is likely that this view will become more prevalent as fees increase, particularly amongst students from families who have not previously participated in higher education. A regional perspective is vital to ensure that the Government's ambitions for wider participation in higher education are realised.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose.

As noted above, the low level of resource is a national strategic issue and needs to be addressed urgently by central government. Unless adequate support is forthcoming for science at both schools and universities, the trend of declining numbers of students taking science and engineering subjects will continue; even successful departments will remain under-resourced leading, potentially, to further closures.

January 2005

APPENDIX 49

Memorandum from Parents Against Cuts at Exeter (PACE)

1. Introduction to PACE

PACE (Parents Against Cuts at Exeter) is a campaign group formed in response to the announcement on 22 November 2004 of the proposed cuts and closures at Exeter University. The members of PACE are parents of affected students; parents of students who believe their science degree programmes will be detrimentally affected by the loss of chemistry; Chemistry graduates of Exeter university now established in their careers in the UK and across the globe; teachers in secondary schools, sixth form and FE colleges and academics in other universities.

Our group consists, therefore, of individuals with wide-ranging personal and professional views and expertise covering both the national issue of science provision and the specific issue of the closure of the Chemistry department at Exeter University. Like Dr Ian Gibson, MP, as quoted in your press release, the PACE campaign group 'want to get to the bottom of recent closures'.

2. The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments

It is our view that the impact of the RAE ratings system has severely damaged the financial viability of university science departments. Overall the impact of HEFCE's research funding formulae, as applied, has served to force the economic strictures and ethos of a business model on academe which is both inappropriate and highly damaging. Competition across and within university departments is detrimental to research with winners taking all and valuable research and exciting initiatives falling by the wayside. The recent reduction in funding to 4 rated departments has meant that the survival of some departments of national and some international excellence has come to depend in part on the personal career choices of an elite group of academics who are regarded as having the potential to obtain large research grants and, therefore, improve the RAE rating of a department in the next round.

3. The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

It is our view that there is no sound academic or educational rationale for the concentration of research in a small number of university departments. We would argue that some of the most exciting and innovative research has emerged from science departments now rated 4, and that a concentration of research in a small number of very large departments will restrict and reduce, rather than improve, the development of science in the UK as a whole.

In addition, universities as a whole benefit from being comprised of a rounded, comprehensive range of disciplines and the consequences of the trend towards concentrating research in a small number of universities will be an increasing number of specialist universities, reduced provision of a healthy range and mix of disciplines overall, and regional deserts in particular subject areas.

4. The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

It is clear that the teaching of laboratory-based subjects is considerably more expensive than the teaching of library-based subjects. Science subjects are of vital national importance and the extra costs of providing an excellent teaching and learning environment for science students must be recognised within the teaching funding formula.

If the teaching of science is not provided with the necessary extra funding, the logical consequences are that institutions will cease to teach science and there will be an even greater proliferation of 'cheap' degree programmes covering subjects that are not of national importance relative to science.

5. The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments

It is our view that undergraduates in top-rated departments, where research is given undue priority over teaching, do not receive the best educational experience. In such departments it is common for 'top' academic staff to have frequent sabbaticals and a light or nonexistent undergraduate teaching load. Such departments also have large numbers of PhD students to whom a substantial amount of the undergraduate teaching load is assigned.

We do not feel, however, that teaching-only science departments are the solution to this problem. Science students benefit greatly from being taught and tutored by research-active scientists who are working at the cutting-edge of new developments. Given the existing, and very serious, problems with promoting the study of science, this aspect of the experience of science students must be protected. This solution, in our view, is to introduce regulations to ensure that an appropriate balance is achieved between the focus on research and the focus on teaching within departments. In this way, both staff and students benefit from working in an academic community in a research-active environment which interacts positively with a properly funded undergraduate teaching programme.

6. The importance of maintaining a regional capacity in university science teaching and research

In our view it is vitally important to maintain a regional capacity in university science teaching research. The closure of the Chemistry department at Exeter University is not only highly damaging to the education and future career prospects of all of its existing science students but also deprives future science students of the possibility of attending their local university. The South-West will become a wasteland in terms of Chemistry teaching and research. The closure of the Chemistry department at Exeter University is in direct contradiction to its claim to promote Widening Participation. PACE members who are science teachers in schools and colleges in the South and South-West of England are particularly angry about the effect on their students who will be deprived of the option to study at the regional university of their choice. These teachers are dismayed to see that one of the effects of the announcement of the closure of the Chemistry Department at Exeter University is that current students are interpreting this to mean that Chemistry is no longer valued and not worth studying. If science departments are concentrated in an ever smaller number of large universities this may well be the message taken by students across the UK.

7. The extent to which the Government should intervene to ensure continuing provision of subjects of national or regional importance; and the mechanisms it should use for this purpose.

PACE members are heartily sick of receiving the same 'there is nothing the government can do' message in response to our letters to the DFES. Education in science is an issue of national importance. The need to promote science and to engage and excite our young people about science is fully recognised and the government can, and should, intervene when individual institutions act in ways that further exacerbate the decline in science. Institutions are totally dependent on the funding received from the government, via HEFCE, and to claim that universities are 'independent, autonomous bodies', as the DFES endlessly reiterate, is a nonsense.

As to the question of the mechanisms that could be used, given the grip of the business model that HE now finds itself within, we imagine that safeguarding science will have to be done by financially-based strategies which give institutions no choice but to comply.

8. Closure of the Chemistry Department at Exeter University

PACE ask the committee to consider the specific issue of the closure of the Chemistry Department at Exeter University which cannot be fully explained by the problems with the provision of science education nationally.

8.1 *Consultation period and time-scale of decision-making process*

The proposed closure of the Chemistry department was announced on 22 November 2004 and was ratified by the Council of Exeter University on 20 December 2004. After the Council meeting on 20 December, the Vice-Chancellor announced that this represented the university's final decision.

Some staff members within Exeter University were made aware of a hole in the budget when it was noticed in late September 2004. There was no proper consultation with or within the affected departments nor was there any consultation with outside bodies or individuals in order to investigate alternative solutions to the financial problems. It is our view that the cuts and closures were forced through with undue haste and without due consideration by or consultation with those affected by them or those who could offer alternative solutions.

8.2 *Premature action to persuade Chemistry students and staff to leave Exeter University*

Chemistry staff were encouraged to consider a voluntary severance package and Chemistry students were encouraged to consider transferring to another university before the closure of the Chemistry department was ratified by Council on 20 December. (Annex A—letter to Chemistry students dated 10 December 2004).

8.3 *Council members put under undue pressure to vote for the cuts and closures*

The minutes of the meeting of the Council of Exeter University on 20 December 2004 show that the Vice-Chancellor told Council members that "if members did not support the proposals they needed to offer realistic alternatives rather than simply vote against"". (Annex B—Minutes of the meeting 04.70 Refocusing the University) (Not printed).

Given the lack of time for consultation on this matter, it is our view that this was an unacceptable, and inaccurate, statement and that Council members should have been free to vote against or to refuse to vote on the matter and that, as the supreme governing body of the university, Council should have deferred the decision until a full review of the whole situation had been undertaken.

8.4 *Financial Mismanagement at Exeter University*

We believe that the finances at Exeter University have been mismanaged and that this, rather than the RAE funding issue, is the real reason for the closure of the Chemistry department. The Chemistry department was a thriving, successful department with healthy and growing student recruitment and was highly likely to achieve a 5 RAE rating in the next round, even without the proposed review of the RAE and the protection of science subjects.

There are many aspects of the management and presentation of the financial situation that warrant scrutiny including the evidence PACE has that the accounts presented to both Senate and Council members in order to justify the closure of the Chemistry department were inaccurate. In addition, the University's commitment to expenditure on new capital projects has left it with an increase in the cost of debt maintenance of £2.6m each year with payments to cover the £18m overspend on the new Holland Hall of residence accounting for over half of this. Such costs are continuing unchecked while the institution loses an excellent and vital science department.

Minutes of the Council Meeting on 20th December meeting show that the University management acted impulsively to the concerns raised by Auditors at a committee meeting on 18th November 2004. At that meeting, the Auditors were reportedly unable to sign off the accounts with an unqualified opinion, until the University had met certain requirements concerning the management of its financial affairs in 2004/5 and 2005/6. The Audit Committee wanted Council and Senior Management to be aware that

— financial covenants with the Banks must not be broken again
— the credibility of senior management was at stake
— a detailed implementation plan should be drawn up

8.5 *Chronology*

On 18th November, the Audit Committee heard the Auditors' concerns about the financial situation. On 22 November, the University announced that the Chemistry Department would close. On 1 December the Senate met to vote on the closure proposals and the measures were voted through. On 16 December the Audit Committee met again and the Auditors' were satisfied that "sufficiently robust measures were being taken to sustain the institution as a 'going concern' ". "Sufficiently robust measures" are taken to be "closures". At some stage it became known to Senior Management that the Auditors would approve the accounts as long as Council approved the SPRC's recommendations on restructuring and expenditure reductions in 2004–05.

The Council met on 20 December and the proposal to close the chemistry department was voted through. It seems that the University announced closures in reaction to the Auditors' concerns and to preserve the credibility of senior management. Satisfying the short-term requirements as stated by the Auditors and preserving the credibility of senior management, rather than the long-term future of Exeter University, were clearly the highest priorities in this situation.

Moreover the closures were announced on 22 November before approval by Senate and ratification by Council. This begs the question of whether the University acted reasonably and legally, with respect to its contractual obligations and moral duty to the students and staff.

8.6 *The future for science at Exeter University*

In the document "Imagining the Future" Exeter University set out its proposals for the future of science at Exeter University which includes the new School of Biosciences. It is our view that these plans are fundamentally flawed. (Annex C—Letter from Dr Hoggett, Chair, Biochemistry Board of Studies). A paper produced by the staff of the Chemistry department which also explains why the future plans are flawed and sets out a detailed and viable plan for the future was dismissed by the senior management team.

The minutes of the Council Meeting of 20 December report the Vice Chancellor's statements on: "the need to build on excellence in [science]" (The RAE rating of Chemistry at Exeter was of "Quality that equates to attainable levels of national excellence in virtually all of the research activity submitted, showing some evidence of international excellence.") and that a critical mass was particularly important in the Sciences, to provide a rich collective research environment and a large body of knowledge for teaching, followed by and , in complete contradiction to, the motion to close the chemistry department, with the consequent cessation of chemistry teaching and research.

8.8 *The current treatment of students affected by the closure of the Chemistry Department*

Given the distress and disruption caused to Chemistry students by the announcement of the closure of the Chemistry department, one might have thought that Exeter University would at least ensure that affected students would be properly informed and supported as they try to make the right decision about how and where to complete their degree programmes. PACE are appalled by the way affected students are being treated. The minutes of the Council meeting of 20 December show that Council members were told that "particular care would be taken in the University's dealings with the students affected, bearing in mind that the University had a contract with each student, and indeed a moral duty, to deliver an experience at least equivalent to the one that would have been experienced had the proposed changes not come forward" (Annex B p.7, point [i]). To date, Exeter University are singularly failing to do this and PACE can present numerous case studies which describe the current experiences of affected student to support this statement. For example, students who wish to remain at Exeter University for the duration of the Chemistry degree programme on which they enrolled, are not confident that their degree will be accredited by the Royal Society of Chemistry and the university are unable to give this assurance.

In addition, science students who are not currently directly affected by the closure of the Chemistry department, including those studying Biological and Medicinal Science, are very concerned about the future RSC accreditation of their degrees. The RSC are unable to confirm accreditation of any Chemistry degrees or degrees with a Chemistry component after June 2005 because Exeter University is currently unable to provide details of their future provision.

8.9 *Conclusion*

In conclusion, PACE members are grateful for the opportunity to present this memorandum to the committee and hope that our views on the national issue and on the specific issue of Exeter University will be valuable to the committee's deliberations. We sincerely believe that a full investigation into the decision-making and consultation process which led to the ratification of the cuts and closures at Exeter University, together with detailed scrutiny of the accounts and accounting procedures, is the very least that is warranted.

Should the committee decide to recommend policy that will result in more science departments being closed in English universities, then the PACE campaign group respectfully request that the committee also recommend policy that will regulate the way in which these closures are achieved and the way in which affected students are treated.

Annex A

Dear

Re: Letter to non-final year-students on single honours chemistry programmes and joint honours chemistry and law and archaeology and chemistry

In the light of the University's decision to cease its activities in single honours chemistry programmes and joint honours chemistry and law and archaeology and chemistry, I am writing to you to give you information that you will need in order to make the best possible decision, to achieve an excellent award at the end of your period of study. You are not being required to make an irrevocable decision at this point but we are asking you as part of a continuing dialogue to consider carefully the information below and provide an expression of interest in the options available by using the return slip provided.

As you will know, I have convened a Student Liaison Group which I chair and which draws upon Guild of Students' representatives, student representatives, Chemistry staff representatives and a member of support staff from central administration. I am extremely grateful to the student reps on the Group, for giving their assistance to this task in what I am aware are very difficult circumstances. The Group has met twice this week and I envisage that it will continue to meet as necessary in the coming weeks and months.

The first task for the Group was to discuss fully the options for students and to seek to provide the fullest possible response at this stage so that students are able to reflect on this information with family and friends over the winter break. This letter has been produced through that process, and I very much hope that you will find it helpful.

What are my options?

As indicated by the Vice-Chancellor when he met with Chemistry students last week, there are a number of options available, and we are not ruling any of these out. However, it is in everyone's interests to start considering their options as soon as possible, particularly so that students who wish to transfer together to other Chemistry departments can make fully informed choices as early as possible and receive maximum support from Exeter and the receiving institution.

Option 1: *Continue to study Chemistry at Exeter*

As discussions get underway with Chemistry staff, we are not yet in a position to know which staff will have left the University by 31 July 2005. However, it is clear that many will do so, which will pose challenges for the delivery in 2005–06 of the full programme of undergraduate Chemistry teaching at Exeter. We will endeavour to meet our obligation of delivering core modules as indicated in the programme specifications, but there will be reduced flexibility in the optional modules and projects offered. We are actively considering whether students could access specialist modules elsewhere whilst continuing to register for an Exeter degree or be taught on the Exeter programme by specialists from other institutions.

Current third year students in Chemistry and Law will be unaffected by the changes as the final year of the programme is taught by the School of Law.

Option 2: *Transfer to other universities to continue studying Chemistry at ESc and undergraduate Masters level*

We have held detailed discussions at the highest level with Bristol and Bath universities and will be able to arrange group transfers to their excellent Chemistry programmes—under these arrangements we would be able to sort out much of the paperwork involved. We are carrying out a detailed mapping of modules at present. Depending on the level of interest shown, we will organise visits to these universities and their Chemistry departments at the start of the Spring term.

We have also been approached by several other universities who are willing to take Exeter students, including Southampton and Surrey, where we have had discussions with senior officers. We will facilitate all transfers, but stress that it is clearly in the best interests of students and receiving universities for this to be handled on a group basis.

In all these cases financial assistance will be provided to students to facilitate transfer and we anticipate that we will be able to offer up to £2,000 to each student to assist with the costs of relocation. Final decisions will need to be made in February.

Option 3: *Transfer to other programmes within Exeter at the end of the 2004–05 academic year*

Transfer to other programmes at Exeter is possible, providing that you have appropriate qualifications, although we will be as flexible as possible. Some programmes (such as Biological and Medicinal Chemistry, Physics, Exercise and Sports Science, and Engineering) may accept students part way through this academic year. Should students be required to drop back a year, financial assistance will also be provided.

Chemistry and Law students can transfer to the Law LLB at the end of this academic year (first years into first-year LLB, second years into second-year LLB, etc).

Archaeology and Chemistry students can transfer to single honours Archaeology at the end of this academic year (first years into second-year Archaeology and second years into third-year Archaeology).

Should you wish to transfer to another programme within Exeter, you should advise us as soon as possible.

What happens next?

The Council's decision will be posted on the University homepage straight after the meeting ends on 20 December.

As part of our dialogue with you, we have provided a form below for you to indicate your current preferred options; please return this as soon as possible, and no later than 31 January. We will be discussing these options with you again early in the Spring term. Although full details about staffing levels here will not be available until later next year (around the start of the Summer term in April), it will be important to make final decisions about transfers as early as possible to ensure that places are available.

Annex C

Dear Vice Chancellor

I am writing as a former graduate in Chemistry from the University of Exeter (BSc 1966, PhD 1969) about the effect of the University's development plans on science teaching at the University. I have no doubt that you have received many messages about the impact of these plans on the Chemistry Department, including from members of University Convocation like me, expressing sentiments of sadness, distress and outrage—all of which I have felt over the past few days. However, I hope that you will read on, because this letter is not simply one expressing the sentiments that you might expect.

I am a biochemist on the staff of the Department of Biology at York. As you will also see from my letterhead, I am Chair of the Biochemistry Board of Studies, so I have an interest in, and some experience of, the interface between the two parent disciplines which are the cause of present concern in Exeter. I believe that I would be right in saying that the external view of the Chemistry Department is that it is stronger in the classical areas of the subject, rather than at the interface with Biology; this is not to disparage the achievement of Professor Jenny Littlechild in securing funding for her Unit. Likewise, the strengths of Biology are seen very much at the organismal level, and beyond, rather than at the molecular or medical levels. The have been recent appointments that are seeking to bridge this interface, but I think that the essential picture is valid.

As I understand the plans, it is envisaged that the solution to the problems lies in a new School of Biosciences. In my opinion, it is very optimistic (and misguided) to feel that salvation lies in that direction. There is a lot of very mature and established competition in the area of molecular biosciences, an area that could not be presently described as secure in Exeter. It will be extremely difficult to replace the bulk of the current Chemistry staff with new staff (presumably of 5/5* quality, since this is what it is all about) in time to achieve much by 2007. Exeter would have to invest massively to achieve the necessary staff recruitment, and there are real chances of failure. In addition, student recruitment in the prospective area is likewise very competitive. I speak with direct experience of both undergraduate and graduate course recruitment. So the new staff, as well as looking to establish their positions rapidly, would have to engage heavily in the business of student recruitment, if they are to match the heroic efforts of the present Chemistry staff in that direction.

In short, the proposed changes are very high risk, in terms of staff appointments and student recruitment, and they likely to be hugely expensive. What is being lost is all too clear to see.

I hope that, before coming to its decision, the University might consider that it can achieve a desirable strengthening of the molecular and medical biomolecular science area within the present departmental structures by routes that are evolutionary—even if with a greater degree of pressure on the two Departments to move in this direction. In my opinion, the absence of a sound Department of Chemistry, with its vitally important expertise across a range of molecular understanding, is a major impediment to a University's efforts to maintain a serious presence in science, even if, as it appears from the current plan, this presence is viewed as being pre-eminently some kind of adjunct to supporting medical science.

Many people will to be telling you about what is about to be lost if this proposal goes ahead, and it is a grievous loss. I am also really concerned that the loss will be to no purpose, as the solution may not be a viable one. The University would be better advised to take a longer term view, and invest at the interface (less that would be needed in the proposed plan) so that the University would have the benefit of the activities and students across the range from chemistry through to the biological sciences.

On a very related but more personal note. My son visited the Chemistry Department at Exeter on a UCAS admissions day last year. Of all the Universities that he visited (also Cambridge, Durham, Nottingham, Bristol and Warwick) the Exeter admissions experience stood out as being in a different league. I am not surprised that admissions to the subject this year have risen so dramatically. Your staff's efforts have been of a very high order of commitment, and it must be deeply depressing that this is the outcome for them. Of course, publicity for the University policy has blown them out of the water this year. I hope that solutions can be found that restore confidence in their subject at Exeter for the future, and would urge you to consider these seriously, even at this late stage. Molecular and medical bioscience is needed at Exeter, but so is chemistry; and the one exists best when supported by activity in the other.

I am forwarding copies of this letter to the members of the Chemistry Department who are on Senate, as well as to one or two other senior members of the Department.

Dr Jim Hoggett

APPENDIX 50

Memorandum from Research Councils UK

INTRODUCTION

1. Research Councils UK (RCUK) is a strategic partnership that champions the research, training and innovation supported by the seven UK Research Councils. Through RCUK the Research Councils together with the Arts and Humanities Research Board (AHRB) are creating a common framework for research, training and knowledge transfer. Further details are available at www.rcuk.ac.uk.

2. This memorandum is submitted by RCUK on behalf of the seven Research Councils, and represents our independent views. It does not include or necessarily reflect the views of the Office of Science and Technology (OST). RCUK welcomes the opportunity to respond to this inquiry from the House of Commons Science and Technology Committee.

3. This memorandum provides evidence from RCUK in response to the main topics and questions identified by the Select Committee. Further details of six of the Councils' discipline specific priorities, activities and concerns are contained in separate Annexes:

Biotechnology & Biological Sciences Research Council (BBSRC)	Annex 1
Council for the Central Laboratory of the Research Councils (CCLRC)	Annex 2
Engineering & Physical Sciences Research Council (EPSRC)	Annex 3
Economic & Social Research Council (ESRC)	Annex 4
Medical Research Council (MRC)	Annex 5
Particle Physics and Astronomy Research Council (PPARC)	Annex 6

GENERAL COMMENTS

4. Anxieties about the financial sustainability of the UK research base as a whole, and about sustaining high quality research capacity across all disciplines and sub-disciplines have grown over recent years. The issues are wide ranging, and include rebuilding and maintaining the physical and scientific environment for conducting research (buildings, major equipment and facilities), attracting enough people into careers in research—and retaining them, maintaining international standards of excellence across the entire research base, and the funding structures and mechanisms (including assessment procedures) for supporting research.

5. Elements of the problem have started to be addressed, through successive infrastructure initiatives (JIF and SRIF), the Roberts review of science, engineering and technology, which drew particular attention to researcher salaries and careers, and through spending review settlements in 1998, 2000, 2002 and 2004, which have been comparatively generous for the science base. In addition, the move to full economic cost funding has helped to identify the real costs of research and how these costs should be met.

6. Although this inquiry focuses upon the sciences in England it resonates more broadly with the current concerns of RCUK, OST and other funders about the sustainability of the research base across the UK and the health of research disciplines and sub-disciplines. This RCUK response therefore raises generic issues which are applicable across the whole research base eg the impact of the Funding Councils' formulae on the financial viability of all departments not just scientific ones.

Response to Specific Questions

A. *The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments*

7. The Research Councils fund the highest rated projects and individuals on the basis of peer review, regardless of departmental RAE rating. In practice, statistics collected by the Research Councils demonstrate a strong correlation between RAE rating and success in winning funding from the Research Councils for research, training or access to facilities.

8. It is clear that the RAE has a very significant role in driving research behaviour and HEI strategic management of research. The RAE should help create a healthy research environment which supports and promotes high quality, properly funded research; these should be the main drivers rather than unsustainable increases in volume of activity. In submissions to the recent RAE consultation exercises the Research Councils argued for the inclusion of institutional research strategies as part of the HEI submission package. These could be used by the Funding Councils to help develop coherent and sustainable future funding plans for HEIs. In addition, given the changing nature of scientific endeavour and the need to strengthen the UK's multidisciplinary capability Research Councils have continued to press the Funding Councils to ensure that the 2008 RAE gives sufficient recognition and weight to multidisciplinary research, collaborative activities and research aimed at influencing policy and practice.

9. Councils also believe that the RAE funding formula is compounding the difficulties for lower-rated departments in remaining financially viable: the way in which funding is distributed means that any department with less than a five could be in jeopardy. This could lead to a loss of research diversity and of pockets of excellence in otherwise less-than-outstanding departments.

B. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend*

10. It is Research Councils' policy to continue to fund excellent research irrespective of location. Research Councils do recognise that this contributes to an increasing concentration of research funding in a small number of HEIs and results in uneven geographical spread of investments. However, in some areas, RCUK believes that some further limited concentration may be desirable to increase the critical mass and sustain strength and depth of knowledge in the core university science departments and to generate a greater degree of concentration around key equipment and facilities. RCUK is also committed to working with other funders and HEIs to ensure that the UK has a research environment which enables multidisciplinary research to flourish. It is important that these multidisciplinary activities are embedded alongside, and linked closely with, strengths in existing disciplines. Closure of departments might reduce the scope for interaction between departments and for multi-subject courses that could encourage a multidisciplinary approach.

C: *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula*

11. Whilst this is not primarily an issue for Research Councils, RCUK is concerned that the new teaching funding formula will disadvantage those laboratory-based subjects where cuts in the unit of funding are proposed and that this will exacerbate difficulties in recruiting undergraduates to courses such as chemistry and the physical sciences. Moreover, even in circumstances where undergraduate recruitment is buoyant, for example in the biosciences, this may be unsustainable in the longer term because increases in undergraduate number are significantly higher than real terms increases in expenditure.

D: *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments*

12. The Research Councils are only one of the parties involved in the debate about the optimum balance between teaching and research, but as a matter of principle believe that research and teaching are usually best done together. Given the Research Councils' position on concentration, the balance in the research-intensive universities is likely to be (relatively) weighted in favour of research. Nevertheless, we also believe that the conduct of research within a department will improve the quality of the teaching. For example, it will help to attract higher quality staff (although the best researchers are not necessarily the best teachers) and will make the teaching environment more research-aware and assist teaching in staying up to date with recent findings. RCUK believes that all research students (masters level and beyond) need to be taught in a department in which a substantial volume of research is conducted.

E: *The importance of maintaining a regional capacity in university science teaching and research;*

13. The Research Councils have a national remit and adopt a UK-wide strategic view on research capability. However, whilst some university-industry collaborations are national or global, Councils recognise that there is a need to stimulate greater engagement between business and HEIs on a national and regional basis to help deliver the innovation agenda. For knowledge transfer to SMEs in particular, close proximity between the SMEs and the researchers in likely to be advantageous. This is primarily an issue for individual universities and their Regional Development Agencies (RDAs), although Research Councils also have a role to play in facilitating and enabling these relationships.

14. The Research Councils' strategic priorities for engagement with the RDAs are knowledge transfer (including continuity of funding to bridge the development gap and articulation of industry needs), training (including articulation of regional needs and involvement of companies in postgraduate training) and large facilities. At an operational level there is extensive interaction between the Councils and RDAs, particularly with those Councils with institutes. Councils and RDAs are working in partnership on a range of regional initiatives, collaborations and facilities, as well as promoting entrepreneurship and knowledge transfer from the research base.

F: *The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose*

15. Not all HEIs can be research intensive and excellent at every discipline. It is therefore important to ensure that UK research funding is focused on the very best researchers whilst stimulating and supporting pockets of excellence in less research-orientated institutions. There is a need for all interested parties, including Research Councils, Funding Councils and the universities, to work in partnership to ensure that research capacity across the research base is maintained. This issue is being specifically addressed through the Research Base Funders Forum, which is initially focusing on the short term problems around health of disciplines and developing a set of metrics to help DfES, the Funding Councils, OST and the Research Councils create and implement evidence-based policy on intervention in subjects giving cause for concern.

16. RCUK has produced a summary of areas where there is a concern over the future supply of researchers and health of disciplines, together with information on grade profile and demographic analysis. This analysis reveals that the question of what constitutes a healthy research base cannot be answered simply: the answer is discipline dependent and not solely a function of numbers of staff or trends in student numbers. For example, there is universal agreement that the decline in numbers of full time staff in the physical sciences is of concern. However, there is also concern over the development, retention and recruitment of world class researchers in business and management, despite an overall increase in numbers of staff in these disciplines. Also, overall upward trends may mask shortages in key sub-disciplines, for example the biosciences appear healthy overall, but this masks gaps in whole animal physiology and some aspects of health services research.

17. Work is now underway to identify a small number of simple quantitative indicators, based on readily available information (Research Council and HESA data) providing insights into any changes in the breadth of the research community and its changing composition. Research Councils also see the value in producing reports, drawing on quantitative and qualitative information such as the proportion of permanent academic staff associated with a particular discipline and their age distribution, numbers of postdoctoral researchers and research students, level and number of sources of research income, demand for research funding and trends in outputs such a publications. This will help highlight emerging and potential threats at the discipline and sub-discipline level. The project should be completed early in 2005. Subsequently the Funders Forum will develop more general metrics on research excellence (outcomes) at institution level (eg a long-term project starting January 2005).

18. The health of the UK research base depends on the continuing supply of individuals at each level of the research community (undergraduate, postgraduate, postdoctoral, lecturer, senior lecturer and professorial). Erosion of this skills base in the UK is of particular concern to the Research Councils. RCUK believes that a multi-Council approach is needed to address skill shortages in key cross-cutting areas and to grow the population of researchers who possess first rate specialist, analytical and transferable skills to enable them to work in multi-disciplinary teams and outside of their discipline area. However, all Councils have an interest in monitoring the health of the research disciplines within their own remits to understand the ability of the research base to renew itself, and all wish to ensure that any cross-Council interventions are sufficiently flexible to enable Councils to take account of the particular needs and characteristics of individual subject areas and disciplines.

19. At the present time, in addition to the work outlined above, the Councils are deploying the additional funding to implement the recommendations of the Roberts Review to provide enhanced postgraduate stipends and postdoctoral salaries in areas of research where there are recruitment issues such as statistics and mathematics. Roberts funding for skills and career development is also being used to increase the level and awareness of transferable and careers skills by researchers. Monitoring and reporting will enable RCUK to build a cross-Council picture of the impact of these investments in due course.

20. Furthermore, all of the Councils already share information and develop joint policy and funding initiatives with each other. There is currently considerable joint activity between the Research and Funding Councils in this area. For example first, EPSRC, in partnership with HEFCE and SHEFC, is taking the first steps towards building capacity through the investment of £10 million in its new science and innovation awards. The purpose of these awards is to secure strategically important research areas that are missing or "at risk" in the UK. Many of these subjects have relevance for the broader research base, for example, in the life and environmental sciences, or in providing the fundamental knowledge that is exploited in astronomy, particle physics and the development and provision of large-scale facilities needed to keep UK research at the international leading edge. They are also essential for future developments in business and public services. Secondly, AHRB, ESRC and HEFCE are developing an initiative which will fund strategic subject centres and training in area based language studies. A major aim of this initiative will be to develop a cadre of researchers able to work at the highest level on for example the economics of nations such as China and Japan while at the same time being able to speak these languages fluently. Thirdly, initial discussions have been held between BBSRC and HEFCE on areas such as whole animal physiology and between ESRC and HEFCE on quantitative social science, and we understand that the HEFCE Board has recently agreed that quantitative social science should be a subject of national strategic importance.

21. In its recent scrutiny of the Economic and Social Research Council, the Committee suggested that a national Strategic Capabilities Fund should be established to address skills shortages and ensure national coverage in key subject shortage areas by building local capacity. RCUK would welcome the allocation of additional resources to support the development of such strategic capabilities, recognising that there are skills issues that could usefully be addressed through the Research Councils. However, ensuring national coverage in key subject areas is mainly an issue for the Funding Councils and would need to taken forward by the Funders Forum. RCUK has worked with the Funding Councils to prepare a report for the Funders Forum which highlights both whole disciplines and sub-disciplines in urgent need of investment if a strong research base is to be ensured. Both the Funding Councils and the Research Councils have expressed a wish to take forward this agenda jointly when the remaining allocations are made.

January 2005

Annex 1

Memorandum from the Biotechnology and Biological Sciences Research Council (BBSRC)

Introduction

1. There is a need for all interested parties, including Research Councils, Funding Councils and the universities, to work in partnership to ensure and maintain the future financial sustainability of the research base, and the health of research disciplines and sub-disciplines. In the biosciences, BBSRC has regular meetings with the heads of leading university bioscience departments from across the UK to discuss strategic issues, including research priorities and the impact of national research policies on the biosciences.

Issues of Concern to BBSRC

2. The overall picture within the UK biosciences is currently one of clear strengths, with a buoyant community competing effectively in the international arena. The recent reports by Evidence for the Office of Science and Technology, PSA target metrics for the UK research base, show that the UK share of citations in the biosciences is second only to the USA. Numbers of researchers in bioscience departments are healthy, and demand for research funding is high. BBSRC is consistently unable to fund all the internationally competitive grants proposals it receives.

3. In common with other research funders, however, BBSRC is concerned about the broad structural issues identified in paragraph 4 of the RCUK submission, especially infrastructure and research careers. It is not obvious that the HEI sector is yet in a position to sustain and capitalise on the current level of interest and expertise in the biosciences. For example, increases in the numbers of undergraduates in the biosciences are running at significantly higher rates than the real terms increases in the level of expenditure in bioscience departments. If the proposed changes in HEFCE's funding models for teaching are adopted the unit level of funding for the biosciences will fall, further exacerbating the problem in England at least. In addition, figures for lecturers seem to show a gradual falling away of numbers in several science areas, including the biosciences, chemistry, physics, mathematics and engineering. Where numbers of HEI staff are growing overall therefore, this may be masking a specific issue with teaching staff, or it may be the result of the uncompetitive rates of the lecturers' pay scale, which HEIs are trying to side-step by promoting staff to the senior lecturers' scale.

4. With respect to research careers, the main issues are set out in the Roberts Report, and the fellowship and student stipend initiatives announced in its wake will help alleviate the most pressing. In BBSRC's case, despite the healthy picture within biosciences as a whole, at a more disaggregated level there are signs of

some difficulty. There is at least anecdotal evidence of skill shortages in certain areas, including whole animal physiology, animal diseases and in the interface areas with other disciplines. These are being addressed by BBSRC in part through targeted enhanced stipends for training awards and targeted fellowships.

5. BBSRC's major concerns, however, relate to areas outside its immediate skills base. The biosciences are becoming increasingly quantitative in approach, and many of the most significant breakthroughs are occurring at the interfaces between the biosciences and other disciplines, particularly the physical sciences, mathematics and computer science. Following the huge strides taken in mapping genomes, many aspects of the biosciences now involve the collection, storage, retrieval and analysis of vast quantities of data, requiring sophisticated understanding of mathematics, statistics and computing. It is therefore at the interfaces that the major issues facing BBSRC arise.

6. The Council has started to address some of these concerns, and is developing programmes in interface areas, in part working with the Royal Society of Chemistry and the Institute of Physics. In particular the BBSRC is:

— funding a research initiative on Selective Chemical Intervention In Biological Systems, an area developed in collaboration with the RSC and EPSRC, and concerned with the synthesis and testing of small organic molecules and their effects on important biological systems;

— developing a tools and resources funding stream that will allow engineers access to responsive mode funds from BBSRC to work on bioscience problems;

— considering how best to build on existing interactions with the mathematical sciences, probably through the funding of research networks.

7. BBSRC already funds significant levels of research in physical science departments, particularly chemistry. As at April 2004, 14% of the BBSRC grant portfolio (by numbers of awards) were held by Principal Investigators in non-life sciences departments, 66% of these being in chemistry departments, with an estimated spend in chemistry departments of £12 million in 2003–04.

Research and the Regions

8. BBSRC funds high quality research in all eligible HEIs in the UK. Funding currently goes to over 100 institutions across all regions. The Council's policy is to fund the highest rated proposals regardless of institution or region. Nevertheless we are keen to develop strategic links with other funders, including the Regional Development Agencies (RDAs), where this will develop and enhance the UK's capacity in bioscience research. BBSRC and RDAs have common interest in ensuring that BBSRC-supported research is exploited. BBSRC has partnered with a number of RDAs in Knowledge Transfer activities, including Young Entrepreneurs Scheme and Industrial CASE awards, and BBSRC Institutes have benefited from joint support for activities such as provision of bioincubators.

Annex 2

Memorandum from the Council for the Central Laboratory of the Research Councils (CCLRC)

A. *The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments*

1. CCLRC facility access and research grant applications are peer reviewed independently of RAE grades.

B. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend*

2. The CCLRC would encourage initiatives which increase the critical mass and sustain strength and depth of knowledge in the core university science departments.

C. *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula*

3. No Comment.

D. *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments*

4. No comment.

E. *The importance of maintaining a regional capacity in university science teaching and research:*

5. The CCLRC focuses on scientific infrastructure issues at a national level, with its users coming from across the UK. When sitting a facility, it is the regional research and support infrastructure (scientific infrastructure, technical support, technical support, equipment, land etc) that is important alongside the regional (AND national) university science base.

F. *The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose*

6. The Government should be taking a "systems" approach and look at the continuum from GCSE through to post-graduate qualifications in key strategic areas. The "core" subjects (maths, chemistry, physics, materials and engineering) are essential requirements for staffing CCLRC facilities and scientific departments as well as for the users of the facilities.

7. The CCLRC has been involved in promoting subjects which are of strategic national importance. CCLRC has created a new MSc in "Accelerator Science" in collaboration with PPARC and the Universities of Lancaster, Liverpool and Manchester in the new Cockcroft Centre at Daresbury.

Annex 3

Memorandum from the Engineering and Physical Sciences Research Council (EPSRC)

1. EPSRC welcomes this inquiry by the Science and Technology Committee as we have serious concerns about:

— the UK's capacity in some strategically important areas of the engineering and physical sciences research base. Research capacity is heavily dependent on the university sector but the base of permanent staff is shrinking in these core subjects (relatively and, in some cases, absolutely). Partly this results from a deliberate shift of resources toward new scientific opportunities in the life sciences, but partly it is an accidental consequence of the turning away from the hard sciences, where resources in universities largely follow student whims and the driving force for universities in appointing (or replacing) academics tends to be teaching loads;

— the supply chain of young people pursuing qualifications in engineering and physical sciences who will provide the future well trained scientists and engineers necessary for the economy as well as the research leaders needed in our universities.

2. The UK is dependent on engineering and physical sciences to provide the basis for the knowledge economy and to contribute to progress in the life and medical sciences. The attached paper (annex A) provides an analysis of the issues of sustaining the core physical science and engineering.

3. EPSRC is taking urgent action in the short term to strengthen research capacity in areas of scientific and economic importance that are especially at risk. In partnership with the Higher Education Funding Council for England (HEFCE) and the Scottish Higher Education Funding Council (SHEFC) EPSRC has launched a pilot scheme to award three to five large, long-term grants (typically £3–5 million over five years) to support research groups (including support for up to three lectureships) in strategic areas. Examples of such areas include statistics, mathematics/computer science interface, chemistry/process engineering interface, power engineering, energy research and the emergent area of cognitive systems. A crucial part of the scheme is a commitment from the host university to continue to support the lectureships after the end of the grant to grow and sustain research capacity.

4. This pilot is a "proof of concept" stage and to have a real effect in halting the decline in research capacity a continuing programme of these awards is needed. In taking this forward EPSRC will work both with existing partners as well as seeking new ones (eg business and the Regional Development Agencies.)

5. The above is an indication of action being undertaken by EPSRC to address immediate issues around research capacity. Research Councils are just one of many partners that have a role to play in addressing these broad issues. To address the problem the development of a framework is needed which addresses the national and regional need for research and training in all key shortage areas, while respecting the autonomy of individual universities to make decisions consistent with their own policies.

Annex A to EPSRC Submission—Sustaining the Core Physical Sciences and Engineering

Summary

1. At a time when the competitiveness and productivity of advanced economies depends increasingly on science and scientists[37], there is a turning away from science, particularly among the young and particularly in the core physical sciences (figure 1). The problem was elegantly and comprehensively analysed in the Roberts Report ("SET for success: the supply of people with science, technology, engineering and mathematics skills"). This is a long-term problem needing long-term solutions (some of which were initiated with the implementation of the Roberts Report).

2. There is an even more immediate problem, however. The UK's research capacity in engineering and the physical sciences is heavily dependent on the university sector. But the base of permanent staff is shrinking in these core subjects (relatively and, in some cases, absolutely see for example figure 2) as is research income and research outputs such as the number of published papers. Partly this results from a deliberate shift of resources toward new scientific opportunities in the life sciences. But partly it is an accidental consequence of the turning away from the hard sciences, where resources in universities largely follow student whims.

3. This paper is concerned with sustaining the UK's research capacity in important areas of the physical sciences and engineering by increasing the quantity of high quality research, reducing the dependence of that capacity on student numbers. That dependence has already led to the closure of 79 university departments in six years in these fields. There is wide concern about the national and regional implications—for example the Institute of Physics has talked of "physics deserts".

4. Action is required to meet the needs of the UK economy and to facilitate further progress in other areas of science.

Why it Matters to the UK Economy?

5. The physical sciences and engineering are remarkable for their importance and pervasiveness throughout the economy. Work by SPRU has demonstrated that:

— industrial R&D managers in all sectors rank research in computer science, engineering and materials as the scientific disciplines most important to them;

— while the pharmaceuticals sector shows a high reliance on the life sciences, in other sectors the physical sciences and engineering are more important and more pervasive (see, for example, figure 3);

— industrial sectors dependent on engineering and the physical sciences represent about 85% of all UK exports;

— the industrial sectors with the highest dependence on engineering and the physical sciences are those with the fastest growth of added value per employee (figure 4);

— postgraduate scientists trained in engineering and the physical sciences are employed widely throughout the UK economy, including particularly the private service sector (figure 5).

6. It matters even more in that, as the report of the Lambert Review states, UK industry is increasingly looking to the university research base to undertake much of its research. It is essential that university research is of adequate capacity and balance.

7. These concerns are not unique to the UK. In the USA, where there has been a similar swing away from the physical sciences and engineering, concerns are being voiced that the economy no longer has an adequate research base in these fields.

Why it Matters to Other Areas of Science?

8. Much of the rapid and exciting research progress in the life and medical sciences has depended on earlier breakthroughs in the physical sciences (eg x-ray crystallography and synchrotron radiation, nmr, amino-acid sequencers, optical tweezers, bioinformatics). This trend will continue. For example, a survey of leading scientists, conducted by PREST, showed that the fields in which excellence is required to sustain the respondent's research were:

— for medicine: bioinformatics, imaging technology, physical sciences in general, engineering;

— for biological sciences: biophysical chemistry, computational biology, bioinformatics, chemistry and chemical engineering;

— for earth and environment: mathematics, physics, chemistry, computer science, engineering.

9. The same messages are confirmed in the BBSRC and NERC Strategic Plans.

[37] Used in the generic sense to encompass the full spectrum of science, engineering and technology.

WHY ACTION IS NEEDED NOW?

10. The reduction in the UK's research capacity in engineering and the physical sciences has happened over a long period and it is not easy to call the point at which some redress is needed. For example, universities' total external research income in engineering and the physical sciences has fallen from 43% in 1985–86 to 33% in 1999–2000. Figure 6 shows the rate of change in recent years. What is clear, however, is that contraction will continue unless positive action is taken to stop it. Further decline could severely hamper improvements in competitiveness in the UK economy. And the restored research capacity has to be in the UK; if it is elsewhere we will begin to lose the ability to understand and use developments elsewhere and will not maintain the research environments necessary to produce trained people.

WHAT IS NEEDED?

11. There is a need to restore research capability without undue reliance on undergraduate student numbers. This will require ongoing and concerted action by a number of bodies. EPSRC is taking a lead by piloting Science and Innovation Awards which are designed to strengthen capacity in areas of economic and scientific importance that are especially at risk. A continuing programme of these awards will be needed to halt the decline.

Figures

Figure 1: Trends in numbers taking A levels, first degrees and doctorates in different fields (from the Roberts report)

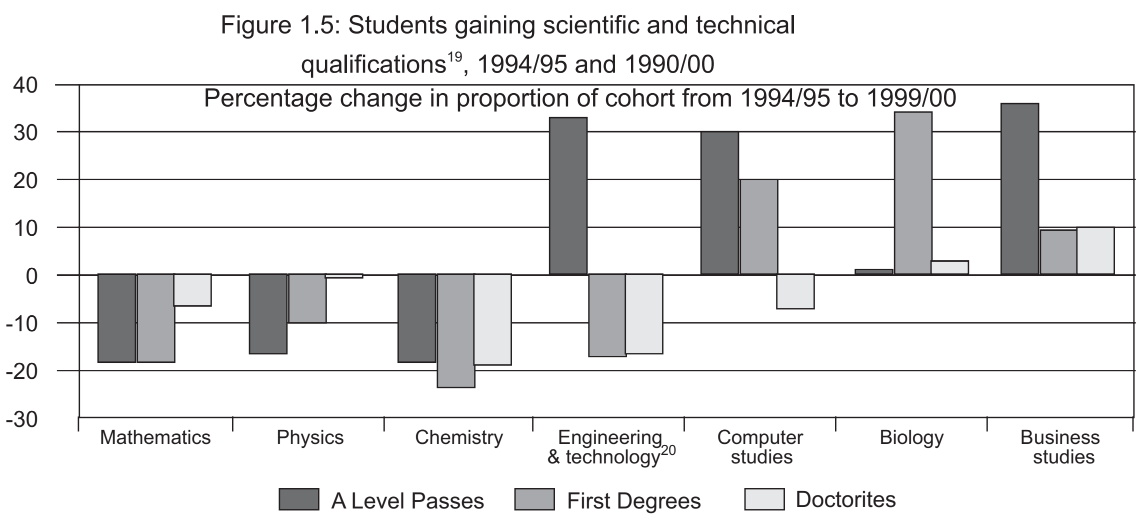


Figure 2: Relative change in Wholly Institution Funded HEI staff numbers for different fields.

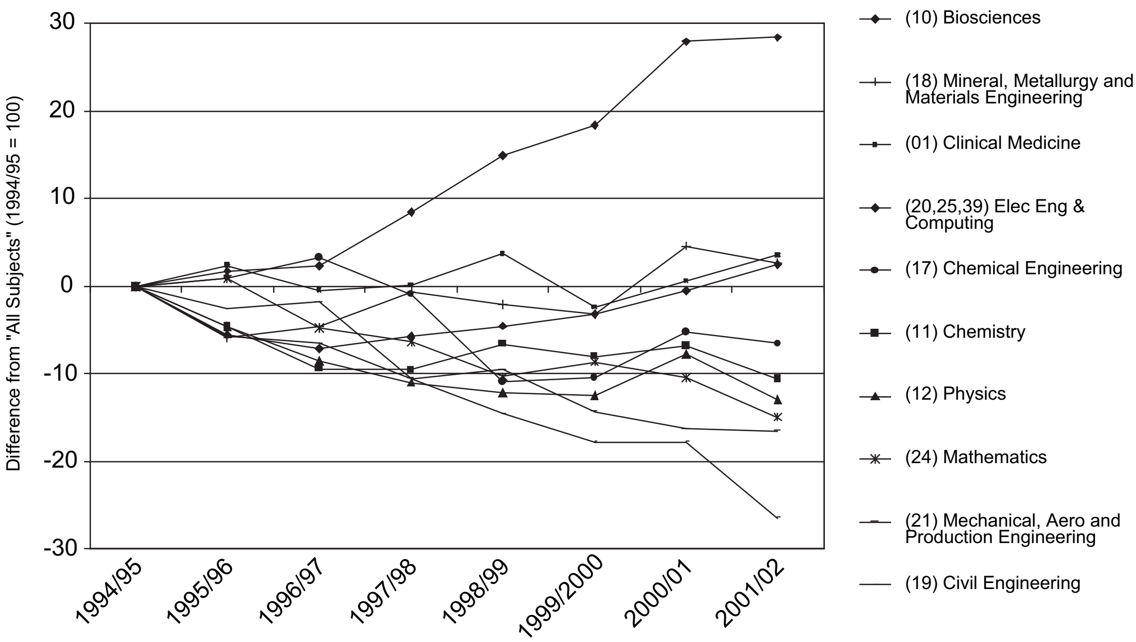


Figure 3: Importance of academic Research in Materials and Biology for Industrial R&D Managers

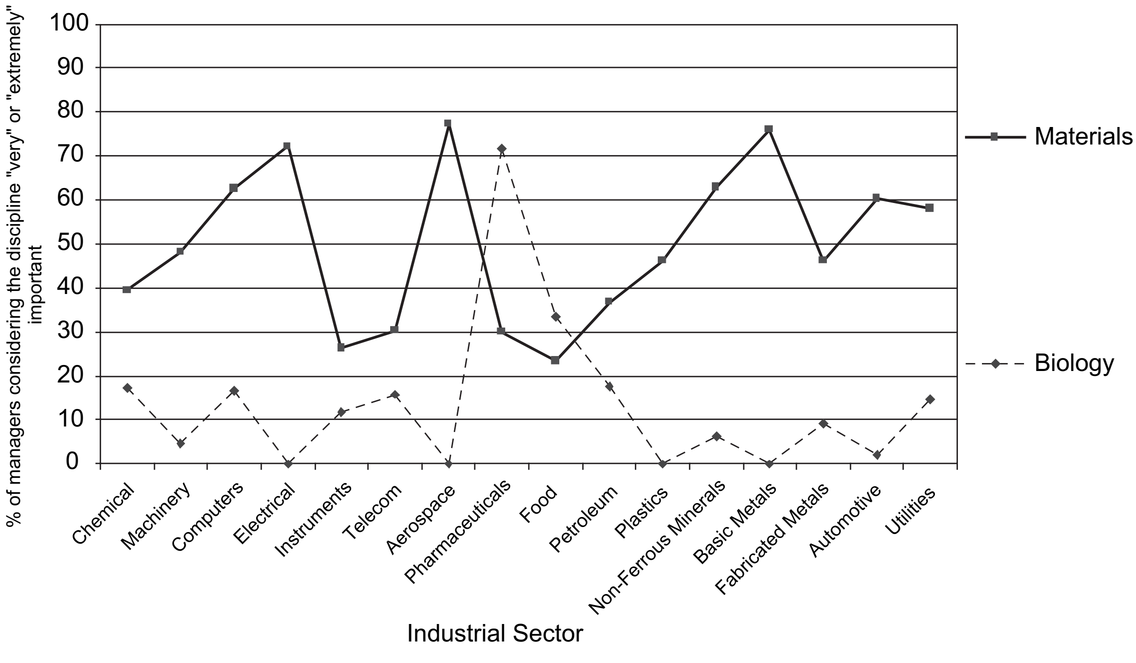


Figure 4: Changes in added value per employee for industrial sectors in which engineering and physical sciences are most relevant (high EPS) and least relevant (no EPS)

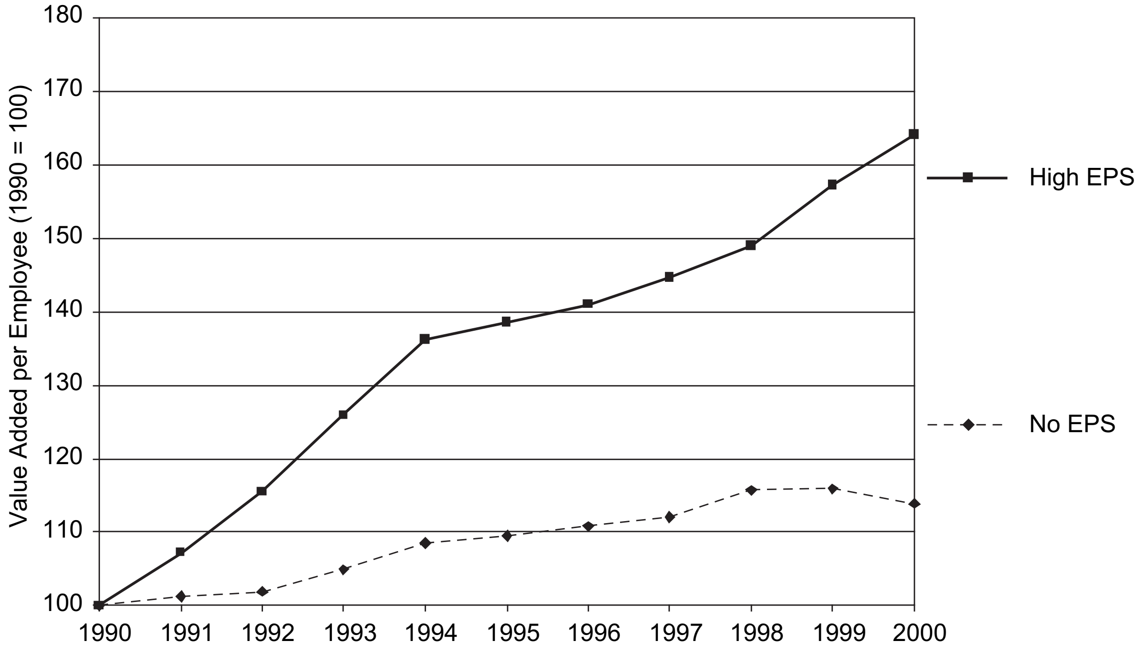


Figure 5: Distribution of Postgraduate Scientists between Sectors compared to Total Workforce.

