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CAN WE LEAVE TRAINING TO THE ACADEMIC WORLD?

The Foundation held a lecture and dinner discussion on 25 June 1997 on the subject "Can we leave Training to the Academic World?" The Rt Hon The Lord Jenkin of Roding was in the chair and the evening was sponsored by British Telecommunications plc and The Engineering & Marine Training Authority. The speakers were Dr Michael Sanderson, Chief Executive, The Engineering & Marine Training Authority, Dr Nicholas Tate, Chief Executive (Designate), Qualifications and Curriculum Authority, and Mr John Berkeley OBE, Manager, Education and Careers, Rover Group.

Dr Michael Sanderson*

Introduction

May I begin by saying how pleased the Engineering and Marine Training Authority is to be given the opportunity to join with British Telecommunications Plc in sponsoring this event to examine the important subject of training, and how and by whom it should be delivered and managed.

Perhaps, I could also take this first public opportunity to offer my congratulations to Dr Tate on his appointment as Chief Executive designate of the forthcoming Qualifications and Curriculum Authority. I know you would all want to join me in wishing him well in the challenges ahead.

Most of my career has been spent in technical and engineering management and latterly in the general management of engineering companies. During the whole of that time – although I have had indirect responsibility for the field of work-based and vocational training and have certainly presented the awards at numerous apprentice prize givings – I have had little direct responsibility for the management of training schools and therefore little opportunity to learn the jargon of the trade.

It was quite recently when I joined the Engineering Training Authority – as it was then known – in mid-1995 that I began to discover just how complex – some might say too complex – the field of industrial training and its associated jargon has become. The last two years have been for me the most intense training experience that I have ever encountered.

The subject we are concerned with this evening spans all industry sectors and most disciplines. I shall try to recognise this and be as generalist as possible, but inevitably I shall not be able to avoid drawing examples from my own 'engineering' industry sector, which I hope is excusable at an event organised by the Foundation for Science and Technology.

As with most questions that have been deliberately phrased to provoke a lively debate, it is worth pausing for a moment and to begin by trying to understand what the question means.

Defining the question

We need to begin with the word 'training'. Is training a shorthand for the acquisition of skills or the imparting of knowledge or just a shorthand for education? In a week's reading of the press, one can find it used in all these contexts.

Or is training, and I take it to be so in this more informed company, a component of the process that Finniston – when he wrote his landmark report 'Engineering Our Future in the 1980s' – called formation in order to avoid the necessity to draw a boundary definition between training and education. Most attempts at defining such a boundary have failed.

I fear that the distinction between education and training – in common with a number of other issues here in the United King-

Summary: Both Dr Sanderson and Dr Tate emphasised the need to achieve a skilled, adaptable and learning workforce. Both discussed the various problems involved. A general conclusion reached was that a combination of approaches was required with government, trainers (including academics), employers and regulatory bodies (to maintain high standards) all playing a role. Mr Berkeley, in a challenging contribution, said that if the next generation was to be better prepared for adult and working life agreement must be reached now on what they should know, understand and be able to do, and who would be responsible for such learning.

dom – is in part a symptom of an artificial cultural divide that we have created for ourselves – a divide which is less evident in Continental Europe, in countries like Germany. In the UK, to use a Mitfordian shorthand, Education is somehow 'U' and Training 'non-U'. Until quite recently, of course, the very structure of government emphasised the divide with education being firmly the remit of the old Department for Education and Training, falling largely within the area of responsibility of the old Department of Employment. Territorial independence was jealously guarded by the responsible officials. Despite the merger of the two Departments, some of the divides are still in place today, perpetuated in part by the retention of some quite anomalous funding methods.

It is noteworthy that a candidate for a National Vocational Qualification level 3 in engineering registered with a Further Education College and funded via FEFC is treated very differently in terms of the support that he or she receives from the public purse, from a candidate registered by the training school at an industrial company and funded in part, via the TEC movement, even though both are working towards an identical qualification.

There is a similar problem with the word 'academics'. Of course, not all those who work in academic institutions are necessarily academics. For instance, are those wholly engaged in research or industrial liaison, or fund-raising or administration, academics just because they are paid on academic scales? Some, I know, would say underpaid on academic scales.

But I fear there is a further question. *Why