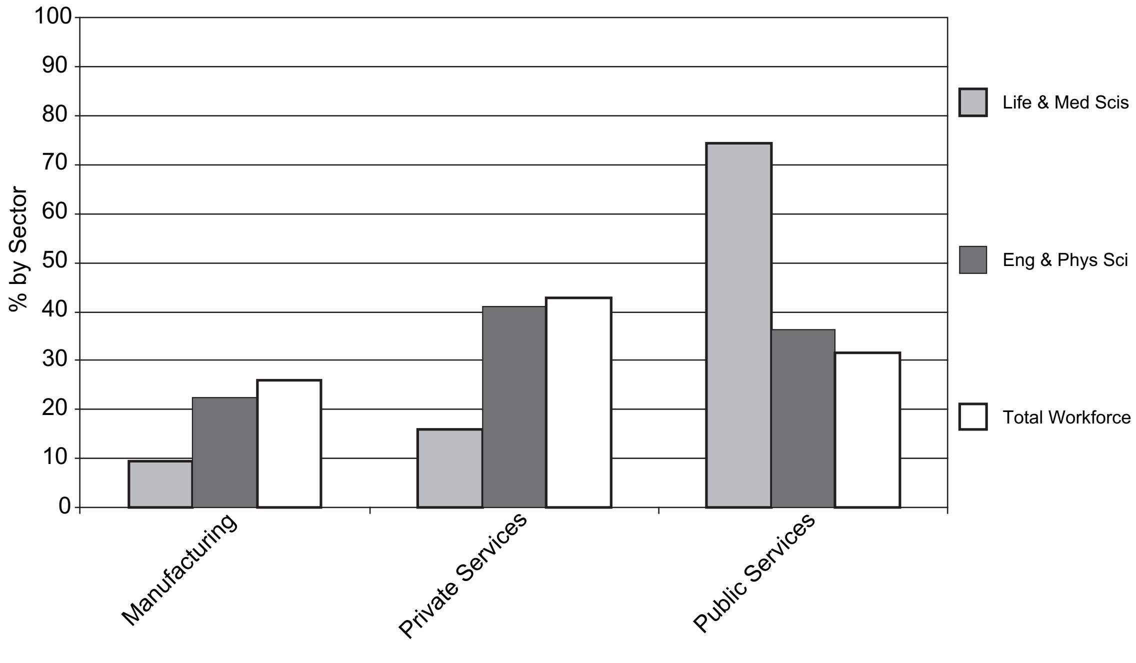
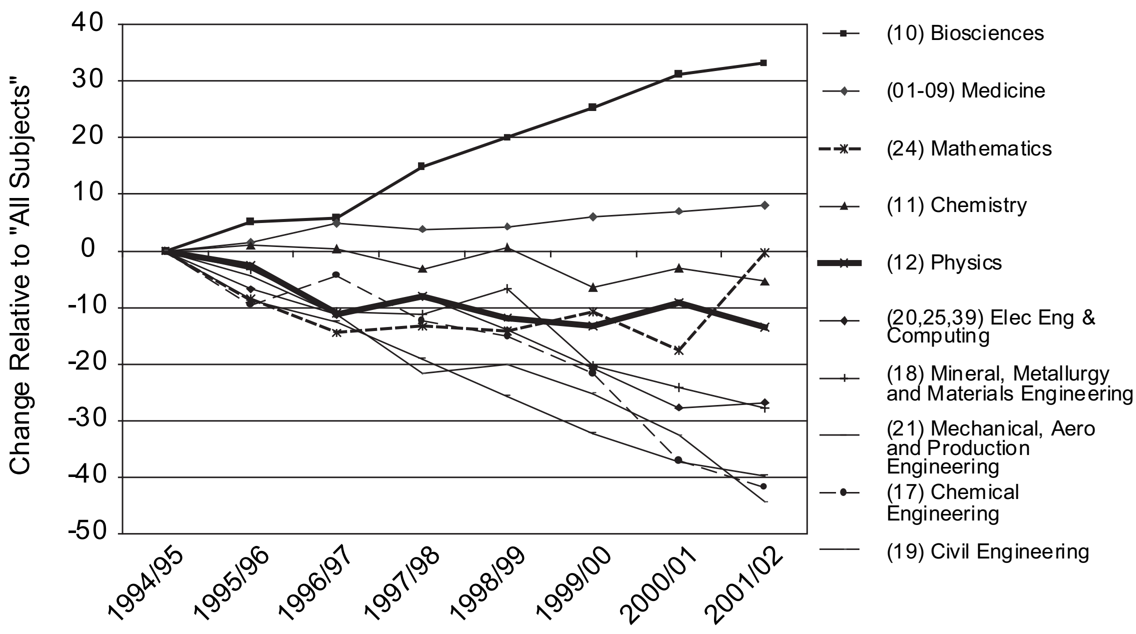


Figure 6: Relative change in HEI's external research income in different fields



Annex 4

Memorandum from the Economic and Social Research Council (ESRC)

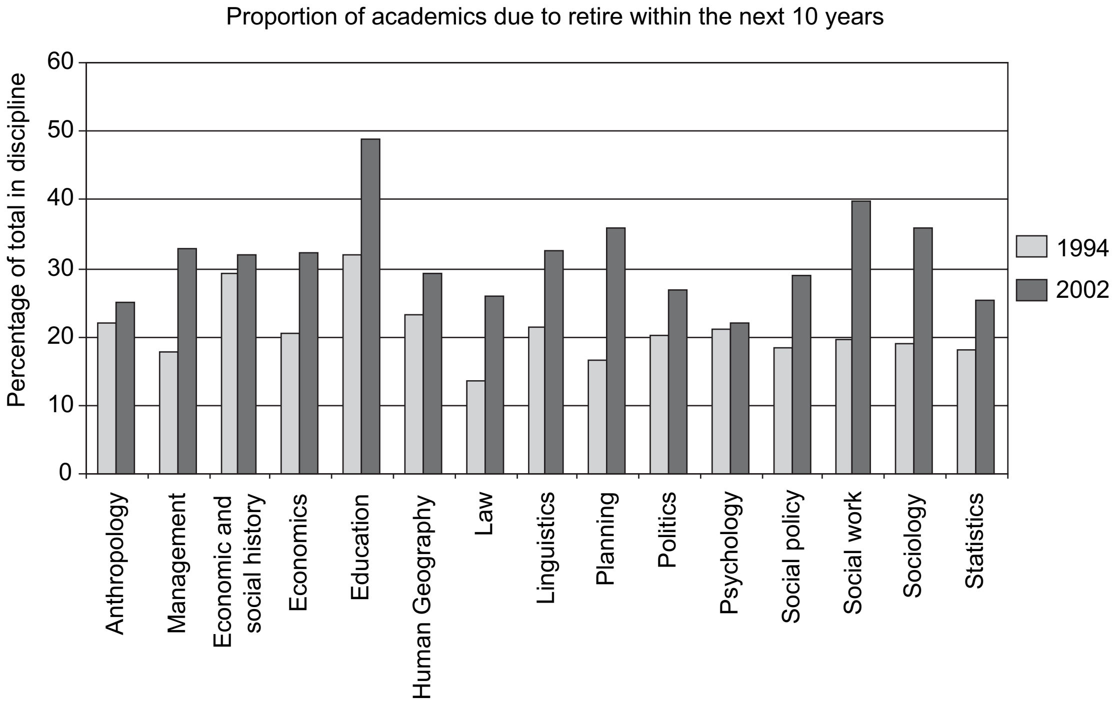
Summary

1. The ESRC's portfolio is incredibly broad and in some of the areas within its remit it would be true to say that interest and demand at undergraduate and postgraduate levels is buoyant and that there are no significant problems with the recruitment of researchers and academic staff. ESRC recognise that the expansion in student numbers in recent years has had a direct effect on staff numbers in popular areas. There are however other areas where there are significant difficulties with the recruitment and retention of high quality people; where the quality of research is not as high as we would wish or where the size and/or age profile of the existing research community is such that there are likely to be significant problems in the years ahead.

2. There are a number of systemic problems: it is now extremely difficult to recruit to posts in quantitative areas of social science. This stems from the lack of quantitative skills at undergraduate and school level and the fact that in some areas, the alternative career options are far more lucrative. A further generic area is the lack of social science researchers with language skills, particularly in non-European languages. There are also significant concerns relating to social statistics, demography, social work and empirical research in law, where the community has always been relatively small but where there are relatively few new people coming through. Finally while there has been a boom in the numbers of staff in business schools this has not been matched by the development of research capacity. ESRC is leading a major programme under SR2000 but this will only contribute to improving the situation, it will not solve it.

The Issues for Social Science

3. The workforce is ageing. In the next 10 years 31% of social scientists are due to retire, and major problems are likely to emerge unless urgent action is taken. As the table below illustrates, there are very serious problems in a number of key social science disciplines, just as there are for physics, mathematics and chemistry where there is widely acknowledged concern about longer term sustainability.



The pattern is not promising particularly in Economics and Management and Business Studies. Impending capacity problems are also clearly evident in Education, Linguistics, Social Work, Sociology and Planning.

4. Recruitment and retention difficulties have exacerbated these problems in key disciplines. For example, in Economics and Management and Business Studies the prospects of more lucrative employment opportunities in the private sector, has meant many promising researchers have turned their backs on academic careers. In addition, the highly competitive nature of the global labour market in these disciplines is making it increasingly difficult to attract top-class researchers from outside the UK. Data on the number of UK doctoral students registered in economics between 1994–95 and 2002–03 showed a fall of 31% from 520 to 360.

5. In some smaller disciplines recruitment and retention problems are also threatening the sustainability of the research base. For example, Social Statistics and Demography are both disciplines where the general lack of quantitative skills is posing serious challenges for future research capabilities. It is critical that we have the capacity in the UK to collect, understand and analyse complex data in relation to a range of social and economic issues. Moreover, there already exist a large number of datasets, many of them held by ESRC funded investments or in central government, which are under-utilised in terms of the secondary work that could be carried out on them. It is also critical that non-academic employers, especially government, can attract people with the necessary skills to work with these data. The early findings arising from the current Inquiry on Empirical Research in Law demonstrate similar problems. In Languages, capacity problems are particularly pronounced in small sub-specialisms such as Chinese, Japanese, Arabic and Asian Studies. This is seriously blunting the ability to understand these vast and important regions of the world and to position the UK to exploit future economic opportunities.

6. The one area we have reviewed recently on a more detailed basis is the field of education research where we are aware of a number of different concerns. These include: the high average age (54) of education researchers, with two thirds of the current academic community over 50 years old; difficulty in recruiting high quality research staff; the overall quality and impact of educational research, including the outcomes of the 2001 RAE under which only two 5* Units were identified; the relative shortage of large-scale quantitative research and of research in particular areas (eg lifelong learning and widening participation); and, career pathways and training, particularly for individuals moving from practice into research. As an applied area, education researchers need both rigorous research training and experience of teaching/professional work within an appropriate educational environment. The target group is therefore the early/mid-career practitioner rather than the newly qualified undergraduate. Recent increases in teachers' salaries are compounding this problem. To give two recent examples, a salary of over £25k was agreed for an unnamed RA on an ESRC grant to allow for the recruitment of someone with classroom experience and, in our Teaching and Learning Research Programme, we have allowed an appointment at £30,660 in order to recruit someone with credibility in both research and practice.

Measures Being Taken

7. The ESRC is taking steps to address a number of these issues. For example, Economics has been identified as a priority area for the allocation of studentships. Similarly, additional awards have been allocated to Social Statistics and the development of quantitative methods. The Council is currently administering a scheme with the ODPM to build capacity in planning by providing 144 new one year housing and planning bursaries per annum for the next three years. Major capacity building elements have also been included under the Teaching and Learning Programme and AIM initiative to strengthen the research base in Education and Management respectively.

8. ESRC will, however, need to commit more funds to training and development over the next few years if we are to attempt to reverse the long term sustainability problems. This new funding will be targeted on a priority set of disciplines, where current evidence suggests the need for functional renewal is most pressing. These are: Economics, Management and Business Studies, Linguistics, Socio-Legal Studies, advanced quantitative methods, Demography and Social Work.

9. It is essential that we work closely with other bodies, such as the Funding Councils and other Research Councils, to address these issues. ESRC are starting to do this. For example, as noted in paragraph 20 of the RCUK submission, the Council are developing with AHRB and the Funding Councils an initiative to build capacity in Chinese, Japanese, Arabic, Asian and East European studies.

Annex 5

Memorandum from the Medical Research Council (MRC)

Comments on Specific Questions

A: *The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments*

1. The RAE is designed to build on strengths which, as a general policy, is one that the MRC strongly supports. However, from the biomedical sciences perspective, the process leads to significant losers in certain key areas. While it is of course open to Universities to allocate their QR funding as they see fit, for example to build up disciplines or subjects that have not been rated at the highest levels, this often does not happen, no doubt for internal political and financial reasons. The current RAE process disadvantages Departments whose research is likely to have most direct impact on policy and practice, particularly in the area of health: health services research (HSR) and the professions allied to medicine (PAMs). Universities do not invest in these areas as they know that it is unlikely to get them any money via RAE, so they go for much "safer" things such as genetics and stem cells. This has meant that in many medical schools clinicians have been replaced by basic scientists in key positions.

2. Such research is usually multidisciplinary, which brings added disadvantages in the way the assessment is applied. Also, the RAE goes against collaboration, as it places greatest weight on the grants and publications of individuals in a single institute. There is not only not a great deal of incentive for people to work across universities in a spirit of collaboration, there is actually a disincentive as the host universities regard it as wasting time when they should be getting grants and papers in for them, not other institutions. In addition, the relevant departments are often newer ones, and/or in new medical schools, and/or in the less research-intensive universities. If such departments are rated at 4 or below in the RAE, it is difficult for them to receive the funding they need to meet the country's knowledge needs and to produce a research-informed workforce.

3. In relation to these, and possibly similar, areas a major problem with the RAE is that it scores people and departments on whether they are of international standing—which usually means publishing in high impact international journals. But of course lots of HSR should be judged not in terms of international science, but of local relevance. Thus, for example, very useful (for the NHS) research on referral patterns in British general practice can never expect to get into the New England Journal of Medicine but, at best, might appear in the British Journal of General Practice which many (including RAE panels) would regard as a "national" journal. Thus almost by definition, much research in primary care in the UK cannot be international: so universities simply close down these Departments (witness the dire straits of primary care departments/research in London). In part, this a problem of new departments with little critical mass and research tradition (see above), but it is also partly inherent in the work they do (and should be doing). Whilst the Select Committee may be more interested in (say) chemistry than HSR, we would like to use this opportunity to make the point that the RAE has been harmful to much applied health research where the target, mainly of necessity, has been a "local" problem.

4. On a couple of more general points:

(i) The timeframe of the RAE makes it difficult for Universities to plan long-term; it may take several years for an activity to lead to outputs that would receive the highest ratings—for example, establishment of tissue banks, data archives, or population cohorts may take more than one RAE cycle to start to deliver—and this will affect viability.

(ii) The RAE does not currently distinguish between departments with upward trajectories (which should be deserving of more support) and those with static or downward trajectories (which may not). Again, while in theory this is in the hands of individual universities to address, in practice they may not be well placed to.

B: *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend*

5. The MRC supports the concentration of research in a small number of university departments. This becomes increasingly important with the tightening of funding. In order to deliver, departments must have a critical mass. Also, multi-disciplinary research usually requires a concentration of expertise. Nevertheless, not all research-intensive universities can be excellent at everything, and it is important that the system allow for, and encourages, pockets of expertise elsewhere.

C: *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula*

6. No comment.

D: *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments*

7. It is difficult to define an "optimal balance". As stated in the comments above, the MRC supports the concentration of research in a small number of university departments. This will mean that the balance in the research-intensive universities will be (relatively) weighted in favour of research. Nevertheless, we also believe that the conduct of research within a department will improve the quality of the teaching. For example, it will help to attract higher quality staff (though the best researchers are not necessarily the best teachers) and will make the teaching environment more research-aware and the teaching itself more up to date with recent findings. Certainly research students (Masters and beyond) need to be taught in a department in which a substantial volume of research is conducted.

E: *The importance of maintaining a regional capacity in university science teaching and research*

8. Regional capacity *per se* is generally not a major concern to MRC. We will fund the best science wherever it is. However, for knowledge transfer to SMEs, there is likely to be benefit in close proximity between the SMEs and the researchers. We see this mainly as an issue for individual universities and the RDAs/DAs. Also, patients benefit if the hospital they attend is a teaching hospital (ie with a medical school), which often means they are also tertiary referral centres. Thus there is a case for medical schools not to be too closely concentrated. Indeed it has been Government policy for many years to match the location of medical schools to patient populations, thereby helping to reduce (geographical) inequalities in health.

F: *The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose*

9. As a matter of principle, we support the independence of the Funding Councils from Government Departments. Government should be cautious in believing it might be better able to judge this issue than the Funding Councils and the Universities themselves. However, we believe the Funding Councils, together with UUK, do have a role in taking a strategic and coordinated approach to the continued provision of subjects of strategic national or regional importance; this should not be left to the individual Universities to decide on their own. However, this is not a simple matter. Universities must have the freedom to re-shape their Departments or other internal structures to meet national needs and to respond to developments in the science. It is not simply a matter of keeping say Chemistry Departments as they are; the types of chemist needed in 10–15 years' time may be very different from those needed now. This requires a long-term view of what national needs will be in the future and how the markets for graduates will develop. For example, the country's "need" for phycisists would not be met if all physics graduates found employment in the city. All this leads to the conclusion that the Funding Councils should use their financial powers to achieve the strategic goals, and that not all funding should be formulaic.

Sustainability of the Research Base in Biomedical and Health Sciences

10. Biomedical disciplines have clearly benefited from the overall increase in investment in life sciences research, and life sciences have not suffered the drop in numbers of students at undergraduate level experienced in mathematics and the physical sciences. However, there are particular areas of the academic base, discussed in detail below, which give cause for concern. Weaknesses and the shortage of research capacity in these areas must be addressed if investments in scientific research are to deliver benefits for health, healthcare and the economy.

Integrative Physiology/Pharmacology

11. *In vivo* experiments using animal model systems are required to build on past investment in genomics research and develop a full understanding of the function of genes. Progress in drug discovery and development also requires in vivo *work to test the rationale and safety of new therapeutic approaches. The reductionist focus of biological research in recent years, combined with the activities of animal rights activists and the increasing costs of animal work has led to a significant decline in the numbers of people experienced in, and able to teach, whole animal work. The Association of the British Pharmaceutical Industry (ABPI) identified a lack of graduates or PhDs with experience of in vivo* work as the most crucial skills gap experienced by their members. ABPI has found that in 2004 only eight UK academic departments provide *in vivo* education at undergraduate level, and that 30% of all academics qualified to teach *in vivo* work will retire within the next five years. Concern is so great that a consortium of pharmaceutical companies has set up a fund to support *in vivo* research and training, and is looking for partnership with Research Councils (MRC and BBSRC), charities and HEIs to address this problem, and it is important that RCs are able to support this initiative.

Clinical and Translational Research

12. Several recent reports[38] have identified the need to strengthen clinical research capacity in the UK, both to ensure that benefits of the explosion of knowledge of basic disease mechanisms can be translated into benefits for health and the National Health Service, and also to ensure the UK remains an attractive location for the pharmaceutical industry to invest in R&D. This has led to the establishment of the UK Clinical Research Collaboration and the commitment of significant additional funding via DH for clinical research infrastructure. The ability to deliver clinical benefits based on the basic science research MRC has funded is threatened by a shortage of experienced clinical and translational researchers and a lack of recruitment of young doctors, dentists and other clinically qualified staff into a research career. A 2003 survey[39] of UK Medical and Dental Schools showed that since 2000 there has been a 30% decline in the number of clinical lecturers in Medicine and Dentistry in and a 17% loss in the overall number of clinical researchers. Many clinical academic posts remain unfilled at a time when the teaching burden in medicine and dentistry is set to rise significantly (eg a projected increase of 40% in the number of medical students). Shortages of academic trainees are particularly acute in certain disciplines, for example pathology, obstetrics and gynaecology, dentistry and public health medicine (see below). A recent report from the Royal College of Paediatrics and Child Health[40] also highlighted a shortage of research capacity in paediatric pharmacology, which maps onto a UK Clinical Research Collaboration priority area. These capacity problems require concerted action from the Royal Colleges, the Department of Health, HEIs and the major funding bodies in medical research to address issues of career structure and other barriers to clinical research careers. MRC is actively involved in various stakeholder groups trying to find a solution to these issues, and additional funding for training and capacity development in clinical and translational research will be required. MRC proposed various initiatives in our SR2004 clinical research bid, including the development of a cadre of "research translators" with new skill mixes.

Public Health and Health Services Research

13. The Wanless report[41] identifies the weakness of the evidence base on the effectiveness and cost-effectiveness of public health interventions as a major constraint to further progress in improving public health and the effectiveness of the NHS. A DH survey in 2001[42] concluded that, although research capacity in this area had increased, there was still a lack of expertise in statistics, epidemiology, social sciences and health economics. The CHMS report[38] shows that public health medicine has been particularly badly affected by the recent decline in clinical academic staff, with a 32% decline overall and a 59% decline in clinical lecturers between 2000 and 2003. A recent DH committee reported a significant shortage of health economists, estimating an unmet demand of at least 50. The weakness in public health research is due in part to its low status in the medical and research community (and in the RAE) and the lack of commercial or financial rewards from this type of research, which means that the majority of investment has to come from public funds. MRC has had a major initiative to increase investment in "Health of the Public" research since 1998 and has been running an earmarked fellowship scheme jointly with DH to help increase research workforce capacity for some time, but further action is undoubtedly required.

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[38] Strengthening Clinical Research, Academy of Medical Sciences, Oct 2003. Bioscience 2015: Improving National Health, Increasing National Wealth. Bioscience Innovation and Growth Team (BIGT) 2004.

[39] Clinical Academic Staffing Levels in UK Medical and Dental Schools, Council of Heads of Medical Schools and the Council of Deans of Dental Schools, May 2004.

[40] "Safer and Better Medicines for Children—Royal College of Paediatrics and Child Health; May 2004".

[41] Securing Good Health for the Whole Population, 2004.

[42] National Academic Public Health R& D Capacity Survey for England 2000/01 J.Weeden *et al.*

Dependence on the Research Base Outside MRC's Remit

14. MRC endorses the point made in the EPSRC annex that progress in medical sciences depends on a strong research base in the physical sciences. There is a particular need for people trained to a high level in mathematics and physics to apply their skills to medical research questions, in areas such as mathematical modelling, structural studies, imaging and informatics. A strong research base in chemistry is also necessary for sustaining progress in medical research, not only to underpin development of new therapeutic and diagnostic agents but also for the design of new molecules used as research tools for manipulating biological systems. MRC is therefore also concerned about the sustainability of the research base in physics, chemistry and mathematics.

Annex 6

Memorandum from the Particle Physics and Astronomy Research Council (PPARC)

1. This memorandum provides some observations from PPARC's perspective.

2. The overall picture for UK particle physics and astronomy is one of strength, vibrancy and growth.

3. As measured by citations the UK is a clear second to the USA in astronomy and is one of the top three behind the USA in particle physics. UK groups are world-leading in a number of specific highly competitive areas, for example, dark matter, gravitational waves, cosmic microwave background radiation, neutrino physics and theoretical modelling.

4. The PPARC community in academia is growing. For example there was a 40% increase in permanent academic staff in astronomy groups from 1995-2002 and this trend is continuing with the formation of new research groups. This growth has been driven primarily by the proven ability of PPARC Astronomy faculty to attract undergraduates.

5. Over 90% of PPARC researchers work in 5/5* physics departments. Competing internationally, often in large scale collaborations, requires departments to have a sufficient critical mass of high quality researchers. PPARC believes that the RAE is a powerful driver towards research excellence. The problem is that the current financial methodology places too much emphasis on rewarding historical achievement with little possibility of upward movement.

6. With its strong requirement for long term commitment to build its large facilities PPARC has and will collaborate with University management in growing capability in specific areas, and in enabling new groups to be created with the necessary critical mass. Examples of recent joint investment, in some cases supplemented by funding from RDAs and private endowment, are:

(a) Glasgow University—Gravitational Waves

(b) Durham University—Institute for Particle Physics Phenomenology

(c) Liverpool, Manchester, Lancaster—Cockcroft Institute for Accelerator Science

(d) Oxford—Adams Institute for Accelerator Science

(e) Edinburgh—Parallel Computer Centre

(f) Warwick—New Experiment Particle Physics Group

7. PPARC has increased the volume of studentships by 30% since 1995 and plans a further increase of 50% by 2007/08. Demand for studentships is running at over three times the number available. The take-up and quality has remained consistently high : an average of 98% take-up in the last nine years and over 60% of students who take up awards have first class degrees.

8. In summary

- the long-term nature of the investment required to enable PPARC's community to participate in the design, construction and exploitation of internationally competitive state-of-the-art facilities provides Universities with a framework within which to plan strategically;
- astronomy and particle physics are successful in attracting students into the physical sciences. Given their skills and the fact that about 50% do not stay in PPARC-funded research they could provide a growing pool of skilled expertise for both other disciplines and the private sector.

APPENDIX 51

Memorandum from the Society of Chemical Industry (SCI)

Strategic Science Provision in English Universities

1. SCI (The Society of Chemical Industry) is an interdisciplinary network connecting industry, research and consumer affairs at all levels throughout the world, focusing on "where science meets business". It provides opportunities for forward-looking people in the pharmaceuticals, food, agriculture, energy, chemicals, water, materials, environmental protection, and construction areas to exchange ideas and gain new perspectives through meetings, magazines, conferences, peer-reviewed journals and electronic interaction. Founded in London in 1881 and in New York in 1894, SCI is a membership association and registered charity.

SCI's sectoral coverage is represented by the following diagram:

2. Countries that expect enterprises and institutions based on science, technology and medicine (STM) to play a significant part in their future national economy and quality of life must expect to invest appropriately in substantial quantities of high quality science education at all levels. Even countries (and they are few in number) that start out from the position that they do not need a large science base because manufacturing and product-related innovation are not priority areas find they struggle without a wide spread of good science education. This is because the procurement, management and delivery of STM-related goods and services, including healthcare, information technology, consumer protection and environmental control, require the sophisticated application of science related skills. In today's complex world, shortage of such skills quickly leads to poor decision-making on future policy and investment, and on the safe and cost-effective provision of the sort of goods and services essential to modern lifestyles. More typically, countries will focus their advanced scientific education and research resources around the industrial and service priorities of their economies. They will do this whilst continuing to ensure excellent primary and secondary level general science teaching to underpin occupational flexibility and responsible approaches to personal and family decisions and wider democratic participation.

3. Although SCI covers a wide range of disciplines even beyond science as traditionally identified, it is indisputable that chemistry is a core discipline throughout the spectrum of STM activity. In addition to the large number of chemists required for direct employment, for example in industry, primary production and extraction, commerce, regulation, liaison and health provision, chemistry teachers are required in large numbers to ensure the provision of key components of a general education and professional "formation" of those destined for a much wider range of occupations. Chemistry is thus not a dispensable or optional extra and a sufficient supply of inspiring teachers at all levels is required to undertake the necessary teaching and training, and to provide a surplus in recognition of the sort of promotion, career development and international movement of people that always occurs.

4. As a teaching subject at the higher education level, chemistry relies upon the stimulus and renewal that comes from interaction with research workers. This cannot be left to chance, but requires spatially distributed centres of excellence covering all of the main centres of population, and with advantage also additional centres of excellence related to particular STM-enterprise or—institution clusters.

5. Examples follow of the views of SCI members in a few of the many sectors in which chemistry plays a major part, as well as those concerned with entrepreneurship, and social and administration aspects of higher education. This has been undertaken at speed to meet the timetable of the Select Committee. It is not exhaustive, either in terms of coverage or of the particular points of emphasis.

6. SCI members in the Pharmaceutical industry emphasise that chemistry is the core discipline in drug discovery and development. Research-based pharmaceutical and biotechnology industries cannot survive without the provision of well-trained chemistry graduates in large numbers. It is also a core discipline in other industries that pharmaceutical and biotechnology companies rely upon, and in medicine and related disciplines. Medicine, in particular, relies on integrated work across the sciences, and medical breakthroughs are often based on collaborative work between departments or the sharing of knowledge and expertise across the sciences. The closure of chemistry facilities puts groundbreaking medicine-related research and development under threat. A recent speech by SCI's current World President, and Chief Executive of AstraZeneca Sir Tom McKillop, (http://www.soci.org/SCI/groups/bsg/2004/reports/html/gs3077.jsp) sets the pharmaceutical sector and its requirements in a global context.

7. Examples of other vital industries and public organisations that cannot operate without well-trained chemists are:

- electronics (semiconductors, displays, LEDs, memory etc);
- the food industry;
- agriculture;
- polymers and coatings;
- environmental industries;
- water industries;
- personal and domestic hygiene and care;
- advanced materials;
- nanotechnology; and
- and many more . . .

As with pharmaceuticals, many other industrial employers in these sectors with R&D, manufacturing and service facilities will prefer to employ qualified nationals in these functions. If the supply and quality is insufficient, the inevitable tendency will be for such high tech/high knowledge/high value functions to be fulfilled by other nationals or in other locations—clearly an effect opposite to the long term intentions of national education and employment strategies.

8. In relation to small and medium-sized enterprises (SMEs) there is a close link between innovation and the supply of suitable employees. Many SMEs have strong ties with one local university department, with sometimes the majority of their staff having been first attracted to the area by the university. Many SMEs have actually "spun-out" of university departments and rely on the same department for consultancy, contract work (such as analysis) and access to lectures and conferences. The weakening of established links to academics will have an impact on innovation and technology transfer between academia and smaller research organisations with limited resources. This in turn will affect the chemistry-based industry, potentially reducing jobs and further damaging the attractiveness of chemistry as a career and degree subject.

9. The relationship between smaller chemistry departments and larger departments is often of a symbiotic nature. Many smaller departments have a reputation for producing graduates who are attractive both to industry and to the bigger university research departments. The majority of jobs for science graduates including teaching are at first degree level. It follows that provision of well-trained science graduates is a vital activity, which must not simply be a by-product from major research schools. A decrease in the supply of research-oriented graduates through the uncoordinated closure of chemistry departments will have severe consequences for both industry and the major research universities. Smaller departments that provide good teaching as well as doing some research and/or provide support for industry should be encouraged and should be judged on the overall value of their provision, not just on research and in particular not just on the level of research income.

10. The social dimension could easily be overlooked. The issue of access is an important one for science degrees. Science has traditionally provided a route whereby people from less well-off backgrounds find success. Many leading chemists in industry and academia came from poorer backgrounds. If chemistry degree courses were only to be accessible to the students with the highest university entrance scores, chemistry would become inaccessible to students who had not fully developed their academic skills at age 18. As a consequence there would be inadequate provision of chemists, appropriately educated for the wide range of technical and research jobs demanded by a high-tech economy. In addition, students increasingly attend universities in their region and so there must be provision for sciences in every centre of the

population. Departments that concentrate on teaching could play a big part in encouraging young people into science. If there is no local provision they will study other subjects that are less beneficial to the economy.

11. The provision of well-trained and motivated graduates for science teaching represents a significant challenge for the future if we are to attract good students into science. Taking chemistry in Britain as an example, only 40 % of chemistry students in years 12 and above are taught by teachers with a chemistry degree. The fact that chemistry graduates are attractive to a range of employers, and can benefit from well-paid careers, has for several decades pulled chemists away from teaching as a primary career option. The same is not necessarily true of graduates from other disciplines for whom teaching may be the major opportunity for employment.

12. In relation to the specific questions about science provision in English universities posed by the Select Committee, there has not been time to survey the opinions of all those in the SCI membership with relevant knowledge and experience, but the following views are thought to be reasonably typical of those with experience of the management of medium-sized English university departments of chemistry:

12.1 HEFCE's research funding formulae has had a very bad effect on the financial viability of many good university science departments. This is the opinion of many chemists, even in "safe" departments.

12.2 The policy leading to the concentration of research in too small a number of departments has been a mistake.

12.3 Weightings in the teaching funding formula are to a great extent arbitrary and have resulted in a "notional" overspend in some science departments.

12.4 All university science departments should be expected to make provision for research. This is not to say that every member of staff has to be both teacher and researcher, but a healthy balance between teaching and research has paid handsome dividends in the past. If research is not encouraged, the quality of the science teaching at first degree level is likely to suffer.

12.5 It is important to ensure that there is adequate provision of a regional capacity in university science teaching and research.

12.6 The UK Government should intervene to ensure the continuing provision of subjects of both national and regional importance.

13. In addition, SCI has a high regard for the data on Britain produced by the Association of British Pharmaceutical Industries (ABPI) and the Royal Society of Chemistry, and urges the Select Committee to accord it proper weight.

14. In summary any rationalisation of research provision needs to be better managed and co-ordinated within England. In assessing the research productivity of a department, account should be taken of the other demands on staff, particularly with low staff numbers, where teaching loads are high. A funding system is needed that allows maintenance of good teaching departments throughout the country, not all of which should be expected to engage in research at the highest level. The country needs sufficient chemistry departments suitably located geographically to satisfy local needs and be properly funded. This will require a major strategic review of chemistry education in the UK, and funding needs to be provided in the very near future to stop the disintegration of chemistry education in UK universities.

January 2005

APPENDIX 52

Memorandum from the University of Central England

1. The Impact of HEFCE's Research Funding Committee Formulae on the Financial Viability of University Science Departments

The departments that suffered most from the RAE funding formulae were those who achieved a 4 in 2001, following either a 5 or 4 in 1996. Departments that focused on improving teaching quality during this period in response to QAA pressures, suffered from lower RAE funding. This in turn undermined the viability of future research and teaching. Engineering faculties such as the Technology Innovation Centre (tic) at UCE, which improved from a 2 to a 3b saw their RAE funding reduced to zero. This resulted not only in a cut-back on research staff but also a loss of research student bursaries, both of which meant a reduced capacity to deliver the small amount of teaching that those staff and students were expected to deliver. While this did not undermine the financial viability of the tic, the impact being marginal, at other institutions this could have been a tipping point.

2. The Desirability of Increasing the Concentration of Research in a Small Number of University Departments

The increasing of concentration of research in a few institutions undermines the viability of the UK science base. While there is no doubt that those departments that are world leaders in their field deserve support, the effect of over-concentration of resources in these departments mean that;

(1) There are reduced opportunities for new researchers to get started.

(2) There are fewer career paths for those that do, meaning fewer opportunities for developing new science.

(3) Old science is rewarded, ultimately leading to stagnation.

(4) Rather than the UK retaining the cutting edge scientists, it is easier for competitors, in the United States for example, to pick off research teams thereby reducing national capacity.

(5) It undermines the capacity of researchers in new universities to service their regional economics.

(6) It has structural effects on the economy, reducing the capacity of universities to respond to the needs of SMEs.

(7) It becomes far more difficult for universities like UCE to attract and retain research-active staff, which, in turn, reduces our capacity to deliver 3rd stream activity in the region, both of which impact on the quality/vibrancy of our teaching.

3. Implications for University Science Teaching of Changes in the Weightings given to Science Subjects in the Teaching Funding Formula

Reduction in the weightings means that students will have less practical work and more PC-based simulation. A reduction of laboratory bench-based sciences takes them further away from the practical needs of industry.

4. Optimal Balance between Teaching and Research Provision; Desirability and Financial Viability of Teaching-only Science Departments

University teaching is stimulated by the development of subject knowledge through research. Not all teachers need be research active and not all researchers need be RAE-active. All teachers need to be "scholarly active". For departments to remain dynamic and attractive to teachers who are up-to-date with new knowledge in their fields, opportunities for research as personal and professional development need to be available. There is no optimal balance that can be applied across all fields of science and engineering, nor across all institutions. The balance will also vary according to the mix of postgraduate and undergraduate teaching provision. As the balance in any university tends towards postgraduate teaching, the need for research-active staff increases.

5. Importance of Maintaining a Regional Capacity in University Science Teaching and Research

Retaining regional research capacity is essential for the economic well-being of the regions. However, it is applied research (not the pure research that has traditionally been measured by the RAE) that is of critical importance for wealth creation in the regions. Pre-1992 universities tend to carry out research for small numbers of large national and international firms. New universities tend to focus on the needs of regionally based SMEs. The research agenda of RDAs are not concerned with fundamental research. They are concerned with applied research and knowledge transfer on a regional scale, which is what the new universities do best. However, the concentration of research funding through the RAE has reduced the capacity of the new universities to deliver this, particularly to SMEs who are not directly affected by the outputs of pure research. While the research base of the old universities may be important for attracting inward investment, indigenous companies are more likely to benefit from the small-scale applied research carried out by the post-1992 universities.

The new universities can also transfer the knowledge generated by the fundamental research of the old universities to regional users, but this requires that the new universities are sufficiently research active to attend the conferences, etc where the new knowledge is disseminated. In an era of rapid technological change, dissemination via publications and students reaches the market too late; for new knowledge to have an immediate impact, it must be adopted, adapted and disseminated rapidly through research networks and knowledge transfer channels. This implies the need for old and new universities in any region to work closely together, for both types of university to be research-active, but for an inevitable division of labour between research and dissemination activities to be recognised and for the support and encouragement of two-way knowledge transfer between them. The new universities therefore have an important role to play in maintaining a regional capacity in science teaching and research, something that is often overlooked.

6. The Extent to which the Government Should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance

Intervention may be needed on both supply and demand. On the supply side, action is required at both secondary and tertiary levels. Falling student numbers needs to be addressed in schools, through stimulating pupil interest in science and engineering. With the increasing financial pressure on students to study in the regions where they live, declining regional provision in some subjects in the regions will result in students being less likely to study science and engineering in the future. Addressing this will require financial incentives for students and/or action to ensure that science and engineering departments in new universities in the regions are given additional financial support to compensate for the loss of RAE funds. Financial support, through third stream Knowledge Transfer funding, is an essential element of this intervention and it is important that any formulae derived from the distribution of HEIF should not result in a further concentration of funding in research-intensive universities to the detriment of the viability of science and engineering in new universities. That is, intervention is not just about supporting teaching facilities in research-intensive universities.

Turning to the demand side, if there is no regional demand for the labour of scientists, any additional investment in science teaching will be lost to the regions. The RDAs' role should be to stimulate this demand by promoting both inward investment and SME development. As indicated above, the latter requires the participation of research-active staff in new universities and adequate funding for the knowledge transfer (KT) activities of these institutions. HEFCE must ensure that the formulae that it uses for the distribution of KT funds do not further undermine the role of the new universities in this field.

January 2005

APPENDIX 53

Memorandum from the Institute of Food Research

The Institute of Food Research (IFR) is an Institute with charitable status, sponsored by the Biotechnology and Biological Sciences Research Council (BBSRC). It is a member organisation of Norwich Research Park and for the purposes of postgraduate training is an affiliated School of the University of East Anglia. We are pleased to offer the following comments in response to the questions raised.

The Impact of HEFCE's Research Funding Formulae, as Applied to Research Assessment Exercise Ratings, on the Financial Viability of University Science Departments

No comment, but see the comment below relating to the isolation of researchers in teaching-centred (or less-research-active) departments.

The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of Such a Trend

Concentration of research within a smaller number of larger units (which may include elements of other research organisations, such as Institutes) can (i) offer advantages of scale in the provision/acquisition of research infrastructure; (ii) increase the opportunities for productive interaction between researchers and for the evolution of collaborative teams; and (iii) mitigate against academic fragmentation and the failure to maintain critical mass. The development of emerging, interdisciplinary themes (for example, integrative biology; nanotechnology) can also create fresh incentives to maintain local "at risk"" research disciplines. A broad, interdisciplinary and long-term view is essential.

The increasing concentration of research within a smaller number of centres will increase the tendency to isolation of researchers working outside these centres. There need to be better mechanisms to ensure that high-quality, research-active staff who work elsewhere (for example in teaching-centred departments) are not forced out of research. This urgently requires inclusive and flexible mechanisms to facilitate the mobility and re-alignment of researchers.

The Implications for University Science Teaching of Changes in the Weightings Given to Science Subjects in the Teaching Funding Formula

It is important that the cost weightings reflect accurately current (rather than historical) relative costs and that the system is sufficiently fine-tuned in terms of subject classification and content. (For example, the weighting given to biochemistry should take account of the expense of molecular-biology teaching within biochemistry.)

The Optimal Balance Between Teaching and Research Provision in Universities, Giving Particular Consideration to the Desirability and Financial Viability of Teaching-only Science Departments

There is no reason why teaching-only departments should not provide an excellent scientific training at first-degree and Masters' levels. One potential model is for teaching-centred departments to have formalised "feeder" status in relation to research centres. This would strengthen the relationship between the two types of institution and should act to raise the status of university teaching.

Consideration should also be given to a measured expansion of high-quality technical training, in anticipation of requirements for an increasing proportion of research-support staff to service the rapid development of high-throughput science. This function could be undertaken by a new category of university and college technical departments providing courses at several levels.

Departments must enrol (only) students of sufficient calibre to ensure that course standards and achievement levels can be maintained. Problems at undergraduate level have a knock-on effect at PhD level where, in our experience, research students are often found to lack basic scientific knowledge. The financial pressure on universities to increase student intakes needs to be relaxed and replaced with a higher level of per capita funding.

The Importance of Maintaining a Regional Capacity in University Science Teaching and Research

Regional science teaching (particularly) is essential, especially given the cost and shortage of accommodation and consequent pressures on students to undertake courses close to their homes. Both teaching and research are critical in promoting a science culture throughout the UK and in building UK-wide links with industry.

There are salary issues that affect recruitment in London and the South-East, but increasingly also in other areas.

The Extent to Which the Government Should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance; and the Mechanisms it should use for this Purpose

It is important that a UK-wide strategy for the provision of science teaching and training is developed, including the issue of harmonisation of standards with the rest of the EU (especially in higher degrees). It should include subject provision across-the-board, including fast-developing subjects such as bioinformatics as well as established core sciences. Regional provision of the teaching of core subjects (whether emerging or established) should be maintained as a priority.

January 2005

APPENDIX 54

Memorandum from the Regional Developments Agencies (RDAs)

1. The RDAs welcome the opportunity to respond to this inquiry. The English RDAs share the concerns of the Science and Technology Committee about critical subject shortages, particularly in the sciences, which potentially have both national and regional impact.

The RDAs can contribute to developing internationally regional and national knowledge economists, based on a sustainable and responsive SET base through:

- International benchmarking with the most dynamic competitive regions to evaluate our future business needs for science provision.
- Brokering collaboration between businesses and between business and the science base to stimulate innovation, enterprise and increase business research and development.
- Brokering greater university and college collaboration where needed, for capacity retention of disciplines of strategic significance for the economy of the region, for both research and teaching
- Recognising the different types of skills needed by the SET-based employees and facilitating coherent learning and skills solutions to meet these needs to increase the "supply chain" of scientists and technicians at regional level.

2. The Regional Developments Agencies Act 1998 gives the RDAs five statutory objectives:

I. To further economic development and regeneration;

II. To promote business efficiency, investment and competitiveness;

III. To promote employment;

IV. To enhance the development and application of skills; and

V. To contribute to the achievement of sustainable development in the UK.

RDAs are business-led and recognise the importance of a strong science, engineering and technology (SET) base to developing and maintaining a healthy, dynamic and sustainable economy through their statutory objectives. This is increasingly reflected in Regional Economic Strategies (RES), and all RDAs have initiated Science and Industry Councils to provide strategic advice from business leaders, vice-chancellors and other key partners such as research councils. The RES focus on delivering sustainable economic development, including increasing productivity through developing competitive, knowledge based economies. Strategic science provision in the universities has a direct impact on the all these objectives. The skills supply is one of the five key drivers of productivity (along with investment, competition, enterprise and innovation), and the regions are fully aware of the importance of a strong and responsive SET base in supporting knowledge-driven economies that promote economic and sustainable development, regeneration, business competitiveness, and high value-added employment.

In the five years since their establishment, the RDAs have made an increasing strategic and financial commitment to the science base. The RDAs currently spend around £0.25 billion per annum on the Science and Technology base. *[House of Lords Inquiry "SETting the Regional Agenda". 2003].* The primary focus of this support is to stimulate business-driven research, knowledge transfer, enterprise and innovation. The new 2005 tasking framework for the RDAs will include targets for knowledge transfer (KT) through increasing the number of businesses collaborating with the knowledge base (including HEIs, and PSREs), and also increasing innovation in businesses. This will assist the government's 10-year target of increasing Business Expenditure on R&D (from 1.24% GDP to 1.9% GDP). To meet this target business expenditure on R&D needs to increase by some £12 billion pa, stimulated by the increase in government spending on the SET base. RDAs are taking on the new "Lambert" role to articulate business need for closer working with the knowledge base in their corporate plans for 2005–2008 through specifically refocused and targeted resources.

The RDAs have a long-term perspective, working on 10 to 20 year forecasting frameworks through their Regional Economic Strategies, and are concerned about the projected shortages of scientists and the implications for employers. While some welcome initiatives to address the shortage of scientists have been introduced by the government in the 10-year investment framework, more needs to be done, and greater regional participation is needed.

3. Data and intelligence available on the supply of scientists has led to growing concerns. Royal Society of Chemistry data[1] shows that there are only around. 3,000 students pa starting Chemistry degrees, with some marked regional variations. The Functional Sustainability sub-group of the Funders' Forum has expressed concerns in a study of the sustainability of the research base this month.[2] This highlights the need for a parallel study of business and industry research, where less information is available. Forecasts of SET teacher recruitment and retention are raising concerns at regional level.[3] Many large and multi-national employers that RDAs engage with refer to SET skills provision as a key factor in their location in the UK and particular regions. These companies are responsible for much of the R&D spend in the UK, so if the SET skills supply dries up then much R&D could move elsewhere, with significant consequences for the 2.5% GVA target for R&D. The supply of PhD students in SET subjects may be at least as critical as the supply of graduates where we do not compare well with major competitors for researchers in employment.[4] To reach the 2.5% R&D target, an estimated 50,000 additional UK researchers are needed.

4. Where UK recruitment is difficult, multi-national employers (and University research departments) can attract high quality graduates and postgraduates from other countries, but this raises concerns about long-term sustainability. At the same time UK graduates without first class degrees may find employment opportunities difficult to find in science based industries and may look for employment elsewhere. This suggests the problem at least currently, is as much one of graduate quality as of quantity, and the fit between employer needs and course provision.

The Impact of HEFCE's Research Funding Formula, as Applied to RAE Ratings, on the Financial Viability of University Science Departments

5. The HEFCE research funding formula as applied to the RAE ratings appears to have a negative impact for science departments, through the low weightings for departments with grade 4 (or less) and for laboratory based science research.[5] The allocation formula could benefit from a rethink as it does not reflect the full cost of these subjects or take account of the potential impact of these subjects on economic development and international competitiveness.

[1] *Daily Telegraph*, 7 July 2000.

[2] Physics—building a flourishing future, Report of the Inquiry into Undergraduate Physics, Institute of Physics, 2001.

[3] quoted in *The Guardian*, Education Section, 5 December 2000.

[4] *Times Higher Education Supplement*, 26 November 2004.

[5] SET for success: The supply of people with science, technology, engineering and mathematics skills: the Report of Sir Gareth Roberts' Review published April 2002.

The cross-subsidy of research funding to teaching outputs by eg postgraduate demonstrators, use of research equipment and project work alongside research groups will impact on the ability of science departments to survive. Universities that do not have significant research income may find it difficult to deliver quality teaching. This may be more starkly apparent in the light of the transparency review which draws attention to the high Full Economic Cost of sciences.

6. The research and teaching factors can reinforce each other, since undergraduate recruitment to departments with grade 4 or lower RAE ratings may be adversely affected, leading to applications with lower A-level point scores, which will impact on the universities Performance Indicators.

The Desirability of Increasing the Concentration of Research in a Small Number of University Departments, and the Consequences of such a Trend

7. Positive effects of research concentration may result if this leads to remaining departments being more likely to have a stronger international profile, as top scientists concentrate in fewer departments. Against this there may be some reduction in breadth and flexibility of the system. A good geographical distribution of research-led departments is important for good business (especially SME)—HE collaboration across all regions, as well (see below) as access for students who wish or need to study near to home.

8. All universities should carry out research but not all universities should do research in every subject. There is a case for ensuring that all universities have baseline research funding (cf PCFC funds) to allow excellence to be nurtured wherever it occurs alongside baseline third leg funding (eg HEIF) to allow responsiveness to businesses to be developed in all universities. There is also potential for more university collaboration at regional and cross-regional levels, perhaps through hub and spokes models,[6] focussed around a small number of globally competitive departments. This could increase the visibility, accessibility and responsiveness of the research base to business needs and near market research. The possibilities for staff in the spokes to carry out research in the hubs transfer could have a beneficial effect in raising aspirations.

The Implications for University Science Teaching of Changes in Weightings Given to Science Subjects in the Teaching Funding Formula:

9. The impact of weightings of teaching allocations for science subjects should be addressed in the context of:

- How many students and what type of degrees are needed?
- How Science Research Infrastructure Funding (SRIF) allocations can be more coherently linked to sustainability?
- The extent to which research and teaching funding mutually reinforce and cross-subsidise.

A more detailed regional perspective is given below (paragraph 10). However well-found laboratories are important and necessary for undergraduate science teaching, to produce research-oriented graduates, advanced technicians able to meet the needs of cutting edge technologies, schoolteachers and scientific entrepreneurs also need to understand and be exposed to the excitement of the subject at the forefront of developments if they are to communicate this to school students or identify advances leading to new products. Consequently it is essential that the teaching allocation weightings for such economically important laboratory-based sciences as physics, chemistry and biology need to be high enough to meet these needs.

The Optimal balance between teaching and research provision in universities, giving particular consideration to the Desirability and Financial Viability of Teaching-only Science Departments

10. Research/teaching balance and teaching only science departments. There are some outstanding teachers who are not active researchers and in principle such departments could exist, but they would struggle with market perceptions of quality, and would not have the funding and infrastructure to expose students to modern equipment and laboratory techniques. The hub and spokes model referred to above[6] may help, and we would prefer to regard the "spokes" as "less research-intensive" departments. These departments might be suitable to teach advanced technical skills, where there are significant shortages in some regions (see below), but partnership with the hubs and businesses would be necessary. For example pairing "spokes" with research-intensive departments or companies to provide "laboratory summer schools" might deal with some of the practical costs.

[6] The weighting for clinical medicine was reduced from 4.5 to 4.0; and the weighting for laboratory science from 2.0 to 1.7.

The Importance of Maintaining a Regional Capacity in University Science Teaching and research:

11. Regional capacity—there are several issues to be considered:

- Regions attach importance to economic development through spin-off and licensing activities of universities, and technology transfer is often most effective at a regional level. Increasing support by universities to provide solutions for local SMEs will be promoted and brokered by the RDAs in their new knowledge transfer role. The retention of capacity in regional universities of disciplines of strategic significance will be needed for the current and future economy of that region.
- A key message from the Lambert report was that the need to increase local business-university collaboration is as important as collaboration with university departments with global status. The location of a university collaborating with businesses depends on the geography of the firms' market and the level of technology. 88 % of companies with local markets use local universities, as do 47 % of companies with regional markets (Community Innovation Survey 2001, quoted in the Lambert report). Even for international markets 26 % of companies use a local university
- Students who wish to study from home or "near to home" will be disadvantaged by the lack of a nearby department. There appears to be a steady rise, of around 1–2 % pa, in the numbers of students studying from home[7], and the incoming changes in fees are more likely to increase these numbers. Social class disparities in HE participation are still strong, and targeting increased recruitment in areas of deprivation will bring in students who may be the first in their family to study at HE level, and may be less likely to study away from home.
- The increasingly tight labour market resulting from demographic trends will create a growing need for work-based learning and continuing professional development. Regional Skills Partnerships have all highlighted the need to invest more in the existing workforce as a priority. Even where employment is high skills are not at a high enough level. Qualified scientists need to continue to learn to remain fully effective, and there may be several regions or sub-regions where companies will not be close to relevant HE departments.
- Not all students are full-time—part-time students account for around 44% of the total entrants to HE and 95 % of part-time students are mature[8]. There are limits to how far such employed students are able or willing to travel, especially if they are parents. Distance learning (pioneered by the Open University) can make an important contribution, supported by laboratory-based summer schools at other universities. Provision also needs to be available to respond to more local employer needs, and these may need to have flexible delivery arrangements, such as innovative ways of delivering part-time undergraduate courses in the work place.[9]
- Increasingly Universities are committed to promoting entrepreneurial graduates. Such graduates benefit from structured interactions between business students and engineering and science students.[10]
- There is a need for different kinds of scientist, including high quality graduates and PhDs for fundamental R&D, and advanced technicians (technologists). The current secondary and tertiary education system does not produce enough of these technologists with excellent technical skills. They need to have the ability to "move atoms around", develop high throughput technologies or help make precision instrumentation for satellites, lasers, magnetic resonance imaging scanners etc RDAs are made aware through employer engagement (including science and industry councils) of these needs. Such training cannot all be gained in university laboratories and may require work-based learning, using industry's instrumentation, with university accreditation of the training.

The Extent to which the Government should Intervene to Ensure Continuing Provision of Subjects of Strategic National or Regional Importance, and the Mechanisms it should use for that Purpose:

12. Intervention may be possible in several ways, and we note progress has started through the implementation of the Roberts review and the 10-year framework, eg the greater support and inducement for teachers of science, and the need to connect the many small initiatives on SET for schools into a more coherent critical mass to have lasting impact. However we need more intelligence and understanding on where to make the best interventions. Government should not intervene at a local or regional level. It may be appropriate to set targets as an indicator of how successful interventions have been. National targets set by HEFCE could be brokered at a local level to encourage matching of supply and demand and effective use of resources.

There are several critical intervention points in the "supply chain":

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[7] *IT insights: trends and UK skills implications,* e-skills UK and Gartner Consulting, November 2004, p 7.

[8] *International Review of UK Research in Computer Science,* Fred B Schneider & Mike Rood, Editors, EPSRC, BCS & IEE, 2001.

[9] *IT insights: drivers of demand for skills,* e-skills UK and MRM Solutions Ltd, November 2004.

[10] *21st century skiolls: realising our potential,* HMSO, July 2003.

— Graduate choice—some 40 % of chemistry graduates become chemists. This is fairly typical, the percentage for civil engineering graduates is about the same. It may be possible to influence undergraduate career choice to increase this percentage. The RSC and CIHE analysed what chemistry graduates do several years ago.[11] An update of this report could identify how career structures may be changing, and how feasible such influencing might be.

— The Lambert Review recommendation 8.2 was that the Sector Skills Councils should have real influence over university courses and curricula. Otherwise they will fail to have an impact on addressing employers' needs for undergraduates and postgraduates. RDAs can also play a brokering role between employers and universities.[12]

— Careers advice—careers advice in schools is poor. Careers advisors need support and the tools to help them to understand and advise on the changing and complex needs of industry.[14]

— Technical routes—As mentioned above, schools should work with employers and universities to develop and promote high status routes for advanced technicians. The new 14–19 curriculum could be used to facilitate this. Highly trained technicians are in strong demand, for example many technicians trained in the Rutherford Appleton Laboratories find better paid employment in nearby Formula 1 teams. There is a lack of awareness of such career prospects in schools, where the nature of the modern "technician"" in under-appreciated. One route might be for employers to recruit technical staff, as early as 16, and develop them by part time study and accredited work-based learning to NVQ3, degree and even masters level (Master of Technology?). Such a route would need to have high status and a more flexible approach to delivery, perhaps through the Lifelong Learning Networks (LLNs) being piloted by HEFCE. These LLNs aim to establish vocational and workplace progression into and through higher education, involve both colleges and universities. LLNs could provide part-time course with accredited work-based learning, and increasingly, virtual work experience (eg 3-D virtual reality to study engine design).

— Schoolteacher support and development—There are many initiatives aimed at helping science teaching in schools, but there is a great need to join these initiatives up—to provide a necklace for the beads—to reduce confusion, and increase impact. There should be one point of contact for schools for SETNET, professional body initiatives, Young Foresight, education-business partnerships, the DfES/Wellcome funded Science Learning Centres (SLCs) and so on, including, additionally, science promotion, role models and media campaigns aimed at schools. This may be most appropriate at a regional level as SETpoints, like SLCs, become regionally based, and RDAs are exploring (with Sir Gareth Roberts) how they should contribute.

— The new SLCs are an excellent initiative, but to be fully effective staff release to attend courses needs to be encouraged. Schools are reluctant to release science teachers because they cannot get cover, and do not want to compromise teaching quality through staff absence. Science teachers (and heads) need inducements to attend courses whether financial (eg bursaries for schools and perhaps "locums" to provide cover) or through a subject-oriented CPD framework for SET teachers.

— Influencing subject choice early—before the age of 13 is critical, as many students have already switched off science. Primary school teachers need more support, and greater coordination with early secondary teaching in communicating the excitement of science. We know that we need to make science fun and exciting at this stage, but progress could be faster. We may be able to learn from parallel initiatives such as Computer Clubs for Girls.[13] Improved careers advice is essential, and better use of information technology can show more widely what SET employment is really like and just how many career options are available.[14]

Summary

The RDAs agree there is a problem in the supply of scientists to be addressed. We need to understand not just how many scientists are needed but what types are needed and how they are best trained to the right levels of quality and fitness for purpose. We cannot afford to underestimate this need, or we risk losing the strong UK R&D base to other countries. We need enough:

1. PhD research scientists comparable with the best internationally.
2. Scientific entrepreneurs
3. Science teachers (preferably with practical appreciation of industry and R&D)
4. Advanced technicians (technologists)

We also acknowledge that SET graduates have much to offer other professions for example:

[11] *IT insights: trends and UK skills implications,* e-skills UK and Gartner Consulting, November 2004, p 18.
[12] *IT insights: trends and UK skills implications,* e-skills UK and Gartner Consulting, November 2004, p 19.
[14] Ruth Kelly, Secretary of State for Education & Skills, BETT 2005 Keynote Address.
[13] *IT insights: trends and UK skills implications,* e-skills UK and Gartner Consulting, November 2004, p 22.

5. Scientists whose reasoning and advanced numeracy skills make them valuable in other occupations eg finance.
6. Scientists who become future managers and leaders.

The RDAs, with the advice of the new science and industry councils and regional skills partnerships, recognise that they have a role to play. This includes providing intelligence to inform the skills needs of regional (and collectively, national) economies, and through partnership working to broker greater collaboration between universities, schools and businesses, and government agencies to meet these needs. Universities have primarily national and international roles. However there are areas where regional needs and university aspirations (and those of employers and representative bodies such as Sector Skills Councils) can be aligned, and these included ensuring that strategic subjects of importance to regional economic development are maintained at appropriate levels. The Lambert review recommendation 8.3 was that HEFCE should "consider whether the UK university system is producing the right balance of graduates in the disciplines that make the economy work", and this Inquiry may mark an important step forward in these considerations.

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Notes and references

1. Royal Society of Chemistry—Regional and devolved administrations scoping study 2004 (draft report).
2. Funders' Forum 25 January 2004.
3. TTA Letter December 2004
4. OECD data for 2001.

	Researchers per 1,000 total employment
UK	5.5
EU average	5.8
Germany	6.7
France	7.1
USA	8.6
Sweden	10.6
Finland	15.8

5. NWDA are collecting data on the changes across different science UOAs since 2000, and the management response in different universities.
6. University of Lille hub and spokes model. IUT lecturers carry out research on Lille campuses during vacations.
7. HEFCE regional consultant 2004.
8. HESA data for 2003–03 entry to HE. For England there were 227,260 part-time entrants (95% mature) and 293,395 entrants.
9. Pfizer's scheme with the University of Greenwich. Students are taught one day a week in the Pfizer training centre and attend intensive laboratory weeks at the university for the first two years of undergraduate study (to HNC level).
10. There are many good examples including the Science Enterprise Centre at Oxford where science students are encouraged to work with MBA students in the Business Plan Competition. From the US, examples include the Dingman School of Entrepreneurship at the University of Maryland where business, engineering and science students share a dorm and work together, and the highly innovative Olin College of Engineering in Boston which integrates a project-based approach to learning with entrepreneurship studies (and the arts) at Babson College.
11. National Institute of Social and Economic Research report (Geoff Mason) to the Royal Society of Chemistry and the Council for Industry and Higher Education. March 1998.
12. For example the "e-Skills degree" in Information Technology Management. SEEDA and e-Skills UK have worked with universities to develop a degree course to meet employer needs more closely.
13. For example Project VIEW (Virtual Interactive Employer Workplace) under development. Addenbrookes Hospital has a road show to emphasise how many different occupations there are for scientists in the health service (ca 46).
14. Examples include Computer Clubs for Girls (CC4G) was developed be SEEDA and e-Skills UK to promote enthusiasm for computing and the application of IT for 11–12 year old girls. Nearly 4000 girls enrolled in the pilot. The success of the scheme has led DfES to fund rollout to all regions.

APPENDIX 55

Memorandum from the Engineering Professor's Council

EPC RESPONSE TO THE QUESTIONS POSED

1. Since it appears that the HEFCE QR funding is a "zero sum" exercise, then the RAE is all about the distribution (or re-distribution) of the available funding. If the available money is distributed more uniformly, then the excellent departments will see a reduction in real terms. If the funding is distributed even more selectively than in 2001, then all the grade 4 departments and most of the grade 5 ones will see a reduction in funding which could be disastrous and would probably result in closures or amalgamations.

2. It is not desirable, in principle, to concentrate research in fewer departments, but appears to be a necessity to maintain quality if there is not more funding.

3. The changes in the funding of teaching are potentially disastrous for science and engineering. It needs to be understood that laboratory-based subjects (including computing) have high standing costs and thus small numbers of students make the cost per student appear high and *viceversa*. A decline in the unit of resource increases the critical minimum size for a viable department. Many departments will now be threatened as a result of the HEFCE changes in bands.

4. The optimal balance between teaching and research provision is all about maintaining a critical mass. It cannot be sensible to have departments devoting a great deal of time competing for limited funds—the UK will not be able to carry out world-class research or teaching. Graduates in science and engineering are crucial for the future of the UK economy and that implies increasing the numbers of well-qualified students entering university courses and sustaining healthy departments to take them. There is little purpose in "propping up" departments that are not academically viable (ie comprised of research-active staff) and struggle to recruit adequately qualified students. However, for a university to maintain strong research, the student-staff ratio needs to be reasonably low so that staff can have the time to undertake research. Any fall in numbers, particularly overseas students, in a discipline could therefore be critical to viability.

5. Centres of research excellence are likely to continue to develop and a regional capacity is important not just for the universities but also for the professions and industry. However, it is important to recognise that science and engineering research is national and international activity. It is also probable that, with increased tuition fees and mounting student debt, a higher proportion of students will wish to attend a local university and live at home.

6. There is a need for Government intervention to ensure continued provision of science and engineering subjects which are of strategic national importance. Thus, for example, it is acknowledged that in certain sectors, such as civil engineering, there is a skills shortage. The funding model for universities does not properly support science and engineering and with the advent of full economic costing some departments, because of their research/teaching mix, may not continue to be economically viable because of pressure from HEFCE resource allocation combined with internal university allocation and taxation models. Possible support mechanisms include providing financial support for academically well-qualified students enrolling on science and engineering courses deemed to be strategically important and ensuring that departments remain viable by not allowing funding to decline in real terms.

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APPENDIX 56

Memorandum from the Open University

The Open University welcomes the opportunity to respond to the Science and Technology Committee questions. The Open University's Science Faculty has an annual budget of approx. £45M, teaching in 2003/04 in excess of 30,000 undergraduate students, approximately 700 taught higher degree students and 750 postgraduate research students, representing about one fifth of the total Open University student population. In UK HE terms, The Open University accounts for 55% of all part-time Biological Science undergraduates and 72% of all part-time Physical Sciences undergraduates (HESA data 2002/3). As well as dominating part-time Science provision this is a major contribution to Science higher education in general

Science students can study individual courses, or follow degree programmes in Natural Sciences, Molecular Sciences, Geosciences, Physical Sciences or a range of combined awards.

The first comment to make is about the assumption that all Science is the same. Where the particular Science does not need a large lab infrastructure (eg theoretical Physics and possibly some aspects of Earth Sciences) there is everything to be gained by continuing to support small groups of individuals rather than looking for concentrations. However it is clear that in the case of Chemistry and Biological Sciences research there is a step function in the provision of laboratories where there is clear advantage in concentrating groups of researchers around the provision of the highest quality of laboratory infrastructure.

The University's Science Faculty offers the following evidence for the Committee:

1. *The impact of HEFCE's research funding formulae, as applied to RAE ratings, on the financial viability of university science departments.*

The change of the funding formula has been an important contributory factor in the closure of some departments. The funding changes, more detailed accounting procedures and introduction of full economic costing are forcing universities to consider the viability of departments. The consequences of grade 4 funding led Exeter, for example, to close its Chemistry department. Whilst the ability of large research organisations to generate major research outputs is clear, it is perhaps a surprise that just as online resources are increasingly becoming available to support widely distributed networks of isolated researchers, the ability of such academics to continue to research is threatened. A policy that limits research to a few large institutions is not only detrimental to research, it also threatens to impact negatively on teaching. Synergy between research and teaching produces an outcome substantially greater than its parts. Small departments where research is no longer funded may not be able to teach science as effectively as those with a strong culture of research. However the funding formulae are not the whole problem, and reduced student numbers have also been an important factor in determining financial viability of departments. Indeed the introduction of SRIF to support infrastructure has been a positive development.

2. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend.*

There is no denying that the large research-based departments are powerhouses of endeavour. The issue here is not so much about a smaller number of University departments, but the implication that research is concentrated in a smaller number of universities. It is not reasonable to expect that every University should teach/research in every subject. Neither is it sensible to jeopardise very highly regarded science research undertaken by a particular research group in a smaller department by withdrawing funding because the rest of the science research at that University is only of national excellence.

3. *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula.*

The experience of the Open University is that the changes have led to a reduction in teaching resource of £2 million. If the effect of the changes is to make some areas of science became uneconomic to teach, the impact on the remaining science areas would be devastating. The missing subjects would still need to be taught as they underpin interdisciplinary and other more "fashionable" areas. Science is expensive to teach (whether face to face or at a distance) because of its very nature, as a subject based in experimental work. Sophisticated multimedia can be used to help explain conceptually difficult ideas and take the place of some practical and field work, but these skills are more complex and therefore expensive to teach than most other subjects.

4. *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments.*

The links between Teaching and Research and vice versa (so-called synergy) are significant and give life to the subject. That is important because people need to be enthused to study and enthused to teach. The two do feed off each other and there are numerous examples in the science carried on at The Open University. The University gave a specific example in its response to the HE White Paper The Future of Higher Education (extract attached together with case study as annex A and B). Our most innovative courses have often developed from research interests and co-publishing of some of our course materials would have been unlikely if it derived from a teaching-only department. The obvious response here is that while there is no problem in principle with having teaching-only departments, the practicality is with the staffing of them. Given the current training of scientists and the role of research in that, it is unreasonable to expect newly-appointed staff to cease what they have spent many years struggling to maintain—that is, their research. The solution may be for some staff to move at some point in their career to teaching-only contracts—especially it they are good at it (and talent in this aspect should be explicitly recognised). However all academic staff should be expected to contribute to teaching (it is after all the core business) but not all to the same extent.

Brian White's early day motion (EDM 290) recognises the benefits that research brings to students. It is not coincidental that this motion was put just two weeks after his participation in the Royal Society's MP/ Scientist Pairing Scheme to improve communications between parliamentarians and academics. To produce a lasting influence on policy, academics have continually to make clear to parliamentarians the importance of the teaching and the research they do.

Charles Clarke, when he was Secretary of State for Education and Skills, said that he wanted to see the days of poor quality teaching become a thing of the past. The way to achieve that is not by artificially separating research from teaching, rather it is by building on their mutually supportive relationship.

5. *The importance of maintaining a regional capacity in university science teaching and research.*

The increasing cost of university courses means that there is more pressure on students to stay at home. The Open University is the only nationwide provider for science HE and it has a strong regional presence. There have been several expressions of interest from local universities in offers of collaboration with the Open University, whereby crucial science subjects can still be delivered in all areas of the country, and this is a matter we are discussing with HEFCE. This is important not just for the students located in the regions where otherwise there is no provision for the science they need, but also for the regionally based industries which rely on well educated graduates in science.

The Open University is able to look beyond regional boundaries, because the university provides a model for supporting science education at a national level, through its distinctive capability to deliver high quality teaching materials and support services to part-time students. The diverse part-time student population includes many undertaking further training in the context of their employment in the commercial world. Moreover, open entry systems on The Open University model for undergraduate students are particularly effective at drawing lower participatory groups into the higher education system (eg students with physical and mental disabilities, women into science and engineering).

6. *The extent to which the Government should intervene to ensure continuing provision of subjects of national or regional importance; and the mechanisms it should use for this purpose.*

The problem is that market forces have no way of supporting things which are not currently in demand but which may be again in the future. Universities have a role as the keeper and nurturer of knowledge for future generations. It is very much the role of Government to ensure that sufficient expertise is maintained in subjects which are not of to the highest priority for the average 18 year old. Also, it is not enough to maintain only those subjects currently thought to be of national importance "future proofing" is like the protection of the Amazon rainforest; you need to preserve something of everything even though you do not currently understand its true importance.

An example comes from the Earth Sciences—an increasingly broad subject(s) area encompassing the whole of the Earth and its systems (Earth Systems Science). NERC's stated aim, advancing the knowledge of planet Earth as a complex interacting system, covers the full range of atmospheric, earth, terrestrial and aquatic sciences from the depths of the oceans to the upper atmosphere (and in The Open University's case the creation of CEPSAR—Centre for Earth, Planetary, Space and Astronomical Research) aims to include planetary science and astronomical research as well). Earth science (geoscience) is important economically (energy, water, mineral resources) and socially (climate change, pollution, natural disasters). The recent earthquake and tsunami in SE Asia serve to emphasise this. Geology as a separate subject is not widely taught in schools and so it is particularly important that as a subject area we communicate well with the public. Earth Science in the UK is now a relatively small grouping (since the Oxburgh report—Dundee, Newcastle, Hull, Sheffield, Nottingham, Swansea, Exeter, Queens Belfast, Reading, Luton have closed their Departments; Glasgow & Strathclyde and Birmingham & Aston have amalgamated; others may yet close). History tells us that an effective science infrastructure does contribute to the national wellbeing. In the 1920s and '30s, when it was clear that the UK science base was uncoordinated, government funding for science took the form of the DISR. After WWII the network of government funded laboratories and grant programmes in the UK, US, and elsewhere was heavily influenced by defence agendas. A better reason to invest in science is provision of undergraduate, postgraduate and life long training. To quote from the Treasury's "Science & innovation investment framework 2004-14" report, "A highly skilled, diverse workforce will contribute to business productivity and innovation, enabling UK businesses to exploit fully new technologies and scientific discoveries, achieve world-class standards and compete globally."

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Annex B

CASE STUDY OF THE INTERACTION BETWEEN RESEARCH AND TEACHING

At The Open University, "Transport Studies" is not a dedicated research and teaching subject, but it does form part of a number of other disciplines, particularly among Technology and the Social Sciences. Transport policy is a very thorny political issue, and research and teaching at The Open University is not just cross disciplinary, but is also cross institutional. Through a programme of linked scholarship in teaching and research we have become part of key networks involving not just academia, but policymakers, transport providers, NGOs, users, consultants and other actors. Increasingly, academic scholarship involves an interactive network of researchers and various institutions. Good research projects emerge from good networks of actors and researchers, which need to be built up over time and be maintained.

For example, the transport part of the RAE 5-rated Design Innovation Group (DIG) research project Factor 10 Futures, emerged initially from contributing to an EU project on the design management of cleaner technologies during 1996–98. The project developed a technique called Strategic Niche Management. A spin-off research paper from this project, prepared for the Swedish Energy Agency in 1998, explored the synergy between technological change and behavioural change measures to radically cut transport's environmental impacts.

This work was considerably expanded into a teaching text for Theme 2, Travelling Light, in the Technology foundation course, T172 Technology for a Sustainable Future (2000)[43]. This somewhat research-led teaching text then became incorporated into a series of related studies in the DIG research project Factor 10 Futures. The methodology was further developed via a series of research related papers, including transport policy user journals, a book chapter, several international conference papers and a keynote talk for a Department for Transport awayday (2000–02). Following this refinement, another version of this work has been incorporated into the second-level Technology Course T206, Energy for a Sustainable Future (2003)[44].

The course material in Energy for a Sustainable Future also incorporates results from another set of research projects that have explored institutional responses to the transport crisis. The course covers how institutions, like hospitals, employers and universities, can implement measures to reduce the transport impacts of the commuting of their staff. Research in this area has of necessity been closely involved with an emerging network of policymakers, researchers, users, transport providers and others. Through this, The Open University has established a reputation of research excellence that has resulted in £250,000 in research grants from the Department for Transport, ESRC, London Transport and other bodies. The transport consultants Atkins have even sponsored a CASE ESRC studentship to further develop the original Strategic Niche Management methodology to be applicable to implementing such policy measures.

Interest is also developing in using Open University course and video materials to provide training packs to help develop the skills that new transport policy initiatives require.

Overall this case demonstrates that the link between doing research and the preparation of credible and current teaching materials is complicated.

APPENDIX 57

Memorandum from Professor Keith Burnett, Oxford University

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments:

The current funding provided by the combination of HEFCE and Research Councils is insufficient, as has been documented in several studies. The research funding is concentrated in the top-ranked departments, but even 5* science departments at Oxford are feeling financial strain, while those with slightly lower rankings are increasingly facing closure.

We hope that fEC will help, but there is a critical period as it is phased in, and financial constraints are so tight that more departments may be closed or irrevocably damaged by cuts in this interim period.

Experimental research is particularly hard hit by the HEFCE formulae, as it requires more infrastructure (space, meeting of health and safety regulations, etc) than does theoretical work. The move towards greater transparency means that management techniques such as charging "rent" for space are increasingly being used. Future advances that will contribute strongly to the UK economy will depend on both experimental and theoretical work and their interaction. Experimental work is recognised as a key part of the training of physicists.

A country-wide survey of the costs of "sciences" needs to be careful to include a balance of experimental and theoretical work to avoid masking the cost of experimental work.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend:

The smallness of the small number is very controversial across the community. However, it is clear that there needs to be some possibility for supporting excellence. Now even excellent departments are struggling to survive and maintain their excellence.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula:

The overall support per science student has steadily decreased in real terms, with the result that science teaching has become seriously under-funded. Now the "enhancement" for the cost of teaching experimental subjects is being decreased, whereas experimental science is becoming increasingly complex. The combination inevitably forces a move to minimal training of students in modern experimental techniques. This cannot be good for the future of UK scientific research nor its science-based industry.

[43] T172 Technology for a Sustainable Future is a level 1, 30 credit point (quarter of full time) course in presentation from 2000–07. It had over 1,600 students in its first year and over 1,200 in subsequent years.

[44] T206 Energy for a Sustainable Future is a level 2, 60 credit point (half of full time) course in presentation from 2003–2010, with 274 students in 2003–04.

Furthermore the overall shortage of funding for university science (teaching plus research) is demoralising UK academic staff to an extent that must also act to decrease the number of students deciding to study science.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments:

The United States is an example of a successful mixture of types of institutions. There are several highly esteemed undergraduate colleges (eg Dartmouth, Swarthmore) where faculty may conduct some research in the summers, but the emphasis is on teaching. Most universities do both teaching and research, with a range of weightings. The US example leads us to think that there is no one "optimum" and it is preferable to let each institution determine its own balance. The current UK finding system doesn't seem to allow such a choice, with departments dependent on research income for survival.

The importance of maintaining a regional capacity in university science teaching and research:

The increasing personal costs of an undergraduate education will lead more and more undergraduates to wish to go to a nearby university and save money by living at home. Thus the importance of maintaining a geographical distribution will increase.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose:

The fact that some departments have already closed is very alarming and should be treated as probable evidence that many others are endangered. Even those not faced with imminent closure will be losing out to departments in other countries in the international competition for the best faculty members in science. This is particularly true in experimental fields where the provision of research infrastructure is crucially important.

At least an interim intervention is urgently needed until fEC is fully implemented and its benefits are felt in the universities.

In addition, a realistic solution to the problem of the missing part of fEC for charity and EU funding is required. The principle of transparency in use of funds argues against using funding from one area to subsidise work in other areas. Charity support is not equally distributed over all sciences, but is concentrated in medical areas. It is good that universities have some freedom in deciding how to use their HEFCE income for strategic developments, but it should not be the norm that QR income "earned" by research excellence for example in a physics department goes to fund the missing fEC for charity-funded medical research. The logical consequence of transparency is that if the UK government wants to get the benefit of charity and EU funding, it should either work with those bodies to get them to pay the full fEC, or it should decide to provide explicit funds to top-up charity and EU grants.

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APPENDIX 58

Memorandum from the Institution of Civil Engineers

The Institution of Civil Engineers (ICE) is a UK-based international organisation with over 75,000 members ranging from professional civil engineers to students. It is an educational and qualifying body and has charitable status under UK law. Founded in 1818, ICE has become recognised worldwide for its excellence as a centre of learning, as a qualifying body and as a public voice for the profession.

ICE has close links with the HE sector, for example through the Joint Board of Moderators (JBM) accreditation—jointly with three other professional bodies—of a wide range of degree programmes, including 4 year MEng, 3 year BEng and foundation years. During this process, involving periodic visits to civil engineering departments, issues related to the scope of this Inquiry are reviewed, including: the departmental resources, staff:student ratios, industrial liaison, research and consultancy activities, and graduate employment.

1. *The Impact on HE of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments*

1.1 At present the UK has a marginal costing system which does not cover full costs; the introduction of Full Economic Costing of Research will help research active universities. HEFCE funding for 2004–05:

- In 2004–05 the HEFCE funding is £3,557 million for teaching, £273 million on widening participation and £1,081 million on research.
- Of the research funding £118 million (about 10%) is available for all grade 4 departments.

— The average unit of resource for 4-rated submissions is capped in 2004–05 in real terms at the 2003–04 level.

The HEFCE policy is not to spread the research funding thinly across the grades.

1.2 The financial viability of a research department, or a department with research aspirations, is thus dependent on a 5 grade or higher. The average unit of resource for units rated 5 and 5* should be at least maintained in real terms

1.3 A 4 grade leaves a financial drop that cannot be immediately offset by student numbers, particularly as the unit of resource, the price group weighting, has reduced. A change from a 5 to a 4 in the RAE has significant financial implications and has led to closure of departments. However, the issue is complicated and this needs to be considered alongside another central problem: HE is not resourced at a sustainable level for teaching (see below).

1.4 The RAE leads to a distortion in relation to staffing—engineering departments now cannot afford to recruit excellent teaching staff who do not have a significant research pedigree. In the 2000–01 RAE, 57% of research active staff were in 5 and 5* departments (an increase of staff of 9,000 from 1996). If a department is struggling, there is a temptation to make appointments with the RAE in mind, ie to appoint academics who will meet the requirement for a minimum of four quality academic papers in the assessment period. These are unlikely to be practitioners from industry, who would bring the full breadth of knowledge about civil engineering. Increasingly, university civil engineering staff lack any industrial experience. The long-term consequence on the education of future civil engineers is serious: students are less likely to interact on a regular basis with practitioners.

1.5 A recent sad example illustrates a further consequence: a young academic is leaving academe because senior staff pass all their teaching on him whilst they carry out research.

1.6 In response to the hostile funding environment, civil engineering departments have closed in a number of universities and in others merged into schools/faculties of engineering or built environment. This led to a decrease in the number of departments submitting under the civil engineering unit of assessment in the RAE from 40 in 1996 to 29 in 2001, a 37% decline. The outcome is that the civil engineering influence has declined, and this will create damage to the civil engineering profession, industry and UK plc. The strength of civil engineering research in the UK is its diversity, and this is because of broadly-based civil engineering departments.

1.7 The RAE can also affect the choice of research topics, and this may be detrimental to the education of future engineers. The HSE Research Report 275 "Identification and management of risk in undergraduate construction courses" (Supplementary report—April 2004) made the following specific conclusion that may be relevant to the Inquiry:

> "The Research Assessment Exercise (RAE) continues to exert a negative influence upon this topic, particularly at Centres where it is seen as a diversion from the main declared focus of maintaining or improving research standards."

1.8 This is coming at a time when the numbers entering civil engineering first degree programmes has increased for the third year in a row, and by 15% in 2004 over 2003. Therefore some reports of government attributing the plight of science in HE to the lack of demand are disappointing and certainly not the case for civil engineering. More could and should be done to communicate the facts—that a degree in engineering will equip young people to pursue an exciting, well-paid career where they can help to build a sustainable environment.

2. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend*

2.1 Increasing the concentration of research in a small number of departments under the present system is desirable in that it enables continuity and quality to be maintained. There is recognition of the need for a critical mass of staff necessary to sustain research in a particular discipline and to ensure impact. Wide dilution and equal funding for each university would not be practicable or useful.

2.2 However, no university has a monopoly on innovation and there must be serious competition in key areas. Concentrating research would be detrimental. It would lead to a loss of regional input and, if based on critical mass, the loss of quality departments with an international reputation. The UK's breadth of civil engineering research would be lost, for example in the sphere of construction management. In addition, it makes it difficult for new departments to join the "research club", with a danger of perpetuating former divides (Russell Group and new universities).

3. *The implications for university science (engineering) teaching of changes in the weightings given to science (engineering) subjects in the teaching funding formula*

3.1 Engineering departments tend to be more financially dependent on teaching than on research. Thus not resourcing teaching at a sustainable level is a central problem for engineering departments. Years ago, the weightings were similar to those for medicine; in 2004, HEFCE changed the price group weightings for science and engineering students from 2.0 in 2003 to 1.7 in 2004, a 15% fall. In this regard there is a disconnect between government policy, with its strong and realistic emphasis on science and technology as a basis for economic well-being and growth, and the HEFCE formula.

3.2 The changes in price group weightings means that departments that are largely "teaching" have suffered a 15% cut in home student income. There is then a tendency for universities to target the recruitment of overseas (non-EU) students instead of home students, thus attracting higher fees, in order to become financially viable without excessive student:staff ratios. If high, these ratios have a significant impact on an engineering department's ability to remain at the leading edge of research (see below). It is noted that Oxford University has just declared a policy to recruit from overseas and reduce home students; we are aware that this policy may become more widespread in the near future.

3.3 The changes in weightings for science and engineering subjects do not seem to take account of the fact that the number of academic staff/student contact hours is typically higher (about 15 hours/week) in these disciplines than in most other subjects.

3.4 In addition, it is a temptation in cash starved universities to distribute this money to other disciplines through the internal accounting models. For example, the imposition of a "space tax" transfers funds from engineering and science (where more space is needed) to other disciplines, thus the engineers then subsidise the arts and humanities. The HEFCE model has put at risk the industrially relevant science and engineering base in the UK.

4. *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science (engineering) departments*

4.1 Research-led universities need to maintain their national and international reputations in order to survive, and their staff:student ratio has to be low (about 1:10 or 12) so that staff have the time to undertake research.

4.2 In teaching-led universities, funding is largely dependent on student numbers. Any fall in numbers, particularly overseas students, in a discipline could therefore be critical to viability. Teaching-led universities play an essential part in the education of incorporated engineers, so an optimal balance is essential. Good teaching is not dependent on good research grading.

5. *The importance of maintaining a regional capacity in university science (engineering) teaching and research*

5.1 It is important to maintain regional provision of civil engineering programmes to meet the needs of those students who, perhaps for financial reasons, seek to study close to home.

6. *The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose*

6.1 Civil engineering is a subject of strategic national and international importance; the future of the UK economy is dependent on these graduates. It warrants a strategic look forward to ensure that the UK both maintains its position globally especially in areas where we currently excel (such as innovation, engineering management, and legal and contracting aspects) and also develops programmes that are at the cutting edge, and that meet the UK's strategic skills requirements.

6.2 On government intervention, there are different views: it is supported, for example where the numbers of graduate scientists and engineers falls below a pre-agreed level. Some argue that the advent of fees from 2006 may force students to concentrate on disciplines which have a revenue stream attached, and hence engineering may benefit; others believe it may make students consider degrees with less contact time than civil engineering so they can undertake part-time work, and numbers will fall. The intervention mechanism could be government scholarships or fee re-imbursement to ensure the number and quality of future graduates in subjects of strategic national importance.

6.3 Some feel that Government should intervene as little as possible, but should be consistent across government's own departments, for example across Construction (where skills shortages are acknowledged and the Minister aims to address) and DfES (in respect of funding models). A view from employers is that it is important that graduates have skill sets that meet the needs of business and the community. This requires there to be a stock take of what is needed and encouraging appropriate provision.

6.4 Government decision-making in relation to policy such as HE funding, would benefit from the inclusion of more scientists and engineers. Training, identifying and encouraging the engagement of leading scientists and engineers in political discussions on such policy issues, is urgently required.

January 2005

APPENDIX 59

Memorandum from Dr Tina Overton, University of Hull

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments;

The funding formula means that all but highest rated science departments are in deficit to their institution. The current funding formula for research will inevitably lead to closures of 3 and 4 rated science departments as VCs balance their books. This is seen as a far more important factor than undergrad recruitment. Recent closures have been of departments in which recruitment was bouyant.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend;

The consequences of such a trend is that science teaching will also be concentrated in a small number of departments as teaching only science departments are unsustainable financially. Science provision will consequently disappear from a large proportion of HE and large swathes of the country. Recruitment to science will diminish as it becomes a marginalised discipline rather than a main stream one.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula;

The teaching funding formula does not support science teaching and departments rely on cross subsidy from research streams to maintain staff and equipment levels. If departments rated lower than 5* in RAE are to survive an increase in the unit of funding for science is essential.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments;

The balance should rightly vary across the sector but research engagement within a science dept is desirable if graduates are to useful to industry. Fossilisation could easily take place in a rapidly developing discipline. Financial viability of teaching only science is doubtful without a change in funding formula.

The importance of maintaining a regional capacity in university science teaching and research;

As undergraduates (particularly WP student) stay at home to study regional provision is essential unless we accept that science is of no strategic importance to the UK. Science education must not come elite, available only in a small number of institutions. The law of diminishing returns means that we need to recruit large numbers of undergrads to provide sufficient graduates for industry. Graduates from elite institutions are less likely to go into industry and commerce but will stay in academia here and abroad.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose.

A difficult one given the desirable autonomy of institutions. But the decline in science provision is funding driven so the funding formula could readily address this issue and make science more secure and desirable for VCs.

January 2005

APPENDIX 60

Memorandum from the Chemical Industries Association

SUMMARY

The Chemical Industries Association (CIA) is seriously concerned by the threatened closure of chemistry departments in the UK, as they are a vital source of trained manpower for the UK chemical manufacturing and research base. The CIA believes a rational, and perhaps radical, realignment of funding for chemistry is required within UK universities, as chemistry departments possessing greater critical mass in research, teaching, training and/or technology transfer are needed to meet evolving societal and business needs.

Greater emphasis needs to be given to creating well-funded and world-class centres of excellence for UK chemistry concentrating on both pure and applied research as well as on the delivery of competent and skilled scientists.

The CIA also believes that special emphasis must continue on supporting chemistry departments in their development of practical skills for the successful integration of trained graduates into analytical services and R&D laboratories in industry.

Introduction

The CIA welcomes this opportunity to present written evidence on this very important issue, which the industry believes is vital to its future success. This evidence seeks to support, from the chemical industry's perspective, evidence submitted by the Royal Society of Chemistry.

With turnover of £50 billion, the chemical industry is one of the UK's largest manufacturing industries. Over the last decade it grew almost three times faster than the average for all industry. It is manufacturing's number one exporter, with an annual trade surplus of £5.6 billion; it spends £2 billion a year on new capital investment and 10% of its sales on research and development. It contributes approximately £5 billion in tax every year.

Skills are vital to the chemical industry, as indeed they are for all of the chemistry-using industries, underpinning everything that we do. The 2001 DTI Chemicals Innovation and Growth Team report identified a sharp decline in the number of students studying chemistry and the chemical sciences. For industries that rely on innovation to deliver value-added, this is of real concern. The decline in students is impacting directly on university chemistry courses leading to a shortage of graduates. The CIA believes that UK industries that rely on their ability to do chemistry will not be sustainable without them—who else is going to develop the innovative products and processes needed to ensure our industries' future?

The chemical industry is truly global and the majority of UK businesses are either foreign owned or have significant operations overseas. Companies make strategic decisions every day on where to place their business globally. A key element to this decision-making is the local availability of skills, chemistry and chemical engineering graduates being of prime consideration. The closure of chemistry departments, potentially leading to a reduction in the overall UK skills base, may therefore have a direct affect on UK PLC's bottom line with jobs and revenue moving abroad. We believe this has already begun to happen.

Society also benefits significantly from scientifically trained individuals that have the ability to draw informed conclusions when presented with often complex and conflicting evidence, for example when considering the GMO debate and Nanotechnology. This is becoming more and more important as the industry continually needs to justify its licence to operate in today's society.

Industry Perspective in Support of the RSC Evidence

The impact of HEFCE's research funding formulae as applied to Research Assessment Exercise ratings, on the financial viability of university science departments

We do not have a view on the closure of individual chemistry departments; we believe that is a matter for individual universities. We do have strong views on, and are very concerned by the overall process that has led this to happen. The need for chemistry teaching to be cross-subsidised by chemistry research is totally unsustainable in today's cost conscious university sector. The UK needs a sustainable chemistry teaching structure, financially independent from research with each student attracting sufficient funding to cover the cost of his or her tuition.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments

Chemistry is a practical, research-based subject. The chemical industry requires graduates that not only understand the basic fundamentals of chemistry but also have experience working in a research environment. The two go hand-in-hand and we believe that neither a teaching only department nor a research only department would equip graduates and postgraduates with the skills that industry needs. However, it should be possible for departments to be excellent at teaching chemistry and be financially viable, without also needing to be world class at research.

The importance of maintaining a regional capacity in university science teaching and research

The lack of maintenance of regional capacity in university science teaching and research is already having a significant affect on areas of the chemical industry. For example, some CIA member companies are unable to find suitable universities in their local vicinity with whom they can undertake collaborative innovation or to whom they can send their staff for training. This increases the cost and inconvenience of undertaking such activities, putting barriers in the way of workforce up-skilling and innovation.

January 2005

APPENDIX 61

Memorandum from the University of Wales

Although we have academic positions in the University of Wales, we believe the enquiry to be conducted by the Science and Technology Committee with regard to university funding within England will be relevant to the current situation in Wales. We therefore hope that the committee will accept this submission of evidence on the impact of current procedures on the funding of Science within Higher Education.

The School of Biological Sciences in which we work was awarded a 4a grade at the last RAE. This means that, on average, all of our academic staff can be considered research-active and many do work of international significance. Despite this, the failure to fund fully departments that achieved 4a grades during the last RAE forced this University to go through another round of job cuts to balance the budget. As a result, staff redundancies within the higher education sector are increasingly the result of financial rather than scholarly considerations. Thus, despite assurances from HM Government of increases in the flow of funding for science the future here is not at all secure, particularly as the level of research achievement required to obtain significant research funding in the next RAE is not yet clear.

Is there any intellectual merit in slicing up the funding cake into larger but fewer pieces and letting the rest of the sector go hungry?

While there may be practical infrastructural advantages in the concentration process, recent funding trends will inevitably reduce diversity in biological teaching and research and fail to reflect the nature of scientific discovery. Research has indicated that the most efficient and intellectually productive units for research consist of relatively small groups averaging around four people. The location of such groups is of secondary importance as high quality ideas often emanate from individuals working alone or in small groups at disparate locations. It may be true that large resources are required to capitalise on new ideas, but this is very often more to do with the commercialisation, exploitation and/or further development of scientific results rather than the quality of the original scholarship.

It is arguable that biological science in particular is so diverse that it presents too many questions and encompasses too many disciplines for its research to be adequately covered in a relatively small number of institutions. Indeed, the research enterprise is a pyramid, with the "high-flyers" at the apex standing on the shoulders and dependent on the efforts of the "foot-soldiers" at the base. It should not be forgotten that it is the latter that provide the numerous citations that give journals in which the former publish their high impact factors.

An understanding of the scientific "process" and enjoyment of science as a subject and a career are not enhanced by having to work in poorly resourced and demoralised institutions, perceived by staff, students and parents to be ostracised from the main stream, and with increasingly little to offer in terms of educational diversity and experience. Efficiency and value for tax payers' money should not simply be measured by staff/student ratios but by some estimate of quality of experience.

In any case, value for money has already been achieved within higher education due to a combination of the relative collapse of average pay over the last 20 years, a massive reduction in all staff categories (academic, technical and administrative) and a steep rise in student numbers. Our primary and secondary institutions are not now treated in this manner: how can it be justified for the higher education sector?

The idea of "teaching only" science departments is the equivalent of "false accounting" and a detrimental step to take when there is an increasing need for graduates to service the needs of modern economies based on practical science. At least until recently, the majority of academic staff were research active in some capacity or other and needed, therefore, to be aware of and able to interpret the scientific literature. We would argue that this is an essential aid to good science teaching in the long-term. One practical example is the contribution to undergraduate practical classes and final year student research projects by way of materials derived from and ideas relating to staff research. A change to "teaching only" status may have little immediate impact on teaching quality in the short-term; it might even improve due to teaching becoming the main focus. However, research experience in successive generations of staff will decrease, soon resulting in teaching from text books alone and with little understanding of the "process" by which that text-book information has accumulated. Many more students will thus be graduating without a full appreciation of the value and process of scientific research. There can be little merit in this learning outcome!

We feel that it is ethically unacceptable for students who may wish to attend their local university to be disadvantaged due to selective regional neglect, no less than when attending school. The research experience—the essence of science itself—should be available to all science students in higher education, as appreciating and being able to apply scientific method is the major quality that a science student should possess. Government funding for infrastructure maintenance and development, along with support staff provision should go to the institutions more directly than it does at present. Too great a dependency on the "full" funding model for grant awarding may benefit the individual researcher, but will be a disaster for the Institution.

It will lead to "boom and bust" in higher education and will prevent stability, long term planning and investment.

We must carefully consider what we want from “science” graduates.

Knowledge without reason and understanding is not science.

January 2005

APPENDIX 62

Memorandum from Loughborough University

This is one of the most important reviews conducted by the Select Committee and we welcome the opportunity to input to it. We would be very pleased to provide any further information that to the Committee that would be of help to your deliberations.

The issues raised by the Committee are at the heart of a university’s governance and strategy, and inevitably there are many factors. The key is the determination of the Council and staff of the university to sustain a successful and vibrant science base in the institution, but external factors have made that a huge challenge. We are proud at Loughborough that we sustain vibrant grade 4 Physics and Chemistry Departments, both of which, with the rest of Science and Engineering, recruited UK/EU undergraduates to target in October this year—indeed Chemistry over-recruited.

We comment in turn on the questions you raise.

1. *The impact of HEFCE’s research funding formulae, as applied to RAE ratings, on the financial viability of university science departments:*

There is no doubt that the funding ratios of roughly 1: 2.8: 3.3 have been damaging for grade 4 departments. They have also no rational basis. For example, they are more selective than would be justified by supporting only research of international excellence and providing zero funding for research of national excellence (according to definitions of RAE grades). As has been analysed by our Vice-Chancellor (see Research Fortnight 15 October 2003), reasonable assumptions and private data suggest that ratios of roughly 1: 2: 3 would be the highest one could justify on the basis of RAE criteria of excellence.

2. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend:*

As background, it is important to recognise that Loughborough has excellent indicators of research activity. As far as externally funded research per academic staff costs are concerned, given our subject mix we have regained top position as the most research intensive university in the UK. This is according to the performance indicators published by HESA.

Five members of senior staff have been chosen as RAE 2008 sub-panel chairs, equal with Oxford and second only to Cambridge who have six—remarkable given the relative size and subject breadth of these institutions. Although supporters of selectivity, we believe that further concentration of research funding would do more damage than any benefit it would bring.

At the heart of our concerns is that it is essential that the purpose of QR funding from HEFCE is clearly re-articulated. This is in the light of the move to full economic costing of research and the change in funding of postgraduate research programmes. The latter move has eliminated the QR income we will receive from overseas research students. The loss to Loughborough is of the order of £1 million and the effect will be far worse for other, larger institutions with a higher proportion of overseas PhD students. The changes are intended to be cost neutral but it is unclear how this will happen through QR allocation.

3. *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula:*

The crisis in science teaching in schools and the associated lack of demand for university places in Physics, Chemistry and Mathematics have meant that HEIs have to use their much needed resource in determined efforts to widen participation and achievement at school as well as to recruit to these subjects in order to ensure departmental viability.

Importantly recent changes (2003–04) in HEFCE policy has further exacerbated this situation. I refer specifically to the decision to cut the funding base to teach students with more than 17 A-level points. This was to release funds to support widening participation. Unfortunately this policy hit funding for science based subjects particularly hard where it is very necessary to recruit well-qualified students. Given our subject mix we were cut by effectively 4% in real terms, and lost c £1 million in funding. Around 14 other HEIs also lost net funding in this change. We fest this was perverse given our reputation in assisting business and industry and our graduate employment record.

The history of HEFCE weights for teaching is complex. Prior to the recent changes, non-lab, intermediate and full-lab were in the ratio 1: 1.5: 2 (and 4 for clinical subjects).

In the Autumn of 2003 HEFCE consulted on proposed weights and suggested an additional band with the ratios 1 : 1.3 : 1.6 : 2 with the last to include Chemical Engineering, Chemistry, Materials and Physics. This change would have seriously undermined our science and engineering subjects. It was a further shock when, after consultation, HEFCE implemented bands of 1 : 1.3 : 1.7. We feel these are not better than the previous weights and continue therefore to use 1 : 1.3 : 1.85. Ironically, we have therefore moved from cross-subsidising non-lab-based to subsidising lab-based subjects!

HEFCE defend their strategy in part by referring to the "block grant" nature of the HEFCE funding, ie they should allocate HEFCE funding as they best see fit. This freedom is largely a chimera. Universities are increasingly transparent in their funding streams and cost-apportionment. It is extremely difficult in an open and collegiate environment to sustain large deviations from income-streaming over an extended period. With the pressures on academics, the elasticity of collegiality is limited. It will be vital for HEIs in the future to be able to take collegiate decisions on other than financial grounds (ironically, now that we have them!).

With a view to ensuring the health of the science base reducing the teaching weight from 2 to 1.7 was the wrong message to send to University Senates and Councils.

4. *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments:*

At Loughborough we strongly believe that teaching in a university department must be research-led. We do not consider teaching-only science departments to be desirable. That is not to say we insist on being funded to conduct research in every aspect of a science subject we teach. In areas of a subject which are outside the immediate research interests of our staff we ensure the highest levels of scholarship are maintained. In this way our teaching is delivered "in the spirit of mutual enquiry", ie research-led.

5. *The importance of maintaining a regional capacity in university science teaching and research:*

It is increasingly important that universities reach out into their local regions. We welcome schemes such as "Researchers in Residence" and funding for the "public understanding of science". The former associates PhD students with local schools. This is to be welcomed as any schemes which burden academic staff with further responsibility would be difficult to reconcile given the pressures they already find themselves under.

Maintaining a regional capacity in university science research is largely driven by regional demand, dictated by the regions' business/industry base. Loughborough has strong connections with business and industry and works closely with our regional development agency.

February 2005

APPENDIX 63

Memorandum from the Institute of Food Science and Technology Trust Fund (IFST)

It is important that the size and scope of the food and drink manufacturing industry is realised. This industry is the largest manufacturing sector in the UK. It has an annual turnover of around £66 billion with more than 500,000 employees in over 7,000 businesses. This is 12.9% of the total UK manufacturing workforce and, in turn, it supports the retailing and wholesaling operations employing almost 900,000 people. The industry also buys more than two-thirds of UK agricultural produce. Hence, its strategic development is essential especially when there are demands in the areas of food safety, product innovation, improved nutrition, waste minimisation and environmental impact.

It should also be realised that Food Science and Technology is a multi-disciplinary subject with many practitioners having experience in Maths, Statistics, Chemistry, Biology, aspects of Physics, Physiology and Psychology in their undergraduate Food Science and Technology degree programmes as well as Food Chemistry, Food Microbiology, Food Safety, Sensory Evaluation, Food Engineering and Nutrition, for example the multi-disciplinary nature of Food Science and Technology has made its graduates very versatile and adaptable and, thereby, sought after by industries other than the Food Industry, for example the biotechnology industry. Other Food Scientists and Technologists enter the profession with degree backgrounds, initially, in Biochemistry, Chemistry, Microbiology, Nutrition, etc and are "moulded" into Food Science and Technology through in-house training. Hence, the availability of the traditional science subjects at university level is essential.

It is very pertinent that IFST hosted a Forum at The Royal Society, London, on 6 October 2004 on the subject "The Future for Food Science and Technology". This focussed on the needs of the Food Industry and profession and how these are met by the secondary, further and higher education sectors. An outcome of this Forum is that IFST along with Improve Ltd (the Food & Drink Sector Skills Council) and the Science Council are collaborating in a project, led by Improve Ltd, to scope the skills needs of, and the shortages experienced by, the Food Industry (processing and retail). All of this is very relevant to the New Inquiry.

It is noted that this New Inquiry is restricted to English Universities. This clearly limits the value of the results and recommendations arising from this Inquiry since many of the issues raised will have UK-wide relevance.

The comments given below are directly linked with the points raised in the invitation to provide evidence.

The desirability of increasing the concentration of research in a small number of university departments and the consequences of such a trend

Although it would be superficially attractive to concentrate R&D in a small number of universities in order to achieve economies of scale and create centres of excellence it should, nevertheless, be recognised that the needs of Regional Development Agencies to support their local, indigenous Food industries requires a countrywide provision of underpinning Food Science and Technology as well as single degree subjects of direct relevance to Food Science and Technology. The consequences of a trend to concentrate research effort would be that research provision could favour one region over another. In this instance research is taken to include industrially-sponsored R&D as well as Knowledge Transfer Partnerships (formerly known as Teaching Company Schemes).

The importance of maintaining a regional capacity in university science teaching and research

This links with the previous paragraph. It is considered self-evident that there should be a good geographical spread especially on a UK-wide basis. This is necessary to meet the civic role of many universities and also ensure that local requirements are satisfied. This is also a significant factor in order to reduce the financial burden now faced by many students when studying at university.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirably and financial viability of teaching-only departments

It is self-evident that the best teaching at university level is research-led. This both enthuses and excites students and optimises their academic achievements. Both academic staff and students will be attracted to departments with a research component and so it can be foreseen that the teaching-only department, which does not fit within a university ethos, would be likely to wither and die.

In terms of overall balance in activity between R&D and teaching it is considered that the majority activity should be research and an appropriate balance between the two activities is suggested to be 60% research, 40% teaching. In the case of Food Science and Technology the majority of the R&D should be strategic as opposed to fundamental or applied.

The extent to which Government should intervene

It is essential that Government should intervene at national level to ensure the continued provision of these strategically important science subjects since these ultimately underpin the development and economic performance and viability of the nation. It is self-evident that almost every aspect of modern life derives from science. Hence, science subjects must be maintained and promoted.

This policy, at regional and local levels, should be the remit of the Funding Councils. As stated previously, this is a UK-wide issue and not one solely for England and so to effectively tackle this on a UK-wide basis the Funding Councils should be involved.

IFST trusts that the Science and Technology Committee will find these comments valuable and the Institute would be pleased to present this evidence orally to the Committee should that be required.

February 2005

APPENDIX 64

Memorandum from the Department for Education and Skills

GOVERNMENT COMMITMENT TO SCIENCE

1. Our science base is among the best in the world, and keeping it so is vital to the UK's status as a key knowledge hub in the global economy. Government's strong commitment to sustaining excellence in science and research was detailed in The Science and Innovation Investment Framework 2004–14, published in July 2004 by HMT, DTI and DfES. It is backed up by substantial new investment across the key departments: over £1 billion additional funding for Science over the next Spending Review period—in addition to the £1.25 billion increase in the period leading up to 2005–06.

2. Our commitment is also backed up by long-term strategic planning. In developing the Framework, we took a hard look at all aspects of research capacity. We are familiar with the concerns prompting the Committee's inquiry, and we welcome this further opportunity to explore the tensions and complexities involved in addressing them. We are confident, however, that the approach we have adopted is the right one to sustain excellence and we do not agree with some of the assumptions the Committee makes in its call for evidence.

3. Chapter 6 of the Framework considers the supply of talent to the science base. It recognises that learner demand is declining at school and university level for some science disciplines which nonetheless remain important to our economy and society. The UK is not alone in facing this decline—many developed nations have similar problems—but we realise that it is those countries which not only recognise but address the issues that will enjoy scientific and economic success in the future. We want the UK to be successful and a leader.

4. "Science" covers a broad range of disciplines and activities, and continues to develop new ones: it should not be surprising that there are fluctuations in popularity within this world. The similarly broad sphere of Arts is also experiencing such fluctuations in demand. The challenge for Government—and for others who need new chemists and physicists—is both to stimulate fresh demand to match our needs and to ensure that capacity is maintained to respond to demand as it develops. This inquiry focuses on the second of these areas, but Government is active in both.

Action on Strategic Subjects

5. A number of departments and courses have been closed by their HEIs over the past few years (and new courses and departments have also been created). The individual cases show a mixture of precipitating factors connected with demand, funding and HEIs' strategic interests. We have already acted to address more widespread consequences of these specific closures, by inviting the Higher Education Funding Council for England (HEFCE) to advise on HE subjects or courses of national strategic importance, where intervention might be appropriate to strengthen or secure them. Science, technology, engineering and maths (STEM) courses are among those subjects of strategic importance and we are seeking HEFCE's views on the circumstances when intervention might be right, and the types of intervention which could be considered.

6. The Office of Science and Technology (OST) and the Research Councils are working alongside DfES to assess and stimulate the "health" of science disciplines, with initiatives aimed at renewing capacity in key research areas. An example of action being taken at Research Council level is the EPSRC's pilot scheme, in partnership with HEFCE and the Scottish Higher Education Funding Council (SHEFC), of Science and Innovation awards to start to restore and renew capacity in some of the most threatened research areas in engineering and the physical sciences, including physical inorganic chemistry and research at the chemistry/chemical engineering interface. These awards are large, long-term grants, typically £3–5 million over five years supporting staff in a research group, with a commitment from the host HEIs to continue support after the end of the grant.

7. As part of its drive to translate overall strategic priorities for the science base into specific aims and objectives for the Research Councils and other delivery agents, OST is actively encouraging them to bring forward imaginative proposals to address the health of key disciplines of science, in particular those which are likely to impact on the successful development of other disciplines. The health of disciplines is also being discussed by the Research Base Funders' Forum set up to allow governmental and non-governmental funders of "public good" research to consider the collective impact of their strategies on the research base.

Research Assessment Exercise

8. The Committee has invited evidence on the impact of the research funding formula, as applied to Research Assessment Exercise ratings. Our research policy is to support excellence wherever it is found, and we make no apologies for providing a higher level of public funding to the best departments. We believe a proper level of funding for the highest quality research is necessary if the UK is to compete globally. Excellent research facilities are competing internationally, and this involves a high level of investment. We are clear that we should not ask excellent departments to take less in order to keep poorly performing departments viable.

9. It is not for Government to assess research quality, of course, and that it why we look to the peer-review based Research Assessment Exercise (RAE). As well as measuring quality, the RAE helps to promote it. Research quality rose significantly in the period between the 1996 and 2001 RAEs, with 55% of researchers found to be working in departments rated 5 or 5* in 2001, compared with 31% in 1996.

10. This general improvement in quality must be a good thing, but it has perhaps brought to the fore difficult decisions for HEIs about departments which perform well, but are not among the best. HEFCE has put in more money from 2004–05 and guaranteed that funding for departments rated 4 will be maintained in real terms as they consider their strategies towards the next RAE. Institutions' decisions may involve judgements about departments' direction of travel, their function in an institution, their income from sources other than Government and other factors. HEIs will want to focus on activities that complement

each other, and serve their overall missions. We would encourage them to do that. By no means will they inevitably conclude that "good not excellent"" departments are not viable: many 4 rated departments are flourishing.

Research Concentration

11. The Committee has invited evidence on the desirability of concentrating research in a small number of departments. Linking funding to the RAE is not aimed at concentrating resources in a small number of departments or in particular institutions, or at creating centres of excellence. It is not Government's policy to concentrate funding or research in this way, and we are not convinced that there is such a concentration. Our policy is to fund selectively, based on the quality of research and we expect institutions to determine where they concentrate their efforts. There may be more concentration than there was 20 or 30 years ago, but we need to recognise the range of high quality research taking place with support from funders other than Government. There is excellent work being done too outside the Russell Group: in the CMU and elsewhere.

12. It is our policy to fund the best research, wherever and in whatever context it is found. Changes introduced by the funding bodies following the review of the RAE after 2001, will ensure that the next RAE in 2008 delivers this policy. "Quality profiling" will replace single averaged ratings for departments, enabling identification and funding of excellent research within and across departments, and other changes will better recognise collaborative and interdisciplinary research. We are pleased that the Committee's report Research Assessment Exercise: a re-assessment in September 2004, following its inquiry on the RAE, has endorsed the 2008 RAE going ahead as planned.

13. The funding methodology for 2008 will not be announced before the submissions process, and this should help to reduce the games-playing which has sometimes obscured the purpose of previous RAEs. As always, funding linked to the RAE will be allocated as part of a block grant to institutions, leaving them free to support departments according to their strategic priorities.

Teaching and Research

14. Universities also have flexibility in deciding where the best balance lies between their research and other activities and teaching. The Committee has raised the question of the balance between teaching and research: the HE Research Forum's gave well considered advice to Government on this in summer 2004, concluding that good teaching should be "research informed". The Forum described a variety of ways in which this may happen, making it clear that there is no straight choice between top RAE performers and "teaching only" HEIs. We recognise the importance of research informed teaching, and we are making some funding available to help develop it in HEIs with less QR income.

15. This is in line with our expectation that, regardless of their other strengths, all universities should provide good teaching. Like QR, teaching funding is part of a block grant, and institutions decide how much they actually spend on what courses. HEFCE decide the formula for teaching funding. They expect to consult on the aims and objectives of a new method for calculating teaching funding in April, with a consultation on an outline method following in November. Work will then be undertaken during 2006, to develop the method in order to inform allocations for 2007–08.

Regional Impact

16. The Committee has invited comments on the importance of maintaining capacity at regional level, and the "regional mission of higher education" is another area on which the Secretary of State has recently sought advice from HEFCE. Generally speaking, we view the provision of university science teaching and research in the context of a national asset, which can make valuable contributions to economic growth at local, regional, national and international levels. Higher education institutions have important international and national roles as well as regional and local roles in supporting the competitiveness of UK plc. These roles are reflected in Individual institution's missions in varying degrees and some institutions will look to have a specific regional role whilst others will concentrate on their international/national roles.

17. We, and institutions, recognise that they can make a valuable contribution to regional economic progress. Our Skills Strategy aims to strengthen regional structures, moving away from a "one size fits all" approach, to one in which skills and business development activities are tailored to meet specific regional, local and sectoral business needs. Universities and colleges are already contributing to this, through membership of the Regional Skills Partnerships being established to address skills and business priorities within each region.

18. HE institutions and Regional Development Agencies (RDAs) have developed HE networks that support collaboration, knowledge transfers, innovation and inward investment as well as the commercialisation of products arising from research and development activity. They have also been partners in inter-regional initiatives like the Northern Way, Midlands Way and Thames Gateway. Involvement in these should help the HE institutions to play to their strengths and pool expertise and resources on a wider front.

19. Government recognises that it is possible that independent universities, acting separately, may take decisions which, taken collectively, are not in the best interests of individual regions (or of the country as a whole). We do not believe, however, that every branch of science (or arts) needs to be taught in every region. Some sciences are specialised to the degree that only one or two centres of excellence will be found nationally. The Framework also sets out that HEFCE will now consider providing additional funding to particular departments if there is a powerful case that weakening provision in a particular region would hinder student access to disciplines that are important to national and regional economic development. We do not believe there to be any immediate regional crisis in science: high quality research departments and associated funding are located throughout the UK in a wide spread of institutions.

Government Intervention

20. At our request, HEFCE is considering what can be done for strategic subjects. Government is prevented by law from instructing universities which courses to run. We do not wish to change this position, and we do not believe anyone else wishes us to do so. It is right and proper that universities, as independent autonomous bodies, take action in support of their individual strategic missions. It is up to each university to decide for itself what its mission is. It is not desirable to revert to a state-controlled curriculum, where government decides what courses universities can run. That route would destroy university autonomy, and leave subjects fossilised according to last century's needs.

21. Government is acting strategically to influence demand for science and technology subjects. As well as providing financial support for research through funding grant proposals under the Dual Support system, one of OST's key objectives, delivered both through the Research Councils and support for Learned Societies, is to fund training for our brightest and best researchers. This is delivered through a range of grant award schemes, including awards to promote international collaboration.

22. We recognise the need take action at both university and school levels. The Framework sets out our plans to increase physical sciences and engineering participation in higher education and improve the quality of science teachers and lecturers; the results for students studying science at GCSE; the numbers choosing SET subjects in post 16 education and further education; and the proportion of better qualified students pursuing R & D careers. This approach recognises that there are no instant solutions, and that demand for these subjects has to be kindled in schools.

23. Within the limits set by respecting university autonomy, we believe that our policies assuring quality and stimulating demand provide the right basis from which to consider any further action to maintain the health of science disciplines. We await HEFCE's advice, and the Committee's views, on whether and what additional intervention may be sensible.

February 2005

APPENDIX 65

Memorandum from the Nutrition Society

1. *The impact of HEFCE's research funding formulae, as applied to RAE ratings, on the financial viability of university science departments*

Comments:

This will tend to concentrate resources towards the best scoring research departments, which will impact on those departments with strong teaching but moderate research. For interdisciplinary subjects such as nutrition, there is an invidious choice of brigading themselves with "easier" groupings to get a higher score, or to risk going in "harder" groups. This conflict between the need to score, and the proper placing of subjects is undesirable.

2. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend*

Comments:

Undesirable. The opportunity to do high quality research in recognised institutions will fall to few students and this would present itself such that a two-tier system in Universities would exist. The standard of those institutions not undertaking research would undoubtedly fall. Concentrating research in a few top-rated departments will reduce the opportunities for career development for the many researchers who have geographical ties for family reasons. This will particularly affect women. It will also reduce the opportunity for career development for those who are not marked out as "high fliers" at an early stage in their careers but who can bring other skills and expertise to a research career.

3. *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula*

Comments:

Emphasis must be to award those teaching science a greater financial incentive.

4. *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments;*

Comments:

There must be encouragement for all Departments to keep up research and teaching. Teaching-only science departments will provide an inferior training for students—being able to carry out research under experienced staff is fundamental to the process of teaching science at undergraduate as well as postgraduate level. However individual members of such mixed departments might have predominantly research or teaching roles, depending on aptitude—good researchers are not necessarily good teachers, and vice versa.

Teaching only science departments would need to receive Government funding to survive.

5. *The importance of maintaining a regional capacity in university science teaching and research*

Comments:

Absolutely critical or else there will be a class (by region) division and unequal access to science in Universities. That cannot be a good thing for UK education. We will fall even further behind in the science quality of our research and reputation. Retaining regional capacity is important for allowing students fromless privileged backgrounds access to high quality training and to supporting local links with industry.

6. *The extent to which the Government should intervene to ensure continuing provision of subjects of national or regional importance; and the mechanisms it should use for this purpose.*

Comments:

The Government should stop at nothing to ensure that science subjects are fully provided in all relevant institutions. Cost should not be a limiting factor since there will be such enormous financial implications to the Government (eg the effects of a shortage of graduates in science on UK business) if chemistry and other key science subjects are taken off the university agenda. The Government must start at the primary school level and undertake a five-year strategy campaign at raising the profile of science in schools, making use of existing science societies (eg physiological, biochemical, nutrition as well as the Royal Society of Chemistry and the British Association). Further emphasis and expansion should be given to the Nuffield Science Bursary Schemes. The GCSE and A level science curricula should also be reviewed and attempts made to allow the subjects to be more appealing to our younger population.

February 2005

APPENDIX 66

Memorandum from the British Computer Society

The British Computer Society (BCS) is pleased to support the submission by the Council of Professors and Heads of Computing (CPHC) in response to your request for further evidence to the inquiry into "Strategic Science Provision in English Universities".

The British Computer Society is the leading professional body for the IT industry. With over 45,000 members in over 100 countries around the world, the BCS is the professional and learned Society in the field of computers and information systems.

The BCS is responsible for setting standards for the IT profession. It is also leading the change in public perception and appreciation of the economic and social importance of professionally managed IT projects and programmes. In this capacity, the Society advises, informs and persuades industry and government on successful IT implementation.

IT is affecting every part of our lives and that is why the BCS is determined to promote IT as the profession of the 21st century.

February 2005

APPENDIX 67

Memorandum from the London Mathematical Society

The London Mathematical Society welcomes this opportunity to bring to the attention of the Science and Technology Committee the continuing erosion in the national mathematics base, particularly in universities. Mathematics underpins the sciences, engineering and business—the loss of the UK's mathematics base critically weakens the very areas on which our wealth and health depend.

The London Mathematical Society is the UK's learned society for mathematics. Founded in 1865 for the promotion and extension of mathematical knowledge, the Society is concerned with all branches of mathematics and its applications. It is an independent and self-financing charity, with a membership of over 2,600 drawn from all parts of the UK and overseas. Its principal activities are: the organisation of meetings and conferences; the publication of periodicals and books; the provision of financial support for mathematical activities; and contributing to public debates on issues related to mathematics research and education. It works collaboratively with other mathematical bodies worldwide. It is the UK adhering body to the International Mathematical Union and is a member of the UK Council for the Mathematical Sciences, which comprises the Institute of Mathematics and its Applications, the Royal Statistical Society together with the London Mathematical Society.

The importance of mathematics in underpinning the physical and technological sciences is well-known; there is a welcome growing awareness that it plays the same fundamental part in the life sciences, in the economic and financial sciences, in the social and health sciences. The need of a healthy economy for an increased flow of persons with good mathematical skills has been recognised in the Roberts Report, in the Government Response to it and in its subsequent Science and innovation investment framework 2004–14. Concerns about the health of the subject in school have led to a programme of reform based on the recommendations of the Smith Report. The needs and reforms identified by these inquiries require a strong and diversified mathematics presence in the HE sector. This cannot be achieved without strategic and coherent use of funding and other mechanisms to fulfil the accepted national needs.

The erosion of national provision, through the closure or merger of departments, recently headlined in the case of chemistry at Exeter, is by no means new but has been proceeding in many areas of the physical sciences and engineering, not least in mathematics. The Council of the London Mathematical Society has been extremely concerned at this loss and, in the last few years, has made representations to the Vice-Chancellors of universities where the Society has heard that such losses are under consideration. Seven universities have been contacted over the past three years—an outline of the situation at one of them (Hull) is attached at Annex A. The Society drew up a Statement of Policy on Mathematics in Universities, which is attached at Annex B.

The following response is aligned to the points identified in the Select Committee's call for evidence (Annex C)(Not printed). References are at Annex D.

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments

Decisions on closure of departments are the responsibility of individual institutions; but such decisions are largely determined by the funding mechanisms and formulas adopted by HEFCE. The way in which these are operating are particularly damaging to mathematics departments, and the health of UK mathematics. Mathematics, requiring primarily "people" costs, is disproportionately dependent on the funding councils, compared with the other sciences and engineering which draw heavily from the research councils.

There is a fundamental lack of transparency which frustrates rational planning: the relationship between RAE grades and funding is not known in advance. The sharp cut off in the funding model adopted subsequent to the last exercise has meant that university departments delivering good degree courses, engaged in research of national importance, have been targeted for closure. It is therefore quite possible that the intentions of the experts on the RAE 2001 panel have been reversed, and there is no mechanism to prevent this situation being repeated in RAE 2008.

Many university courses properly involve a serious mathematics component. The interplay of the teaching and research funding models encourages non-mathematics departments to teach this material themselves, effectively using teaching money to subsidise their research work and improve their future RAE grades.

Such changes have the immediate effect of damaging mathematics departments in some institutions. The health of the whole science and engineering complex is damaged by the loss of mathematicians and their contributions. These changes are often made without reference to the immediate or long-term needs of the students.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

The desirability of concentration will vary from subject to subject; the model appropriate for subjects requiring access to large and expensive specialist equipment is inappropriate for mathematics. While mathematics is no longer dependent (if it ever was) just on pen and paper, the usual expensive facility needed by mathematicians, high-power computing, is a resource shared with other subjects. The critical mass needed for successful collaborative mathematical research is not great, and collaborations can flourish without physical proximity.

An increased concentration of research in a few departments will restrict student opportunity to study mathematics as a live subject in a research-active department. Teaching with conviction depends on doing one's own mathematics; when mathematics is alive in one's own life, one can convey mathematics to students as a living subject, not a set of dead and boring rules from the past.

Concentration, moreover, will damage the symbiotic relationship between mathematical scientists and other disciplines in research. The vitality of application-driven research in mathematics depends crucially on research-active mathematicians being available.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

Mathematics teaching is inadequately resourced by the current formula. The weightings stand in need of a fundamental review; to base a revision principally on current subject costings merely perpetuates an unsatisfactory position.

Mathematics teaching is in practice very costly in staff time. The acquisition of mathematical skills requires the doing of mathematics (it is not good enough for the student to be an attentive listener and an efficient information processor). Thus, in addition to funding for lectures and associated information-transfer activities, extra funding is required to pay for the essential learning structures in which students learn to do mathematics themselves, not merely see it being done. Such intensive teaching, with a high staff: student ratio, is the mathematical equivalent to the science or engineering laboratory.

The mathematics community has welcomed the broadening access agenda; its successful implementation in mathematics requires that resources intended to support these students are expended on subject-specific support.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments

Mathematics is an evolving subject, and honours mathematics degrees are properly taught in research-active departments where mathematics is being done. We reiterate two earlier points. First, a good mathematics programme can be taught by a collection of mathematicians with different research areas; there is no essential need for large numbers in every area (a model promoted by the research funding formulae). Second, there is no essential need in practice for concentration of mathematics departments—it is neither desirable nor necessary to have teaching-only departments in regard to honours-level courses.

Moreover, even those universities not teaching mathematics at this level will need mathematicians to support research and teaching in other courses and departments.

The importance of maintaining a regional capacity in university science teaching and research

There is a pressing need for widened participation in mathematics courses, from single honours to joint and combined degrees which provide solid mathematical understanding to areas of application. This can only be achieved by ensuring that there is access to mathematics courses not only in all regions, but also in a wide spectrum of HE institutions. It implies that there is access to mathematics by mature students, those studying part time, and by entrants from non-traditional backgrounds. Recent HEFCE data show that several of the universities rethinking their mathematics provision are in regions of limited access.

Mathematicians in universities offer other benefits at a local level—for example the CPD needs of mathematics teachers (which are highly subject-specific) cannot be met if there are mathematical "deserts". Regional Development Agencies will want to have the input of research-led departments into their strategies for local business and industry.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose

The great technological advances of the twentieth century have their origins in blue-skies mathematical research, with British-based research prominent. Our excellence, and its far-reaching but as yet unknown implications, is at threat (see report of the recent International Review of Mathematics Research in the UK) from a shrinking of our university base.

The UK needs to increase its output of mathematicians and those with qualifications requiring strong mathematics skills. Such skills are needed at all levels, in teaching, research, in the finance sector, in business and industry. Mathematics graduates are eminently employable in well-paid careers. Yet the numbers pursuing mathematics and maths-based subjects into higher education are falling. The Government's responses to the Roberts Report and the Smith Inquiry have recognised the strategic importance of mathematics.

We urgently need to increase the output of mathematics graduates, and only through Government intervention can the aims set out in the responses in the previous paragraph be achieved. Two actions are needed by Government to address this shortfall.

First, the Select Committee has rightly identified the need to address the erosion of provision in strategic science subjects as a critical point of intervention, as this limits the UK's potential to produce the numbers of graduates in STEM subjects that the country needs.

Second, yet more action must be taken to ensure that more young people enter mathematics courses in universities in order to produce enough well-qualified people to meet national demands. This in turn relies on having enough well-qualified mathematics teachers in schools to motivate and develop pupils' mathematical ability. Unless this can be achieved then the negative feedback (fewer maths students leads to fewer maths teachers leads to fewer maths students, etc) will result in ever-diminishing numbers of qualified people.

Possibilities to increase the pool of mathematics graduates include: an initial injection of additional grants/bursaries/fee waivers to encourage good students to take mathematics degrees; additional money to support university mathematics staff to provide CPD work for teachers both to re-energise the teachers and update their knowledge; money to bring all teachers teaching mathematics up to mathematics degree level knowledge (currently 30% of such teachers do not have mathematics degrees). Money is needed to support academics in setting up programmes to work in schools to inspire school students to take up science at A level and beyond; in this respect further support is needed for the schemes run by the TTA—the SAS scheme which pays undergraduates to teach in schools and encourages them to take up a teaching qualification after graduation, and the UAS scheme (initially set up by Simon Singh) which supports universities in offering accredited modules supporting science and mathematics teachers in schools.

Conclusion

- The loss of the mathematics base and of mathematics courses in universities threatens not just mathematics itself but also the subjects and sectors that draw on mathematics—from the natural sciences and engineering to economics and business.
- The loss of institutions offering good mathematics course provision (in some areas leaving "deserts") deprives many people of the opportunity of studying mathematics and offering their skills in teaching, industry, business and research.
- The primary cause for this loss of provision is the way in which funding for mathematics is provided by the funding (including research) councils, which fails to reflect the nature and needs of mathematics, leading to apparently "uneconomic" mathematics departments.
- Mechanisms based entirely on student demand are inadequate to preserve our mathematical base until the crucial increase in numbers is achieved, other mechanisms are needed.

February 2005

Annex A

Case Study—Mathematics at the University of Hull

1. Student Numbers (Provided by HESA):

Year	*Single honours*	*Joint honours*
1996–97	187	37
1999–2000	183	37
2002–03	151	64

2. RESEARCHER NUMBERS (TAKEN FROM RAE 1992, 1996, 2001):

Year	*Research-active staff*		*Research assistants/students*	
	Pure maths	Applied maths	Pure maths	Applied maths
1992	9.0	8.0	n/a	n/a
1996	9.0	10.1	n/a	n/a
2001	7.5	8.25	9.0	6.0

3. RESEARCH MEASURES (TAKEN FROM RAE 1992, 1996, 2001):

Year	*RAE rating*		*Research income*	
	Pure maths	*Applied maths*	*Pure maths*	*Applied maths*
1992	3	3	n/a	n/a
1996	4	3b	n/a	n/a
2001	4	4	£22,600	£20,973

4. TEACHING QUALITY (EXTRACT FROM QUALITY ASSESSMENT EXERCISE, MARCH 1999):

The graded profile indicates the extent to which the student learning experience and achievement demonstrate that the aims and objectives set by the subject provider are being met. [4 = maximum]:

Aspects of provision	*Grade*
Curriculum Design, Content and Organisation	3
Teaching, Learning and Assessment	3
Student Progression and Achievement	4
Student Support and Guidance	4
Learning Resources	4
Quality Management and Enhancement	4

5. LETTER FROM THE VICE-CHANCELLOR, DR DREWRY, TO THE PRESIDENT OF THE LMS, PROFESSOR J T STUART (24 JULY 2002)

At the outset, I should state that the University shares many of your concerns and views with respect to the role of Mathematics within the University and the contribution of the discipline to society. I am sure that you will also be aware of the very significant commitment the University has made to the development of research in Mathematics with the establishment of our first research institute—the Hull Institute for Mathematical Sciences and Applications (HIMSA)—accompanied by the appointment of several outstanding mathematicians.

With regard to possible changes in respect of the provision made by the University of Hull, the situation is that we are currently reviewing the University's entire academic portfolio in the light of the Government's agenda for HE together with current and predicted recruitment trends and anticipated developments in HE. The principles on which we are basing this review form part of our Way Forward strategy—approved by our Senate and Council—and have been subject to further consultation in the University. As an integral part of this process, the Department of Mathematics is reviewing its portfolio of programmes and is currently developing a number of initiatives, which offer significant potential to contribute to the continuing development of the discipline within the University and which seek to engage the changing student profile. I am appreciative of the concerns you have expressed and assure you that the LMS Policy will be taken into full account as part of our ongoing deliberations.

6. QUOTES FROM THE UNIVERSITY OF HULL WEBSITE (JANUARY 2005):

Welcome to our medium-sized Department, known for its friendly and personal atmosphere. Students, teachers and researchers work together to pursue their common interest: mathematics and its applications. The Guardian University Guide (05/2002) ranked us among the top-20 mathematics departments in the country.

Our degree programmes have one of the best completion rates and our students graduate with excellent employment prospects . . . We make an extra effort to help you through your first year since Getting Started at university is a challenge.

Research in Mathematics at Hull enjoys an international reputation in areas ranging from geometry and financial mathematics to continuum mechanics and mathematical physics. The Hull Institute for Mathematical Sciences and Applications (HIMSA), set up in 2000, promotes national and international collaboration in interdisciplinary research.

Admissions to all undergraduate mathematics programmes have been suspended for the 2005–06 Session.

7. Drop in Demand Forces Hull to Axe Maths (THES, 17 December 2004)

Hull University is to close its maths department in the face of falling student demand for the subject. The university has said that existing staff will be moved to York University to ensure that students "continue to have access to high-quality mathematics education in Yorkshire".

David Drewry, Hull's Vice-Chancellor, said: "Hull is not unique in experiencing recruitment difficulties in mathematics and we have to take notice of, and respond positively to, the needs and requirements of our students."

. . .

Hull said it would set up a new Centre for Mathematics to provide maths teaching for other disciplines, and it would continue to train school maths teachers. Dr Jarvis commented: "This is a hurried add-on that appeared after staff and unions pointed out the serious knock-on effects and the far-reaching consequences the closure of maths would have." He said the centre would not attract high-calibre mathematicians and would probably have to be closed in a few years.

Annex B

LMS Policy on Mathematics in Universities

1. Mathematics is a core subject in universities (and indeed in schools); it provides a language and an underlying structure for studies in all the sciences, in engineering, finance, economics, management and in education studies.

2. By their very nature, all these subjects develop; they are not static. The same holds good for mathematics, which also is dynamic and not static. New mathematics is frequently required by other disciplines, and indeed other subjects often provide a stimulus for new mathematics, just as mathematics can and does stimulate developments in the sciences and elsewhere.

3. There is a pressing (and recognised) national need for graduates in mathematics and for graduates with joint degrees involving mathematics, such as Mathematics with Computer Science or with Management Science. Such graduates are needed in schools, industry, the City, government service and elsewhere, and of course, within Universities themselves.

4. For the reasons indicated above, it is important that members of University departments of all kinds should have ready access to active professional mathematicians.

5. Teaching of mathematical subjects is intrinsically a person-intensive activity; students must come to terms with intellectually demanding concepts and the subject is sequential, requiring good mastery at each stage. This requires high levels of one-on-one contact with active professional mathematicians.

6. Mathematics is often, even usually, a component of study for a degree in many other fields, including for example, Physics, Electrical Engineering, Management Science and others. Such teaching of mathematics is often described as "Service Teaching". It is essential that such courses should be taught by those who are professional mathematicians and who have (or are prepared to acquire) an empathy with the other discipline, whether it be biology, chemistry, Equally essential is that there should be close, friendly relations between the mathematicians (usually the Mathematics Department) and the "receiving" department, so that there is real agreement on both the mathematical needs and the mode of teaching. In short, the students have to be motivated as to the need for certain types of mathematics; some students are happy with a study of mathematics "for its own sake", but the majority are not and require motivation. The needs of the students have to be paramount.

The guiding principle for successful "Service Teaching" must be an academic one, with a firm adherence to the good of the students' education. A resort to financial considerations (as implied sometimes by a department taking on its own mathematics teaching) is usually not in the best interests of the students and is therefore unacceptable.

7. The changing patterns of pre-university preparation and the Government's wish to broaden access to higher education will require greater, not less, time to be devoted to the transitional period. Broadening access also requires potential students to have appropriate access to courses. This objective cannot be achieved if regions of the UK develop in which students (such as those unable to study far from home, mature students or those from less traditional backgrounds) have no local access to mathematics at higher education level.

8. For the reasons given above, the London Mathematical Society takes the view that every University should have a sound and visible core of research-active mathematicians. Without such a core a University is incomplete.

Adopted by Council, January 2004

Annex D

REFERENCES

1. *Making Mathematics Count*, the report of Professor Adrian Smith's inquiry into Post-14 Mathematics Education (February 2004)

2. *Making Mathematics Count*, The Department for Education and Skills' response to Professor Adrian Smith's Inquiry into Post-14 Mathematics Education (July 2004)

3. *An International Review of UK Research in Mathematics*, EPSRCıCMS (March 2004)

4. *SET for Success*, the Report of Sir Gareth Roberts' Review (April 2002)

5. *Investing in Innovation: A strategy for science, engineering and technology* (Response to SET for Success), HM Treasury/DTI/DfES (July 2002)

6. *Science & innovation investment framework 2004–14,* HM Treasury/DTI/DfES (July 2004)

7. *Young participation in higher education*, HEFCE (January 2005)

APPENDIX 68

Memorandum from the CBI

INTRODUCTION

The CBI welcomes this inquiry and is pleased to provide written evidence to the Committee. The main points of our submission are summarised below:

— HEFCE's funding formula places increasing pressure on institutions with non-5* rated science departments by encouraging vice-chancellors to focus funding on those departments that will be rewarded by the RAE.

— While we support the creation and fostering of recognised centres of research excellence there is concern that the RAE does not recognise, and fails to support, the breadth and depth of research talent that exists in the UK research base—much of which offers critical expertise to both large businesses and smaller companies.

— The issue which needs to be addressed is how best to support a number of small leading-edge institutions while retaining the vitality of the broader science base.

— The CBI believes there no reason why teaching and research must be bound together. If the funding formula can be changed accordingly, teaching-only science departments could be viable. One proviso would be that links must be maintained between teaching establishments and the research base.

— The highest priority should be on forging a reputation for the UK as a place from which and in which to do science and conduct innovation-related activity. The most relevant perspective is therefore the outward facing one, in which the UK's strengths and weaknesses, including the capacity and vitality of its science base, are considered in a global sense.

— Strategic, long-term skills planning founded on an evidence-based assessment of the UK's future skills needs should provide the rationale for any intervention by government. Limited intervention now is more desirable than wholesale intervention at a later stage in an attempt to recover lost time, or to attempt to rescue the science base. The cost of not getting it right now will be to fail to deliver in the future.

1. *The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments*

HEFCE's funding formula is placing increasing pressure on institutions with non-5* rated science departments by encouraging vice-chancellors to focus funding on those departments that will be rewarded by the RAE. Departments that are perceived to be the least financially viable in their own right are likely to be considered for closure.

As the effects of the funding regime become more acute it is likely that most science departments will also look increasingly to high fee-paying international students to supplement their income.

The combination of these factors will have two particular consequences for the UK science base. First, it is unlikely that the remaining 5/5* departments will be willing or able to expand to provide the places formerly offered by departments that are forced to close. This will lead to a diminution of national provision in science subjects. Second, this overall reduction will be compounded by further reductions in provision for UK students. This on its own will have a significant impact on UK industry as it is recognised that many international students will ultimately return to their home countries, leading to an overall weakening of the UK science base.

2. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend*

There is obvious merit in creating and fostering recognised centres of research excellence to permit prestige institutions to compete on a level footing with the world's best science departments.

However, such an effort must not compromise the breadth and depth of research talent that exists in the UK research base. Many departments or individuals which fall outside of this "world class" categorisation offer niche, but critical, expertise and have a proven ability to respond positively to the needs of both large businesses and smaller companies. It would be unrealistic to assume that this type of niche service and level of responsiveness to industry would be provided by a small handful of centres of excellence.

There are two further potential negative consequences of concentration which must be guarded against: a reduction in overall capacity in the science base and a lack of competition between leading researchers.

Assuming that it is desirable to have some concentration of expertise, the main issue to be addressed is how best to manage the process of supporting a number of small leading-edge centres of excellence while retaining the critical niche areas of excellence that support industry so well.

An unreformed RAE is not the tool by which this will be achieved. There are concerns that the process has already begun as a consequence of the RAE funding formula and that expertise on which industry relies is now being threatened.

3. *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula*

The likely consequence of a reduction in the weightings will be to exacerbate the under-funding of science departments. Any erosion of the differentials in the funding formula will therefore further weaken the provision of science teaching in the UK by making such courses less financially viable.

Under-funding limits the ability of departments to offer quality facilities and curricula to students. A reduction in the weightings given to science subjects will further diminish the attractiveness of science courses to prospective students. This situation will only serve to undermine the government's objective of making the UK the location of choice for science and innovation activity.

Under-funding of science teaching has traditionally been offset by the diversion of quality related research income. The trend of increasing selectivity of the RAE means that this is a less viable option.

Given that the funding councils make additional funding available to meet needs such as the maintenance of historical buildings, we feel that argument could reasonably be made for additional support for sciences and other subjects of national importance.

4. *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments*

The government's ambitions for 50% of school leavers to attend university will make it very unlikely that teaching can remain coupled with research in the long-term as the necessary growth in teaching resources is unlikely to be matched by growth in the level of support for research. It is almost inevitable, therefore, that the conduct of research alongside teaching in all science departments will have to be reviewed in the future.

In so doing, the optimal balance should be determined by an evidence-based assessment of the UK's future skills needs to define what level of teaching and research support is and will be demanded by an innovation driven, globally competitive economy.

To limit the quantity and quality of either by perpetuating the bond between teaching and research in academic institutions might be to limit the chances of realising the government's objective of making the UK the location of choice for innovation activity.

Conducting under-graduate teaching and post-graduate research in the same institution is undoubtedly a great attraction to both staff and students. However, it is only at the very highest academic level that teaching is significantly enhanced by research. For the most part, the undergraduate curriculum need not be taught in a research environment.

Teaching-only science departments should serve to increase the capacity of the science base, producing more graduates for industry and might also permit the quality of teaching in UK universities to flourish.

The view of the CBI is that there is no reason that teaching and research should always be bound together. If the funding formula can be changed accordingly, teaching-only science departments could be viable. However, one proviso would be that links must be maintained between teaching establishments and the research base.

5. *The importance of maintaining a regional capacity in university science teaching and research*

The highest priority should be on forging a reputation for the UK as a place from which and in which to do science and conduct innovation-related activity. The most relevant perspective is therefore the outward facing one, in which the UK's strengths and weaknesses, including the capacity and vitality of its science base, are considered in a global sense. In this sense the regional focus is redundant—the UK does not need, nor can it sustain, leading edge research institutions in every discipline in every region of the country.

The focus should be on a building up and sustaining a small number of national centres of excellence, supported by high-quality broad capability within a discipline both to meet the needs of industry and to ensure the future capacity of the science base. Regionality is not the key issue: as we noted in our response to Q2, maintaining the breadth and depth of UK talent in the science base is of paramount importance.

There is an argument for maintaining regional teaching capacity, in particular because of the pressures on student finances created by the variable fees regime. However, it is our belief that, where possible, full-time degree students will continue to be mobile, attracted to the best universities—although this must be monitored closely.

6. *The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose*

The continuing decline in the number and quality of science graduates poses a significant threat to the UK's future economic success. In order to realise the ambitious policy commitments of the 10-year investment framework for science and innovation, the government must assume greater responsibility for determining investment priorities in higher education.

Strategic, long-term skills planning founded on an evidence-based assessment of the UK's future skills needs should provide the rationale for any interventions.

Already there is an evident need for greater financial support for courses which are costly to run, such as science courses, and within that provision a clear need for a more strategic approach to developing and maintaining teaching and research capacity. The present system sees funding spread too thinly coupled with a failure to take account of strategic priorities.

In the short to medium term there is a need not only to ensure continued provision, but also to reverse the decline in provision that has already reduced the capacity and quality of the UK science base.

Limited intervention now in the form of strategic skills planning to target resources is more desirable than wholesale intervention at a later stage in an attempt to recover lost time, or to attempt to rescue the science base. The cost of not getting it right now will be to fail to deliver in the future.

February 2005

APPENDIX 69

Memorandum from the Biosciences Federation

The Biosciences Federation was founded in 2002 in order to create a single authority within the life sciences that decision-makers are able to consult for opinion and information to assist the formulation of public policy. It brings together the strengths of 35 member organisations, including the Institute of Biology, which represents 45 additional affiliated societies (see Annex). The organisations that have already joined the Biosciences Federation represent a cumulative membership of some 65,000 bioscientists and cover the whole spectrum from physiology and neuroscience, biochemistry and microbiology to ecology and agriculture. The Biosciences Federation is a registered charity (no. 1103894).

Responses to the Particular Points Identified by the Committee

The impact of HEFCE's research funding formulae, as applied to RAE ratings, on the financial viability of university science departments

1. Income from both research and teaching is vital for most universities, and the challenge is to manage the balance between these according to the standing of departments. Research in universities has been funded at very much below the full economic costs for at least 20 years. The steep gradation in QR funding between RAE 4 and 5 ratings following the 2001 RAE exercise has impacted particularly on the financial viability of departments ranked below 5, and has been cited as a factor in recent well-publicised decisions to close physical sciences departments. Universities are increasingly pursuing strategies to maximise QR income, and focusing resources on groups capable of achieving 5 or 5* grades. Science departments scoring below 5 are vulnerable to closure for strategic reasons because of the extra expense for laboratories, technicians and equipment required for teaching as well as for research. It is often assumed that biosciences have been less affected than physical sciences because they have been relatively successful in retaining student numbers. But closures of departments and courses are beginning to impinge on the full breadth of

biology, including some of the more molecular areas and particularly applied areas such as agriculture. Furthermore, threats to the viability of disciplines such as physics and chemistry are threats to the underpinning support of the current excellence of UK biosciences.

2. Both the provision of additional funding through the Research Councils to enable universities to recover the full economic costs (FEC) of research, and the change in RAE 2008 to a grade profile approach, could improve the financial viability of university science departments. The latter may remove the current financial "falling off a cliff" that results from a drop of RAE grade below 5, but this depends entirely on the weightings allocated to the new star grades for individual researchers. It remains essential that the very best research is funded at an internationally competitive level, but the weighting for work of national importance that has the potential to develop to become internationally competitive needs to be restored to something like its value prior to RAE 2001.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

3. The Biosciences Federation recognises that critical mass of researchers and good shared facilities are often central to good biological science. In many areas of biology that require large facilities or specialised expertise, the concentration of resources is particularly necessary and, in any case, an inevitable consequence of a finite budget if high quality outputs are to be maintained.

4. However, the Biosciences Federation has argued consistently that the grade weightings applied after RAE 2001 have led to too much research concentration; it is already greater than in most comparable countries. For many subjects there is little evidence that research is more productive in large units (1), and in many disciplines it is clear that small groups can do research of international excellence. The Biosciences Federation is concerned that further concentration could eliminate whole areas of research and expertise from English universities and reduce the strength in breadth of knowledge and opinion that characterises the UK in international surveys (2). It is to be hoped that the grade profile approach in RAE 2008 will prove to be efficient in identifying and supporting pockets of research excellence in otherwise less research-intensive institutions.

5. Other likely consequences of a trend towards more research concentration include:

- restricting the availability of research-informed teaching;
- creating problems for less research-intensive universities in recruiting and retaining staff;
- making it more difficult for new areas of research to emerge;
- hindering the formation of new research teams outside the main centres and improving the performance of such units;
- reducing the capability to tackle regional research problems;
- loss of talented researchers to overseas institutions.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

6. In a survey of Heads of Biosciences Departments that the Federation undertook in the autumn of 2004, 87% of respondents considered that the current unit of resource for teaching biosciences does not meet the costs of course provision. The consequences noted most frequently were an inability to provide an appropriate level of practical training, field work or project work; an unacceptably high student:staff ratio that adversely affects the student experience; and an inability to renew and maintain high-cost lab equipment. Biosciences courses have to be subsidised by various means, which makes them an attractive target for closure in order to reduce overall institutional costs.

7. Evidence has been emerging that the difficulty in providing adequate practical training in undergraduate courses is causing problems for the pharmaceutical industry. In his role as Chair of the Association of the British Pharmaceutical Industry Academic Liaison Group, Dr Malcolm Skingle (GlaxoSmithKline) told the Federation: "International pharmaceutical companies have located in the UK in order to interact with the excellent academic research base. In recent years pharmaceutical companies have been alarmed to note that biosciences graduates frequently lack practical skills that would formerly have been taken for granted, and this has encouraged companies to recruit more staff from abroad."

8. The campaign by science-based organisations deterred HEFCE from splitting subjects in teaching price band B in 2003 following its consultation on the future teaching funding method. Save British Science pointed out, however, that the revised weightings that HEFCE introduced still meant a significant shift of funding from laboratory-based subjects to arts subjects. It is essential that TRAC methodology is used to determine the real cost of providing science courses, and for HEFCE to commit to meeting such cost. Any increase should not be achieved by shifting funds from one area of science to another, since this would defeat the primary objective.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments

9. It is not possible to define an optimal balance since this will vary among institutions. For all institutions, overall income from teaching and research will have most impact on the viability of departments. For both pragmatic and financial reasons, there should be a broad spectrum of offerings whose appeal will vary according to the needs and interests of individual students. Instead of all universities attempting to market themselves on the same model, they should emphasise their distinctive qualities and philosophies with regard to the higher education opportunities they provide.

10. The question as to whether teaching can be separated from research has been raised in a number of consultations in recent years. Among Federation societies that submitted views to the current consultation, a large majority again insisted that exposure to research is needed to provide enthusiastic and informed teaching. Otherwise there is a risk of teaching becoming stale, outdated, and uninteresting. The Federation supports the view that specialised final year teaching, which is often influenced by the research interests of the department, is better provided by staff with first-hand experience of the research. Set against the general statement that teaching and research cannot be separated is the abundant evidence that staff who have been recruited to major teaching roles, and assessed primarily on their achievements and potential in teaching, can be very successful teachers.

11. Among less research-intensive universities there is scope for imaginative solutions for exposing final year undergraduates to research-informed teaching. These include developing creative links with neighbouring research-intensive universities, institutes or industries, whilst focusing themselves on resources and innovations in teaching. Consideration should also be given to alternative models of higher education. Two-year Foundation degrees in specialised, teaching-only institutions could be encouraged for many students, with transfer to research-intensive institutions for an Honours year only for those both seriously considering, and capable of pursuing, a research career.

12. Provision of the current 3 or 4-year Honours degree with students having no access to research-informed teaching is considered undesirable, although it may be financially viable. Many university departments already survive on very little HEFCE research funding. Non-research departments would need to have a workload model that reflected the commitment to teaching, which would almost certainly mean a high student:staff ratio and consequently a further reduction in practical training. It is questionable how employable the graduates of such departments would be. It is likely that such departments would also experience difficulty in recruiting and retaining quality staff and maintaining morale.

The importance of maintaining a regional capacity in university science teaching and research

13. It is essential in a leading Western economy and society that all the major branches of science are represented in the UK as a whole, and that there is the capacity and expertise to perform competitive research in all these branches at least somewhere in the UK. But it is difficult to argue that all branches must be represented in all regions if there is not the student demand for the courses, the capability of winning significant academic research funding, or the pull from regional businesses to provide industrial research funding support.

14. Set against this, the disadvantages of not maintaining a regional capacity in science teaching and research include:

- It is government policy to encourage more social diversity in higher education. Evidence shows that students from under-represented social groups are more inclined to live at home and study at a local university. If science disciplines are not fully represented this could lead to such students pursuing whatever courses are available rather than those that are of strategic importance to the UK.
- The forthcoming introduction of increased tuition fees could lead to increasing numbers of students choosing to study at a local university.
- The government is very keen to promote the development of small companies and existing science-based industries on a regional basis. Easy access to the science department of a local university is important for such industries in terms of providing consultation, research support and activities such as the KTP scheme.

The extent to which the government should intervene to ensure continuing provision of subjects of national or regional importance; and the mechanisms it should use for this purpose

15. The government should have the capacity to intervene, but first it must accurately characterise the problem, which has been brought about largely by a lack of cohesion in prior policy-making. For example, the present difficulties for the physical sciences are caused by a shortage of student demand for courses and an inability to recover the full costs of providing expensive science courses. Any action by the government must address these issues. The Federation would not support ad hoc subsidies to particular universities to maintain failing courses.

16. To address the demand issue, government action needs to invigorate science teaching throughout primary and secondary schooling, sixth-form colleges and Further Education colleges. This may need curriculum changes and improved resources for practical work as well as incentives for more good graduates to enter science teaching. The government should also encourage and support outreach activities from universities, scientific societies and research councils, for instance, and ensure that pupils are able to receive reliable advice on the opportunities that a training in science can open up. Bursaries in selected subjects may need to be offered to provide an incentive to study science in higher education.

17. The finance issue could largely be addressed by HEFCE identifying through TRAC methodology the real cost of providing science courses, and applying a more realistic unit of resource (see paragraph 6). This will be helped if the new grade profile approach in RAE 2008 leads to some relaxation in research funding selectivity, but three more years is a long time to wait for this development. Universities themselves have a responsibility to consider imaginative ways of sustaining the physical and applied sciences. For example, many crystallographers and enzymologists are chemists, and chemistry can be organised to generate stronger links with its end users in biosciences or materials science so as to reduce the overall costs to universities of maintaining chemistry expertise.

February 2005

REFERENCES

1. Funding research diversity: the impact of further concentration on university research performance and regional research capacity. A report by Evidence Ltd for Universities UK (2003)

2. PSA targets for the UK research base. A report by Evidence Ltd for the Office of Science and Technology (2004)

Annex

Member Societies of the Biosciences Federation

Association for the Study of Animal Behaviour
Biochemical Society
British Association for Psychopharmacology
British Biophysical Society
British Ecological Society
British Lichen Society
British Mycological Society
British Neuroscience Association
British Pharmacological Society
British Phycological Society
British Society of Animal Science
British Society for Cell Biology
British Society for Developmental Biology
British Society for Immunology
British Society for Medical Mycology
British Society for Neuroendocrinology
British Society for Proteome Research
British Toxicological Society
Experimental Psychology Society
Genetics Society
Heads of University Biological Sciences
Heads of University Centres for Biomedical Sciences
Institute of Biology
Institute of Horticulture
Laboratory Animal Science Association
Linnean Society
Nutrition Society
Physiological Society
Royal Microscopical Society
Society for Applied Microbiology
Society for Endocrinology
Society for Experimental Biology
Society for General Microbiology
Society for Reproduction and Fertility
UK Environmental Mutagen Society

Represented through the Institute of Biology

Anatomical Society of Great Britain & Ireland
Association of Applied Biologists
Association of Clinical Microbiologists
British Association for Cancer Research
British Association for Tissue Banking
British Crop Protection Council
British Inflammation Research Association
British Microcirculation Society
British Society for Allergy Environmental and
Association for the Study of Animal Behaviour
Association of Clinical Embryologists
Association of Veterinary Teachers and Research Workers
British Association for Lung Research
British Biophysical Society
British Grassland Society
British Marine Life Study Society
British Phycological Society
British Society for Parasitology

Nutritional Medicine
British Society for Plant Pathology
British Society of Animal Science
Fisheries Society of the British Isles
Galton Institute
International Association for Plant Tissue Culture & Biotechnology
International Biometric Society
Marine Biological Association of the UK
PSI—Statisticians in the Pharmaceutical Industry
Royal Zoological Society of Scotland
Society for Anaerobic Microbiology
Society for the Study of Human Biology
Society of Cosmetic Scientists
UK Registry of Canine Behaviourists
British Society for Research on Ageing
British Society of Soil Science
Freshwater Biological Association
Institute of Trichologists
International Biodeterioration and Biodegradation Society
International Society for Applied Ethology
Primate Society of Great Britain
Royal Entomological Society
Scottish Association for Marine Science
Society for Low Temperature Biology
Society of Academic & Research Surgery
Society of Pharmaceutical Medicine
Universities Federation for Animal Welfare

Represented through the Linnean Society

Botanical Society of the British Isles
Systematics Association

APPENDIX 70

Memorandum from the Academic Staff, Department of Chemistry, University of Exeter

This submission is divided into two main sections—a generic response to the questions posed by the Committee and a small annex that highlights some aspects of the recently announced closure of Chemistry at Exeter.

The views are those of the academic staff within the Department and are not necessarily representative of an official University view.

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments

The Research Assessment Exercises, which have run over three iterations in their present form, at one level satisfy a perceived need for Universities to be accountable for the work they do in research. There is then a potential parallel with Teaching Quality Assessments that seek to monitor delivery of, and provision for, teaching of degree programmes. However, successive RAEs have increasingly geared funding towards more highly rated departments to the extent that after RAE2001, the desire in HEFCE had initially been to withhold QR funding from all but 5- and 5*-rated units of assessment (it is relevant to talk about HEFCE in particular, as funding structures are slightly different, we believe, in Wales and Scotland).

An important piece of background here is that for many years, Universities have been subject to 1% "efficiency gains" year on year and pay awards have been underfunded. This squeeze on the central grant has been a major driver in Universities following government funding initiatives and in seeking to maximise their income from QR through the RAE. This has led, inevitably, to those who can afford it buying in high-profile, high-grant-earning staff to ensure a strong RAE return. Of course, many of these staff came from more "lowly" departments where they had been nurtured from first appointment—departments where life had probably been tougher and departments where ongoing institutional support was less clear. This culminated in RAE2001—a triumph of form filling over process—where the number of staff in 5- and 5*-rated UoAs increased massively from 1996.

With such strong grade inflation and a fairly fixed pot of cash, the first result was that departments with 5-ratings were likely to lose money in order that the 5* departments be "properly" rewarded. This downward pressure led to the initial decision not to fund grade 4 departments and it was only some time later that money was found to preserve some QR funding of 4-rated UoAs and to restore at least level funding to 5-rated UoAs. It should, of course, be remembered that grade-4 status does not imply that a department is substandard or unsuccessful. Indeed, HEFCE define grade-4 departments as demonstrating "national excellence in virtually all of the research activity submitted and showing some evidence of international excellence".

Clearly then, despite the fact that most Departments derive the majority of their income from teaching streams (fees and income from the HEFCE contract) (see also below), the difference in resource available to grade 4 UoAs compared to grade 5 or 5* UoAs (and later 6* UoAs) is huge. Many Universities will then operate an internal accounting system that allocates to a Department all the money it earns and then taxes it under various spending headings such as costs of services (water, electricity, gas, oil), central administration (always large), strategic funds and, in many cases, space.

What is absolutely clear is that science is expensive and requires, in the majority of cases, appreciable and occasionally substantial, amounts of space. The TRAC exercise, which seeks to identify the real overhead costs of research, suggests a figure significantly in excess of 200% of direct costs (ie salaries), whereas Research Councils now pay 46%. This is scheduled to change totally by 2010. So research is subsidised by teaching. But then the teaching is expensive, too, for laboratories and equipment must be provided and maintained. In our own University, the arbitrary financial model imposes a punitive cost multiplier for all space in science because "it is expensive to maintain".

So, how should a University deal with varying levels of QR income from its different subject areas? Universities have a range of approaches. Being academic institutions, one might suppose that a University would come up with an academic plan and would make the financial model fit that plan. We believe that there are few Chemistry Department in the UK in surplus—Oxford Chemistry is running at a current annual deficit of £1 million as reported widely in the media before Christmas. So if a University wants Chemistry (or any other loss-making subject) it needs to develop and use a financial model that facilitates this. The model must include cross-subsidy between disciplines, which may be more or less transparent. In Universities that have made a commitment to Chemistry, it is interesting that in many cases space is not charged and cross-subsidy exists. In this way, many Universities have risen successfully to the challenge of managing their funding in order to preserve central subjects.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

The trend towards the concentration of research is predicated on the need for UK science to be competitive with the best laboratories in countries such as the USA and Japan, where funding patterns are different and there is generally more resource available. Such a trend appears to accept that size is the predominant factor in scientific "clout", yet it is true that much good science has come out of smaller departments. For example, the whole world-wide liquid crystal industry took off following discoveries made in the Chemistry Department at Hull University in the early 1970s. Liquid crystal displays are now the dominant display technology worldwide, and despite advances in other technologies, will remain so for very many years to come.

Of course, it is true that in some circumstances, assembling larger teams to tackle particular problems can be advantageous, but the continued concentration of funding into fewer, larger units does assume that this is only way to do things. This is clearly not the case.

One consequence of this approach is that it can become increasingly difficult for small-to-medium-sized Departments to grow to the size necessary to "fit" the current model of concentration, for this requires financial commitment from the University in terms of both staffing and capital resource. In Universities of more modest means, good Departments may exist without any real hope of expansion.

An additional point is that the concentration of effort will inevitably not result in all Universities having an appropriate spread of interdependent subjects. For example, suppose a University withdrew from Chemistry. How might it realistically plan to continue cutting-edge research in modern Biology or Medicine with their huge dependence on the Chemical Sciences?

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

As the Inquiry will be aware, subjects are grouped into one of four bands for the purposes of allocating funding. In band D are the classroom-based subjects (English, History, etc) that are funded with a multiplier of 1. Subjects with some laboratory component (eg Modern Languages, Psychology) are Band C and are funded with a multiplier of 1.3, while medicine (Band A) is funded with a multiplier of 4. Sciences such as Chemistry, Physics and Biology come within Band B where the multiplier has recently dropped to 1.7.

The amount of staff-student contact time in sciences is heavier than in the Arts subjects due mainly to laboratory classes and also the use of the lecture as the primary means of communicating new information. This had led to lower student/staff ratios in the sciences. Further, in addition to seminar rooms and staff offices, sciences need laboratories (which must be staffed), equipment (which has a finite life and so needs replacing on a rolling basis) and consumables (where inflation outstrips the normal 2-3% uplift in budget heading each year). The cost of such provision is clearly very much more than 70% greater than that provided to, for example, History.

Thus, science teaching is underfunded and yet this scarce resource needs to be used to subsidise research as outlined above. This is clearly crazy.

In the last two years, Universities were consulted on proposed changes to the formula described above—changes that would have seen the teaching multiplier in physical sciences increase to a multiplier of 2, but with a larger base unit of resource by which the 2 was multiplied. Interestingly, Vice Chancellors (so we are led to believe) did not support this change as most Universities can recruit more heavily into Arts and Social Science subjects and so would have lost out financially under the proposed change. The result was effectively the status quo, save for the re-banding of a small number subjects.

One other thing bears comment at this time. The Times Higher Education Supplement reported in November 2004 on the official acceptance on the link between good research and good teaching. This coincided with information that HEFCE was likely to make more money available for teaching in certain subjects, but that none of this additional teaching resource would go to UoAs with grade 4 RAE ratings or lower. While academics have long argued the positive link between good research and good teaching (especially in practical subjects where final-year research projects rely on active researchers), we believe that the approach that HEFCE is believed to be considering for adoption, uses that link to further concentrate funding in a way that the argument never intended.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments

In our professional experience, individuals become academics because they with to undertake original research and because they wish to share and communicate their passion and enthusiasm for their subject. This argues for a "good" department to have both teaching and research. And the balance? Increasingly the "next RAE" has dominated thinking and decisions made in Universities on a day-to-day basis, and people worry about "overteaching" and the detrimental effect this has on time available for research. Thus, we believe that RAE factors (along with the increasingly burdensome and obtrusive rise in administration and paperwork[45]) can squeeze time that individuals would wish to assign to teaching. However, we believe strongly that this is not an argument for teaching-only departments for all the reasons that were expounded in the previous paragraph to do with the positive research-teaching link. Further, we do not believe that this constitutes an argument for a Foundation Degree component in "teaching-only" departments as we believe strongly that students should be taught be active practitioners at each stage of their degree.

The importance of maintaining a regional capacity in university science teaching and research

In England, the tradition has been for students to move away from home to read for a degree, contrasting to some degree with practice in continental Europe, in Scotland and to some extent Wales. The abolition of maintenance grants, the emphasis on Widening Participation, and the advent of tuition fees will all conspire to ensure that a great number of students will study at, or close to, home. If their chosen subject is not available at their local institution, then they will be faced with the choice of moving away (which may not be viable financially, or which may be impossible for many mature students with families) or studying another subject. Of course, not all institutions can offer all subjects, and some will have historical specialities, but the wide availability at local institutions of what might be perceived as core subjects, or those valuable to a particular region, ought to be a realistic goal.

In this context, it is important that the London-centric view of regions does not always prevail. For example, the South-West extends another two-and-a-half hours driving time from Exeter, which is, in turn, more than an hour distant from Bristol. Asking someone from Penzance to study Chemistry in, for example, Bristol is akin to asking a Londoner to study in Leeds (driving time) or north of Newcastle-Upon-Tyne (train travel time from Kings Cross).

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose

However this is answered, the question is highly contentious. Universities are in the position of being independent in their decision-making, yet centrally reliant on Government for the bulk of their cash. This means that they will jump through whatever hoops a Government puts in front of them (RAE, TQA, Widening Participation), but Government keeps its hands off when a subject area is closed down, even when such an act contradicts its own policy for provision of strategically important subjects.

Increasingly, Government's agenda is about the next election (wherever we find ourselves in a parliamentary term), whereas Vice Chancellors often stay little more than five to eight years in one place and so work to a different set of imperatives. The most powerful incentive Government can offer is money and the carrot most attractive to cash-strapped Universities is also money. Government has been ingenious in ensuring that reluctant Universities chase money attached to initiatives they would otherwise rather ignore. Should Government wish to take control then we are sure it can find a way.

Given the above and that Government has already defined certain subject areas as being of strategic importance, then where an individual University's decision-making jeopardises that policy, surely Government has a duty to intervene.

[45] The Committee may wish to consider to what extent the funds provided to Universities are used in central administration, to what purpose, and to what extent that is desirable.

NOTE:

We have to some extent interchanged the terms "Department" and "Unit of Assessment". In reality, these are often coincident, although this is not necessarily the case.

Annex

THE EXETER DIMENSION

We would like to conclude by offering some observations pertinent to the recently announced closure of Chemistry at Exeter. We provide these comments against the relevant questions.

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments

Given the age profile of our staff (mostly young in 2001 and starting to build their own research reputations), a Grade 4 in RAE2001 was a sensible objective and was supported fully by the University with a view to returning a Grade 5 submission (or equivalent) in the subsequent RAE. Having realised this mid-term objective, the drive to fund only 5- and 5*-rated UoAs did not help Exeter Chemistry (rated Grade 4 in 2001) as Grade 4 UoAs were eventually given access to a QR pool that was initially fixed in monetary terms. This reduced income attributable to the Department.

The management regime of Vice Chancellor and Registrar changed in the period 2002–03 and led to a change in funding model to one in which all income was assigned to the Schools and all costs and expenditure were charged. This led to an apparent deficit in Chemistry, and yet in spite of public assurances by the Vice Chancellor that cross-subsidy between academic Schools would be retained and indeed "would make it easier to keep the School (of Biological and Chemical Sciences) open", less than a year later, cross-subsidy is gone and has been used as the argument for closure. The closure of the Chemistry Department at Exeter therefore arises directly from the lack of cross subsidy. There has been no attempt to revise the financial model in order to preserve Chemistry (and the other subject areas that will be cut) in the light of the effects that its imposition will have on the University. The imposition of a particular financial model has thus been put above any academic vision. HEFCE's research funding formulae represent a significant challenge to Universities—one that Exeter did not even try to meet. What adds insult to injury is that the figures used as the basis for the closure were in error and our attempts to discuss this error with the University led to silence (68% of the deficit arose from activity in other parts of the School other than Chemistry).

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

We have argued that concentration of research is not a panacea and believe that there is a role for medium-sized Departments like that found in Exeter.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

It will not escape your attention that attracting students in the Physical Sciences is difficult, and for many years Exeter did not meet its University-set quota for intake. However, it has worked extremely hard at this (being held up as a model practitioner internally) and has, for the last three years, been at or over quota. This year, it was the only non-Oxbridge Chemistry Department not in clearing. The University says that we have the third lowest entry qualifications for our students, yet our efforts in recruitment have resulted in an increase in the qualifications of our students on entry. Since the introduction of Curriculum 2000, the average entry qualifications of our students has risen by the equivalent of one A-level grade each year. Furthermore, our open-minded admissions policy means that the Department of Chemistry is a rle model in the University for meeting its targets in Widening Participation. In addition, applications have risen by more than 20% in each of the last two years and were on a steep upwards trend this year. To get to such a position is the envy of almost every Chemistry Department in the country.

Closure is, therefore, particularly galling given that demand for our programmes was great and increasing. A sensible funding model for teaching would have made a huge difference.

The importance of maintaining a regional capacity in university science teaching and research

We have argued aspects of this point in our general response. However, once more there is a particular local dimension given the concentration of Chemical Industry on the North Cornish coast (eg Key Organics—Camelford; Maybridge—Tintagel; Tripos—Bude). Relationships with these companies are good, they have employed many of our graduates and some of their staff have undertaken CPD with us. The potential for collaboration with researchers at the University also played a significant part in attracting the Meterological Office to the City of Exeter, and a number of joint projects had already been established with staff in Chemistry. This local provision is now set to disappear. Where was the RDA?

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose.

If Government has a policy that seeks to protect Chemistry as a subject, then it seems strange that it appears willing to allow a University's finance model to overtake an academic agenda and drive a coach and horses through that policy without so much as a murmur.

APPENDIX 71

Memorandum from Dr Nigel Stanfield Clarke

I submit this document in my private capacity, my interest in this inquiry stems from my holding a Bachelor's and Doctor's degrees in Chemistry from the University of Exeter.

THE SPECIFIC CASE OF THE CHEMISTRY DEPARTMENT AT THE UNIVERSITY OF EXETER

The University of Exeter has announced a number of drastic proposals which it terms "Refocusing the University" In practical terms this involves department closures—in the case of the chemistry department this means the loss if a strategic science subject—and staff redundancies. In my opinion this is not so much a "refocusing" but a "limited field of view with loss of resolution"—to continue the optical analogy.

I refer mainly to the minutes of a meeting of the Council of the University of Exeter held on 20 December 2004. (attached)

(A) These minutes indicate that the decision to close the department of chemistry was taken impulsively under the threat of the Auditors not to sign off the accounts, because of the poor financial situation at Exeter and the Auditors warning that the credibility of Senior Management and Council was at stake. In other words. the decision to close the Exeter Chemistry department was taken at short notice, under duress, with personal credibilities as priorities, without due consideration for the consequences, and with insufficient opportunities for alternative solutions to be proposed by staff affected.

(B) Moreover, the Council members were browbeaten into voting unconstitutionally for the closures by the Vice Chancellor "if [council] members did not support the proposals they needed to offer realistic alternatives rather than simply vote against". My argument is that there had been no time for any of the involved parties (staff students senate council) to prepare such alternative proposals.

The arguments presented by the university to council are often contradictory:

For example the Vice Chancellor talked about "the need to build on excellence in science" (the Chemistry Department had achieved a 4 rating in the last RAE http://www.hero.ac.uk) He said that critical mass was particularly important in the Sciences". He spoke about the need to "glory in the University's achievements particularly in regard to Science [....] and science base". This is perplexing since the main part of the meeting was about CUTTING out the main central science of chemistry, ignoring achievements and reducing the science base.

The Vice Chancellor said that a strategy for growth should recognise Exeter's individuality and not simply be based on comparisons with other institutions. Elsewhere he confounds his argument, justifying his closure proposals by directly comparing Exeter with other institutions Oxford, Sussex, East Anglia, Cambridge and the institutions mentioned by the BBC.

He spoke about the 2008 RAE and concluded that there would be no funding for 4 rated departments. In this he is assuming that the 2008 RAE would actually take place, not taking into account the widespread misgivings about the exercise and indeed doubts whether it will take place at all. If the 2008 RAE does take place how can he assume that Exeter chemistry would NOT receive a 5 or 5* rating. Even if the status remained at 4 there is no hard evidence that no funding would be forthcoming.

The timing of the closure announcements and meetings to approve and ratify give cause for concern.

In the summer of 2004 the University was happy to announce a £3 million refurbishment of the Chemistry laboratories. The Head of Department Prof Duncan Bruce announced record high levels of undergraduate recruitment. The Science Minister Lord Sainsbury toured the university on the occasion of the BA meeting in September and was pleased with developments and achievements in Chemistry. On 22 November a bare two months later, the closure of the chemistry department was announced, on 1 December Senate approved the closure and on 20 December Council ratified it.

However it is important to note that on 18 November, four days before the closure announcement, the audit committee was informed by the auditors that

> the accounts would not be signed off unless certain requirements
>
> concerning financial management had been met.

The closures were announced on 22 November.

Senate met on 1 December to vote on the closures and approved them.

A subsequent meeting of the Audit committee was held on 16 December, four days before the Council meeting.

The Auditors were satisfied that "sufficiently robust" measures were being taken to sustain the institution as a going concern. They would sign off the accounts for 2003–04 as long as [on condition that] Council approved the [..] recommendations for restructuring and expenditure reductions.

At the council meeting of 20 December the representative of the Audit committee said that Audit committee wanted Council to know that

Financial covenants with the banks should not be broken again

The Credibility of Senior management and Council was at stake

In other words, the University acted under the Auditors duress to propose sufficient closures and staff cuts in order to enable it (the University) to get its accounts signed off and to preserve the credibility of Senior Management and Council.

It is to be assumed that the University's accounts for 2003–04 have now been signed off given that Council have approved "sufficiently robust" recommendations for restructuring and expenditure reductions.

It is a great shame that no importance had been attached to and insufficient opportunity allowed for, finding alternative solutions.

There may be one exception. As Professor Talbot Head designate of the proposed School of Biological and Chemical Sciences so disparagingly said of proposals by chemistry staff to create a School of Natural Sciences; ". . .[it] might seem attractive, but . . . .it represented the management of decline and an unwillingness to make difficult decisions."

It is perhaps not surprising that someone in Prof Talbot's position would indeed make such a statement.

The Importance of The Science of Chemistry

A typical dictionary definition of chemistry might be:

1. The science of the composition, structure, properties, and reactions of matter, especially of atomic and molecular systems.
2. The composition, structure, properties, and reactions of a substance

but this is to ignore the scope and position of chemistry as THE central science. Chemistry has interfaces with the other "pure" sciences of biology and physics and geology. Chemistry has interfaces with chemical engineering and with the metallurgical and materials sciences. Thus chemistry occupies a central location in an interdisciplinary sense. Chemistry is animal, mineral and vegetable. Chemistry occurs over a wide range of energy scales. At absolute zero, chemistry is almost (but not quite) halted. At moderate temperatures, molecular processes dominate. At higher temperatures molecules fragment and atomic behaviour becomes more important, it is only at the highest energies when atoms themselves cease to exist that it might be considered that chemistry stops. But let things cool off and chemistry starts up again. Chemistry spans the size scale from sub-atomic species to extended materials. Chemical molecular phenomena are universal, from the behaviour of compounds on in and beneath the earth, chemical processes in our seas and atmosphere to the composition of interstellar dust and gas, and the chemistry of the very stars themselves. It is true to say that the atoms and molecules inside us, indeed us ourselves, we are all made of stardust!

Without a study of chemistry, the centralised science and these interfaces cease to exist and therefore the valuable interfacial teaching and research will be lost.

Career Choice and Continued Professional Development

This section is concerned with the possibilities of career choices and continued professional developments which the academic study of chemistry can afford. I cite my own career choices and subsequent development in example only.

I would like to demonstrate the powerful impetus to a career which chemistry can impart and the lifelong benefits which a knowledge of chemistry can bestow, and from which personally I have benefited.

As mentioned in the introduction, I have a BSc (1st class) in Chemistry and a PhD from the University of Exeter. I chose chemistry above physics to study at university because of my experiences at A level. I was fortunate, in the Chemistry Department at Exeter to encounter a dedicated enthusiastic staff teaching a strong core chemistry course, around which one could study ancillary subjects (in my case, mathematics (compulsory) and physics (optional)). One could also follow a number of chemistry options which enabled one to specialise or generalise. I chose to specialise in physical chemistry, and chose options accordingly. I graduated with a solid grounding in chemistry, mathematics and physics, the latest knowledge of physical chemistry and research experience. This stood me in good stead for my next career choice; what research and where? The answer was easy; remain at Exeter, but study at the interface between physics and chemistry, supervised by world class researchers and carry out experiments at international facilities. My PhD was financed by the then SRC under the CASE Award scheme, and involved neutron scattering research at the Atomic Energy Research Establishment at Harwell, the Rutherford Appleton Laboratory and the Institut Laue Langevin Grenoble.

This short cv is just to underline the scientific flexibility, which a degree in chemistry can generate.

This flexibility, and agility of mind acquired during the Exeter Chemistry years allowed me to then move into academic research in materials science, advanced instrumentation R&D, defence R&D, and defence project management. From there I moved into intellectual property—as a patent examiner, thence into IT project management, and I am currently in a marketing and promotion post in an international organisation. (European Patent Office). During my professional development I have acquired professional qualifications in chemistry and in physics, and I have recently been designated a chartered scientist (CSci) as conferred by the Science Council.

This career history is not to promote myself, but to highlight the wide possibilities that study of chemistry can provide. My own wide range of career options, development and experiences would not have been possible had I not studied chemistry at Exeter. I should like to take this opportunity of thanking my mentors at Exeter during the 70s and 80s for their guidance and inspired teaching.

I owe a lot to Chemistry and in presenting this document, I hope to put something back.

February 2005

APPENDIX 72

Memorandum from Universities UK

INTRODUCTION

1. Universities UK is pleased to be able to submit evidence to the Science and Technology Committee and aid its inquiry. On the 30 November Diana Warwick wrote to the Committee Chairman to outline Universities UK's initial views on this issue in the light of the announcement of the proposed closure of the Chemistry department at the University of Exeter. We hope that this letter was helpful in informing the session held with the Science Minister, Lord Sainsbury, on this matter. This written memorandum reiterates and builds upon the key points made in that letter.

2. We acknowledge the concerns, expressed by the Committee and many others, about the closure of Chemistry departments within the HE sector. Universities UK's membership is currently looking at how we can explore further the implications of such closures at a local, regional and national level, and have been discussing with Government and the Funding Councils the underlying problems and possible measures that may need to be introduced to address them.

3. The reasons for such closures are complex and vary from case to case. However, we would make the following broad points:

- Funding for both teaching and research in English universities is currently inadequate. In general, both are loss-making activities for universities. This leaves Vice-Chancellors with little room for manoeuvre and especially vulnerable to changes in the allocation methodology or fluctuations in student demand for certain subjects.
- The Government's stated policy to further concentrate research funds in top-rated departments is misguided. We warned in 2001 that it could have an adverse impact at the level of individual subject provision, and believe that our predictions have been proved accurate. Our fear is that the impacts of any further concentration of research funds may prove irreversible. The Government should reconsider the policy of concentrating research funding further before further damage is done to the strength of the research base.
- While we understand that the Committee has a particular interest in Science and Technology subjects, we note that the funding constraints and policy decisions outlined above are likely to impact on a wide range of subjects. We do not believe that intervention on behalf of, for example, Chemistry would be sensible if it meant removing funding from other subjects or other parts of the system. A large proportion of teaching and research in HE is not science and technology based, though is just as vital to the UK as a whole. Indeed, the letter from the Secretary of State for Education to HEFCE has asked for views on minority languages and vocationally oriented courses of particular interest to employers in areas of growing importance to the UK economy, as well as science-technology-engineering-mathematics.

4. Universities UK believe that there is a need for open and transparent dialogue between the higher education sector and all relevant parties. In particular, it will be important to make progress based on robust and relevant evidence. Universities UK look forward to responding to the Funding Council's proposals.

Summary

5. In December Universities UK wrote to the then Secretary of State for Education, Charles Clarke, in response to his letter to the Funding Council outlining the agreed views of the UUK Main Committee. The key points in this letter can be summarised as follows:

(i) There is a real concern that HEFCE intervention will compromise institutional autonomy and investment decisions will be distorted.

(ii) Despite improved funding settlements in recent years, the sector's finances remain finely balanced: institutions cannot afford to subsidise courses for which there is insufficient market demand;

(iii) The financial effect of increasing research concentration also needs to be considered: the combined impact of low demand and cuts in funding for departments rated 4 has compelled universities to make difficult decisions about the future of specific departments;

(iv) Uncertainty about the funding impact of the next RAE is a further constraint on institutions' long term financial planning;

(v) The underlying problem of variable demand relates to decisions made by students in schools and greater priority needs to be given to stimulating interest in national priority subjects in school. (In some of the examples employers would have a role in sending a clearer market signal);

(vi) Any assessment of provision in these subjects in England needs to take account of the position in other parts of the UK.

6. As we have made clear in previous submissions to the Committee, Universities UK believes that reasons for decisions to close a department can be complex and reliant on a number of factors. Departments rated 5 or 5* which are also recruiting students may remain secure, but when one or other side of this equation is changed, a department may become vulnerable. In some cases the combined impact of falling student rolls and cuts in university research funding can leave Vice-Chancellors with little choice but to close a department.

7. Much may be achieved by stimulating student demand, particularly by encouraging potential scientists during the 14 to 19 phase. The problems with demand in Science Engineering and Technology subjects (SET) were analysed in some depth in Sir Gareth Roberts' report, *SET for Success*, and we welcome the government's move to support many of Sir Gareth's proposals. We do recognise, however, that this will represent a practical challenge for schools, and that these are long-term solutions that will need time to bed down. Meanwhile universities are working hard to reach out to potential students and there are some notable example of efforts to encourage participation in science in Universities UK's 2002 report *Social Class and Participation*[46]. For example, the University of Ulster runs a programme called "Step up to Science" which targets school pupils from the lower social classes who are about to start GNVQ studies in science subjects.

8. In some cases, falling student demand does not appear to be a factor. Universities UK believes that the effects of cuts in funding for departments rated 4 in the RAE have been deeply damaging. We have welcomed the committee's support for our view that the concentration of research funds has gone far enough, and that Government should provide public funding to sustain research of the level described by the 4 grade, because of its importance in regional terms, but also because this is the research which is likely to provide the basis of future world-class discoveries.

9. Whilst we welcome the substantial additional funding provided in the last two spending reviews to meet more of the full economic costs of research councils projects, up to 80%, the pressures on university research departments may well increase in coming years as HEIs move towards implementing full economic costing and ensuring that the research base is sustainable across all activities. For example, as the full costs of EU funded activities come into focus, research funded through the Framework Programme (FP) will be potentially unsustainable in the medium to long term. This will undoubtedly result in a reduction in the current volume of EU funded research. UK universities will therefore not be in a position to take advantage of any increase in the budget under FP7 and risks losing its position as the premier recipient of EU research funds unless the UK Government is able to provide support for this at a national level and ensure that more of the full economic costs is provided by the EU. Failure to address this problem could result in significant damage to UK higher education and UK competitiveness as a whole. It is not unlikely that increased pressure on this front will add to the vulnerability of some academic departments.

10. If the general financial circumstances of our universities were healthier, Vice-Chancellors might well be able to put off, or avert completely departmental closures. However, there is currently little slack in the system and Vice-Chancellors may have to make tough decisions in the interests of the survival of the rest of the institution. We hope that the introduction of variable fees in 2006 will begin to address at least part of the problem by reducing the extent to which universities make a loss for teaching certain subjects. However, there will continue to be a significant funding gap.

11. We firmly believe that if the Funding Council does decide to introduce measures to address vulnerable subjects and courses, they should be supported with additional funds, and should be sustainable in the long term.

[46] *Social class and participation* (2002), Universities UK.

Select Committee Questions

The impact of HEFCE's research funding formulae, as applied to RAE ratings, on the financial viability of university science departments.

12. The key issue here concerns the rules for funding QR following the outcome of the 2001 RAE. The results of the 2001 RAE exceeded expectations, but the failure of the Government to fund fully the results caused extreme concern to the academic community. In many cases, Vice-Chancellors had invested heavily prior to RAE 2001 in the expectation that if they were successful in raising the quality of research in a department to a level of national and some international excellence, funding would follow roughly in proportion to past RAEs. Indeed of the research submitted at the last RAE, 64% was found to be of national or international excellence, a rise from 43% at the previous RAE. This outstanding success of UK research in universities made the impact of the actual funding decisions following the 2001 RAE doubly hard to bear.

13. In particular, Universities UK has been deeply concerned by the cuts in funding to departments rated 4 and below. These changes have had a significant impact the finances of those institutions affected by the cuts. We know that Professor Steve Smith has provided you with information which shows that in the University of Exeter a 4 ranking unit got 55% of the funding per staff member given to a 5* unit and 66% of the funding for a 5 in 2001–02, by 2003 that had fallen to 30% of the 5* and 36% of a 5.

14. Use of the HEFCE funding formula to manipulate retrospectively is highly damaging to sector and we remain concerned that the funding outcomes following RAE2008 will continue to be open to manipulation.

15. Universities UK is therefore concerned that there is as yet no clarity about the future relationship between research assessment and funding for RAE2008. If universities are to sustain their activities and avert closures they must be able to plan on the basis of some reasonable assumptions about future levels of income. This issue should really have been considered as part of the 10-year science and innovation framework given that this was intended to provide an overarching strategy for the medium term and allow more for effective planning within the research base. Universities UK has stated that it is essential for the funding for the different rankings to be reasonably predictable so that higher education institutions can invest and plan within a stable financial framework.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend;

16. All the evidence suggests that the current basic research profile of UK universities shows research of international standards. We are gravely concerned that increasing levels of selectivity in research funding will damage this. It is critical that the balance between funding top-rated departments to support excellence, protecting areas of research excellence across the sector and the encouragement of new and developing areas of research is not further distorted through fundamental revision to the allocation of public funding.

17. As the Committee will be aware, in 2003 Universities UK commissioned a report from Evidence Limited, Funding Research Diversity[47], to explore the impact of any further concentration on university research performance and regional research capacity. The study aimed to gather evidence to test the assumptions and implications of the UK government's White Paper proposals for university research funding. The policy as proposed is not based on any clear evidence though would change the structure of the research base by concentrating funding in the largest and most highly rated university units.

18. The Evidence Ltd study was very clear in its conclusions. It found that firstly there is no evidence that there is a current problem with performance of the UK research base that needs to be addressed, either overall or at the level of the units most likely to see a funding loss. Second, if there were an emerging problem, then there is no clear evidence that the UK's research performance would benefit from further concentration of research funding. Third, there is evidence that research concentration as proposed would seriously exacerbate existing regional differences in research capacity and performance. We have included a copy of this report with the submission.

19. The report specifically looked at the impact of research concentration on regional research capacity, which is a key consideration when looking at this issue. If all regions had similar proportions of four and five graded staff and units, and similar distributions by subject then policy changes would be balanced by pro-rata losses and gains. However, this is not the case and selectivity and concentration will inevitably favour those regions that already have a relatively high number and proportion of research excellent staff and units. It therefore pertains that regions with a relatively high proportion of four units, and a high proportion of staff in such units, will lose relatively more of their capacity if funding is reduced for four graded units. Regions with a high proportion of five units will make a relative gain if funding is more selectively concentrated on the highest performing units. For those institutions facing cuts this will inevitably present difficult choices when considering which departments are financially sustainable.

[47] Funding Research Diversity: summary report (2003), Evidence Limited.

20. Universities UK made these arguments clearly to the Government in our 2004 Spending review submission, *Achieving our vision*[48], which also suggested that removing or reducing funding from departments graded three and four would have a significant impact on individual subject areas and would likely damage the teaching mission.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula;

21. The impact on science teaching of recent changes in the HEFCE formula for allocating resources for teaching to institutions for science based subjects will vary across the sector depending on the particular circumstances of that institution and the way in which resources are allocated internally. Universities UK believe, however, that there are two additional and more fundamental issues that need to be considered—the inadequate funding base for university teaching and learning and the historic basis upon which the funding is allocated.

22. The inadequate public funding base for teaching and learning provided for English institutions through HEFCE remains a major difficulty for the sector. It is well known that there has been a 40% reduction in the level of unit funding in the last 10 years alone, and significant damage has been done by many years of under-funded expansion. As stated in our 2004 Spending Review submission, Transparency Review data demonstrates that the total overall cost to universities and colleges of delivering teaching and learning activities is significantly in excess of the price paid for them by government. This situation was worsened by HEFCE's recurrent funding allocations for 2003–04, when in attempting to make provision for the additional costs to institutions of recruiting and retaining widening participation students, it chose to top-slice the mainstream teaching grant to increase widening participation funding. UUK have consistently asked that the additional costs of widening participation be identified and met by the funding councils from additional funds provided by government. As UUK stated in our response to the Government's White Paper[49] "Mainstream teaching does not cost less because widening participation costs more". Unfortunately, in a number of institutions, this policy hit funding for science based subjects particularly hard.

23. Part of the problem is that the HEFCE allocation formula is based on a combination of historical assumptions and annual expenditure data. Any formula for allocating funds to institutions needs to be informed by a full economic cost model. A full cost model would, for instance, take into account factors such as capital depreciation and the need to reinvest in teaching and learning infrastructure. We therefore welcome the incorporation of this element into the current review of the funding formula.

24. As we have suggested, if the financial position of universities was healthier, institutions might be able to put off or postpone difficult decisions, or, perhaps more importantly, make decisions based on non-financial criteria. The most recent financial forecasts for English higher education institutions provided to HEFCE reveal a continuing level of instability in the sector's operating base. HEFCE previously estimated that the sector in aggregate needs an operating surplus of at least 3 to 4% of income per annum to provide a positive cash flow for reinvestment and to fund future developments. In fact, the operating surplus for 2002–03 was 1.3% and for 2001–02 was 0.4%. These are average figures across the sector—large numbers of individual universities are in a far worse position and will be making business decisions based on the need to reverse historical deficits.

25. We hope that the introduction of variable fees in 2006 will begin to address at least part of the problem by reducing the extent to which universities make a loss for teaching certain subjects, however, it is essential that income from fees is truly additional and that the publicly provided unit of funding is not further eroded.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments.

26. We do not believe that there is any such thing as an optimal balance between teaching and research. Not only would this be impossible to define and prescribe but also, quite rightly, this differs across institutions depending on their own institutional priorities and missions. However, Universities UK has maintained that higher education institutions benefit from the vital interdependence of teaching and research and that removing or reducing funding for departments graded four and below will have a significant impact on individual subject areas. Removal of research funds is likely to damage the teaching mission, as staff will lack the necessary resources to maintain their knowledge at the cutting edge of their discipline.

[48] Achieving our vision: Universities UK Spending Review Submission for England and Northern Ireland (2004), Universities UK.

[49] Universities UK's response to "The Future of Higher Education" (2003), Universities UK.

27. The work of Professor Sir Graham Davies' Research Forum has been helpful in informing this debate. In their advice to Ministers[50] the Forum have suggested that "in each academic department, (or within each course team), there needs to be appropriate resources, a reasonable research culture, and sufficient research activity (broadly defined) to enable such programmes of study to be designed, led and taught effectively." The Forum go on to suggest that "It is clear to us that, effectively managed, student learning can benefit immensely from staff research, and that students not exposed to staff research in an appropriate environment may be at a disadvantage as compared to those who are." Universities UK would support this view.

28. The Forum also suggested that the focus on research in RAE terms can have a distortionary effect on overall provision within the sector. ". . . since the RAE is at present the only mechanism by which basic funding to support research in departments is delivered, the pressure to be research active in RAE terms is immense—and distorting of what the sector overall requires. It is clear, therefore that more imaginative approaches are needed than those currently available for providing research resources to underpin teaching at a higher education level." This conclusion has led the Forum to proposed a funding model that would provide for a practical level of funding to support research informed teaching in HEIs with low levels of QR funding. Universities UK have welcomed the Government's recognition of the principle that "less research intensive institutions should be supported in developing a research informed teaching environment"[51]; however, we are still concerned that the level of investment proposed falls far short of the investment level that would be needed to deliver a meaningful impact.

29. In summary UUK believe that a research culture is integral to teaching at university level. The financial viability question is, therefore, not about the viability of teaching only departments, but instead about the level of resource that would be needed to effectively sustain a research informed environment across the sector.

The importance of maintaining a regional capacity in university science teaching and research.

30. Universities UK recognise the vital importance of science, engineering and technology (SET) to the UK economy at regional, national and international levels and the key role that universities play in delivering this. Universities also engage through a wider range of activities that impact on quality of life, social inclusion, societal infrastructure and cultural enrichment. We would therefore accept that there is a need to ensure a sound, broadly based capacity in teaching and research across all key areas in order to allow institutions to respond to current and future demands.

31. It must be remembered, however, that the role that individual universities will play in sustaining capacity in university science teaching within a region will differ significantly across the UK. It, therefore, may not be necessary to have a chemistry department in every university in the country and it will not always be true that it is wrong for a university to close down a department. In addition if a department is closed within any institution this may not mean that work has completely ceased in that area. Provision in that discipline may be maintained within a department of a related disciple. We therefore doubt that a one-size-fits-all approach to this issue would be helpful—indeed we are concerned that justifiable public and political concern about certain subjects, such as chemistry, may lead to policy makers ignoring problems in other areas, which may be equally significant in the long term.

32. Evidence suggests that the concentration of research funding disproportionately affects some regions over others. We note the Association of University Teachers publication *The Risk to Research in Higher Education in England*[52] that draws attention to the fact that "in some English regions less than half the assessed research has a secure funding future". We also note that there are a wide variety of "vulnerable" subjects (if you take loss of research funds as an indication of vulnerability), and that it may be difficult to judge the relative impact of the loss of capacity in certain subjects as compared to others. Further work in this area is needed, and while Universities UK is currently considering some of the issues raised by our Evidence report with a view to adding to this debate, we believe Government and the Funding Council could also play a role in gathering evidence.

33. Any review should also consider the articulation between different areas of Government policy. In particular we are concerned about the the tensions inherent in policy alignment at national and regional level. This issue is explored in a recent report by the Higher Education Policy Institute (HEPI), Research and the Regions[53] which makes valuable inroads into exploring the regional aspects of research structure in the UK, and we commend it to the committee. The report explores the connectivity between university research activity and economic performance and, on the other hand, the importance of proximity to the transfer of research findings from discovery into application. Significantly it examines the impact of the current research policy environment. A key conclusion of the report is that it is not always clear that the emergent regional framework is consciously linked to pre-existing, and nationally oriented, policies and

[50] Advice from the Forum to Ministers can be found at http://www.dfes.gov.uk/hegateway/hereform/heresearchforum/index.cfm

[51] Secretary of State's grant letter to HEFCE on funding 2005–06 to 2007–08.

[52] The risk to research in higher education (June 2003), Association of University Teachers

[53] Adams and Smith *Research and the Regions: an overview of the distribution of research in UK regions, regional research capacity and links between strategic research partners* (2004), Higher Education Policy Institute.

agents relevant to knowledge growth and exploitation. This effectively means that the goals and objectives of regional policy may pull in a different direction to those at national level, a contradiction that can leave institutions in a position where they may have to make very difficult decisions.

34. The Universities UK report *Patterns in Higher Education: Fourth Report*[54] also provides a useful overall analysis of the geographical differentiation and diversity within the sector. Interestingly the report shows that there is actually little coherence in the concept of the regions in regard to higher education. Geographical boundaries between regions of England are such that natural groupings of institutions are separated, while some areas within several regions are without any local HE provider. As the report suggests, this echoes the findings of the HEPI report on Research and the Regions, which noted that "it remains unclear whether there are regional dimensions to the suite of university research services that could be distinguished from the local (city) scale and the wider (national) scale".

35. We have included a copy of the Patterns 4th report with this evidence as this also provides clear information on trends in numbers of enrolments in SET subjects and changes in numbers of institutions making provision for teaching major subjects (at a national level) in these subjects.

The extent to which the Government should intervene to ensure continuing provision of subjects of national or regional importance; and the mechanisms it should use for this purpose

36. As we have stated the reasons behind departmental closures can be complex and reliant on a number of factors, which include overall under-funding of teaching and research and a lack of student demand. Whilst it is still to be seen whether any of the short term solutions that have been proposed in recent months would be appropriate, UUK feel that it is far more important to look at the broader policy and funding context in the medium to long term to ensure that this is structured so as to give institutions the sufficient levels of funding and freedom that they need to respond effectively to needs at regional, national and international levels.

37. If progress is not made based on robust and relevant evidence that helps identify the true nature of the problems and informs longer term sustainable solutions we could ultimately end up with short term micro management of the research base in a response to current 'hot spots' which, aside from its own unintended consequences, would distort institutional strategies and priorities. This would not be desirable.

February 2005

APPENDIX 73

Memorandum from Professor MacDonald, University of Lancaster

The Committee is inviting evidence on the following points:

1. *The impact of HEFCE's research funding formulae, as applied to RAE ratings, on the financial viability of university science departments;*

Grade 4 in the RAE means that departments include international and national research. It does not indicate weak research. But the funding model has potentially made many Grade 4 science departments non-viable. Universities have adopted a variety of mechanisms to cope with this. For example, some departments have been asked to take large student numbers. Research in others has been cross-subsidised from financially more viable departments. Neither approach has had the effect of improving the quality of research.

2. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend;*

We feel that it is entirely wrong to restrict science research to a small number of departments. It engenders a "comfort" culture, which in turn can lead to fossilisation in terms of new ideas and enthusiasm. Critically, it also restricts mobility among young researchers. A disastrous consequence of over-concentration might be that most students would attend universities without research in science. If science research is focussed in some universities and non-science research in others, then universities identified as research-led in other areas would simply cut science to maintain their research-led position.

Modern science makes greatest advances in interdisciplinary work, both with other science departments and, increasingly, with departments in the social and management sciences. We are not advocating the unsustainable situation where all universities have the full spectrum of the sciences. Rather, we see a situation where each institution develops its preferred, integrated combination of the natural-social-management sciences and can compete for funds accordingly.

[54] *Patterns of higher education institutions in the UK: Fourth Report* (2004), Universities UK & Standing Conference of Principles.

3. *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula;*

Our experience is mixed in relation to specific disciplines. The extra funding given, for example, to Physics has been helpful but has not been sufficient to make a real difference. On the other hand, the reduced funding for Biological Sciences and Environmental Sciences has had a deleterious effect on their work. Rebanding Psychology puts serious constraints on laboratory-based work.

More generally, we asked our Finance Office to do an exercise on the effects of rebanding and reweighting across different faculties. The exercise was based on applying the rebanding retrospectively to 2003–04. The income lost for our two science faculties together was £1.4 million, which went to humanities, social sciences and management. This means that the university received proportionally less funding than before the rebanding and reweighting exercise. While HEFCE may argue that it is up to the university to allocate its funds in accordance with its strategic plans, this is somewhat disingenuous. Universities have internal financial pressures and any shift in income will ultimately be reflected in shifts in resource. Quite simply, if less money comes in for science, less will be distributed to science. This seems a retrograde step at a time when the government is trying strenuously to strengthen the UK science research and teaching base.

4. *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments;*

As a research-led university, we are opposed to teaching-only science departments. It is our experience that, whereas non-research active staff can teach adequately at Year 1 (and maybe 2) level(s), they are usually unable to deliver cutting-edge material to more advanced courses and are ill equipped to offer relevant project work. Science thus becomes more restricted, there tends to be more handed-down truth and a lowered ability to understand how science is made.

Such a move could have far reaching consequences. Teaching-only departments would depend entirely on student demand and would have to put on courses to attract students, whatever the national need or employability issues. Science teaching would be two tier—with some students in non-local, research-led science departments asking high grades, others in local, teaching-only departments asking low grades.

5. *The importance of maintaining a regional capacity in university science teaching and research;*

Students tend to attend relatively local universities. They will move away from science if they cannot do science at their local universities—except for high achievers who go to the institutions asking for high grades. Industry, particularly SMEs, uses expertise in local universities. Industry deserves/requires more than "handed-down" knowledge. In fast-moving industries the need is for up-to-date research, not for handed-down research. Teaching-only departments can pass on knowledge made elsewhere, but will not themselves be innovative enough to give industry the science innovation edge.

There is, however, a strong case that regional capacity can be built up through inter-university collaboration. We have been working closely with other research-led universities in the north-west to develop, where possible, complementary science research programmes.

6. *The extent to which the Government should intervene to ensure continuing provision of subjects of national or regional importance; and the mechanisms it should use for this purpose.*

Some recent Government initiatives, eg those aimed at stimulating growth in Mathematics and Statistics, have been very welcome and potentially successful. The introduction of Full Economic Costing will encourage us to critically examine our priorities and the efficacy of our financial models. More problematical nationally is how to deal with the decline in such essential subjects as physics, chemistry and engineering. As a short-term measure, departments could be helped by direct Government funding. Ultimately, however, their viability will depend on healthy student recruitment and retention in the field. That requires convincing schoolchildren of the value and personal benefits of a carer in science and technology.

February 2005

APPENDIX 74

Memorandum from the Joint Committee for Resources in Higher Education

I am writing in my capacity as Chair of the Joint Committee for Resources in Higher Education. The Joint Committee is the umbrella group for the three main bodies that represent British Psychology: The British Psychological Society, (with over 40,000 members), the Experimental Psychology Society (with 600 members) and the Association of Heads of Psychology Departments representing (over 100 Departments).

We wish to submit comments in relation to the call for evidence for the inquiry into the steps being taken to safeguard an adequate level of science teaching and research across universities in England. Accordingly, attached are two responses, one prepared by the Research Board of the British Psychological Society and the other prepared by the Experimental Psychology Society (which has already been submitted to you directly by the EPS). The Association of Heads of Psychology Departments has not prepared a separate response but it is supportive of the general comments outlined in the BPS and EPS submissions.

We wish to draw your attention to the following common themes of both submissions:

1. The RAE-linked funding formula will continue to produce substantial effects on the quality of HE provision in this country—the impact of which will be felt by students, academic staff and ultimately society. The funding formula has become overly weighted towards 5* and 5 rated departments.

2. We believe that increased concentration of researchers in a small number of university departments would have serious consequences for research, due to the potential lack of recognition of excellent individuals who may not be employed at these "centres of excellence", which may stifle creativity and scientific development. This may in turn, result in increasing problems of attracting good young researchers into academia as the number of positions that are available to them diminishes.

3. We believe that concentrating top researchers in just a few university departments would seriously impact on the quality of teaching that would be afforded to the undergraduate and postgraduate populations, with consequent implications for the research base of this country.

4. We are particularly concerned, given changes in the weightings given to Psychology in particular in the teaching funding formula, that university income "generated" by the large numbers of Psychology undergraduates is no longer sufficient to support the teaching of science subjects to the levels needed to support a proper education based on quantitative experimental approaches. Without adequate science-based funding, we are in danger of no longer being able to provide the intensity of practical scientific teaching, and the associated transferable skills, that this country's economy has enjoyed to-date.

Psychology is the fastest growing subject in science, however, many departments are now stretched to intolerable levels.

5. A balance must be struck in research-active departments between support for nationally and internationally recognized research, and support for teaching.

6. Maintaining regional capacity in science teaching and research is essential.

7. Whilst it is appropriate that HEFCE continue to manage funding provision of different subjects, we would urge HEFCE to encourage the collection of data which do more adequately reflect the true teaching cost. This disparity, between actual cost and the costs on which formula funding are based, is particularly noticeable in the case of the teaching of science subjects, and is certainly the case with our own subject, Psychology.

February 2005

Annex A

EXPERIMENTAL PSYCHOLOGY SOCIETY

We are writing as Hon Secretary and President of the Experimental Psychology Society in response to your call for evidence to the Science and Technology Committee's Inquiry into strategic science provision in English universities.

Briefly, The EPS was founded in 1946. Its role is to facilitate research in experimental psychology, and scientific communication among experimental psychologists and those working in cognate fields. As such, we regularly liaise with the research councils on issues of science funding in the UK. The EPS is the foremost society for the scientific study of Psychology (with 20 members that are also Fellows of the Royal Society, and a further seven that are Fellows of the British Academy); it has an active membership of around 650, with members in mainland Europe and elsewhere overseas, including the US. Membership is restricted to scientists with a proven ability in Experimental Psychology (they must have published their work in a major peer-reviewed journal and have presented their work to the Society at one of its meetings). More information about the EPS and its history can be found at http://www.eps.ac.uk. The EPS holds regular scientific meetings, three times a year, at which members and guests present their work; it publishes the Quarterly Journal of Experimental Psychology and other occasional publications. It sponsors scientific workshops on special topics, and awards grants and prizes to facilitate postdoctoral, postgraduate and undergraduate research. The Bartlett Lecturer, chosen annually by the Society, is recognized as one of the major intellectual awards in Psychology.

We believe that the provision of adequate resourcing is particularly germane in respect of Psychology, given that it is the largest scientific discipline as measured in undergraduate numbers, and ranks third overall. Also noteworthy is that, as a science, it attracts a greater proportion of women than do other scientific disciplines. It is also the case that, as a general scientific degree course, it offers significant transferable skills and given the numbers of students obtaining these skills, it no doubt has a significant impact on the graduate workforce and economy of this country.

Below are brief comments on the 5 points for which you are requesting evidence:

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments

We believe that it is essential to fund excellence in science departments, and that it is right that where excellence exists it should be supported. We are concerned, however, that the funding formula has now become overly weighted towards the departments rated 5 or 5*, and departments that achieve national excellence and are awarded a 4 receive disproportionately low income on this stream. This in turn impacts on the ability to train the future research scientists that will sustain both the future science base and the future economy of this country.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend

It is true that there are certain sectors in which large groups are required in order to enable scientific research. This is true in aspects of genetic research, medical research, space exploration, and so on. However, much of science is due to the endeavours of individuals working in small teams, with perhaps just one principal investigator aided by a research fellow and/or graduate student. In these cases, a well-funded department provides an infrastructure and ethos that is certainly beneficial. But to deny a talented individual researcher support because he or she happens to work in a university department that has not been deemed a "centre of excellence" is to impede the entrepreneurial spirit that pervades scientific investigation. We believe a balance can, and should, be found between catering for efficient research infrastructures as well as catering for the individual scientist. In respect of the consequences for teaching, we believe that concentrating top researchers in just a few university departments would seriously impact on the quality of teaching that would be afforded to the undergraduate and postgraduate populations, with consequent implications for the research base of this country.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula

We are particularly concerned, given changes in the weightings given to Psychology in particular in the teaching funding formula, that university income "generated" by the large numbers of Psychology undergraduates is no longer sufficient to support the teaching of science subjects to the levels needed to support a proper education based on quantitative experimental approaches. You may know that HEFCE rebanded Psychology teaching recently, in a way which will shift funds away from many of our best Departments and therefore cause harm to initiatives in neuroscience, brain imaging, behaviour genetics and other high-cost areas. To be taught as a science, psychology requires intensive laboratory practical courses, computer courses, and training in statistical methods. In Year 3 of a typical course, each student undertakes an individually supervised research project that takes up many contact hours with the HEFCE-funded faculty member responsible for that student. Without adequate science-based funding, we are in danger of no longer being able to provide the intensity of practical scientific teaching, and the associated transferable skills, that this country's economy has enjoyed to-date. Although in principle the change in the weighting may not significantly change the teaching funding to individual institutions, we believe that the rebanding of Psychology sends a signal to universities that they need not invest in Psychology training to the extent that they once did.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments

We see nothing wrong in teaching-only science departments, and indeed, Polytechnics, as they once were, provided an enormously fruitful science base through what were often teaching-only science departments. However, given that research-only science departments are unlikely to be financially viable, a balance must be struck in research-active departments between support for nationally and internationally recognized research, and support for teaching. There has undoubtedly been an increase in teaching and associated administration for research-active HEFCE-funded faculty, and we view this as an impediment to the high quality research that is in danger of no longer being the hallmark of the UK University system.

The importance of maintaining a regional capacity in university science teaching and research

We believe that regional capacity in science teaching and research is essential if we are to attract prospective scientists from different social and cultural communities within the UK. A danger inherent in centralizing science teaching and research in a few centres of excellence, or in a few geographical areas, is the attribution of elitism to scientific endeavour, and this would undoubtedly put off many of the population who may otherwise go on to become the leading scientists of the future. Indeed, scientific diversity, without which science cannot evolve and advance, would suffer were there not also geographical diversity.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose.

It is unclear whether the Government should intervene in light of mechanisms already in place via HEFCE funding. We believe, however, that there has been a tendency to base formula funding of particular subjects on data which do not accurately reflect the true cost of teaching students in a particular subject or within a particular department. Whilst it is appropriate that HEFCE continue to manage funding provision of different subjects, we would urge HEFCE to encourage the collection of data which do more adequately reflect the true teaching cost. This disparity, between actual cost and the costs on which formula funding are based, is particularly noticeable in the case of the teaching of science subjects, and is certainly the case with our own subject, Psychology (and see our response in relation to the question on science subjects and the teaching funding formula).

Professor Gerry Altmann, Hon Secretary
Professor Andy Young, President

Annex B

British Psychological Society

This response has been prepared by the Research Board and the Psychology Education Board of the British Psychological Society. The British Psychological Society is the professional body and Learned Society for psychologists in the UK. It represents nearly 40,000 members working in all branches of psychology research and practice. A briefing note on the role and remit of the Society is attached for your reference.

As a general point, while accepting there are serious problems in some disciplines, based on the current figures from UCAS, it would be misleading to talk of a flight from science in Universities. The figures show that between 1996 and 2003, the numbers of students admitted to science degree courses, as defined by the JACS codes, increased by 13.7%. Whilst there is a drop in the numbers for physical sciences, this is more than made up for by the increase in biological and computer sciences. We think that science, as well as other "shortage" subjects, face problems that reflect perverse outcomes of the separation of funding for teaching and research, and the resultant lack of integration of educational provision. There are incentives for departments to compete rather than cooperate in recruiting students, and there are incentives to pursue research as an alternative to teaching. These incentives may be amenable to structural interventions at the level of HEFCE and individual institutions. Beyond these factors there are societal changes (both in attitudes and in employment opportunities) that are likely to impinge on students' decisions about which subjects to pursue. In general, a sensible strategy is likely to respond to the flow of these changes rather than attempt to resist them.

1. *The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments*

We believe that UK research continues to suffer from insufficient long-term, and insufficiently broadly based support.

We do not object, in principle, to the policy of assessing the quality of research. However, the funding formula applied following the RAE has resulted in very intensive recruitment and the movement between institutions of research leaders and research role models. This must significantly deplete the research capacity of the many smaller and less powerful departments. By fostering this movement of highly experienced and active researchers into a smaller number of departments and institutions, the funding formula separates teaching and research so that the latter can take place in fewer locations. It also results in discriminatory funding such that excellent researchers in departments with lower ratings receive less financial support for their research than researchers of equal stature in departments with higher ratings. In practice, those lower status departments have much higher teaching loads and student numbers, making it less and less possible to conduct high quality research. Since there is quite a lot of movement of staff immediately before and between RAEs (eg hiring of new staff to match changing student numbers), this means that the funding mechanism privileges some individuals on bases that are largely independent of the quality of their own research. It seems likely that less mobile individuals (such as people with dependent relatives) and people whose research is not mainstream are disadvantaged by this system.

Even if it were possible to justify the refusal to fund "national" level research in departments rated 3 or below, the continuing increase in the funding differential between 4 and 5 rated departments seems to us unjustifiable, as the former certainly include international quality research. If the aim was to bring about improvements it could easily be argued that the most effective targeting of additional resources would be to the 4 rated departments.

The operation of the funding formula flies in the face of work that has been done in UK universities over the last 40 years to ensure that teaching is research-led. In disciplines such as psychology, development of research skills is a fundamental part of learning, and a prerequisite for professional training. Obtaining a PhD in psychology requires advanced research skills. A PhD is also a de facto requirement for becoming a lecturer in psychology in most departments. However, this seems unsustainable if large numbers of departments will no longer have the funding (or opportunity) for staff to conduct research. Ultimately, therefore, although the funding mechanism is supposed to strengthen UK research we think there is little evidence that it will improve the best research (which is already excellent), and a very strong possibility that it will damage both overall research capacity and teaching.

2. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend*

The RAE-linked funding formula will continue to produce substantial effects on the quality of HE provision in this country—the impact of which will be felt by students, academic staff and ultimately society. Removing/reducing research funding from departments rated as below 4 in the 2001 RAE will continue to propagate the following effects.

Effects on the student experience

- An impoverished research culture will remove resources that would traditionally have been available from research income but also used to enrich teaching within an institution. Within a science context this would include additional practical facilities as well as research students to help in practical classes as demonstrators and also as seminar leaders.
- Reduced exposure to, and participation in, research activity at undergraduate level. In the past such activities could facilitate intellectual development of undergraduate students enabling them to understand the provisional nature of much knowledge. It could enable them to form their own judgements from evidence and challenge the judgements of others thus training them to synthesise and apply knowledge in various contexts. In other words they could learn, in the broadest sense, to be researcher oriented—an entirely appropriate outcome in an advanced knowledge economy. A HE sector in which substantial parts fail to provide a research-enriched environment will fail to facilitate such intellectual development of its students will be failing the needs of society.
- Difficulty in the provision of practical work for undergraduate students, especially the student-driven research project (often centred on staff research interests), which we anticipate will make the subject less attractive to students. This will perpetuate the problem of recruiting for the sciences and result in a concomitant reduction in suitably qualified outgoing graduates to teach science in schools and drive the knowledge economy.
- Reduced opportunities for ethnically and socially diverse student populations (as well as mature students) who typically attend "newer", less research-intensive institutions that have been most affected by the new funding formula.
- Intensification of a 2-tier sector in which even many of the country's most highly qualified students are unable to gain entry to be science undergraduates at the most research-intensive institutions. Places for undergraduates will be reduced at these institutions as staff concentrate on research (to maintain their research-linked funding and status), and the recruitment of overseas (full fee-paying) and post-graduate teaching.

Effects on academic staff

- It is the combination of teaching in a research-informed environment, and researching in an organisation where that research can be applied in advanced teaching—that makes a university job attractive. It is the reason why a Ph.D is now the "entry ticket" to an academic post in HE and why new members of academic staff in all universities are expected to undertake training in effective teaching and research project supervision.
- Increasing difficulty in attracting good young researchers into academia as the number of positions available to them which will support their research is diminishing.
- Removal of the "academic ladder" as platform institutions from which young professions can get a foothold (in both teaching and research) before progressing onto more research intensive institutions.
- Ossification into a 2-tier system will damage (if not remove) the chances of talented lone researchers of any age from undertaking their research—even in collaboration with research-intensive institutions, as the shift in emphasis away from research and towards teaching makes too many demands on their time.
- Make it practically difficult for academic staff to fulfil the Government's requirement of knowledge transfer to private, public and voluntary sector organisations. (The Lambert Report makes clear that this is a requirement of all universities, albeit in different ways and with different emphases, and not just the preserve of a few.)

— Increased pressure (stress) on academics in research-intensive institutions as they strive to ensure excellence in research productivity within an increasingly competitive environment. Examples of such pressure include frequent (sometimes monthly) monitoring of output and repetitive short-term target setting by line managers. Not all research thrives in these conditions—some research projects are long-term in nature and rely on creativity and intellectual freedom.

Effects on psychology in particular

— The quality of HE psychology teaching in the UK is overseen by the British Psychological Society (BPS). Only BPS accredited undergraduate degrees are accepted for admittance in postgraduate psychology training. To gain accreditation courses need to provide students with extensive training in research methods and provide opportunities for each student to undertake an empirical research project—all this is vulnerable to the effects of the research funding formula, as the gradual erosion of a strong research culture may inevitably have knock-on effects for the ability of departments to make adequate provision for such empirical project work. The long term impact upon this expanding science discipline (which attracts many females into science) will be that courses will have to close or be "dumbed down" to the point where they are no longer accredited and do not teach science. This will result in a significant net reduction in the numbers of students receiving science training in higher education and therefore a significant reduction in the numbers who could teach science either at school or university level.

3. *The implications for university science teaching of changes in the weightings given to science ubjects in the teaching funding formula*

With respect to Psychology in particular, we feel that the assumptions underpinning the current fee-banding for psychology do not fully reflect factors that should determine the funding formula.

Currently, psychology degrees in over 100 Universities aim to meet the Society's criteria for accreditation for the Graduate Basis for Registration, that enable students to progress to advanced training in either research or practitioner areas. These criteria require that at least 30% of each year of a typical undergraduate degree is taken up with laboratory work, including a stand alone research project in the final year. Almost all psychological research now requires the intense use of high specification computers and other specialised equipment to run experiments and analyse data. The specialist equipment ranges from EEG and heart-rate monitoring systems to digital video studio facilities. Almost all psychological research requires human participants, which in turn requires support in terms of suitably controlled laboratory environments, support staff and relevant safety precautions. Thus, the teaching of psychology involves very significant support in terms of equipment, space, personnel and technical expertise. As a scientific discipline, psychology also relies very heavily on large numbers of specialist journals, and these also constitute a significant demand on resources. In sum, in any respect that matters, psychology is an intensive laboratory discipline.

Psychology is the fastest growing subject in science. However, many departments are stretched to intolerable levels. Those that do have substantial research income have to subsidise their teaching from research resources—the under-funding problem needs to be resolved rather than compounded.

Funding teaching on historical baselines is retrogressive and harmful to newly developing subjects. While it is always possible to teach something with any unit cost, however small, by setting the funding of psychology below what is needed for a fully effective degree programme, HEFCE is harming the education of the large number of science graduates the discipline is producing.

The re-banding of Psychology to C seems to reflect a HEFCE presumption that psychology costs less than it had previously thought. However, this reflects several misunderstandings of the situation. First, undergraduate numbers have expanded so quickly in psychology that universities have not been able to transfer the funds to keep pace (to do so would have forced unreasonably rapid closures and problems in other departments). Second, it has meant psychology departments are always underfunded as the funding formulas usually make adjustments in the year following the new increases in student intakes. Third, psychology has a very active research base, and this has undoubtedly helped to sustain teaching, not only by injection of funds but by providing doctoral and postdoctoral researchers who can contribute to teaching on a casual basis. Finally, it is sometimes mooted that the *reason* for declines in undergraduate enrolment in other science areas is the success of psychology. We doubt there is any evidence (other than correlational) for this claim. If anything, psychology has been the source of strong recruitment *into* science by people who might otherwise choose subjects in law or the humanities. Psychology requires students to become adept at statistical analysis and scientific method and experimental design, and requires knowledge of measurement in both biological and neurological and behavioural domains using a range of technologies. Thus, the discipline strongly reinforces, rather than undermines the value of science in society.

4. *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments*

There will always be some universities that rate more highly on research excellence than others. These are likely to include departments that lead the world in science innovation often utilising large scale resources. The problem arises when this is taken to the extreme and many HE institutions (or departments) are excluded from participation in any research culture at all. The cost of maintaining a research culture in less-research intensive institutions has been over exaggerated (particularly given that many of the infrastructure elements are required for teaching too) and the value of maintaining a research culture has been seriously underestimated. Only now are the true impacts to society beginning to be understood (closure of departments, shortage of well qualified science teachers and disengagement of our young people with science education).

We argue that it is not essential for every member of academic staff in every department to be an active researcher to foster a successful culture of research so beneficial to both staff and student (as outlined above). "Pockets" of research of national excellence are valuable in their own right and should be supported. Systematic withdrawal of resources for this strand is short-sighted and devalues the quality of undergraduate education for both staff and students.

5. *The importance of maintaining a regional capacity in university science teaching and research*

It may be that in some areas of research regional capacity is irrelevant. Perhaps only one or two centres in the UK could study stem cells. In many other subjects research expertise and skills are very important within a local or regional context. This is likely to be true of electronic engineering or microbiology but it is especially true in psychology. Regional and local NHS can much more easily attract good clinical psychologists if they perceive opportunities for research locally, particularly in the form of a research orientated university department. Similarly, local authorities that need to conduct research on behaviour benefit from the local presence of psychologists with research skills.

We also reiterate the point that concentration of research funding will mean that smaller departments (eg those at regional universities) may become less able to recruit excellent research staff. In turn, this means that students in those regions, many of whom have to attend their local university for financial reasons alone, will be denied access to a vibrant research-led teaching environment. We do not believe this outcome is educationally desirable and doubt very much that it will be beneficial for science as a whole. If "real" science becomes the preserve of a limited number of institutions and departments, large numbers of students at other places will feel that the value of the science they study is low, and that the pursuit of science is beyond their capacities. Research into "stereotype threat" shows all too clearly how situations structured in this way can lead to self-fulfilling prophecies. The consequence is masses of unrealised potential, and perhaps unrealised potential of the masses.

6. *The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose*

In much of psychology good work is recognised through standard systems of peer review (eg in journal publications and research grant funding). The infrastructure and facilities required for teaching, particularly to achieve the Graduate Basis for Registration with the BPS, should be comparable across institutions. The GBR criteria were originally developed in a context where teaching and research were symbiotic, and thus recognised the value of both activities for the other. The current funding arrangements attempt to disaggregate the teaching and research functions to a degree that is counter-productive in terms of teaching key-skills. This needs to be recognised and addressed in future.

All professional postgraduate training courses in psychology in the UK have the Graduate Basis for Registration as a compulsory entrance requirement. GBR is typically obtained through the completion of an undergraduate degree in psychology that has been accredited by the British Psychological Society. The requirements for such accreditation are very stringent, as outlined previously. The provision of accredited training courses at undergraduate level are of particular importance due to the current shortages in professional areas such as clinical, educational and forensic psychology.

For example, currently there is a shortage of clinical and applied psychologists to work within the National Health Service (BPS, 2004; DH/HO/BPS, 2005). As clinical guidelines (ie NICE: National Centre for Clinical Effectiveness) recommend the effectiveness of psychological therapies for a wide range of conditions, and service users request greater access to psychological therapies, it is unlikely that even current estimates of 15% more psychologists will meet demand. Moreover, as with other areas of clinical academic practice, it is difficult to recruit and retain clinical psychologists onto the post-graduate training courses which are based in HEIs. The pressure particularly on clinical psychology research have been documented by Thomas, Turpin & Meyer (2002), who argued for greater support of clinical psychology research in the HEI sector.

Moreover, there are well in excess of 800 psychological staff in the prison and probation services. This figure includes psychological assistants, but the overwhelming majority of the latter have psychology degrees and progress to the psychologist grades.

The re-banding of psychology by HEFCE also reflects a decision to shift resources designated to area of science to another. But this is partly a process of robbing Peter to pay Paul. Financially undermining a very strong science discipline seems to us unlikely to be a sensible basis for strengthening science as a whole. As we mentioned earlier, universities often use psychology as a means of attracting students into other science subjects (eg through joint degrees and options courses in psychology).

University education is already more attractive to female than male students, and within science, Psychology recruits female students very strongly. Therefore it represents a portal through which talented young women enter science. We believe the wrong message is sent by downgrading the funding status of our discipline. This reinforces the message that "real" (ie expensive) science is not for women. We believe that a constructive strategy for building in areas of strategic importance is to respond to the motivations and interests of the potential students in those areas. For example, a shortage of chemists could be addressed by offering both financial (eg fees waivers) and intellectual incentives (eg joint degrees with other subjects that talented students may be interested in) for students to pursue degrees in chemistry, The advantages of such a strategy include both increased recruitment in the university sector but also increased numbers of people who could subsequently teach science well at school level, which would then feed back into the university system.

Annex C

The British Psychological Society

1.1 The British Psychological is the learned and professional body, incorporated by Royal Charter, for psychologists in the United Kingdom. The Society, which has a total membership of over 40,000, is a registered charity. It celebrated its centenary in 2001.

1.2 The key Charter object of the Society is "to promote the advancement and diffusion of the knowledge of psychology pure and applied and especially to promote the efficiency and usefulness of members by setting up a high standard of professional education and knowledge".

1.3 The Society is authorised under its Royal Charter to maintain the Register of Chartered Psychologists. It has a Code of Conduct and investigatory and disciplinary systems in place to consider complaints of professional misconduct relating to its members. The Society is an examining body and grants certificates and diplomas in specialist areas of professional applied psychology. It also has in place quality assurance programmes for accrediting both undergraduate and postgraduate university degree courses.

1.4 As a learned scientific society, The British Psychological Society publishes 10 scholarly refereed journals and maintains an extensive library of scientific periodicals. Two main Society conferences are organised each year, and many of its over 30 specialised sub-groups organise sectional conferences throughout the year.

1.5 The Society has 14 Sections representing the main scientific fields of study and it has nine Divisions representing the different areas of professional applied psychology in which services are provided to members of the public, namely clinical, counselling, forensic, educational, health, occupational, teaching and research, and neuropsychology.

1.6 Divisions and other sub groups advise on issues from the perspective of the particular specialist group, but only the Board of Trustees of the Society or one of its main Boards (Professional Practice, Research, Publications and Communications, Psychology Education, and Membership and Professional Qualifications) has authority to determine corporate policy and speak or respond to consultations for the whole Society.

Annex D

Association of Heads of Psychology Departments (AHPD)

We are writing to you as Chair and Secretary of the Association of Heads of Psychology Departments (AHPD) in response to your call for evidence to the Science and Technology Committee's Inquiry into strategic provision in English universities. The AHPD is a voluntary grouping membership of which is open to any Institution/Department running an undergraduate or postgraduate course recognised by the British Psychological Society. There are 110 Member institutions.

1. *The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments*

AHPD represents departments awarded widely varying ratings in the last RAE. Unsurprisingly, the membership holds a range of views on funding matters. However, there is a strong consensus across the membership that research funding has become overly weighted towards the most highly graded departments, and that this can only have deleterious effects on the practice of research and the transmission of research skills to future cohorts of students.

2. *The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend*

Although there a clear case can be made for establishing large research concentrations in certain disciplines, in many disciplines a distributed network of research nuclei can offer an at least equivalent level of creativity and efficiency. Reducing the number of research active institutions (or departments), whether by accident or design, is likely to make recruitment of new HEI staff increasingly difficult and to impact negatively on the economies of less favoured regions, particularly those in need of regeneration.

3. *The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula*

Until the recent re-banding of all Psychology provision to band C, AHPD members were split between those receiving B band and those receiving D band funding. Inevitably, the change is seen differently by these two groups. However, banding determined institutional income does not translate straightforwardly into departmental income, and the entire membership is concerned about the maintaining of teaching standards for psychology as student numbers continue their rapid growth. Teaching of practical research skills and adequate supervision of undergraduate projects are particularly vulnerable to resource shortages. That Psychology is perhaps the largest discipline teaching such skills, as well as the science attracting the highest proportion of female students, needs greater recognition by HEFCE.

4. *The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments*

We consider that teaching-only departments are certainly preferable to a loss of particular subjects in particular regions. This is especially the case given that increased tuition fees are likely to persuade ever greater numbers of less well off students to study at their local HEI. As previously noted, however, thought will have to be given to how staff of a suitable caliber can be recruited to such departments.

5. *The importance of maintaining a regional capacity in university science teaching and research*

As already remarked, maintaining regional capacity in science teaching and research is of great importance in ensuring access to science for less well off students as tuition fees increase, and also to strengthening economic and other links between Universities and their local communities. The experience in Psychology is that individuals who train as professional psychologists (eg Clinical, Educational, Occupational) do not readily re-locate to areas lacking the university-research rich environment to which they became accustomed during their training.

6. *The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose*

AHPD members hold a range of views on these highly complex issues, which concern the teaching of other disciplines in addition to the Sciences (eg Languages). If intervention were to become policy, then subject specific tuition fees would provide one mechanism of implementation. Another would be to offer some form of preferment to those students undertaking joint degrees in one popular and one less popular subject.

Professor Angus Gellatly
Dr Chris Fife-Schaw

APPENDIX 75

Memorandum from the Higher Education Policy Institute

1. The Secretary of State has asked HEFCE to investigate what should be done about subjects which are important to the nation but which are under threat because of the closure of university departments, and the Select Committee is now investigating the same issue. Are these just knee-jerk reactions to something which is no more than the normal ebb and flow of university activity? Or is there a real problem, and if so

what is its nature? The closure of a number of university departments recently has certainly been high-profile, and has attracted extensive media coverage. The departments concerned have covered a range of subjects—chemistry, Middle Eastern studies and architecture, for example. Why should these be of concern suddenly whereas universities have been opening and closing departments for many years? And why should it matter anyway if a university decides to close a department?

2. The reason why there may be good grounds for concern is that universities make decisions about such matters in light of their perceptions of their own interests; and it is therefore a legitimate question to ask whether the sum of the interests of individual universities necessarily equates to the national interest. On the other hand, even if it does not, it is equally legitimate to ask whether bureaucratic or political intervention is likely to lead to better results than universities acting in their own self-interest, even if those results are sub-optimal. Finally, by way of introduction, it is worth bearing in mind that after the 1989 Research Assessment Exercise there was not a single chemistry department that received lower than a 2 grade that was left intact. The closures and mergers that followed 1989 were generally applauded as an example of strong and decisive management.

3. In asking HEFCE for advice about this question, the Government is essentially considering supply-side interventions, and this seems to be the focus of the Select Committee's review as well. One cannot be unduly critical about this, since by and large, supply-side actions are the most tractable, and they are what Governments can most easily undertake. However, there is no reason to think that the fundamental problems being faced by the subjects in question are ones of supply, and there are some spectacular examples of supply-side action in the past which have failed to have any effect whatsoever. A good example of this was the Government's engineering and technology initiative in the early 1980s, where a great deal of additional money was provided for science and technology places in universities which subsequently stood empty, with gleaming equipment and vacant laboratory benches. The supply was increased, but there was no corresponding demand. On the other hand, teacher education is an area where it is well-known that the supply-side is not the problem, and the Government has responded by providing strong incentives aimed at increasing student demand, and with some success.

4. There has, of course, until now been one well established entirely supply-side programme. However, although the HEFCE minority subjects programme is one that is aimed solely at supply, this is very small scale, and almost by its nature is not scalable. On the other hand, it explicitly recognises that that there are some subjects that are important (the criterion for importance is academic diversity) which need explicit funding if the UK is to maintain a presence in that subject. In terms of rationale, that is relevant as we look more widely at subjects where provision is in decline, and it would be legitimate to extend the criteria to subjects where the nation needs to have a source of expertise for diplomatic or other reasons. It should be noted that in the interests of reducing the number of special funding initiatives HEFCE has decided to stop the specific funding of minority subjects after this year, and to provide the additional money to the universities concerned in their block grants.

5. More generally, to the extent that supply may be a problem, what are the drivers that may lead universities to decide to reduce the supply of places in particular subjects? The first that has been suggested is cash. The HEFCE method of funding teaching is very blunt and does not differentiate greatly between subjects in the funding that it provides. HEFCE's method—with only [four] funding bands to differentiate subjects—is only sustainable because of the fact that money goes from HEFCE to institutions as a block grant. On this view, it does not matter very much how universities receive their money because it is a zero sum game that is being played—if they received more for some subjects, they would receive less for others—and universities are free to allocate the money internally as they see fit. The problem with this, entirely rational, view is that it ignores the fact that, to some extent anyway, universities—particularly when funding is tight—feel obliged to minimise their expenditure relative to their income. Therefore, the present funding method, taken together with the autonomy that they have, may induce them to cut back on subjects that are expensive to provide and to focus more on subjects that are cheaper to provide and that bring in similar income. Universities need to be careful. The alternative is a more directive funding approach by HEFCE, which is what would be implied by a larger number of funding groups.

6. The second driver that is sometimes mentioned is selective research funding. In itself, that is unlikely to be the cause of the closure of departments—there are a large number of departments of chemistry, for example, which receive little if any research funds, yet others which do are closing. However selective funding may play a part: it means that some universities that generally aspire to be leading research players may feel that the level of research funding from HEFCE that they would command in subjects with the lowest RAE scores would be insufficient to keep those departments in the state to which they have become accustomed. In this case, closures are driven by institutional strategies to concentrate on their strengths and not to be active in areas where they are not strong.

7. So although there are supply-side drivers that may play a part, they are not dominant, and supply-side action is unlikely to be effective in resolving the issues that have led to the decline of the subjects in question. Nevertheless, even if the fundamental problem, and the answer to the problem, is not one of supply, that is not to say that there is no supply-side role for the Government. It is essential that if demand were to pick up, the infrastructure for meeting the demand should not have withered away, and should be available to meet that demand.

8. If the primary driver of the difficulties that in some cases have led to closure are not of supply, but of student demand, then that leads to rather different approaches than if the problem was one of supply. Certainly, there have been shifts in student demand recently, both as far as A-level uptake is concerned and undergraduate study. Table 1 shows that the number of A-level students in physics, chemistry and mathematics have fallen steadily since the mid-1990s (although in Chemistry and Mathematics numbers may have stabilized in the past year or two). This decline needs to be seen in the context of an overall 9% increase in A level entrants in the same period.

9. Because of changes in nomenclature and definition, it is more difficult to be confident about changes in the uptake of university places, and the HESA data are not shown here because they are almost certainly misleading. One would assume that A level entries will in due course be reflected in HE enrolment, but a careful study will be needed of the HESA data to establish if this has been so.

10. It is clear that student demand is dynamic, and rightly so. Students respond to market signals, and if there were evidence that employers were crying out for more students with these qualifications, they would take them at university—unless, that is, they did not have the prior requirements or intellectual ability to study them. The subjects that are mentioned as being under threat are notoriously more "difficult" than many others. Good evidence about the drivers of student choice is essential if solutions are to be prescribed. Otherwise we will find we are prescribing the wrong solutions to misdiagnosed problems.

11. One further fact that needs to be taken into account in considering the relationship between demand and supply in the subjects is the extent to which supply has been maintained through the period of student downturn. It will be seen from Table 2 below that staff numbers in chemistry, physics and modern languages have held up remarkably during a time when student numbers have almost certainly declined sharply. This suggests that universities have not simply reduced their provision in line with changes in student demand, but have held on for a while to satisfy themselves that the changes were not going to be reversed. And the fact that the age profile of staff in Chemistry and Physics appears to have been maintained, as is apparent from Table 3, seems to indicate that staff are still being recruited to these departments, despite declining student numbers. Moreover, there is an opportunity cost associated with maintaining provision at this level in the face of declining demand: other subjects have less favorable staff:student ratios than they would otherwise have in order to maintain staffing in the subjects concerned.

12. Whatever the cause of the problems, there may be a case for taking supply-side action to address the closure of departments. But if so, the purpose of such action cannot be simply in order to ensure that the status quo is maintained in all subjects. The policy aim has to be clear, and it could be, for example:

(i) That all universities should do all subjects.

(ii) That across the country as a whole there should be a sufficiency of provision in all subjects (but the notion of "sufficiency" would need to be defined).

(iii) That a level of expertise should be available to meet the nation's needs for specialist information and advice.

(iv) That all regions should have a minimum level of capability in all subjects.

(v) That the subjects on which the academic health of a university more generally depends should be maintained (though such a rationale, if it exists, is unlikely to be more felt more acutely outside than inside the university).

13. These are just examples of the sort of policy aims that might underpin action. But as the actions may be very different in response to different policy aims it is essential to be clear about what it is intended to achieve.

14. If it is decided that something should be done about the supply of places in these and other subjects, a number of issues arise that need to be addressed.

(i) Who can decide which subjects are the ones that need attention, and the extent of the attention that they require?

(ii) Who is to say where they should be studied?

(iii) How can such decisions be taken? What are the criteria that can be brought to bear in deciding the subjects and the extent of attention that they need.

(iv) Who is to say what is the right number of places is that is required? It could be argued, for example, that previously too many chemists or modern linguists were produced—who can say that that is not the case? Is there evidence that industry is crying out for more? If so, why is the market not working? Perhaps the answer is to ensure that better market information is provided. More likely, market dynamics may be working in one way for some subjects and in a different way for others.

15. In terms of what to do next, if action is to be taken, then on the supply side any action will need to have an eye to the drivers that are possibly at work—including the funding methods and research selectivity, but also institutional autonomy. It may be that a degree of institutional autonomy will need to be sacrificed in order to ensure the national interest. And until supply increases, it needs to be understood that there is an opportunity cost to be paid in maintaining supply in the face of falling demand. On the demand side, the obvious answer might be to identify measures to stimulate demand. However, there is recent evidence that

demand may not be particularly price sensitive, and if that is so, then any measures to increase demand are unlikely to be successful unless they take a long-term view. Action is probably required at school level to stimulate greater demand, and successful short-term interventions may not be available.

Table 1

	2004	*2003*	*2002*	*2001*	*2000*	*1999*	*1996*	*% change*
Physics	24,645	26,278	27,860	28,031	28,191	29,552	28,400	−13.22
Chemistry	32,151	31,065	32,324	33,871	35,290	35,831	34,677	−7.28
Mathematics	51,212	49,183	48,654	59,220	58,689	61,245	59,038	−13.25

Table 2

CHANGE IN STAFF NUMBERS—1998–99—2002–03

	1998–99	*2002–03*	*% change*
Chemistry	3,612	3,520	−3
Physics	3,407	3,700	9
Mathematics	2,850	2,840	0
French, Spanish & German modern languages	1,406	1,585	13

Table 3

STAFF AGE PROFILE IN CHEMISTRY AND PHYSICS

	1998–99		*2002–03*	
	% under 35	*% over 54*	*% under 35*	*% over 54*
Chemistry	27	25	25	21
Physics	16	30	16	27
All subjects	19	16	17	20

February 2005

APPENDIX 76

Memorandum from UK Computing Research Committee

The UK depends for its future economic success, national security and wellbeing of its citizens on the quality of S&T teaching and research in its Universities. In the 21st century ICT is an essential and indispensable part of the S&T portfolio. The UK produces ICT graduates of the highest calibre, carries out world class research and is investing in programmes such as e-Science that are the envy of other countries. However, along with other subjects ICT is seeing a decline in UK students applying to carry out undergraduate and postgraduate degrees. The UK needs a highly trained and professional ICT workforce. Our universities are the principal means to secure this workforce.

ICT is well spread across UK Universities. Almost every UK University teaches the subject and there is a strong core of Universities researching the area. ICT has traditionally been a good recruiting ground for students but recent years have seen a dramatic decline in application numbers. Last year some of the strongest ICT Departments in the UK resorted to clearing. There is every chance that ICT courses will close and a number of Universities are reviewing the status of their ICT Departments.

The Select committee invited comments on a number of particular points and we set out our responses below.

1. HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, has had a significant impact on the financial viability of university ICT Departments. In particular Departments dropping from five to four will have seen dramatic reductions in their HEFCE research income.

2. In common with S&T funding in general a relatively small cohort of Universities attract a large proportion of the research funding available. Over 50% of the EPSRC's general S&T funding is secured by 12 universities. The EPSRC is also the largest funder of UK ICT research which in this case includes electronics and photonics. Currently 10 Departments take well over 50% of all available research funds. There has been an increasing trend towards concentration in fewer larger research groups.

3. The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula has had a direct impact on computer science. HEFCE moved it from the higher B band to C band funding. This has been injurious particularly to those courses with a high laboratory based element. The single band does not discriminate between courses with a high laboratory component and those without.

4. The optimal balance between teaching and research provision in universities will vary across institutions. In a context of strong application numbers then teaching-only departments are viable. They become much more difficult to sustain at current application levels. It is always desirable where possible that teaching be informed by research. The exposure of students to the latest work in a field helps develop their own critical faculties, and to be taught by those advancing the subject can be both inspirational and lead students into research themselves.

5. In ICT we see strong local and regional effects. For example, York now has over 120 ICT companies many of whom work with or are spin-offs from the local Universities. Phenomena such as Silicon Glen (the Edinburgh and Glasgow corridor), Silicon Fen (the Cambridge area) and the M3-M4 corridors all owe their success, in part, to the strength of local universities providing both a research base and supply of trained graduates.

6. In critical S&T areas the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance. We have already seen the consequences of under recruitment in the area of Power Engineering. This recognition, albeit, late in the day, led to courses with associated bursaries that have succeeded in attracting students to provide the next generation of power engineers to develop, run and maintain our electricity grid. This sort of expertise once lost is expensive and difficult to reacquire. In ICT there are particular areas of research and teaching that are known to be problematic—examples include; security and privacy, distributed systems, and complex IT architectures. An audit of critical long term knowledge across S&T sectors would seem sensible.

The health of University courses depends crucially on the wider economic context. The economic outlook for ICT remains mixed. There is evidence within business that ICT expenditure is now rising after a period of tight budgets. Young people looking to choose a career still imagine that after the heady days of the dot com boom ICT does not offer the remuneration and security it once did. However, employers complain of skills shortages in this area. Companies are now offering retainers to students to ensure that they join them at the end of their studies. It is expected that 2005 could see much higher competition between companies vying for ICT talent.

In the absence of home applicants Universities recruit increasing numbers of overseas students to undergraduate and postgraduate courses. Increasingly our ICT Departments depend on overseas talent to carry out their research.

It is timely to review the amount and balance of our investment in S&T teaching and research at our Universities. At the same time we need to foster a more positive attitude in young people towards S&T.

UKCRC would be happy to answer follow-up questions on any of these points.

February 2005

APPENDIX 77

Memorandum from QinetiQ

INTRODUCTION

1. QinetiQ is Europe's largest integrated R&D organisation, with nearly 9,000 employees throughout Britain, over 7,000 of them scientists and engineers and including some 1,000 PhDs. Their first degrees cover a wide range of disciplines, but there is a predominance of physics, mathematics, electronic engineering and computer science graduates. QinetiQ aims to recruit around 300 graduates each year (this year: 143 between April and September), and is thus one of the foremost employers of new science and technology graduates in the UK. The subject of the Committee's inquiry is thus of great importance to us.

2. QinetiQ offers a wide range of world-class capabilities to a customer base which is expanding steadily beyond its traditional defence business, both in the UK and globally. In order to maintain this position of excellence, it needs continually to maintain and enhance its staff of top-of-class science and technology graduates.

The Importance to the Economy of Encouraging Science in British Universities

3. An assured supply of well-qualified and enthusiastic graduates is essential to the maintenance of a thriving modern economy and a sophisticated industrial base. The UK defence and security industries, with which QinetiQ is closely interlocked, enjoy a world-class reputation, and such an intake of science graduates from home universities is essential to the maintenance of that reputation.

4. For these industries to continue to compete on the world stage, they must offer challenging jobs to attract graduates and encourage sixth-formers to choose science and technology as an option when deciding their route through university. Increasingly the need to do this is recognised.

5. Although the *SET for Success review,* published in April 2002 by Sir Gareth Roberts, found an overall increase in students seeking science and technical qualifications, it also reported a downturn in the numbers following courses in physical sciences, mathematics and engineering. These trends would be worrying if continued over the medium term.

6. The Secretary of State for Trade and Industry recognised in launching the DTI's Five Year Programme *Creating Wealth from Knowledge* in November 2004 that science and technology are the key to Britain's continued industrial and economic success. It is implicit in her comments that enough graduates must be available in these fields for the science- and knowledge-based industries to achieve their potential.

7. These reports point to a single conclusion: that the future of "UK plc" is dependent on our competing successfully with rising science and technology capabilities in other countries, particularly in Asia. Unless we maintain and nurture our standards through higher education, particularly in maths, the sciences, technology and engineering, we will struggle to hold our ground in the world economy in 10 years' time.

The Importance of UK Graduates to Defence Work

8. Only high quality UK national science and engineering graduates can take the nation's defence technology industry forward to protect its defence interests in the future and maintain the UK's reputation in this field of expertise. Were the supply of UK national graduates from home universities in key scientific disciplines to dry up or their quality to deteriorate, vital research would, in time, simply not be done and Britain's ability to defend itself would be in jeopardy.

9. A particular issue for the UK knowledge base, in which the defence and security industries have a particular stake, is the propensity of many English universities to take students from overseas in preference to UK students. Oxford University is the latest to declare a reduction in places for British students and an increase on places for foreign students. While the Government has removed some barriers to overseas students remaining in the UK after completing their PhD, the overwhelming majority will at some stage in their career return home, taking the knowledge with them and strengthening the competitiveness of their overseas parent country.

10. While increasing the number of foreign students and researchers in UK universities has many desirable effects, it would be totally counterproductive if it were at the expense of UK nationals who would therefore be denied a role in important UK science base industries.

QinetiQ's Experience of Graduate Recruitment

11. QinetiQ goes to great lengths to recruit graduates with high levels of attainment, a positive attitude and the potential to achieve, and has won awards for its recruitment campaigns from the Chartered Institute of Personnel and Development, including the prestigious 2004 Grand Prix Award. Our presence at career fairs in universities is central to this, and the presentation of science and engineering to the young as a stimulating and enjoyable career to pursue is at the core of all such activity.

12. QinetiQ encourages students from an early age to take an interest in science, arranging school visits to its research centres and participating in competitions like Young Scientist of the Year. It is one of the most active companies in the Year in Industry programme, taking 37 students in the financial year to this April and winning the scheme's Best Partner award.

13. We are nevertheless finding it each year more difficult to recruit the necessary quality of staff and, unchecked, this is likely to become more and more of a problem until it becomes critical for us, the UK defence industry and British industry generally.

14. This experience confirms the conclusion of the *SET for Success* review that the "disconnect" between the strengthening demand for graduates on the one hand and the declining numbers of mathematics, engineering and physical science graduates on the other is starting to result in skills shortages. Initially this is felt at the bottom of the pyramid, but in due course it could work its way through to senior level.

THE IMPORTANCE OF UNIVERSITY RESEARCH

15. Historically the government research establishments that now make up QinetiQ were responsible for the creative process which goes from scientific invention through to application in the field.

16. The decline of the MoD's research budget (having once been on a par with the OST budget, by 2006 it will be about one-seventh) has meant that the UK is now far more dependent upon university research yielding the basic insight from which QinetiQ scientists can explore the innovations which lead to the equipments which enable armed forces to be successful in their missions.

17. This is not well understood, nor is it compatible with the increasing overseas orientation of our universities.

February 2005

APPENDIX 78

Memorandum from the Institute of Physics and Engineering in Medicine

1. THE SEVERITY OF THE PROBLEM

1.1 The Institute of Physics and Engineering in Medicine would like to emphasise the importance of science and technology, both in terms of direct benefits to the UK economy and to society in areas such as healthcare and our cultural heritage. Both the Prime Minister and the Chancellor of the Exchequer in their speeches to the Labour Party conference in Brighton, stressed the importance of improving the knowledge and skills of the workforce so that Britain can continue to compete in high-tech sectors of the global economy.

1.2 The government's 10 year framework for science[55] estimates that academic research underpins up to 5% of sales in some industries. All high-tech industries are based ultimately on the fruits of academic research, and in our field the figure must be nearer to 100%. These academic developments must be translated into industrial products, either by or in collaboration with industry, and then used to develop new clinical techniques of direct benefit to patients. Physical scientists and engineers are vital at all stages of this process, whether working in academia, industry or as clinical scientists in the NHS.

1.3 In the multidisciplinary field of medical science represented by the Institute, this problem is compounded by the well-attested erosion of academic medicine.

1.4 Despite the need to improve the scientific and technical skills base, recent years have seen a worrying decline in provision of science courses, particularly in fundamental sciences such as physics and chemistry.

1.5 There is a vicious circle in that decline in science course uptake and places not only has direct implications for the academic, industrial and NHS workforce, but also impacts on the availability and skills of the next generation of science teachers, fuelling a spiral of decline.

1.6 The problem is worse than the estimates in the 10 year framework suggest. For example the number of HEIs offering physics courses declined from 79 to 53 between 1994 and 2001[56]. About 30% of physics departments closed between 1994 and 2004. Since 1997, the number of materials science undergraduates have fallen by 40%, despite this being a subject with strong industrial demand.

1.7 Increasing participation in higher education means that more students from poorer backgrounds will enter the system. It is important, both in terms of social justice and for the national economy, that these students have the opportunity to study a full range of scientific disciplines.

1.8 The absence of specific science subjects such as Physics will lead to "science deserts". This will work against the government's regional development policies, as set out in the 10 year framework for science.

2. NATURE OF THE PROBLEM

2.1 The problem is sometimes attributed to poor student uptake, sometimes to the cost of science course provision relative to *per capita* funding, and sometimes to the effects of overselectivity in research funding. All three elements are important, and there is a complex interplay between them.

2.2 Poor uptake of science courses at university is strongly linked to poor uptake of science A-levels at school. This is a problem common to degree courses requiring specific A-levels, which for example also affects modern languages. In the case of the sciences it is compounded by the fact that science A-levels are perceived as being difficult and likely to impact on a candidate's overall A-level score.

[55] Science and Innovation Investment Framework 2004–14. HM Treasury, 2004.
[56] Physics: Building a Flourishing Future. Report of the Inquiry into Undergraduate Physics. Institute of Physics, 2001.

2.3 There is a recognised shortage of teachers qualified in physical sciences. For example, it is believed that the majority of physics teachers currently are life sciences graduates. This is likely to impact on the quality of their teaching in non-specialist areas and hence on the enthusiasm imparted to students. No central data exists to verify this, and the government has recently agreed to conduct a survey to find out exactly who is teaching physics in schools.

2.4 There is a lack of recognition of the importance of basic science subjects with candidates preferring the more fashionable areas of science. For example, forensic science courses are burgeoning, allegedly due in part to popular television series, but there are apparently up to 200 applicants for each job in the field.

2.5 Against the background of poor uptake, it is easy to see that science course closures may be driven by market forces. Such courses are expensive to run, with high fixed infrastructure costs that cannot easily be met with the income from small classes. Although universities may choose to invest strategically in expensive sciences, it is hard to see why they should chose to do so unless there is a clear benefit in sight for the university or earmarked funding is available.

2.6 These developments cannot be treated in isolation from the issue of overselectivity in research funding through the RAE. Forthcoming replacement of "make-or-break" grade boundaries with departmental quality profiles is a welcome initiative, but it remains to be seen how far these changes will address the problems of the current system. Overselectivity is extremely damaging to departments rated four in the current RAE, who have lost 42% of their funding since 2001. Faced with the combination of this underfunding and poor uptake of expensive courses, many universities feel that they have no choice but to close departments that are merely "nationally excellent".

2.7 The 10 year framework recognises the geographical disparity in research funding. This disparity is due to the effects of RAE over-selectivity, and contributes directly to the development of "science deserts".

2.8 Establishment of "teaching only" departments is sometimes proposed as a means of addressing this problem. However, in science good teaching at degree level requires a research base. The Higher Education white paper[57] cites a report[58] on the interactions between teaching and research in HE, which found that it is not necessary for academics to be involved in research in order to provide excellent teaching. Whilst this was the overall conclusion of the report, as far as science is concerned it actually came to the opposite conclusion, stating: "for students in some disciplines some of the staff at least do need to be involved with research", and "we find that this relationship is generally much closer, in the science-based subjects". As far as teaching-only institutions are concerned, the authors stated that "it might be difficult for such institutions to teach very research-intensive subjects".

2.9 Having less physicists in hospitals and education will affect other professions because they are reliant within their own professional and educational development for training provided by physicists, for example radiographers, medical staff (radiologists, oncologists etc). Also other industries that have relied on this source of expertise will in future suffer a shortfall.

3. What Should be Done About it?

3.1 The government's recognition of the problem of science course provision in the 10 year framework, with initiatives to examine the effect on access at regional level and the model for funding teaching, is welcome.

3.2 Initiatives to identify strategically important subjects and make additional funding available through HEFCE are also welcome. However, we agree with other commentators[59] that this funding is needed urgently. We caution against a lengthy investigative process, during which time further departments will be lost (as indeed they have been since this initiative was announced).

3.3 A serious policy issue is, to what extent should HEIs, essentially independent institutions, be encouraged or required to make available places match likely employment demand, as has been done by capping medical student numbers? Given the amount of public money invested in HE, it does not seem unreasonable that HEFCE should be required to steer funding in this way. However, other initiatives are needed as well.

3.4 A crucial element in increasing uptake of science courses at university, and hence the technical skill levels of the workforce, lies in strengthening science and mathematics teaching at school. The seeds of mathematical illiteracy, in particular, are sown at an early age, and attention must be given to mathematical aspects of early years education if current shortcomings are to be redressed effectively.

3.5 We support improved links between schools and universities, including the partnerships, student associates scheme and ambassadorships discussed in the framework paper.

3.6 There needs to be strengthened careers advice in schools, including careers advisers with scientific backgrounds who are familiar with the range of careers open to science graduates.

[57] The Future of Higher Education. Department for Education and Skills, 2003.

[58] Interactions between Research, Teaching and Other Academic Activities. HEFCE, 2000.

[59] Eg articles by Brian Iddon MP and Peter Main, *Science in Parliament*, Summer 2004.

3.7 The White Paper comments that 40% of mathematics graduates are needed to go into teaching in order to meet government targets. This is a tall order given the pay and status of teachers relative to other possible career choices for graduate mathematicians, who are much sought after in the financial sector. The new higher education funding regime makes it even less realistic.

3.8 Similarly, better salaries and career structures are needed to encourage good science graduates to remain in science research and university teaching. This is especially true with the advent of higher tuition fees. Salaries for graduates in research and junior academic posts are already unattractive, and will fall further in real terms when fee repayment begins. Thus they will become even less attractive relative to the higher salaries offered to much sough-after graduates in subjects such as mathematics and physics by industry and the financial sector.

3.9 A mechanism is required to ensure that the teaching role of academics is genuinely accorded equal status with research, particularly in research-intensive institutions that have traditionally emphasised the importance of research over teaching.

3.10 In our field of clinical science, the recent StLaR report[60] has recognised that "Very few individuals from the NHS move into FE/HE appointments and do not see fulltime positions in this sector as attractive for salary, career progression, job satisfaction and other reasons". Thus academic salaries are now unable to compete even with those offered by the NHS, which are not usually thought of as particularly generous.

3.11 The 10 year framework recommends that the relevant sector skills councils should consult on future training needs for science, engineering and technology. This work should include ensuring that course provision is sufficient to meet regional and national needs. We suggest that the sector skills council relevant to healthcare, Skills for Health, should also be involved in this consultation to ensure that the numbers and skills base of NHS scientists is sufficient to reverse the current decline and ensure that the tremendous opportunities opened by initiatives such as the human genome project are realised.

February 2005

APPENDIX 79

Memorandum from the Institute of Horticulture

1. The Institute of Horticulture (IoH) is the professional body representing the discipline of Horticulture in the United Kingdom and Republic of Ireland. The Institute's members pursue careers in throughout production, environmental and social horticulture. The Institute is a member of the Biosciences Federation (BSF) and an Affiliated Society to the Institute of Biology (IoB).

2. The IoH has been party to the formulation of the submissions made to this Inquiry by both BSF and IoB and supports them. The IOH, however, provides the following additional information and views specifically with regard to the lack of provision now made in the UK for the study of Horticulture as a discipline in the higher educational sector.

3. Over the past 10–15 years 75% of the UK's provision for the study of Horticulture and Horticultural Science in research lead universities has disappeared.

4. The incorporated colleges with affiliations to neighbouring universities provide a tactical response to the loss of research based higher educational provision with, for example, courses for students of micro landscape design and management, arboriculture and turf science.

5. The nation is now failing to supply sufficient applied science graduates capable of providing the strategic vision needed to ensure the continuation of a viable discipline of horticulture. This supply underpins the industry sectors exploiting the business opportunities presented by the control of plant growth and reproduction. These businesses are an essential part of national wealth creation and safeguard an assured continuation of fruit and vegetable supplies, the sustainable management of the fabric of our urban and rural public green spaces and application of plants and their products for social welfare and well-being.

6. By contrast, the Government is making substantial financial provision to support its recognition of the importance of horticultural products in their contribution to national health, welfare and well being. The "5-a-day programme" funded by the Departments of Education and Skills and Health identify the opportunities that the consumption of fruit and vegetables make to reducing cancer and coronary diseases. Through the Commission for the Built Environment (CABE)'s commitment to the importance of urban green space the Office of the Deputy Prime Minister seeks to enhance and sustain the physical and mental welfare and well-being of our population.

7. These products of horticulture cannot be made available sustainably without the necessary scientifically educated staff specialised in the discipline of Horticulture who are required for middle and upper management. Skills gaps have been identified across the discipline of Horticulture and they are now at their most critical in the national shortage of scientifically qualified strategists needed to fill middle and upper management ranks in all aspects of the discipline.

[60] StLaR HR Plan Project. Phase 1 Consultation Report. September–December 2003. Department for Education and Skills and Department of Health, 2004.

8. Measures aiming to increase this Nation's supply of science based horticultural graduates are urgently required.

9. The Institute, in line with Government policy on openness and Science and Society Select Committee recommendations, are pleased for this response to be publicly available and, with permission will place a version on www.horticulture.org.uk and in the Institute's journal *The Horticulturist*.

10. Should the House of Commons Science and Technology Committee require further information or have queries regarding this response then they should in the first instance address these to: Mrs Angela Clarke, General Secretary, The Institute of Horticulture, 14/15 Belgrave Square, London SW1 8PS; email: ioh@horticulture.org.uk .

February 2005

APPENDIX 80

Memorandum from the Association of University Research and Industrial Links (AURIL)

1. Introduction

AURIL is the UK's national Association for Knowledge Transfer professionals and others who work in or with Higher Education concerned with the generation, development, dissemination, application, commercialisation and transfer of knowledge for both UK well being and economic competitiveness.

At present, individual membership stands at a total of 1,600 and all UK Universities are represented. Most recently, steps have been taken to form the Institute of Knowledge Transfer (IKT) as the UK national overarching body for professional standards in the field and which will embrace all UK organisations concerned with knowledge transfer within and beyond the Higher Education sector.

AURIL welcomes the opportunity to present evidence to the Science and Technology Committee and has prepared its submission in accordance with the points contained in its announcement of the inquiry into Strategic Science provision in English Universities (Tuesday 21 December 2004).

2. Points

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments.

HEFCE has developed its research funding formulae over several separate Research Assessment Exercises since their inception in 1989 and have remained consistent to the principles of recognising and resourcing Research excellence in UK universities, whatever it is identified by the peer review process utilised to provide the national ratings which arose for each exercise, and on an increasingly more selective basis.

The precise nature of the Research funding formulae is not know at the time of each RAE although the principles to be used in delivering research excellence are known in advance of each exercise and have been derived from comprehensive consultation with and beyond the sector.

Given finite resources for research, the funding formulae have reflected genuine excellence as measured on an intentional scale and in accordance with the principle of selectivity. There has been a good correlation between the allocation of resources for research through RAE and those won by open competition in the form of research grants and contracts from all other research funders including the UK Research Councils.

At the same time, the Treasury's Transparency exercise has demonstrated that Research in all UK universities has not been run at a surplus over many years. Resources have simply not been adequate to cover the full costs of all research being carried out. New resources for research are being used, together, with new methodologies to ensure full economic costing, such that universities can retrieve this situation.

There is no evidence, in AURIL's view, to show that the particular operation of the research funding formulae has disadvantaged University science departments *per se*.

The financial viability of all science departments results from the trading performance of those departments from all activities and all income streams—teaching and learning, research and other trading services (eg commercialisation etc). Whilst it is true that universities allocate resources internally in a variety of different ways, many simply reflect the ways that those resources flow into the University.

Some universities would argue that the sharpness of the funding divide between those rated 4 and those rated 5 as reflected in the funding formulae, has been a particular challenge. No funding is allocated via QR for departments rated below 4. In particular, the problem of "islands of excellence" within larger, less well-rated departments, presents a difficulty of sustainability but, as long as both the funding formulae for research and the RAE itself are based upon subject groupings, pockets of excellence must be a matter for individual universities to address.

The desirability of increasing the concentration of research in a small number of university departments and the consequences of such a trend.

The increasing use of the principle of selectivity in the allocation of resources for research together with that of separating and accounting separately for funds allocated for teaching and learning and for research will inevitably concentrate sustainable research in fewer and fewer departments. Principles of the full economic costing will also continue to bear down on research which is not sustainable in the longer term. Assuming that it remains desirable only to fund research of the highest quality as measured by national and international excellence, this trend will continue. It should be remembered that there is no place for funding second rate research nor should there be as earlier command economy experiences demonstrate.

The implications for University science teaching of changes in the weightings given to science subjects in the teaching funds formula

Presumably, unless additional resources were involved, any such changes would be to the detriment of other non-science based subjects. Any movement towards privileging science subjects in the teaching formulae should be carefully considered beforehand.

Student numbers are clearly an issue in this discussion. Fewer science students with appropriate qualifications means less resources, a diminution of quality and a steady decline. Taken together with falling research funding the continuing financial viability of a given department comes into question. Some science subjects might simply become uneconomic to teach for some universities who cannot afford to continue with the high level of investment necessary to sustain them.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments.

As autonomous institutions regarded as being businesses in the private sector, this must really be a matter for individual universities to decide on the basis of their individual missions, academic strategies and business projections. It cannot be a case of single solution applicable to all universities. As far as knowledge transfer is concerned commercialisation can occur from knowledge used in teaching and learning research or from both. The entrepreneurial culture can pervade both. A teacher or a researcher is regarded more widely as a core academic value. The adoption of full economic costing approaches will mean that financial viability must be considered for all activities, dependant or independent teaching and learning and research whatever the pedagogic relationship espoused by some for a link between the two. It is strongly argued by some that as science is based upon experimentation and observation there is a firm benefit where science teaching takes place in a research environment and students gain experience of research culture alongside their syllabus. It is further suggested that, rightly or wrongly, student choice of course and University is based, in part, on an understanding of research reputation.

It should be remembered that science discipline teaching can take place across the University irrespective of its configuration into faculties, schools or departments at any given time.

Thus, even where closure takes place, this does not necessarily imply loss of capacity because on-going research can be embedded in other departments and courses can continue to be taught across other remaining departments.

The importance of maintaining a regional capacity in University science teaching and research.

It is not clear that regional economic strategic need can only be addressed, as far as access to science is concerned, if capacity exists in local universities. The relationship between university research and regional economic activity has long been synenogous in England at least, but, over time, it has been a dynamic relationship with economic activities and needs changing as some areas decline and others rise. It is important that regions retain science skills in the workforce and foster technology-based economic development but this can be done by accessing the relevant University wherever it exists in the UK or Europe. This has long been the case.

Any attempt to maintain artificial regional science capacity could lead to a loss of excellence. If regional development agencies seek to underpin regional science capacity resources that should only be allocated on the basis of perceived excellence in research and teaching as measured by national parameters and performance metrics.

The extent to which the government should intervene to ensure continuing provision of subjects of strategic national or regional importance and the mechanisms it should use for this purpose.

Government should intervene only by:

— continuing to enhance the amount of resources available overall for allocation for research and teaching through HEFCE

— continuing to stimulate market demand among businesses and employers in the UK to acquire science-based research and science graduates as the route to their own global competitiveness.

— Continuing to stimulate at primary and secondary levels to take up science-based subjects in order to maintain a flow of able and excellent students and researchers for the next and subsequent generations.

— Continuing to stimulate the science base to transfer knowledge as effectively as possible in the post-Lambert environment.

February 2005

APPENDIX 81

Memorandum from the Association of University Teachers

1. INTRODUCTION—THE NEED FOR STRATEGIC INTERVENTION

On behalf of over 48,000 academic and related staff, the Association of University Teachers (AUT) welcomes the select committee's inquiry into strategic science provision in English universities.

A strategic approach to the issues raised in the inquiry is exactly what is needed in higher education at the moment. We are firm advocates of the autonomy of higher education institutions—believing this to be a fundamental bulwark against political interference in what is taught and researched in this country—but we nevertheless believe that it is entirely right and proper for strategic intervention by the funding councils to ensure the health of the HE sector over the medium and long-term. In short, what may be right for individual universities working to short-term funding streams may not be the best approach for the long-term health of the sector and of the country.

It is clear to us that the nature of this intervention could take two forms:

(1) financial support for struggling departments and courses. This could be provided via HEFCE or possible through the RDAs;

(2) a fundamental review of the structure and funding of the sector—and in particular the future of research funding—which would address the underlying causes of the current problems, namely, the RAE, the funding attached to RAE ratings and the immediate impact of fluctuations in student demand.

We look forward to engaging with HEFCE's advice on supporting struggling courses in areas of "national strategic importance" (as outlined in the Secretary of State's letter). However, while providing additional funding for struggling departments may well succeed in the short-term, it will do very little to address the long-term drivers towards closure.

It is the long-term drivers of the current shift towards greater research concentration, departmental closures and permanent loss of expertise and knowledge that need addressing. The AUT believes these drivers to include:

— the centrality of the RAE to university decision-making at the expense of teaching and other activities;

— decline in student demand in recent years for certain subjects leading to consequent funding hits;

— the ever-greater concentration of research funding in the 5s and 5*s;

— the reduction in research funding for the 4s and the removal of any QR funding for the 3as;

— short-term funding streams leading to short-term decision-making;

— increasing inter-departmental competition leading to a decline in cross-subsidy between departments;

— failure to address the impending huge loss of staff to retirement.

This submission focuses on these factors and especially the effect of the RAE and the current teaching funding formula on university science provision. It also addresses the importance of the relationship between teaching and research and examines the Government's response to the current crisis in university science.

Throughout this debate, it is important to remember that the problem is not confined simply to science and engineering but affects a range of different subjects including the arts and humanities (especially modern languages).

2. Departmental Closures in Science and Engineering

Recent closures in science and engineering subjects, particularly chemistry and physics, have been mainly in pre-1992 higher education institutions—Kings College, Queen Mary, Dundee, Swansea, Exeter, Newcastle and Keele (one of the main exceptions is Anglia Polytechnic University). However, these recent closures are part of a longer term problem affecting both pre and post-92 institutions.

In the last six years 79 science and engineering departments have closed.[61] In physics, 30% of departments have been shut down since 1992. The Royal Society of Chemistry (RSC) reports that 28 institutions have abandoned undergraduate provision in the last nine years.[62] At the moment, there are approximately 35 to 40 chemistry departments. However, the best case scenario put forward by the RSC is that 20 will survive and at worst only six (Durham, Cambridge, Imperial, UCL, Bristol and Oxford) will remain in 2014.

3. Structural causes of the decline of science

(i) *Fluctuating student demand*

There are a variety of reasons for the growing number of departmental closures. Obviously a major factor is the decline in student demand in core SET subjects such as physics and chemistry. For example, numbers of applications to study chemistry fell from 4,000 in 1997 to 2,700 in 2003 (in physics it fell from 3,526 in 1997 to 3,165 in 2003).[63] The demand problem manifests itself differently in physics and chemistry. For example, in physics, there has been a fall in the number of students studying the subject at A level whereas in chemistry, the numbers at A level have remained steady, but fewer students are going onto study the subject at undergraduate level.

A long-term education strategy is needed to address the problems of falling student demand—both at A level and undergraduate level. This is clearly an area in which a number of agencies, including the government, are actively trying to improve the attraction of the sciences to young people.

However, it is also important to consider that when viewed over the long-term there are often short-term increases or declines in demand for subjects. For example, for many years computer science was hugely popular with students leading to a rapid expansion of provision in an area which looked like it would remain popular for evermore. The latest UCAS figures show a continuing decline in demand for that subject. Indeed, both maths and chemistry have shown increases in student take-up this year of 9.4% and 1.2% respectively.

The crucial issue about this is the difficulty in closing and possible future re-opening entire departments over the course of a few years. It is hard enough to do this in a humanities subject but in the sciences, where expensive laboratories and equipment are needed, it becomes almost impossible. Once a department is closed it is likely never to be revived.

The permanent loss of such equipment, expertise and knowledge is a shockingly wasteful approach to the long-term health of the research and teaching base in this country.

(ii) *Impact of the Research Assessment Exercise*

At the same time, many of the recent closures are not the result of low student numbers. For example, applications to study chemistry at Exeter University reportedly rose by 21% last year with five students applying for each place.[64] There are clearly other factors at work. One of the most important is the impact of the Research Assessment Exercise (RAE) on the financial viability of a large number of university science departments.

The Committee's first report into the RAE suggested that the exercise is "a contributory factor" in departmental closures.[65] In fact, AUT believes that the RAE is fundamental to the current crisis.

In our examination of job cuts in higher education (appendix 1), we found that the large number of redundancies in 2002 followed the results of the 2001 RAE. While cuts in 2003 were relatively low, the number of cuts in 2004 has risen, as institutions position themselves for the next exercise. Our evidence suggests that "a large proportion of the academic job cuts are related to the RAE, given that 50% of the cuts have been in the 94 Group and the 'non-aligned' pre-92 sector."[66]

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[61] MacLeod, D (2004),"This could be the last time", *Guardian online*, 9 November 2004, http://education.guardian.co.uk/egweekly/story/0,5500,1346153,00.html

[62] Fazackerly, A (2004) *Times Higher Education Supplement*, "Desperate for a spark to ignite student interest", December 2004, pp 6–7.

[63] Fazackerly, "Desperate for a spark to ignite student interest".

[64] Halpin, T (2004), "Chemistry suffers new setback", *Times online*, 23 November 2004, http://www.timesonline.co.uk/article/0,,3561-1371312,00.html

[65] House of Commons Science and Technology Committee (2002), *The Research Assessment Exercise*, Second Report of Session 2001–02, p 21.

[66] Association of University Teachers, (2004) *Job cuts summary 2002–2004*, December 2004.

As predicted by the committee, the revised mechanisms for the 2008 exercise have not prevented "the RAE from continuing to compromise the provision of science and engineering in the UK."[67] During the last year there has been an increase in the number of chemistry departments that have closed; a trend that has been recognised by the Government ("I think this particular problem arises because of the pressures which are coming from RAE, essentially") but also appears to have taken them by surprise.[68] Increased selectivity in the allocation of research funding, through the RAE, is forcing institutions to cut staff and departments, even though they may well be judged as doing research of national—and even international—excellence.

Not only is this a cause for concern over the loss of our research capability, it has a significant impact on the provision of science teaching in our universities. The job cuts we have seen recently have indeed often been offset by the recruitment of new staff. As such, on a national or indeed regional level, there may not appear to be a huge problem. However what this does mean is an ever-increasing move away from staff who may focus on teaching and towards those for whom research is their strength. Once again this underlines the shift in emphasis towards research, often at the expense of the student experience.

(iii) *Concentration of research*

The Government's decision to cut funding from departments rated 4 and below is a key factor in recent departmental closures. We have long argued that the current policy of concentrating research funding on 5 and 5* rated departments will fail to sustain "world-class research" because it risks killing off the sources of academic creativity in departments rated 4 and below. This view has been backed up by research from Evidence UK:

> "Although grade 4 research is less excellent than the peak, it has significantly more impact than research at UK and world average level. Grade 4 units are a 'platform' level of quality research that can develop into world class 5 and 5* research. Attrition of this lower platform through lower core funding and flexibility would have significant medium term effects".[69]

Increased selectivity is putting much valuable research at risk, and undermining the government's policies of enhancing regional research collaboration between universities, and of developing links between universities and the businesses in their regions.

While the recent announcement by HEFCE to maintain funding in real terms for departments rated 4 in 2005–06 is to be partially welcomed, we fear that this will do little to alleviate the problem. Indeed, the upcoming funding allocations from HEFCE to institutions for 2005–06 sees a 4% increase in funding for the 5s and 5*s—the funding gap between them and the 4s is growing ever-wider reducing the long-term viability and attraction of 4-rated departments.

The earlier cutbacks in research funding, problems with student demand and the difficult settlement for teaching in higher education will continue to cause financial problems for university science departments.

(iv) *Subject weightings*

One of the reasons for this relates to the funding for teaching in higher education. There is strong evidence to suggest that existing subject weightings are insufficient to meet costs of science subjects such as chemistry and physics. It is clear that the current formula used by HEFCE to calculate funding for teaching does not adequately take into account the actual cost of teaching SET subjects, leaving departments subsidising their teaching from research funds. As a result a large number of science and engineering departments are in deficit. For example, Oxford University's chemistry department—one of the most prestigious in the OECD—is dipping into its reserves to cover a £1 million annual deficit.[70]

Last year, HEFCE to some extent acknowledged the problems faced by physics and chemistry departments by proposing to split laboratory subjects into two price bands, with chemistry and physics assigned to a higher one.[71] However, the proposals would have cut funding from other laboratory subjects such as the biological sciences and amounted to a redistribution of funding within the science budget. Save British Science, for example, calculated that the core sciences and engineering would have lost £22 million

[67] Science and Technology Committee Second Report (2005), *Annual report 2004*, p 16.

[68] These are the comments of Lord Sainsbury of Turville in his response to this committee "I think it is true that, up till the last year or so, we have not seen this position where vice chancellors are taking quite such a tough view about which departments they focus on, with the impact that we have seen on the closure of chemistry departments." Minutes of evidence taken before the Science and Technology Committee, 1 December 2004, http://www.publications.parliament.uk/pa/cm200405/cmselect/cmsctech/uc8-i/uc802.htm

[69] Evidence UK (2002), *Maintaining research excellence and volume*, A report by Evidence UK to the Higher Education Funding Councils for England, Scotland and Wales and to Universities UK, July 2002.

[70] MacLeod, D (2004), "Cash crisis at Oxford's chemistry department", *Guardian online*, 29 November, http://education.guardian.co.uk/universitiesincrisis/story/0,12028,1362061,00.html

[71] Higher Education Funding Council for England (2004), *Funding method from teaching 2004–05: Outcomes of consultation* http://www.hefce.ac.uk/pubs/hefce/2004/04–24/04–24.doc

from the HEFCE proposals.[72] As a result, the proposals were abandoned by the funding council. In future reviews, the AUT believes that the additional costs of teaching all laboratory sciences should be reflected in a revised funding formula developed by HEFCE.

4. The Link Between Teaching and Research

The AUT's view is that research and teaching are closely interlinked and that teaching-only science departments are undesirable. The research-teaching link may be particularly important in science and engineering. Research shows that the direct relationship between teaching and research is "generally much closer in the science-based subjects" and "it is probably necessary for this relationship to work in order for students to have a sufficiently developed interest and ability to be able to benefit".[73]

The importance of the research-teaching link was recently reaffirmed by the Higher Education Research Forum (HERF). Chaired by Sir Graeme Davies, the forum was asked by ministers to develop advice on the relationship between research and teaching in higher education institutions. In their view, the evidence:

> "[This] suggests that in each academic department (or within each course team), there needs to be appropriate resources, a reasonable research culture, and sufficient research activity (broadly defined) to enable such programmes of study to be designed, led and taught effectively. It does not imply that every academic member of staff in every department in every institution of higher education will have to be entered for the RAE or should be pursuing Research Council grants.[74]

The advice to ministers proposed a new funding model that could provide funds to support 'research-informed teaching' in institutions with low levels of RAE funding. The proposed funding was for approximately £25 million. The DfES accepted the HERF advice but the department appears to have adopted a minimalist agenda. Rather than recurrent funding, the £25 million will be a single allocation spread over three years (with only £2.5 million allocated in the first year).[75] It is difficult to see how a single, temporary allocation will enable staff and students the opportunities to benefit from 'research-informed teaching'".

(i) *viability of teaching-only science departments*

Aside from the ongoing debate about the link between teaching and research there is another key issue here. If it is proving financially unviable to maintain a science department when it has received only a 4 in the RAE, what chance is there when it receives no research income? In the current financial regime it would appear to be absurd to even contemplate opening a fully-equipped, up-to-date modern science department without any research income stream.

5. Regional Capacity

The AUT believes it is vitally important to maintain genuine regional capacity in university science teaching and research. In a detailed report published in the summer of 2003, we identified the risk to research in higher education as a result of an increasing concentration of funding.

The report found that in some English regions, less than half the assessed research has secure future funding. For example, more than half of the assessed research in the East Midlands is under threat because of 2001 RAE assessments, even though only one-quarter of departments were rated 1–3a.[76] At the moment, the market approach is failing to deliver adequate regional provision, for example, there are no 5 or 5* chemistry departments in Wales and in the eastern region of England, Cambridge is the only institution to provide physics. With an increasing number of students attending local institutions, this development has negative implications for the government's widening participation agenda.

One of the potential ways forward is the development of research collaboration. In Scotland, we have recently seen the announcement of two research pooling initiatives.

In physics, the Scottish Universities Physics Alliance (SUPA) involves six universities—Edinburgh, Glasgow, Heriot Watt, Paisley, St Andrews and Strathclyde. These departments will be expected to collaborate to ensure coherent research programmes in astronomy and space physics, condensed matter and materials physics, nuclear and plasma physics, particle physics and photonics.

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[72] Save British Science (2003) *Paying the proper price for the job—SBS response to the consultation on developing the funding method for teaching from 2004–05*, SBS 03/20.

[73] JM Consulting and associates (2000) *Interactions between research, teaching, and other academic activities*. Final report to the Higher Education Funding Council for England as part of the Fundamental Review of Research Policy and Funding, July 2000, p 23.

[74] Higher Education Research Forum (2004) *The relationship between Research and Teaching in institutions of Higher Education*.

[75] Department for Education and Skills (2004) *Higher education funding 2005–06 to 2007–08*, Grant letter to HEFCE, 13 December 2004.

[76] Association of University Teachers (2003) *The risk to research in higher education in England*, http://www.aut.org.uk/media/pdf/risktoresearch—all.pdf

ScotCHEM—the chemistry pooling plan—brings together under one umbrella two new groupings. WestCHEM comprises Glasgow and Strathclyde universities and EastCHEM brings together Edinburgh and St Andrews. Both schemes have been supported by funding from the Scottish Higher Education Funding Council and the Office for Science and Technology.[77]

A version of the collaboration model may provide a way forward for English institutions within each region. However what is clear is that there is very little sign of any strategic thinking around regional provision. Where there is, it tends to be related to research activity as described above. Knowledge transfer, business links and, crucially, teaching do not feature in this regard.

If the sector and government is truly committed to widening participation and ensuring all have access to higher education then it has to provide a solution to the following problem: as students increasingly study from home—a trend which will inevitably increase once top-up fees are being paid—how are we to ensure all students have access to all subject areas? Mature students, those from low-income backgrounds and students with families are all less likely to study away from home. They are the very ones that we are all committed to encouraging into HE and yet they will increasingly be disenfranchised from HE through a lack of choice.

6. The Next Generation of Scientists—Solving the Retirement Time Bomb

Another key issue that affects the strategic provision of science is how the higher education sector will recruit the next generation of academic and academic related staff. In particular, we would like to flag up the issue of the "demographic time bomb" in university science departments.

The UK academic profession is generally getting older, with 23% aged 50-plus in 1995–06, rising to 28%in 2002–03. The ageing trend is seen particularly in the largest group of academics, who are engaged in both teaching and research. More than one-third of them are aged 50 and over.[78] At the other end of the age spectrum, the proportion of younger teaching-and-research academics is falling. In 1995–96, 19% of teaching-and-research academics were aged to 34. By 2002–03, the proportion of teaching-and-research academics aged to 34 had fallen to 14%.[79]

The changing age profile affects some subject areas more than others—and what is clear is that the "retirement bulge" is a key problem in science and engineering. For example, 46.1% of academic staff in civil engineering and 45.6% of academic staff in mathematics are aged 50 or over.[80]

A range of reports in recent years have pointed to recruitment and retention problems in UK higher education among academic, academic related and other university staff. For example, the Roberts review into science careers identified "a shortage of quality applicants for many academic jobs; an ageing demographic profile of academic staff in SET—with many older staff in physical sciences and mathematics in particular; and low academic salary levels, operating to inhibit the recruitment and retention of scientists and engineers, particularly in areas with high housing and living costs" (5.32). Another major deterrent is, of course, the high level of casualisation in higher education research and teaching posts.

As part of the Roberts review, the report modelled the demand for academic staff in SET to maintain staff in 2010 at 1998 levels. It found that 13% more physics staff, 22% more engineering staff, and 33% more mathematical staff would be needed by 2010 to maintain staff numbers at 1998 levels (5.41-42). The report continued: "If student demand in these areas increases as a result of the actions recommended in this report, and the Government's work on achieving its 50% target for participation in higher education, this need will be greater still" (5.43).[81]

Without new recruits into the profession, it will not be possible for universities to deliver the kind of student increases envisaged by the government's 50% participation target. It should be borne in mind that for the kind of students the government would like to attract into higher education—ie those who come from lower socio-economic groups and without a family background of proceeding to higher education—proportionately more teaching staff will be required because such students will need greater support from academic and academic related staff if they are to succeed in their courses. As a result, new ways of attracting staff into academic careers, particularly in science and engineering should form part of any strategic review of subject provision in English higher education.

[77] Scottish Higher Education Funding Council (2004), "Green light for research pooling", Media release 29 November 2004.

[78] Members of the Universities' Superannuation Scheme and the Teachers' Pension Scheme, which are the main pension schemes for UK academic staff, may retire from the age of 50.

[79] For further information see the AUT report, The Unequal Academy, at http://www.aut.org.uk/media/pdf/aut–unequalacademy.pdf

[80] For the full breakdown of different "cost centres", see Unequal Academy, p 24.

[81] HM Treasury (2002) *SET for Success: The supply of people with science, technology, engineering and, mathematical skills.* The report of Sir Gareth Roberts' Review, April 2002. http://www.hm-treasury.gov.uk/Documents/Enterprise–and–Productivity/Research–and–Enterprise/ent–res–roberts.cfm

7. *Government Intervention—the Need for a Fundamental Review*

We see there being two possible routes that the Government and the funding council could take: direct intervention to tackle the symptoms or a root and branch review of the underlying causes of the current crisis in science.

The Government's recent announcement to seek advice from HEFCE on how to protect university courses of "national strategic importance", including "science, technology, engineering and mathematics", is a welcome change of policy and a recognition of what AUT and others have been saying for a long time. It is important that HEFCE are being asked to examine a range of different subject areas (although we believe that it should be widened to include other subjects such as modern languages).

However, the AUT believes that the proposal doesn't go far enough. The review will not be tackling the root causes of most of the problems we are facing now, including the impact of the RAE and the funding mechanisms. We are also concerned that there will be no extra funding for any recommendations.

We believe a fundamental review is needed. It could start from the premise of why it is that a leading university such as Exeter feels it necessary to close a successful research department in a subject area considered strategically important and which consistently attracts a high number of undergraduate students? The AUT is not arguing for direct government intervention in the affairs of autonomous universities. Instead, we are saying that it is entirely right and proper for government to ensure that the funding and regulatory regime within which universities operate is fit for purpose. On recent evidence, this would appear not to be the case.

At the same time many of us within the sector have argued for the last few years that the decision to cut research funding to 4 rated departments was seriously flawed. The AUT has not heard a convincing argument as to why England is not prepared to adequately fund research of national excellence. Likewise, when the government is quite rightly focussing on the value of science and research to the future of this country, it is strange that the funding cannot be found to ensure 4 rated departments are economically viable. We are hardly talking vast amounts of money here, especially when compared to the overall funding available.

As such, a fundamental review could examine all these issues and ensure that the funding and strategic planning that does exist in HE is actually alleviating and not contributing to the current decline.

Without such a review, the English higher education sector and hence the future provision of science research, teaching and knowledge transfer faces an uncertain future in which market-led student demand and RAE-driven funding pressures are the major factors behind every strategic decision.

February 2005

APPENDIX 82

Memorandum from Professor Steve Smith, Vice-Chancellor, University of Exeter

Reasons for the Closure of Chemistry

There are four principal reasons which led the University's Senate and Council to vote in favour of closing Chemistry.

1. Funding for 4-rated departments has been reduced. Since the 2001 Research Assessment Exercise (RAE), research funding for Chemistry has fallen by 42% to £16K per member of staff. This compares with 5-rated Physics, which receives £46K per member of staff.

2. Financial deficit. Although Chemistry recruits students to quota it still loses £188K a year on teaching. On research, Chemistry loses £605K a year.

3. Decline in research earnings. The value of research grants awarded to Chemistry since 2001 has fallen by 36%.

4. Enabling the University to continue to compete at the highest level. In the 2001 RAE Exeter entered 37 subjects (the average for 1994 Group universities is 22). The closure of Chemistry and other changes in the academic portfolio will bring the number of subjects down to 29, enabling the University to concentrate on its strongest academic areas. This is vital given the increasing concentration of research funds in 5 and 5* rated departments mentioned in 1 above. No other closures are planned.

Although Chemistry is being closed the number of science students at Exeter remains the same with places being transferred to a new School of Biosciences. The strongest areas of Chemistry research, which are at the interface with Biology and Physics, will be retained.

The Offer to Current Students

The University fully appreciates that this is an unsettling period for the students. It is also obvious from talking to the students that there is unlikely to be a "one size fits all" solution. Three options for further study have therefore been worked out in consultation with them.

1. Remain at Exeter to finish the Chemistry course. The University will make the necessary arrangements to provide teaching, by "buying back" staff who accept voluntary severance and/or by employing other staff on teaching only contracts. The University will know by the end of February how many students wish to stay and it will then be possible to say how many teaching staff are required. Offers to stay on and teach the students have already been made to a number of Chemistry staff. Given that many university Chemistry departments in the UK do not recruit to quota there should be no particular difficulty in recruiting extra teaching capacity if necessary. Labs and equipment are NOT being closed down and will continue to be available.

2. Transfer to another University. This was developed as an option in response to a request by the students themselves. Senior management have been working closely with Bath and Bristol universities, who were selected because of their high academic standards and proximity to Exeter. Provided they pass their end of year exams at Exeter, students can transfer straight into the next year at Bath or Bristol. Other universities have also offered places. If a student transfers to another university they will receive a single payment of £2K to cover expenses. If by transferring to a university other than Bath/Bristol they have to repeat a year they will receive £3.5K.

Transfer to another degree at Exeter. The same £2K/£3.5K deal applies.

The University has investigated the deals offered by other universities who have closed departments and, to our knowledge, the £2K/£3.5K deal is the most generous ever offered.

The timing of the Announcement

The timing of the announcement was driven by two factors outside of the University's control. Firstly, Chemistry was expected to make a loss this year, but it was not until after the start of the autumn term that the chemists forecast an even greater divergence from financial targets. This was no longer sustainable. Secondly, the government's stance on national shortage subjects (ie no extra funds to support 4-rated science) did not become clear until November. A strong policy steer was obviously necessary before a decision about Chemistry's future could be taken.

The Communication Process

A communication plan was developed to tell Heads of Schools first, staff in the affected departments second, students third, and then the media. It would be done in quick succession.

The Heads of the Schools most affected by the changes met individually with the Vice-Chancellor between 5 and 9 November 2004. The news was broken to all Heads of School and the Guild of Students at a meeting of the Senior Management Group (SMG) on Thursday 18 November. SMG were asked to keep the information confidential until other groups had been told. The communication plan was thrown into complete disarray when the Royal Society of Chemistry's Press Officer called the University on the afternoon of Friday 19 November to say they were issuing a press release immediately to the regional and national media. The RSC were informed that there would be no announcement about Chemistry until the following week, but went ahead anyway. A copy of their press release is attached. Stories were carried over the weekend by West Country Television, the Western Morning News and BBC Radio Devon. Staff and students therefore found out about the closure from the media first and were quite rightly angry.

The "leak" resulted in much more media attention on Monday 22 November, which had to be dealt with and which consumed some of the time set aside for staff and students. Staff were informed as planned that afternoon. The Vice-Chancellor met with the Guild of Students on Tuesday 23 November and with Chemistry students on Wednesday 24 November. This was followed up by a letter to all Chemistry students on Thursday 25 November.

Strenuous efforts have been made to keep students up to date with developments.

1. A Student Liaison Group consisting of University staff, members of the Guild of Students and Chemistry students was established to aid dialogue. It met on 6 December, 8 December, 11 January and 1 February.

2. Students were updated on developments sent by letters on 25 November, 10 December, 11 January, 17 January and 3 February. A joint letter was also sent by the Heads of the Chemistry departments at Bath and Bristol on 24 January.

3. Coaches were organised so that students could visit the Chemistry departments of Bath and Bristol Universities on Friday 11 February.

4. Students (only about six) who were still undecided about which option to take were offered one-to-one meetings with a Deputy Vice-Chancellor on Monday 14 February.

5. Staff have been constantly available to answer questions from parents and students.

February 2005

APPENDIX 83

Memorandum from Cancer Research UK

About Cancer Research UK

1. Cancer Research UK[82] is the world's largest independent cancer research organisation with an annual research spend of over £213 million. Cancer Research UK funds research into all aspects of cancer from exploratory biology to clinical trials of novel and existing drugs as well as population-based studies and prevention research.

2. Cancer Research UK funds research through its own institutes in London, Glasgow and Manchester, and through grants to researchers in UK universities and medical schools throughout the UK. In addition, there are a number of Cancer Research UK Units and Clinical Centres in hospitals and medical schools across the UK which are supported both through grants and by direct employment of the staff by the charity.

3. As a result of this funding structure, Cancer Research UK works in partnership with individual higher education institutions, particularly those that host Cancer Research UK Units and Institutes. The most common pattern is for tenured staff at institutions to hold research grants, which then support the direct costs of the research in the laboratory. In some cases Cancer Research UK will meet the full salary costs of the principal investigator, who, in a few cases, will be an employee of the charity but based in the higher education institution. We have also made contributions to a number of infrastructure projects, including the recent part-funding of new laboratories in Manchester, Glasgow and Bradford.

Investment in Science in Universities

4. Investment in science is an essential component for economic growth. Biomedical research greatly benefits the health and prosperity of the nation. Sustainability should therefore be at the heart of any research funding policy. Government funding for research infrastructure in universities is essential for maintaining and promoting the high standard of scientific research conducted in the UK.

5. Cancer Research UK relies on a steady stream of new, high-quality laboratory and clinical researchers, many of whom are trained within the universities and medical schools in the UK. We are committed to promoting career progression for researchers and to encouraging researchers from many disciplines to focus on the problem of cancer.

6. Our main priority is to fund research, and as a result we do not have a direct obligation to support either the NHS in its provision of clinical services, or the higher education sector in its provision of undergraduate and graduate teaching. However, we take a long-term view of our research and recognise that the cancer researchers of tomorrow are the enthusiastic and motivated undergraduates in university science and medical departments today.

7. It is essential that the departments in which researchers are based continue to have the financial support needed to operate effectively and competitively. Although Cancer Research UK grants do not contribute to the indirect costs of the research, in line with the policy of most medical research charities, our researchers are involved in all aspects of the workings of science departments.

8. A strong research infrastructure is essential to train, recruit and retain the best quality staff. It is important to maintain the high level of partnership currently seen in research funding. Cancer Research UK's success relies on ensuring we commission the most talented clinical and laboratory scientists in the business to undertake research and to train the researchers of the future. Government commitment to explicitly link the money it provides for research support in universities to projects funded by charities such as Cancer Research UK has strengthened this partnership and provides additional support to allow our work to continue.

Teaching and Research Provision in Universities

9. Many of the research staff funded by Cancer Research UK are involved in teaching in their host university. In addition, Research Fellows whose salaries are paid in full by the charity are encouraged to contribute to their university's wider functions, either through teaching on their department's courses or by training PhD students in their laboratories.

[82] Registered charity no. 1089464.

10. We strongly believe that undergraduates and graduates should have the opportunity to learn directly during their education and training from the many internationally-recognised researchers that we fund. We believe that this exposure to high-quality science is an important factor that will prompt them to consider a future career in research. In addition, it is often the case that the best teaching is to be found in departments with an active research programme.

11. It is disappointing that, due to a lack of research projects available at some university sites, some undergraduates are not given the opportunity to get involved in research during their degree. We believe that all undergraduates should have the opportunity to benefit from hands on experience in research as part of their education.

Career Structures for Scientists

12. Young scientists are particularly vulnerable to the uncertainties of a scientific career. When considering the science provision in universities it is important not to overlook the problems associated with retaining the best scientists in the longer term. We therefore recommend that the Government takes a coordinated approach to developing career structures that attract new scientists into universities and the UK pharmaceutical industry and enable clinical and basic researchers to advance through their careers with some measure of security.

February 2005

APPENDIX 84

Memorandum from Dr Robert Leeming

The HEFCE's research funding formulae will have a devastating effect on emerging research groups and those who are striving to move upwards. The bulk of funding will go to those who have proved themselves in the past but that is no guarantee for the future. Unfortunately we are stuck with this as private research funding is becoming increasingly international with global economics. Inevitably this will lead to fewer research groups in fewer universities and less likelihood of novelty. Research groups usually start with one good idea then proceed from innovative research to pot-boilers. They should stand on their present merit and potential difficult to put into practise as the peer review system is not without serious flaws.

In tertiary education, the value of research is that it gives enthusiasm to the teaching process which can otherwise become depressingly stale.

Regional distribution is not of paramount importance, England is small and people are mobile. However, the juxtaposition of mathematics and physics also chemistry and biology in any single university must be put into the context of its curriculum. Molecular biology (for example) and biochemistry are not exclusively contained by what are generally understood to be biology and chemistry.

The basic sciences (chemistry, physics mathematics and biology) are of strategic importance economically and the only way they can be strengthened is by subsidising students fees and/or selective funding of universities teaching them. The cost to the country of the proliferation of "Media Studies" "Psychology" "Forensic Science" and the effect on the graduates when they find their degrees have no market value is deplorable. That money could be put to better use.

I am retired from my several University attachments but retain an honorary post as: Honorary Senior Clinical Fellow, Clinical Chemistry, Children's Hospital, Birmingham.

January 2005

APPENDIX 85

Memorandum from Dr GC Bye

I write to express my concern at the growing trend of closures of chemistry departments in universities particularly since it seems not to be as a result of shortage of student applicants (although this itself could become serious) but of the cost of providing the subject.

For the long term, the current trend raises alarm at the prospect of falling numbers of chemistry graduates available for teaching in schools. How often one reads of people who have followed a particular subject through life as a result of enthusiasm inculcated by a stimulating specialist schoolteacher!

A decline in the number of graduates with skills in the physical and chemical sciences (and engineering) will have serious consequences for the economy on all time scales. I do not believe that our economy can survive on service industries alone. Because of a linking thread of physical chemistry, my own research experience involved: materials for oil industry catalysts, ceramics, cement, the environment (one example acid mine drainage) and low level nuclear wastes and it shows how widely applied chemistry ranges.

I hope that this timely Enquiry can convey to the Minister for Further and Higher Education the importance of preserving the departments which produce graduates important to the economy. We cannot allow the relatively short term nature of market forces to lead to a continuation of the almost irreversible loss of university resources.

January 2005

APPENDIX 86

Memorandum from Richard Sear, Lecturer, Department of Physics, University of Surrey

The committee has asked for comments on a number of different points. I reproduce these points below, together with my comments.

The impact of HEFCE's research funding formulae, as applied to Research Assessment Exercise ratings, on the financial viability of university science departments;

It is obvious that under the current formula three and four rated departments are not even close to being financially viable. This is resulting in a number of them being closed.

The desirability of increasing the concentration of research in a small number of university departments, and the consequences of such a trend;

I am not aware of any hard evidence that concentrating research is having a positive or negative effect on research. However, it is clear that the trend is pulling money away from departments that between them teach a significant fraction of UK physics (and chemistry) undergraduates. It is therefore having rather unfortunate consequences for physics teaching.

The implications for university science teaching of changes in the weightings given to science subjects in the teaching funding formula;

The current fees are inadequate to pay for teaching physics degrees in the way they have been traditionally taught in the UK, ie, with substantial time in experimental and computing labs, and a relatively high staff to student ratio.

The optimal balance between teaching and research provision in universities, giving particular consideration to the desirability and financial viability of teaching-only science departments; Teaching-only physics and chemistry departments are nowhere near financially viable within the current model for the funding of UK universities. I do not know enough about the situation in biology to comment. Also, the strong connection between research and teaching has been a strength of UK universities.

The importance of maintaining a regional capacity in university science teaching and research; and

As I understand it, the government wishes to support/regenerate regions such as the north east. University science departments, amongst others, can play a role here, but to do so they need to be funded adequately. Putting large sums of government money into trying to boost high tech manufacturing in a region while allowing science and engineering departments in that region to close is sheer stupidity.

The extent to which the Government should intervene to ensure continuing provision of subjects of strategic national or regional importance; and the mechanisms it should use for this purpose.

I do not think direct intervention in individual departments is appropriate. The closure of physics and chemistry departments is simply universities responding to government policy. All the government needs to do is to change the funding model to one where grade 4 departments are not too far away from being financially viable. Incidentally, merely redistributing the money from 5 and 5* departments to 3 and 4 departments will cause severe problems for the 5 and 5* departments. For example, I believe the 5* rated Oxford chemistry department is already heavily loss making. The combined total of the HEFCE money distributed according to RAE ratings and the fee income is simply inadequate to maintain the current university physics and chemistry infrastructure. Therefore, either more money will be found or this infrastructure will continue to contract.

January 2005

APPENDIX 87

Memorandum from Professor Brian Fulton, University of York

This inquiry is, perhaps, somewhat overdue, but very welcome. The high and continuing rate of closures of science departments over the last decade has been very worrying and those of us involved in Higher Education have long believed it will lead to future problems for the UK.

I will not dwell on the reasons for the closures as this will no doubt be well documented in other submissions. Briefly, it results from two pressures from government, the push for universities to be self sustaining businesses and the push for "excellence" without regard to the consequences. These two recent factors, coupled with a long term underfunding (the unit of resource allocated for science student is manifestly too low) has brought about a situation where many universities can no longer afford to run science courses.

I would like instead to illustrate the danger of these continuing closures by drawing attention to the threat to our future provision of people trained in nuclear skills. My interest in this, and the reason for drawing it to the Committee's attention, is that I served on the cross-department government working group which looked at this recently. Our report was published by the DTI two years ago (http://www.dti.gov.uk/energy/nuclear/skills/nsg.shtml) and drew attention to the looming shortage of personnel with expertise in nuclear physics—the "nuclear skills shortage". The reasons why this is a problem for the UK are detailed in the report, and include the need for people to enter nuclear medicine (20% of us will have a nuclear medical treatment at some point), the power industry (25% of our electricity comes from this sources and defense (we still maintain a nuclear deterrent).

One important contribution to meeting the UK's nuclear skills needs is to provide a steady output from universities of students who have covered nuclear physics in their degree courses. If students have not encountered such material in the final years of their course, they are unlikely to consider the field for a career. In most universities the final year, advanced courses are provided by active researchers and so reflect the research activities in the department. However there are now only eight universities in England which have active nuclear physics research groups. Consequently the number of graduates who are likely to consider nuclear related employment is small, and a threat to our efforts to avert the impending skills shortage. This diminished number of departments is the result of years of underfunding and contraction of research in physics departments to those areas which are "in vogue" at any given time and hence likely to bring in the most research funding. Any Vice-Chancellor in the country will have no truck with arguments that continuing a research area is important for the UK's strategic interests—in the present climate he or she is solely interested in the financial viability of each department.

We are in fact about to see an immediate worsening of the nuclear skills problem as a result of another physics department closure. It appears, and the Committee may be able to verify this, that Keele University is in the process of withdrawing its Physics degree course. Keele is one of those few departments with a nuclear physics research group, so within a few months we may see a reduction to just seven universities in England with active nuclear physics research, and so giving advanced undergraduate courses in the field. This loss of another of the few places where graduates can be interested in nuclear science has not come about by any conscious act, it is simply another fallout from the financial pressures which continue to cause institutions to close physics departments. In the extreme, if such unplanned actions continue, it is possible that the UK could end up with no active nuclear physics research in universities (which would have serious consequences for UK national security) and no advanced nuclear physics being taught to undergraduates (with serious consequences for the already grave nuclear skills issue).

Although I have chosen to highlight the serous consequences of unplanned, ad-hoc closures of physics departments in terms of the nuclear skills issue, it is possible that similar problems may be developing in other specialist areas. I hope that the Committee will be able to raise the very serious problem which has been allowed to develop through the long-term underfunding of science departments. The country will continue to need a steady output of students trained in nuclear science, but without some action it is possible that universities will fail to provide this.

January 2005

APPENDIX 88

Memorandum from Professor Paul G Hare, Heriot Watt University

1. I am writing in connection with your inquiry, "Strategic science provision in English universities". Although I am an academic in a Scottish University, my views about the subject of your inquiry may still be useful to your Committee. Moreover, it seems to me that much of your inquiry is likely to be of interest and relevance to the Scottish universities, even though our funding arrangements are dealt with by the devolved administration. For despite devolution, we operate in essentially the same competitive environment as the English universities, implying that any significant changes that your Committee recommends regarding the English universities are highly likely to exert a parallel impact in Scotland.

2. It is clear that HEFCE's research funding formula based on RAE200l, taken together with the available funds for supporting university research, has resulted in even greater concentration of research funding than universities expected before 2001. I would judge that departments rated at 5, 5* (and more recently, the notional new category, 6*) will be adequately funded to undertake high quality research provided that their student numbers, and hence their HEFCE teaching grant, are sufficient to provide a high level of core funding. My strong impression is that current funding formulas would make it exceedingly hard for a strongly performing research department to manage by specializing (almost) solely in research (incl PhD student supervision).

3. Equally, a department without substantial research funding from HEFCE would be severely constrained as to the volume and quality of research that it could support. Hence departments rated at 4 in RAE200l would often, in my judgement, be struggling to finance research at an adequate level unless they benefit from additional support from within their institution, essentially transfers from other departments.

4. The likelihood, therefore, must be that high-level scientific research in English universities will become increasingly concentrated as science departments close or restructure, and I would expect this tendency to be reinforced by the outcome of RAE2008. Somewhat similar tendencies will be observed in Scotland, too.

5. Your Committee asks whether this is a good thing or a bad thing, from various points of view. My view is that the question should be considered in two parts: (a) Does the expected research concentration result in a greater overall volume and/or higher quality of UK scientific research? (b) How much high-quality scientific research does the UK need?

6. On the first question, evidence about the benefits or otherwise of research concentration is not abundant, but I would argue that such concentration is only likely to prove beneficial to the extent that the underlying "research production function"—about which, I must say, we know shockingly little in any depth—is subject to increasing returns to scale. This can be the case in subject areas needing very large pieces of equipment, for instance, though even there one can question whether it is necessary to bring the best researchers together in the same institution, or whether it might suffice to arrange regional co-operative networks enabling researchers from diverse institutions to access the necessary equipment. The other frequently cited source of increasing returns is the externalities arising from researchers working on related topics talking and interacting with each other. In other words, this is a point about "research culture" and about opportunities for colleagues to learn from each other, thereby enhancing the productivity of the whole team. For small groups this is quite a strong argument, though the point can also be addressed through personal networking, and studies of the dynamics and effectiveness of research groups rarely show much improvement once a group gets to about eight people.

7. Hence on this part of the question, I would conclude that in certain areas of scientific research involving specialised and expensive equipment needs, or where there are special benefits from large research groups, the concentration going on in UK university science can be defended on aggregate (system-wide) productivity grounds. In many areas of research, however, it seems to me that the case for research concentration is at best not proven and at worst could be positively damaging. Further study would be needed to establish in exactly which areas concentration really was beneficial for the UK.

8. The second question in para 5 asked about overall UK needs for high-level scientific research, since I consider it very difficult to take a view about research trends in English universities without standing back and setting that concern in the context of the country's needs. One way of thinking about this would be to investigate the demand for scientific manpower in the UK. This is rather a large task, and not one that I can claim to have undertaken for your Committee. However, it is not hard to find a few pointers to the current state of demand; for brevity, I merely list a few points:

— A quick look at New Scientist and other relevant publications shows that many scientific jobs, even for experienced post-docs, offer rather low wages and/or fairly short-term contracts;

— In many areas of science, there are few UK citizens undertaking PhDs, raising questions about recruitment to the next generation of academic posts in our universities;

— Your Committee will be aware that in academia itself, salaries at all levels have fallen far behind other comparable professions in the last 23 decades. I know this both from my own personal experience and by observing my own university's recruitment problems. We can usually find people to fill posts, but sometimes we have little choice but to accept people who are less well qualified than we would like. Increasingly, we fail to get good UK applicants and have to employ people from overseas; such people are ofien very good, of course, but they are unlikely to offer the same institutional commitment that we might expect from our own citizens;

— The share of industry within the UK economy, and within that the share of highly scientific branches such as chemicals, has been falling both in GDP terms, and even more so in employment terms. This trend is familiar to most young people, making it rather understandable that increasing numbers of them elect to pursue higher education in disciplines outside the traditional core sciences. One may find this trend in some ways regrettable (and I do personally), but I would doubt whether it is a matter over which government intervention can exert great influence.

9. These points, taken together, suggest that the effective demand for scientific manpower in the UK is relatively weak and is likely to remain so. This is despite years of government propaganda about the so called "knowledge economy", whatever that is supposed to mean. I conclude that the UK probably does not need as many good scientists as we are currently training, and that if provision was significantly curtailed, we might well create a happier situation—within a decade or two—in which scientists could expect to enjoy relatively higher incomes than they can now, would enjoy greater public respect and admiration, and would contribute more to the economy than they do now.

10. The latter point arises from the "selection effect" that would start to operate quite rapidly once a general perception of improving conditions for scientists took hold of the popular imagination. For then ambitious young people would indeed start to see their futures in terms of scientific careers, and the best people would increasingly be drawn into such a direction. That would surely be a welcome contrast to the present situation in which many universities actually offer lower entry standards to incoming science students in order to fill their allotted places than they do, say, to management students. Such policies are driven by the current "rules of the game", but they are surely not the way to build and maintain a high-level, internationally competitive science establishment.

11. I hope the above points make my general views on the subject of your inquiry sufficiently clear without my needing to repeat conclusions. I only wish to refer to one further point, about the question whether the Government should intervene to ensure provision in subjects of "strategic national or regional importance". The short answer, I believe, is normally "no", essentially because I consider Government to be far less well informed than universities to judge what academic programmes an individual university, or universities in a given region, can or cannot afford to maintain. In addition, it is not clear to me that the Government is particularly competent to judge what disciplines are or are not of strategic importance. Any attempt to make such judgements is likely to suffer the same fate as old-fashioned and long discredited manpower planning.

12. While I do not believe the Government should intervene directly, in the manner of central planning, there could be little objection to a bit of targeted, competitively allocated funding. Universities these days increasingly respond to incentives, and targeted programmes inviting bids from institutions can be an effective way of eliciting high quality responses. In my own area, transition economies, this approach worked pretty well during the 1990s, both at UK level (via the ESRC) and at EU level (via elements within the PHARE and TACIS programmes). In a particular area of science, for instance, HEFCE, OST or the relevant Research Councils could invite bids for 5–10 year programmes involving a mix of advanced teaching and research to stimulate new developments (eg network algorithms applied to telecommunications; nanotechnology applied to medicine; mathematical theories of coding, etc).

Finally, let me provide some personal information about myself I am Professor of Economics and Director of Research in the School of Management and Languages at Heriot-Watt University, and have taught and researched in Scottish universities since 1972. The above comments are entirely my personal views and should not be considered as representing an official view of my institution. If anything that I have said is unclear or insufficient for your purposes, I would be happy to provide additional comments to the Committee at any time.

January 2005

APPENDIX 89

Memorandum from Professor Stuart Palmer, University of Warwick

The University of Warwick is concerned about the potential effect of closures of science departments in other universities across England upon the vitality of the science community, research and opportunities for students, should this be a continuing trend.

Warwick believes that the closure of departments has arisen from a combination of factors including changes in the research and teaching formula, the deadline in popularity of science subjects reflected in falling university applications and A level study and the increasingly difficult financial position of many universities as a result of an overall decline in the unit of resource. Universities are inevitably focusing upon deficit activities to produce savings in a management environment which encourages transparency, accountability and value for money.

The University recognises the need for increasing selectivity of research funding formulae as applied to Research Assessment Exercise (RAE) weightings, noting the significant cost of infrastructure required to conduct world leading and internationally significant research in science. It may be inevitable therefore that some universities may disengage from research and focus upon scholarship or other applied activities. However, the interaction between research and teaching is fundamental to inform the currency and progress of the subject, and to the continuing supply of scientists to underpin the research base (as identified in the Roberts Review of Science in 2002). The University believes that whilst there may be a place for teaching only provision at eg Foundation degree level, there is an optimal number of research intensive departments to ensure adequate supply of high quality scientists and teachers and to foster a vibrant national research community which will attract and retain the best scientists within this country.

However, the impact of increasing selectivity has been to significantly reduce income to institutions from HEFCE where RAE grade positions have fallen. The recurrent investment required in infrastructure, equipment and staffing cannot be quickly responsive to changes in the funding formula. The change in the teaching funding methodology for 2004–05 has reduced the relative resource for the science subjects covered by the Inquiry (by −3.4%). This has exacerbated the financial income position of departments which may also be experiencing difficulties in recruitment due to national decline in applications in some subjects.

The Committee should note that the HEFCE formula is a block grant and therefore institutions can and do determine where funding flows to individual departments, and subsidise activity which is key to the University's mission and strategy. Warwick has sustained key strategic areas of activity, and has been able to do this through strategic investment of surpluses derived from other sources of private income. However it is inevitable that universities facing financial difficulties will focus upon activities requiring substantial subsidy and apply the HEFCE funding model to identify these areas.

Warwick does not believe that the Government or HEFCE should actively intervene to prevent closure of departments or dictate supply of subjects provided by individual Universities. Improvements to the overall unit of resource will facilitate the ability of institutions to subsidise activity which is key to the strategic aims of the institution and the country. The Government should ensure that the HEFCE funding methodology does not erode the unit of resource for science teaching and research further. Where institutions decide upon closure of activity in light of strategic interest, the Government may wish to consider ways of facilitating transfers of research expertise (eg through transitional funding) and the redistribution of national and regional impact of supply of student places to mitigate the effect.

January 2005

APPENDIX 90

Memorandum from Professor Chris Hawes, Director of Biology Research at Oxford Brookes University

I am writing to you in my capacity as Director of Biology Research here at Oxford Brookes, as I and many of my colleagues are getting increasingly concerned about the research funding policies being pursued by Hefce, which are threatening to further damage the UK science base. I was extremely saddened to discover the other week that Hefce now intends to phase out funding for research students in departments rated 3a in the last RAE. This is an extremely retrograde step that once again will have an adverse effect on postgraduate training across the UK and will further concentrate science research in fewer so called research active universities. This policy is an insult to the scientists and lecturers in departments such as mine that are carrying out excellent externally funded research (both Research Council and industry funded) and have a long record of training PhD students to a high level. Indeed would the Research Councils fund us if we were deemed incapable as Hefce is suggesting by its actions? There must be many departments and research groups across the UK that are threatened by Hefce's actions which will undoubtedly stifle the development of any emerging research in such units and further deprive undergraduate scientists of any interaction with the research environment.

Enclosed is a copy of a letter I have written to Hefce asking them to reconsider this policy. I believe the time has come where a stand has to be taken against Hefce's policy of starving high quality research groups of research funding just because they are not in a highly rated RAE unit. Indeed one could interpret Hefce's action as a deliberate policy to stop newer research active departments from achieving the success they deserve. Can I ask your Committee to look closely at what many scientists in the UK now perceive to be the ill informed policies of the funding council, when you scrutinise the methods of research funding distribution.

February 2005

APPENDIX 91

Memorandum from Kevin Solman

I wish to make the following points as regard the strategic science provision in English universities:

HEFCE's current research funding formulae as applied to RAE ratings, severely penalises those departments graded as 4 or below. From my own experiences, many departments working at grade 4 undertake excellent teaching and research. With the emphasis on research funding, and the huge financial incentives of achieving a grade 5 or 5*, teaching is often seen as being of less importance and as such the commitment to undergraduate students is reduced. Staff are encouraged to work increasingly on research and spend less time (and effort) on teaching.

— If the decision is taken to designate a small number of universities as research institutions, and ensure they are given most of the research funding, this would, by implication, leave the remaining universities to be perceived as second-class teaching establishments. This is reminiscent of the old system of universities and polytechnics.

— Proper funding needs to be implemented for both teaching and research to be undertaken at all universities. From my own experience, these two approaches compliment each other. The research outcomes should be directly fed into teaching in order that our universities can continue to provide the highest levels of education using the latest technology and ideas. By separating research and teaching we are in danger of presenting second-rate teaching using outdated and cheaper technology and ideas. Obviously some universities will have a greater emphasis and higher profile in research, but this should not be to the detriment of teaching.

— There should be a serious attempt to provide high quality science teaching and research at a regional level. My son is currently at Exeter University studying Chemistry, but seven weeks into his first year the vice-chancellor decided to axe the department. The manner of his decision illustrates a complete disregard for the subject and all the staff and students. There is now no university in Cornwall, Devon, Somerset or Dorset which teaches BSc Chemistry. Our nearest university is Bristol—an excellent institution, and I hope my son is successful in transferring there to complete his studies.

— The closure of many key science subjects in universities across the country sends a detrimental message to today's youngsters. With less students studying subjects such as chemistry and physics, there are fewer qualified school teachers in these areas, which leads to poorer science teaching of 11–18 year olds, resulting in lower numbers studying A-level chemistry and physics, and reduced university applications in these subjects. A vicious spiral. I am aware of cases where schools have been unable to appoint qualified physics teachers and have had to recruit teachers from other disciplines to fill the vacancy. Such teachers cannot be expected to project enthusiasm for a subject they have not studied.

— University teaching and research should be multi-disciplinary. I teach hydrology and environmental chemistry in a university geography department, and enjoy working closely with colleagues and students in many other disciplines (eg chemistry, biology, geology, engineering). Co-operation between subjects is important to all areas of science and where universities have withdrawn key disciplines I believe the ramifications will be felt in many areas of both teaching and research across the university. My students benefit from being able to use the facilities of other departments within the university and similarly I teach students from other disciplines. The loss of pure sciences such as chemistry and physics will have knock-on effects on other departments and the quality of their teaching and research.

Thank you for reading these comments and I hope the future of education in this country can be improved.

February 2005

APPENDIX 92

Correspondence between Mr Michael Lloyd, father of PhD student at the University of Exeter, and the University of Exeter

Email of 3 January 2005

Dear Vice-Chancellor,

I acknowledge receipt of your letter dated 2 December. I had hoped that subsequent events would have clarified the position with respect of the options for the students and the rationale for your decision to close Chemistry. However, I was very concerned with the distress shown by my son who just started his PhD last October when he came home this Christmas. Moreover, the email he received just before Christmas from the Deputy Vice-Chancellor was in no way reassuring and added to his distress as it contained no information whatsoever for him about his options.

I am therefore requesting the following information under the Freedom of Information Act and Environmental Information Regulations:

(1) Full details of the options for 1st year PhD students, particularly those holding EPSRC studentships as part of a EPSRC grant, to continue at a level equivalent to that they would have enjoyed at Exeter. Please note, I am not asking for any personal data;

(2) You refer in your letter of 2 December to a loss of £2 million a year for Chemistry and Biology. I wish for information of the details of accounts for Chemistry, Biology and Physics separately for the University's financial years 2000, 2001, 2002, 2003, 2004. These accounts should contain both the income and expenditure and any internal charging mechanisms, including laboratory space. Moreover, I wish for information of the details to explain the effects of the current and previous RAE and the recent research transparency review;

(3) I wish to be informed on how much it costs to teach a biology, chemistry and physics undergraduate;

(4) There will be associated costs in closing Chemistry. I wish to be informed of the costs of this;

(5) All Chemistry laboratories are subject to varying levels of contamination and clean-up. I wish to be informed of the state of contamination and the associated costs of clean-up to enable the laboratory space to be re-utilised;

(6) Your letter refers to the strategic nature of your decision. I wish to be informed as to why you consider Chemistry would not be financially viable as a top research rated department in the next RAE, assuming it would be successful in getting a five or five star rating. In contrast, I wish to be informed as to why you consider the new School of Biosciences to be viable;

(7) I wish to be informed why you do not consider Chemistry to be essential for continued success in research in the bio-sciences and medicine, as I understand that research in these areas are very much your strategy (http://www.ex.ac.uk/news/newscouncil.shtml);

In requesting all this information, I am assuming that the information is readily in electronic format and is readily available as part of the considered decision making over a period of time and will not exceed the £450 cost limit under the Freedom of Information Act. I refer to your evidence of March 2003 to the Select Committee on Education and Skills (http://www.parliament.the-stationery-office.co.uk/pa/cm200203/cmselect/cmeduski/425/3061232.htm) as well as the informed decisions of Exeter's Senate and Council.

I have copied this email to the Select Committee on Science and Technology. In making the request for information under legislation, I realise that there are up to 20 working days for you to respond to me.

This could mean that I would not have information in time to write to that Select Committee by 5pm Friday 28 January. I therefore hope that the Select Committee can themselves pursue some of the above questions.

Yours sincerely
Michael Lloyd

REPLY TO EMAIL OF 3 JANUARY 2005

31 January 2005

Dear Mr Lloyd,

Thank you for your e-mail of 3 January 2005 requesting information regarding the closure of the Chemistry department, under the Freedom of Information Act and Environmental Information Regulations. Each of the issues raised in your e-mail is answered below, please note that in some instances due to matters not yet finalised the University does not hold the information requested.

Request 1—Full details of the options for 1st year PhD students, particularly those holding EPSRC studentships as part of a EPSRC grant, to continue at a level equivalent to that they would have enjoyed at Exeter

The options available to first year Chemistry PhD students are being examined urgently by senior staff within the School of Biological and Chemical Sciences and University, in consultation with the EPSRC. In broad terms, the options open to the students are:

(a) to stay at Exeter with their current supervisor or, subject to discussion and agreement with the student, with a new supervisor; or

(b) to move to a new university in the UK with the current supervisor or, subject to discussion and agreement with the student, to a new supervisor.

The specific options available to each student will depend on the circumstances of each case, in particular the decision with regard to future employment taken by their supervisor, the availability of suitable alternative supervision at Exeter, the wishes and personal circumstances of the particular student, and the nature of the funding, if any, associated with the student and the restrictions, if any, attaching to that funding.

We will be holding a general meeting with first and second year Chemistry PhD students on 27 January to discuss the options in general terms. Thereafter we will arrange individual meetings with students to discuss their individual circumstances, concerns and preferences. Further individual meetings will be held to discuss specific options, once decisions and choices of individual members of staff become known in February and March.

Request 2i—You refer in your letter of 2 December to a loss of £2 million a year for Chemistry and Biology. I wish for information of the details of accounts for Chemistry, Biology and Physics separately for the University's financial years 2000, 2001, 2002, 2003, 2004. These accounts should contain both the income and expenditure and any internal charging mechanisms, including laboratory space

Accounting Details for Biology, Chemistry and Physics covering the University's financial years 2000, 2001, 2002, 2003 (2004–05 is provided separately due to a new Resource Allocation System.)

The data summarised in Table 1 are extracted from the University's pre–2004 resource allocation planning model. This model was not fully inclusive (as it did not allocate all indirect costs to Schools).

However, if it is assumed that indirect costs are allocated to Schools on a flat rate basis (for example as a percentage of income receipts), then an approximate estimate of University support can be made. This allocation method is generalised, but does indicate that Chemistry's contributions towards central costs fell short of a "sustainable level" by a significant margin in each of the years reviewed. The table that follows indicates the position for each of the science subjects requested.

Table 1

ANALYSIS OF INCOME AND EXPENDITURE FOR BIOLOGY, CHEMISTRY AND PHYSICS—2000–01 TO 2003–04

	2000–01	2001–02	2002–03	2003–04
	£000	£000	£000	£000
	Income/Cost ——▷			
Biology				
Income, including grant, fee and other receipts	2,608.8	2,712.0	2,698.3	2,797.3
Resources allocated for expenditure	(1,795.0)	(1,913.6)	(2,004.4)	(2,214.8)
Surplus/(Deficit) before full allocation of indirect costs	813.8	798.4	693.9	582.5
Surplus/(Deficit) assuming a flat rate allocation of indirect costs as described above	**117.4**	**52.0**	**(111.0)**	**(249.0)**
Chemistry				
Income, including grant, fee and other receipts	2,042.6	2,074.2	1,843.3	1,924.1
Resources allocated for expenditure	(1,972.7)	(1,998.8)	(1,925.5)	(1,930.8)
Surplus/(Deficit) before full allocation of indirect costs	69.9	75.4	(82.2)	(6.7)
Surplus/(Deficit) assuming a flat rate allocation of indirect costs as described above	**(475.9)**	**(496.0)**	**(632.0)**	**(577.0)**
Physics				
Income, including grant, fee and other receipts	1,946.5	2,008.3	2,234.9	2,557.3
Resources allocated for expenditure	(1,698.5)	(1,755.6)	(1,871.0)	(1,948.3)
Surplus/(Deficit) before full allocation of indirect costs	248.0	252.7	363.9	609.0
Surplus/(Deficit) assuming a flat rate allocation of indirect costs as described above	**(272.5)**	**(299.0)**	**(302.0)**	**(151.0)**

BUDGET OUTCOMES FOR 2004–05

The shortcomings in the pre-2004 method of resource allocation and the need to review the sustainability of activities (in line with the requirements of the transparency review), led to the introduction of a method of resource allocation from 2004–05 known as the "Income Distribution Model". The reasons and advantages of the revised approach are summarised below.

- The model operates across the University, comprehensively allocating income, direct and indirect costs to Schools (supporting both devolved accountability and the strategic management of University assets and finance);
- Transparently reveals the business position of each School indicating clearly whether Schools' are in surplus or deficit and the level of cross-subsidy (providing evidence of the sustainability of University activity);
- Provides clear incentives for income generation as Schools retain all income received, £ for £;
- Drives costs to Schools based on activity levels (rather than assuming these vary with total income generation). For example, premises costs are based on metered utility usage (as far as possible) and the relative costs of maintaining different categories of space—classroom/seminar, serviced space, etc. Personnel costs are allocated based on staff numbers.
- Provides mechanisms for investment through contributions to a Strategic Development Fund;
- The model is comparatively simple, stable and objective in its methodology.

Outcomes of this resource allocation method for each of the Science Schools are indicated in Table 2 (below), together with the basis on which costs are driven down to School level. The new method of resource allocation operated at School level, and therefore income and costs for Biology and Chemistry are aggregated resulting in the number of Academic staff in the School of Biological and Chemical Sciences being approximately twice that of the School of Physics. The initial assessment and forecast for the 2004–05 budget revealed an operational deficit of £1.473 million (as above), since then adverse variations have been identified, these related to under-recruitment (£205k), a shortfall in research and other income (£266k) and increased costs (£133k), creating the deficit of £2 million that you refer to in your letter.

Table 2

OUTCOMES OF THE 2004–05 INCOME DISTRIBUTION MODEL FOR BIOLOGY, CHEMISTRY AND PHYSICS (JUNE 2004 INITIAL BUDGET POSITION)

	Biology and Chemistry *£000*	*Physics* *£000*	*How the budget is calculated*
Research Income			
Funding Council Grant	912.7	969.5	Based on Funding Council methodology
Income from projects etc	951.0	652.0	100% of income generated
Sub Total:	1,863.7	1,621.5	
Teaching Income			
Fee Income	1,383.2	753.8	100% of earned income
Funding Council Grant	2,728.1	1,145.0	Based on Funding council methodology
Other (mainly relating to short courses)	13.4	(2.9)	100% of earned income
Sub Total:	4,124.7	1,895.9	
Other Income			
Endowed and Other Funds	25.8	0.0	From School Business Plan
Strategy Fund transfers and loan repayments	(51.0)	0.0	
Allocation to meet start up costs—University of Exeter in Cornwall	188.0	0.0	From School Business Plan—Central allocation to support School during initial period
Other	46.8	56.6	
Sub Total:	209.6	56.6	
Total Income:	**6,198.0**	**3,574.0**	
Direct Costs			
Salaries etc	3,906.3	2,100.3	From School Business Plan
Part-time teaching	41.5	82.0	From School Business Plan
Library	154.8	64.6	From School Business Plan
Equipment	123.0	89.6	From School Business Plan
Consumables	291.6	56.4	From School Business Plan
Travel and Vehicles	22.0	5.1	From School Business Plan
Other—Field Courses, Marketing and Student Recruitment, Scholarships	110.2	50.0	From School Business Plan
Sub Total:	4,649.4	2,448.0	
Surplus before Indirect Costs:	**1,548.6**	**1,126.0**	
Indirect Costs			
Space—charge is based on m^2 occupied	1,565.4	538.5	Includes utilities costs (representing a proxy based on metered usage); maintenance (reflecting price groups used by the Funding Council which are deemed reflect the differential costs that apply to laboratory and desk/seminar space) and other charges (at a flat rate)
Professional Services (including Finance, Personnel, Payroll, Communication and Partnership, Library, IT, Sports and Student facilities)	1,449.6	685.4	Allocated using drivers that reflect School activity—eg student/staff numbers etc
Strategic Development Fund	232.1	108.2	Contribution calculated by reference to academic and student numbers

	Biology and Chemistry *£000*	*Physics* *£000*	*How the budget is calculated*
Sub Total (Indirect costs)	3,247.1	1,332.1	
Surplus/(Deficit) on School Activities	(1,698.5)	(206.1)	
Impact of target reductions within Schools and Professional Services set by Planning and Resources Committee to limit overall planned deficits to the working parameter of £1.5 million (pending strategic action subsequently agreed)	225.2	64.9	
OperationaL SuRplus/ (Deficit) = underlying Trading Position	(1,473.3)	(141.2)	

Request 2ii—I wish for information of the details to explain the effects of the current and previous RAE and the recent research transparency review

Table 2 details the value of funds attributed to the School of Biological and Chemical Sciences based on performance in the 2001 RAE and current activity levels. The approach used replicates the methodology applied by the Higher Education Funding Council, taking account of quality ratings (Biology and Chemistry being rated 4; Physics 5). At present, no detailed guidance on the financial aspects of the RAE 2008 has been received, although the recently issued guidance for panels indicates that quality thresholds will be higher than ever.

In relation to the transparency review, the new Resource Allocation Model conforms with best practice recommendations that costing and budget models are reviewed and alignment considered. This ensures consistent information is provided to Schools and that informed decisions are taken in relation to the sustainability of activities. The transparency review should result in some additional Research Council income for Chemistry, but this will be insufficient to address the sizeable deficit currently identified.

Request 3—I wish to be informed on how much it costs to teach a biology, chemistry and physics undergraduate

It is not possible, in a research-led University, to precisely quantify the cost of teaching per undergraduate, as there is a strong interrelationship between teaching and research both academically and in resource allocation/deployment. However, the Higher Education Funding Council for England (HEFCE) classify these three subjects as Price group B, the base price for a full-time undergraduate from the EU in Price group B is £5,922.8. This is not the actual amount that the University receives per student from HEFCE, but is a notional amount that HEFCE believes represents the University's teaching activities. A similar methodology is used to distribute resources within the University's Resource Allocation System.

Request 4—There will be associated costs in closing Chemistry. I wish to be informed of the costs of this

The University does not yet know the full costs of closing the Chemistry department, since the principal costs will be those related to staff reductions. Negotiations regarding staff reductions are on-going and until these have been finalised the full costs cannot be quantified. Given the financial position of the School the reduction in costs will clearly have a payback within a year or so.

Request 5—All Chemistry laboratories are subject to varying levels of contamination and clean-up. I wish to be informed of the state of contamination and the associated costs of clean-up to enable the laboratory space to be re-utilised

Staff in Chemistry are very diligent and contamination of surfaces are no greater than would be expected for a typical university chemistry department. The facilities are considered safe to work in. There has been no major chemical spillage.

The planning of the decommissioning of Chemistry has only just got underway; nothing could be done prior to the Council ratification of the decision on 20 December. An estimate for the normal annual cost for disposal of hazardous substances from Chemistry via licensed contractors is between £5,000 and £10,000.

It is estimated that it may cost between £15,000 and £25,000 to dispose of hazardous materials no longer required.

Where possible scientific equipment and chemicals will be reused or recycled, rather than categorised as waste. It is likely that most of the laboratories will continue to be used in scientific work by the new School of Biosciences. In any adaptation or decommissioning of facilities the appropriate areas will be fully decontaminated by specialist contractors, in accordance with current health and safety legislation.

Following a meeting of the Safety Committee on Thursday 20th January, a Safety plan for the phasing out of Chemistry is being drafted.

Requests 6 and 7

I wish to be informed as to why you consider Chemistry would not be financially viable as a top research rated department in the next RAE, assuming it would be successful in getting a five or five star rating. In contrast, I wish to be informed as to why you consider the new School of Biosciences to be viable.

I wish to be informed why you do not consider Chemistry to be essential for continued success in research in the bio-sciences and medicine, as I understand that research in these areas are very much your strategy.

The financial viability of Chemistry, were it to achieve five or five star rating would not be known until after the 2008 RAE, this is the same for all subjects. In fact, as noted above the quality profile for the next RAE is different (see www.hefce.ac.uk for details).

The rationale behind focusing on the University's strength and a new School of Biosciences is set out in broad terms in the Imagining the Future paper which was agreed and supported by Council. Further detail behind the decision made by Council can be found in the draft, unconfirmed minute from Council on 20 December 2004.

This response has been prepared in accordance with a request received under the terms of the Freedom of Information Act. In the event that it is regarded as unsatisfactory, the recipient is advised to make representations in the first instance to the University's Data Protection and Freedom of Information Officer.

Dr Philip K. Harvey
Deputy Registrar and Academic Secretary
University of Exeter

APPENDIX 93

Memorandum from Nicola King, postgraduate student at the University of Exeter

In answer to the proposal to concentrate research in a smaller number of departments and the viability of having research only and teaching only departments.

Top quality students are inspired to do research because they are taught by world-class chemists and can see the potential for careers in academia. A major part of any chemistry degree is practical work especially the opportunity to carry out research as part of a final year and it is often a natural progression to carry on to a PhD and have a career in chemistry as a result of this opportunity. The current quality and quantity of research students will not be maintained if under-graduates are taught by staff who do not carry out research. I am a final year PhD student and I remained at Exeter to do my PhD because I did the research element of my final year with an very well respected chemist and an internationally known expert in his field. Working with him in my final year inspired me to carry on research and do a PhD and I am now looking for a further university based position as a post-doctoral researcher with a view to a possible career in academia. However with the current trend for closing small departments and the lack of funding available I cannot see how I can achieve this, current post-docs and junior academics looking for positions are finding it almost impossible. If research is concentrated in a small number of institutions there will not be enough jobs for young academics to gain the experience needed to establish themselves in a very competitive area. There is much criticism of the "brain-drain" to Europe and America however in many cases it is the only option as there are not enough positions for those wishing to do scientific research and many are left with little choice but to go abroad.

In conclusion, I have loved my time in Exeter, as an undergraduate I was inspired to be taught by academics who were doing cutting edge research and were not simply teachers, they had a real hands-on understanding of what they were teaching us and made it so much more real than just equations on paper. I carried on to do a PhD because I enjoyed working with an inspiring and well-respected academic who had previously taught me. I would like to think that I have a potential career in academia but am feeling very disillusioned with the way science is run and funded in this country and I cannot see that in five years time there will be a job for me here if the number of teaching and research universities continues to decline. Finally I am not alone in my opinions, many of the students I have spoken to do not see a bright future for themselves in chemistry in the current funding climate.

February 2005

APPENDIX 94

Supplementary evidence from the Higher Education Funding Council for England (HEFCE)

1. *What criteria does HEFCE use to determine whether or not it is in the national interest to sustain capacity in a subject in the absence of student demand?*

The Council has long recognised that there is some HE provision which is in the national interest but which it would not be reasonable to require institutions to make within their formula-based allocations for teaching and research. We began making a non-formula funding allocate to these minority subjects in 1991; in the current academic year we have allocated £2.8 million in their support. The initiative has been reviewed on several occasions since its inception, most recently in 2004.

We have defined minority subjects as those which are unlikely in the foreseeable future to be able to attract ratios of students to staff which can usually be sustained through formula-based funding. In practice we identify them as those subjects which both are isolated academically from other subjects and are able to enrol no more than 100 students throughout the UK.

We maintain specific provision for minority subjects only in exceptional cases and where we judge that the national interest requires this. For this purpose the national interest is defined as:

(a) The needs of diplomacy: This covers the full range of UK interests, influence and commitments overseas and requires a supply of independent expertise to be available to respond to the patterns of UK interests as they vary over time.

(b) The needs of industry and commerce: International trade and the development of overseas markets demand knowledge of local language and culture. Again, as international trading patterns change, so do the countries and regions about which knowledge is required.

(c) Maintenance of academic diversity: Minority subjects contribute to the diversity of provision by HEIs and their continuation is important to maintaining the balance and breadth of discipline expertise in the UK. Minority subjects by their nature are dependent upon a very small group of experts and would quickly become in danger of disappearing if the number of new first degree entrants were allowed to decline too far. Once gone, the reintroduction of a subject would be unlikely.

This initiative is targeted at very small and specialised provision. We recognise that some further action in support of strategic subjects could be appropriate and, following receipt in December of the Secretary of State's letter asking for advice in relation to strategic subjects, I have established a Board advisory group. This group will provide advice about criteria that might be used to determine which subjects are strategic and which vulnerable and advise on the nature of support that could appropriately be offered by the Council for such subjects. The Group will report to our Board in June, whereupon I will pass the advice of the Council to the Secretary of State.

2. *The teaching weightings assume a certain range of student numbers for each department, effectively raising the unit cost of running a small department. On what basis would you consider making greater financial provision for departments with fewer students?*

The response to question one above shows the criteria under which we have made additional funding provision available for very small teaching units.

It is not strictly true to say that the teaching weightings assume a "certain range of student numbers for each department". As described in our written evidence to the Committee, the weightings are derived from financial information returned from institutions to HESA. The model uses average expenditure by student FTE across four weighting groups, but does not take account of the number of departments represented by those numbers of students. It is perhaps also important to restate here that the majority of teaching funding is allocated as a block grant and that HEIs are free to allocate their funding across their subject portfolio as they see fit. It is their decision whether or not to maintain small (or indeed large) departments.

That said, we understand that small institutions often carry disproportionately high central and administrative costs. Through a review carried out in 1998 we recognised that small size can be important in offering distinctive provision to students and should be taken into account as a factor in contributing to additional costs. We therefore offer a specific premium to these institutions, which are defined as those having less than 1,000 full-time equivalent students. The premium is set at a level which does not perpetuate inefficiency or discourage collaboration.

3. *What progress has been made with the pilot scheme using TRAC methodology to calculate the costs of running a course?*

We have recently let a project to a joint consultancy to look into the use of cost-based approaches to funding in order to inform the ongoing review of our teaching funding method. The review will include the consideration of TRAC as a possible methodology to draw on. We are happy to share the full tender specification with the Committee if this would be helpful. In brief we have asked consultants to:

(a) Outline the general policy arguments for and against utilising a cost-based approach (as distinct from an expenditure based approach) to inform a teaching funding method.

(b) Consider to what extent a cost-based approach can and should be used by HEFCE to;

(i) identify and reflect the actual cost of those features of HE provision that may warrant differential funding in its funding method, including but not restricted to "subject", "mode", and "level" and including concepts of "investment modelling".

(ii) identify the overall cost of sustainable teaching across the higher education system which at least maintains current teaching quality and academic standards.

(iii) identify the overall cost of sustainable teaching in an individual institution which at least maintains current teaching quality and academic standards.

(c) Consider the practical requirements and implications of any proposed uses of a cost-based approach that address i–iii above.

The final report will be submitted to HEFCE officers by the end of June 2005.

4. *What measures do you use to measure the adequacy of undergraduate science provision at a regional level?*

The Board advisory group will consider the provision of science at a regional level as one aspect of the advice that we will give to the Secretary of State in June.

We are proactive in building relationships in the regions. As a national funding body HEFCE believes it must work with others when considering the adequacy of regional provision. (We would also remind the Committee that we do not have planning powers in this respect). Over the last year we have worked with a range of stakeholders to establish the priorities for investment in HE in the regions, and this has included looking at the available data on levels of provision and discussing them at a number of seminars held across the country. More details of these discussions can be found at http://www.hefce.ac.uk/aboutus/regions. In addition, where significant closures are signalled, we hold discussions with the relevant RDA to establish their view on the need for that provision and their willingness to invest.

Moreover, we maintain close and regular contacts with all institutions and are often able to support them in decisions about subjects. For example, we were able to assist in the transfer of physics provision from Birkbeck to UCL, University of East Anglia to Bath and from the University of Essex to York. Whilst these transfers, often decided on the basis of research interests, are inter-regional we considered that assistance was important in order to safe-guard the health of the subject nationally. We are currently helping to retain Chemistry provision in the South West region by offering further places to Bristol and Bath following the closure of Exeter's Chemistry Department.

I hope that you find this response useful, please do not hesitate to request further information or clarification.

March 2005

APPENDIX 95

Supplementary memorandum from the Department for Education and Skills

Demand and Supply of SET Graduates

The Roberts review was commissioned at the time of the 2001 budget as part of the Government's strategy for improving the UK's productivity and innovation performance. It stemmed from the Government's concern that the supply of high quality scientists and engineers should not constrain the UK's future R&D and innovation performance.

The review, published in April of 2002, found that in comparison to other countries, the UK has a relatively large and growing number of students studying for scientific and technical qualifications. However this growth is primarily due to the increases in the numbers studying IT and the biological sciences, with the overall increase masking downward trends in the numbers studying mathematics, engineering and the physical sciences.

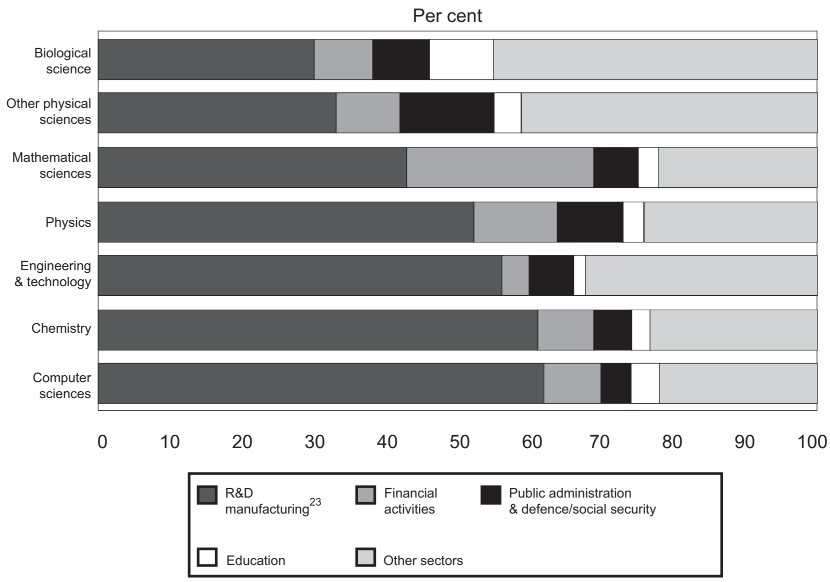
Coupled with this finding that the supply of graduates from certain subjects are falling the report also found that scientists and engineers in the UK are in demand from a wide range of sectors, not just the conventional higher education and R&D occupations, but also from sectors such as financial services who are increasingly demanding highly numerate graduates and postgraduates.

Figure 1 shows the destination for first degree graduates entering employment in 1999/00. It illustrates that in many science and engineering subjects over half of all new graduates enter employment working in "R&D manufacturing". Maths and physics graduates can also be seen to be the most likely of this group to enter the financial service sector, which is consistent with the highly numerate and problem solving nature of these degrees.

Focussing on the needs of the higher education sector, the Roberts review worked in collaboration with HEFCE to develop a model of the stocks and flows of academic staff in UK HEIs. The ageing demographic profile of the academic workforce is of significant concern as it is likely to create staffing problems in future years. 16% of academic staff were due to retire within 10 years in 1999–2000, and this figure increases when we constrain ourselves to look at certain sciences. For example over 25% of the academic staff teaching Maths, Physics or Chemistry were over 55 in 1999–2000.

Table 1 shows the actual and forecast inflows by SET discipline in 1998, 2005 and 2010. It illustrates the varying picture across subject groups with the most critical need arising in Mathematics and Engineering, which require a 33% and 22% increase in inflows in 2010 respectively, in order to preserve the 1998 staffing figures. To meet this forecast demand of maths academics in 2010 the Roberts review estimates that institutions would have to recruit just over 50% of the 1998–99 output of Maths PhD students.

Figure 1



Source:HESA

Table 1

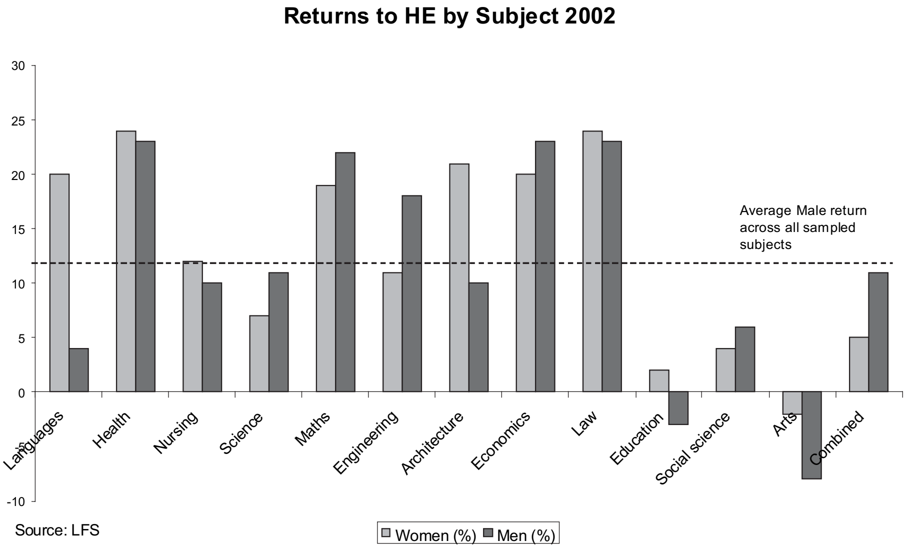
	Actual 1998 inflow	Forecast need in 2005	Percentage change 1998-2005 %	Forecast need in 2010	Percentage change 1998-2010 %
Bilogical sciences	511	407	-20	415	-19
Chemistry	133	143	8	129	-3
Physics	124	153	23	140	13
Other physical sciences	169	118	-30	128	-24
Matehmatical sciences	144	213	48	192	33
Computer science	361	302	-16	314	-13
Engineering	498	632	27	610	22
Total	5,871	5,271	-4	5,337	-3

Source: HEFCE (forthcoming) Academic staff in higher education: trends and projections

Returns to HE

A further indicator of the relative demand for graduates of certain subjects is the returns that they receive in the labour market. Figure 2 illustrates that Maths and male Engineering graduates enjoy a return significantly higher than the average (male) return to HE, indicating that demand for graduates in these disciplines is relatively high.

Figure 2



RECRUITMENT DIFFICULTIES AND SKILLS SHORTAGES

A study by Mason (1999) found that some 41 percent of recent recruiters of technical graduates reported that they had some difficulty in meeting their recruitment targets. The main areas of expertise reported in shortage all involved electronics and/or software engineering, design and programming.

The table below taken from Mason (1999) shows the incidence of recruitment difficulties by sector and the extent of these difficulties.

Table 2

	Percent of recruiters reporting:	
Sector	*"Very Difficult"*	*"Difficult"*
Electronics	20	37
Machinery	8	33
Pharmaceuticals	10	23
R&D Services	13	30
Computer Services	10	27
Financial Services	5	26

QUALITY VS QUANTITY IN THE SUPPLY OF SET GRADUATES

Across the whole sample of recruiting enterprises in the Mason (1999) study, the estimated median number of applications received for each advertised position for a technical graduate ranged from 29 (physical sciences) to 46 (computer science). So this hardly suggests a deficiency in the quantity of technical graduates.

Electronic engineering was the only discipline in which the report found an apparent shortfall in the quantity of graduates due to the very specific nature of the job they were being recruited for. In the other disciplines recruitment difficulties appear to have more to do with quality shortcomings than any overall deficiency in supply.

Just over three quarters of firms within the survey that had recruitment difficulties reported some dissatisfaction with the quality of job applicants, in particular their "lack of appropriate work experience" followed by "lack of commercial awareness/understanding" and "weak communication and presentation skills".

Recent unpublished research commissioned by the DfES asked a sample of employed graduates 3.5–4 years after they had graduated the extent to which certain skills were developed on their undergraduate course and subsequently how much they were used in their current employment. It found that just over 80% of respondents found spoken communication skills were used a lot in their current jobs,

[83] The Class of 99: A study of the Labour Market Experience of recent graduates: unpublished.

however only just over 35% of respondents thought that such skills had been developed a lot on their undergraduate course,[83] so this problem of weak communication skills may extend beyond just SET graduates.

Factors Affecting Selection

As part of the Mason (1999) report recruiting firms were asked to rank their selection criteria on a scale of one to four, with one being not at all important and four being very important. Table 2 shows the employment weighted average ranking given to the various factors.

Table 3

Selection Criteria	*Employment Weighted Average*
Class of Degree	3.34
Previous work experience (eg sandwich placement)	3.03
A level Score	2.77
Reputation of Specific University	2.69
Whether candidate attended Old or New University	1.78

Larger employers were more likely to attach greater importance to a university's reputation and this was further borne out by the pattern of response to a question about the extent to which enterprises target specific university departments in the course of their recruitment campaigns. But even after allowing for the employer's size the reputation of the graduate's university is clearly deemed less important that their class of degree and relevant work experience.

So do graduates benefit from attending the more prestigious universities?

Analysis looking at graduates more widely has discovered that even after controlling for individuals' personal characteristics, graduating from a Russell Group Institution adds between 0 and 6% to male graduate earnings compared to graduating from a modern university. The respective figure for a female is around 2.5%.[84]

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APPENDIX 96

Supplementary evidence from the Department for Education and Skills

Response to Q 516

Ways in which Sector Skills Councils (SSCs) are working with DfES, HEFCE and the universities to ensure that employer demand for specific skills is met through the educational system

1. Through SSCs, employers will contribute to identifying the specialist and generic skills required to meet their current and future business needs particularly those which will improve business performance, productivity and competitiveness. The key mechanism will be Sector Skills Agreements. The agreements will provide the framework for SSCs to work with employers in their sectors, with key agencies like HEFCE and with Government to address priority skills issues.

2. Four SSCs are currently developing the first agreements. Two of these have a particular focus on SET: SEMTA (science, engineering and manufacturing technologies) and e-skills UK (focussing on the IT industry and IT users and IT professionals). The other two are Skillset (currently looking at broadcasting, film and inter-active media) and ConstructionSkills.

3. In preparing their agreements the four SSCs have undertaken a thorough assessment of the sectors' needs, covering the long-term, medium-term and short-term, mapping the drivers of change in the sector five to 10 years ahead and determining the implications for skill needs. They have also reviewed the range, nature and employer relevance of current training and education provision at all levels including in Higher Education (HE). Through an analysis of the main gaps and weaknesses in workforce development SSCs have identified the priorities they wish to address through their agreements.

[83] The Class of 99: A study of the Labour Market Experience of recent graduates: unpublished.
[84] Conlon and Chevalier (2003) Does it pay to attend a prestigious university, CEE discussion paper.

4. The four SSCs have now published draft agreements and are in the process of consulting with key partners such as HEFCE, UUK (Universities UK), QCA, the Learning and Skills Council and with DfES. The agreements will be finalised by the end of March 2005 and will contain a summary of the analysis and identified priorities and an action plan encompassing the deals and agreements that have been put in place between the SSC, their employers and partner agencies to address the priorities.

5. HE has emerged as a priority for all four SSCs with each identifying HE related proposals which they wish to develop during the first year of their agreement. e-skills UK, for example, have developed an new IT degree in a partnership between universities and industry. It incorporates the technical, project management, business and interpersonal skills required for a range of IT professional careers. e-skills UK expect the new degree to be offered in five universities from Autumn 2005.

6. SEMTA, through their analysis of current and future skills needs have highlighted an increasing demand for higher level skills (Levels 3, 4 and 5) for craft persons, technicians and professional engineers over the next 10 years. As part of the response to this need, SEMTA are developing a model for a fast track Foundation Degree Apprenticeship and are discussing with DfES funding support for piloting the model from autumn 2005.

7. In addition to specific proposals, the four SSCs have identified through their agreements a number of common themes where they wish to see action from Government and funding bodies including: the need for closer cooperation between HE institutions and employers in the design of courses to ensure their relevance to industry; an improvement in the Information, Advice and Guidance (IAG) services with a greater input from industry via the SSCs; more flexible progression routes from 14-19 and beyond; and a greater recognition and support for industry identified priorities in funding decisions.

8. The DfES, HEFCE and other partner organisations are working with the SSCs to agree how industry can engage more fully in the design of courses, for example via HEFCE's HE Academy. Similarly, discussions are continuing about how to support greater SSC involvement in IAG and HEFCE have agreed that the Skills for Business Network, which represents all SSCs, will have an opportunity to respond collectively to the consultation paper due for publication in April about the future funding regime for HE. In addition the recently published White Paper "14–19 Education and Skills" gives SSCs a key role in developing the new specialised diplomas, with IT and engineering amongst the first four lines to be introduced by 2008.

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Annex

LIST OF RESEARCH ON WHY STUDENTS CHOOSE SPECIFIC SUBJECTS

Sources that are relevant include:

1. Connor H, Burton R, Pearson R, Pollard E and Regan, J (1999) "*Making the Right Choice. How Students Choose Universities and Colleges*". Institute for Employment Studies, UUK.

Social studies attracts a higher proportion of older people (over 21) than physical sciences or humanities. By gender, women now form the majority share of total applications via UCAS to full time courses, but they are still seriously under represented in engineering/technology (only 12% are women).

The study found that the right course is the most important criterion guiding aspiring students' choice of where to study. This is endorsed by other research, eg UNITE/MORI 2004, YCS HE module cohort 10 sweep 2, Connor *et al* 2001b and Davies *et al* 2002.

Those applicants who preferred science subjects rather than the arts or social sciences were more inclined to cite research reputation and employment prospects as more important factors in their choice of institution.

2. Connor H, Pearson R, Pollard E, Tyers C and Willison R, (2001a) "*The Right Choice?*": a follow-up to "*Making the Right Choice*" Institute for Employment Studies, UUK.

The study found familiar patterns of subject participation by various characteristics. Science/engineering/technology courses were more popular among; males, younger students, Asian students and those coming from comprehensive schools.

The study found few apparent differences in choice of subject according to whether the applicants had familial experience of HE.

3. Connor H, and Dewson S, with Tyers, C, Eccles, J, Regan J, and Aston, J, (2001b) "*Social Class and Higher Education: Issues Affecting Participation by Lower Social Class groups*" DfEE Research Report No 246.

This report found that current full-time students had chosen their subject or course mainly out of interest but also for career reasons (and that there was little difference by social class in the reasons given).

4. Davies P, Osborne M, and Williams J, (2002) "*For me or not for me—that is the question. A study of mature students' decision-making and higher education*" DfES Research Report 297.

This report found that over two thirds of potential mature entrants said that their choice of HEI was influenced by the structure/mode of study/timetabling of the course.

5. Dearing Report 2, (1997) "*Students motives aspirations and choices*".

The report found that the most cited reason as to why students had chosen their course was because they liked it and the subjects it covered. However this reason was given a lot more by full-time as opposed to part-time students.

Students' reasons for choosing their course were grouped into four distinct categories:

(i) Intellectual—related primarily to their intrinsic interest in the course, the subjects covered, and the academic standing of the course and institution;

(ii) Pragmatic—related principally to practical issues such as the part-time structure of the course, proximity to home, etc;

(iii) Instrumental—associated with the outcomes of the course and especially, students' longer term job and career prospects;

(iv) Fatalistic—related to negative reasons such as being the only place offered.

The report found that the majority of full time students opted for their course for predominantly intellectual reasons. Part time students were more mixed in their response, but were mostly pragmatic.

6. Callender C, (2003) "*Attitudes to debt, School leavers' and further education students' attitudes to debt and their impact on participation in higher education*" UUK.

Callender (2003) found that amongst potential entrants the costs of going to university led half to apply to universities nearer their homes and nearly two-fifths were taking a subject with better employment prospects.

7. Mason G, (1999), "*The Labour Market for Engineering Science and IT Graduates: Are there Mismatches between Supply and Demand?*" DFEE Research Report 112.

This report draws on interviews conducted with sixth form students, which suggests that one reason for the low take up of SET subjects is due to their poor "image", with opinions of certain occupations conforming to well known stereotypes.

8. Brooks R, (2002), "*Edinburgh, Exeter, East London—or Unemployment? A review of young people's higher education choices*", Educational Research, Vol 44, No 2, pp217–227.

This article concludes that young people's access to and interpretation of information is often patterned by their gender, ethnicity and socio-economic status. It therefore recommends that research needs to be moved beyond absorption of information to look at the construction of socially differentiated dispositions to HE.

9. Brennan J, *et al*, (1999), "*Part—Time Students and Employment: Report of a Survey of Students, Graduates and Diplomates*". www.dfes.gov.uk/dfee/heqe/ousubstan—final.doc

This study of part-time students found that 32% of those identified as being most career orientated in their studies chose engineering, technology or building courses. It also found within their sample that slightly more females studied sciences, (due to the presence of subjects allied to medicine within this category) whilst a much higher proportion of males followed courses in engineering, technology and building.

Research in Progress

10. UK Secondary Pupils' Perceptions of Science and Engineering—Project Reference 6201.

This project aims to identify the key issues involved in young people's decision making processes when choosing further study and careers;

as part of this overarching aim it will identify key issues regarding the decrease of young people opting to study science and engineering post compulsory schooling.

APPENDIX 97

Supplementary evidence from the Regional Developments Agencies (RDAs)

Q1. *Please could you supply any data that you have on the proportion of new graduates that take up jobs in the region in which they studied? [Q 284]*

1. The data on graduate take of jobs in the region in which they studied is not straightforward, since many graduates return to their region of domicile to take up employment. The available data is generally for graduates as a whole rather than specifically for SET graduates. We have tried to summarise the data here together with some information on RDAs operate graduate retention schemes.

2. Although it seems fairly obvious to expect some regional disparities in graduate employment and in retention of graduates within the region they studied reports about the graduate labour market rarely include any regional breakdowns including those relating to SETs (science, engineers and technologists). A general shift to London and the South East is the main flow, although the North West also performs strongly in attracting graduates. For instance:

(i) "*What graduates do?*" (see www.prospects.ac.uk) provides a subject but not a regional breakdown for jobs taken by undergraduates (though a similar report on masters graduates does, see below);

(ii) A 102 page Engineering Council report (2003) contains a digest of statistics on engineers but makes no reference to regional patterns;

(iii) The *SET for Success* report (The Roberts Review) did not include any regional statistics, nor did the DTI's report SET4women.

However, a research study in progress at DTI is analysing graduate employment on a regional and sectoral basis (but not by subject), which should be finished soon, and so data will be available in future (for further details of the SG project contact Isoken.Imaghodor@dti.gsi.gov.uk).

3. Some regions are more concerned than others with graduate retention, eg SWRDA and EMDA have both undertaken specific research projects to find out how to try to stem the outflow from their region (see para 5 below).

4. HEFCE produces an annual Regional Profiles report (see www.hefce.ac.uk), which gives a great deal of information about HE in each region, and includes graphs showing the percentage of graduates from HEIs in each region who find employment within their region. However, there is no single graph showing the regional pattern of retention, and no separate figures for SET graduates. Estimates taken from each of the regional sections of that report [see Table 1] show that London is the most successful region in retaining its graduates (70%), followed by the North West and North East (62% and 59% respectively). The least successful is the East Midlands (39%).

5. The HEFCE report uses HESA data on destinations of leavers from HE base on the annual returns by HEIs. HESA publishes a table annually (in a report which has to be purchased, not available on website) showing a geographical distribution of UK domiciled students remaining within UK and entering employment in their region of domicile (NB this is by region of domicile, not by region of HEI). Data on this are shown in Table 2. This shows Greater London and North West as being most successful regions in retaining their domiciled students (66% and 69% respectively), and East England being the least successful (46%).

Table 1: Percentage of graduates staying on to work in the region of their HEI (first degree graduates, 2003)

Region of HEIs	*% of graduates in jobs staying to work in region of HEI*
North East	59
North West	62
Yorks and Humber	51
West Midlands	52
East Midlands	39
South West	52
East England	50
London	70
South East	53

Source: based on data in HEFCE Regional Profiles

Table 2: Percentage of first degree graduates going to work in their region of domicile, (England 2001)

Region of domicile	*Total of graduates employed in England*	*% of total (England) employed in home region*
North East	5,115	63.5
North West	11,865	68.7
Yorks and Humber	8,430	61.3
West Midlands	9,235	60.7
East Midlands	7,535	51.4
South West	9,340	50.1
East England	3,835	46.1
South East	23,125	52.2
Greater London	13,595	66.4

6. According to "What do Graduates do?" (See www.prospects.ac.uk), all regions of the UK retain at least half of all of their *masters graduates*. The least successful regions at retaining masters graduates are the East Midlands (52.0%) and the East (53.7%), both heavy exporters of masters graduates to London. Indeed, the capital was the most likely destination for masters graduates who did not stay in their home region, reinforcing the image of London as a lure for graduates. (NB home region referred to here is region of domicile).

Table 3: Retention of masters graduates by regions of the UK

Region of domicile	*% of masters graduates staying to work in home region*
Northern Ireland	90.6
Scotland	85.1
Wales	74.5
North East	79.1
London	77.7
North West	72.5
Yorkshire & Humber	69.4
South West	60.4
South East	57.6
West Midlands	56.9
East	53.7
East Midlands	52.0

Source: What do graduates do? (www.prospects.ac.uk)

7. HESA does not publish graduate employment data on a regional basis by subject, so, in order to find out more about the pattern for SET subjects, a special analysis was ordered. This showed that the most successful regions in retaining their SET graduates are London and the North West (both just over 60%), while the least successful is the West Midlands (41%), followed by East Midlands, Yorkshire and Humber and the South West (45–49%).

Table 4: UK domiciled leavers in SET subjects, qualifying in 2002–03, from English regions and their likelihood of staying in their home region

Location of Institution	*Number getting employment in own region*	*Number getting employment (all locations)*	*% getting employment in own region*
North East	1,490	2,745	54.3
North West	3,473	5,655	61.4
Yorkshire & The Humber	2,285	4,840	47.2
East Midlands	1,625	4,100	39.6
West Midlands	1,720	4,155	41.4
East	1,290	2,840	45.4
London	4,065	6,710	60.6
South East	2,820	5,565	50.7
South West	1,840	3,755	49.0

Source: HESA (DELHE survey, 2004, special run)

Notes for Table 4:

1. The coverage is all graduates ie postgraduate and undergraduate qualifications are combined.
2. Percentages are calculated as: the number employed in the region of their institution expressed as a percentage of the total number from that region getting employment (in any location, in UK or overseas).
3. The SET subjects are: biological sciences, physical sciences, mathematical sciences, computer science and engineering and technology.
4. The reference date for this DLHE return was 15 January 2004, ie it refers to the initial employment of graduates, which for most of them is approx six months after qualifying and leaving HE.

There is likely to be a different pattern for different SET subjects—in particular differences between Computer science and others, and also probably differences between postgraduates and undergraduates. These data are available for further analysis.

8. Various **regional graduate services** are aimed at helping graduates to find employment in their home region, or encouraging others to the region. They mainly offer the following types of services/activities:

- — Making graduate vacancies more visible, providing information to graduates about local vacancies (on website, central database).
- — Researching students views, to find out more about what attracts them to the region, or might encourage them to stay.
- — Giving financial incentives to employers (especially SMEs) to recruit a graduate, or take a student on a work placement.
- — Outreach work promoting graduates services of HEIs, through eg Business links.

Some do most of these, others focus mainly on the first one. Some regional services are organised by individual universities, others by regional HEI partnerships, often with RDA funding. The number of graduate projects per region varies between one and six (see www.prospects,ac.uk for more details of each region's graduate services). A few projects seem to give more emphasis to graduate retention issues than others, ie aimed at promoting the attractiveness of region in employment terms or seeking to counter views that few graduate jobs are available in the region.

A few examples to illustrate:

(1) Yorkshire and Humberside has run a successful *Graduate Yorkshire* programme— see *www.graduatesyorkshire.info*— which has been funded by the RDA (Yorkshire Forward) at a cost of around £900k for three years (2002–05). It has one website which brings three careers services activities together—JobLink (vacancy advertising), Yorkshire Jobshop (part-time and temp jobs) and Impact (encouraging ethnic diversity recruitment)—plus Mad2move, a site which promotes living in Yorkshire. Around 200 live vacancies are up at any one time, and a target of 350 placements annually has been reached. Further funding applications is being considered to continue it, and include more outreach activities and improved careers advice for self-employed.

(2) West Midlands has *Graduate Advantage*—funded by RDA (West Midlands Advantage), to the cost of £3.5 million over five years. This includes a vacancy advertising service, central CV pool, vacancy work placements in SMEs and graduate work placements.

(3) North West : *NW Sago* is a programme funded by the NWDA and Regional office of the NW, at a cost of £175k per year. This includes a vacancy advertising service and e-alert service. Second phase is underway to link it to HE component of new activities of Business Advisers of Learning and Skills Agencies.

(4) In East Midlands: EMDA has a set of programmes offering graduate skills to small businesses, aimed at encouraging graduate employment in the region (and so reduce losses to other regions, this has come from the EMDA regional strategy). *Get on with Graduates, Graduate gateway and G2B* are all aimed graduates (Year in Industry and STEP activities are also encouraged, for undergraduates). See also EmGrad on-line service and report *Get Ahead,* by Jeanne Booth for EMDA which gives more details of the region's graduates services. Many employers have reported that the graduates performed much better than expected and businesses had experienced real and beneficial changes to products, markets, customer handling and ICT. Even where graduates move on after one or two years, employers were positive about their experience, and looked to recruit again.

(5) In South West: Grads Southwest is a collaborative project among all HEIs in region and the RDA (see www.gradssouthwest.com). It promotes the south west region as a place to work, and provides information to both graduates and employers (job vacancies, careers guidance, emails about vacancies, etc). SWRDA commissioned a major research study from IES a few years ago to investigate graduate flows (see *Choices and Transitions: a study of the graduate labour market in the South West, 2002)*

(6) In Scotland, a regional project has focused specifically on the science and technology community—*TalentScotland.com*—funded by Scottish Enterprise. It includes job alerts, promotion of vacancies, e-alerts, etc.

Q2. *To what extent to universities and businesses need to be located in close proximity in order to facilitate knowledge transfer and commercialisation activities?*

The Community Innovation Survey (CIS 3) in 2001 provides data, which clearly shows [Table 5] that firms with local markets collaborate with their local universities in almost 90% of their collaborations. Even companies with international markets work with local universities in a quarter of their collaborations.

Table 5: UK university business-collaborations split by market size of company and university location. (CIS 3, 2001 cited in the Lambert Review 2003)

Type of firms' largest market	*Local university* %	*National university* %	*Overseas university* %
Local	88	12	0
Regional	47	53	0
National	37	47	16
International	26	48	26

International firms can and do access universities across UK and overseas regions. It is the small and medium sized companies who are most likely to need to work with universities in close proximity. These companies make a substantial contribution to the economy—for example in the SE region, 47% of manufacturing GVA comes from companies with 50–500 employees—and form an important target group for the regional initiatives for increasing business-knowledge base collaboration.

Q3. *What influence do Sector Skills Councils currently have over university courses and curricula, and what role do you envisage for them in the future?*

The recently formed Sector Skills Councils include SET-oriented SSCs such as SEMTA, COGENT and e-Skills UK, and are all business-led organisations. For example the e-Skills UK Board is chaired by Larry Hirst, CEO of IBM UK and includes senior executives from Microsoft, Dell, Fujitsu and BT.

The SSCs are responsible for producing Sector Skills Agreements, which will include:

— Labour market intelligence on the demand for skills and the match with the skills supply.

— Demand-led advice from business on curricula to encourage greater work-readiness of graduates.

The SSCs do not directly fund education and will work mainly through influencing funding bodies such as the Higher Education Funding Councils eg HEFCE, and the Learning and Skills Councils. Current dialogue with HEFCE is predominantly on Foundation Degrees, where most additional students are being targeted.

The RDAs work closely with the SSCs and are in regular contact, for example all Regional Skills Partnerships have SSC representation and several SSCs have regional managers. RDAs can perform a catalytic role through for example, providing local intelligence on supply and demand and funding pilot schemes [see example below].

The future role for SSCs could include:

— Stronger advisory input to funding councils.

— Kite-marking of employer-led courses.

— Encouraging employer engagement and coordinating business input to course delivery through lectures/presentations, tutorials, projects and work-based placements.

— Increasing demand for these courses through improved careers advice and guidance in schools.

Example: SEEDA has worked with e-Skills UK to develop a new employer-led degree in response to employer demand for more work-ready employees in the area of Information Technology Management. The curriculum was developed in consultation with both employers and academics, and includes a strong emphasis on project management as well as technical and personal skills. Employer input is built into the degree from day one, through "guru" lectures (delivered simultaneously to several universities), tutorial support and advisory input on project-oriented work, and culminates in a work-based project. The degree is currently being piloted by two universities, and is planned to roll out to up to 12 universities across the country.

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APPENDIX 98

Memorandum from Scientists for Labour

1. INTRODUCTION

Scientists for Labour (SfL) is an organisation open to members or supporters of the Labour Party who are interested or involved in UK science and technology. Since its establishment in 1994, it has become a strong political voice for science. In July 2002 the Labour Party admitted SfL as an Affiliated Socialist Society.

Many members of SfL are university academics and researchers, key stakeholders in higher education. Our submission to this inquiry builds on previous contributions to the debate around the Higher Education White Paper and subsequent Act, the Roberts review of the RAE and the Labour Party Education and Skills

Policy Commission. We have drawn attention to the problem and impact of science course closures in all of these previous contributions, and welcome the opportunity to focus on it in this submission to the Science and Technology Select Committee.

2. The Severity and Impact of the Problem

— The Committee will need no persuasion as to the importance of science and technology, both in terms of direct benefits to the UK economy and to society in areas such as healthcare and as a part of our cultural heritage.

— Both the Prime Minister and the Chancellor of the Exchequer in their speeches to the Labour Party conference in Brighton, stressed the importance of improving the knowledge and skills of the workforce so that Britain can continue to compete in high-tech sectors of the global economy.

— The Government's 10 year framework for science[85] estimates that academic research underpins up to 5% of sales in some industries. This surely is to look only at very short–term impact, as all high-tech industries are based ultimately on the fruits of academic research. These academic developments must be translated into industrial products, either by or in collaboration with industry, and then manufactured and utilised by workers who also have scientific and technical skills.

— Despite this acknowledged need to improve the scientific and technical skills base, recent years have seen a worrying decline in provision of science courses, particularly in fundamental sciences such as physics and chemistry.

— There is a vicious circle in that decline in science course uptake and places not only has direct implications for the scientific workforce, but also impacts on the availability and skills of the next generation of science teachers, fuelling a spiral of decline.

— The problem is worse than the estimates in the 10 year framework suggest. For example the number of HEIs offering physics courses declined from 79 to 53 between 1994 and 2001.[86] About 30% of physics departments closed between 1994 and 2004. Since 1997, numbers of materials science undergraduates have fallen by 40%, despite this being a subject with strong industrial demand.

— Increasing participation in higher education means that more students from poorer backgrounds will enter the system. It is important, both in terms of social justice and for the national economy, that these students have the opportunity to study a full range of scientific disciplines. The development of, for example, "physics deserts": areas of the country bereft of undergraduate physics provision, militates against this.

— These and other "science deserts" are an obstacle to the Government's regional development policies, as set out in the 10 year framework. We do not believe that the solution lies entirely in inter-regional knowledge transfer, as is suggested in the framework paper, since the whole tenor of that paper recognises that strong local universities are essential to the regional economy.

3. Why is it Happening?

— The problem is sometimes attributed to poor student uptake, sometimes to the cost of science course provision relative to *per capita* funding, and sometimes to the effects of overselectivity in research funding. All three elements are important, and there is a complex interplay between them.

— Poor uptake of science courses at university is strongly linked to poor uptake of the necessary A-levels at school. This is a problem common to degree courses requiring specific A-levels, which for example also affects modern languages. In the case of the sciences it is compounded by the fact that science A-levels are perceived as being difficult and likely to depress a candidate's overall A-level score. Furthermore, most university physics departments regard A-level performance in mathematics as of greater importance than that in physics itself.

— Another relevant factor is the shortage of teachers qualified in physical sciences. For example, it is believed that the majority of physics teachers currently are life sciences graduates (and so may be lacking crucial mathematical skills). This is likely to impact on the quality of their teaching in physics in particular, and hence on the enthusiasm imparted to students. No central data exists to verify this, and the Government has recently agreed to conduct a survey to find out exactly who is teaching physics in schools.

— It is also felt that "market breakdown" has occurred, in that school students are failing to appreciate the advantages of science subjects that confer excellent transferable skills and career options, while other subjects have become fashionable out of all proportion to job opportunities. For example, forensic science courses are burgeoning, allegedly due in part to popular television series, but anecdotal evidence suggests that there are up to 200 applicants for each job in the field.

[85] Science and Innovation Investment Framework 2004–14. HM Treasury, 2004.

[86] Physics: Building a Flourishing Future. Report of the Inquiry into Undergraduate Physics. Institute of Physics, 2001.

- Against this background of poor uptake, it is easy to see that, in the free market model that now operates in the HE sector, science course closures may be driven by market forces. Such courses are expensive to run, with high fixed infrastructure costs that cannot easily be met with the income from small classes. Although universities may choose to invest strategically in expensive sciences, it is hard to see why they should chose to do so unless there is a clear benefit in sight for the university or earmarked funding is available.
- These developments cannot be treated in isolation from the issue of overselectivity in research funding through the RAE. Forthcoming replacement of "make-or-break" grade boundaries with departmental quality profiles is a welcome initiative, but it remains to be seen how far these changes will address the problems of the current system. Overselectivity is extremely damaging to departments rated 4 in the current RAE, who have lost 42% of their research funding since 2001. Faced with the combination of this underfunding of research and poor uptake of expensive courses, many universities feel that they have no choice but to close departments that are merely 'nationally excellent'.
- The 10 year framework recognises the geographical disparity in research funding. This disparity is due to the effects of RAE over-selectivity, and contributes directly to the development of "science deserts".
- Establishment of "teaching only" departments is sometimes proposed as a means of addressing this problem. However, in science good teaching at degree level requires a research base. The Higher Education White Paper[87] cites a report[88] on the interactions between teaching and research in HE, which found that it is *not* necessary for academics to be involved in research in order to provide excellent teaching. Whilst this was the overall conclusion of the report, as far as science is concerned it actually came to the *opposite* conclusion, stating: "for students in some disciplines . . . some of the staff at least do need to be involved with research", and "we find that this relationship is generally much closer, in the science-based subjects". As far as teaching-only institutions are concerned, the authors stated that "it might . . . be difficult for such institutions to teach very research-intensive subjects".

4. *What can be done about it?*

- The Government's recognition of the problem of science course provision in the 10 year framework, with initiatives to examine the effect on access at regional level and the model for funding teaching, is welcome.
- Initiatives to identify strategically important subjects and make additional funding available through HEFCE are also welcome. Perhaps in future HEFCE could be required to ring-fence a proportion of income from variable tuition fees for this purpose. However, we agree with other commentators[89] that this funding is needed urgently. We caution against a lengthy investigative process, during which time further departments will be lost (as indeed they have been since this initiative was announced).
- A serious policy issue is, to what extent should HEIs, essentially independent institutions, be encouraged or required to make available places match likely employment demand, as has been done by capping medical student numbers? Given the amount of public money invested in HE, it does not seem unreasonable that HEFCE should be required to steer funding in this way. However, other initiatives are needed as well.
- It should not be assumed that aspects of the problem that are associated with the RAE will necessarily be solved by the forthcoming changes to that exercise. The situation should be monitored to see what improvements, if any, result.
- A crucial element in increasing uptake of science courses at university, and hence the technical skill levels of the workforce, lies in strengthening science and mathematics teaching at school. The seeds of mathematical illiteracy, in particular, are sown at an early age, and attention must be given to mathematical aspects of early years education if current shortcomings are to be redressed effectively.
- We suggest that the proposed survey of science teaching should be widened to look also at which institutions are producing would-be teachers, and whether there is any correlation with departmental size or RAE score.
- We support improved links between schools and universities, including the partnerships, student associates scheme and ambassadorships discussed in the framework paper.
- There needs to be strengthened careers advice in schools, including careers advisers with scientific backgrounds who are familiar with the range of careers open to science graduates.

[87] The Future of Higher Education. Department for Education and Skills, 2003.
[88] Interactions between Research, Teaching and Other Academic Activities. HEFCE, 2000.
[89] Eg articles by Brian Iddon MP and Peter Main, *Science in Parliament*, Summer 2004.

- Joint degree courses, such as physical sciences and sports science, should not be undervalued (nor risk closure). While such courses may not attract the aspiring Nobel Prize winner, they provide an excellent source of schoolteachers.
- The White Paper comments that in order to meet Government targets for teacher recruitment, 40% of all mathematics graduates would be needed. The current figure is much smaller, which is not too surprising given the pay and status of teachers relative to other possible career choices for graduate mathematicians, who are much sought after in the financial sector.
- Similarly, better salaries and career structures are needed to encourage good science graduates to remain in science research and university teaching. This is especially true with the advent of higher tuition fees. Salaries for graduates in research and junior academic posts are already unattractive, and will fall further in real terms when fee repayment begins. Thus they will become even less attractive relative to the higher salaries offered to much sought-after graduates in subjects such as mathematics and physics by industry and the financial sector. It is no longer just these high paying sectors that compete with universities for the best graduates: academic salaries are now uncompetitive even with those offered to scientists in the NHS.
- A mechanism is required to ensure that the teaching role of academics is genuinely accorded equal status with research, particularly in research-intensive institutions that have traditionally emphasised the importance of research over teaching.

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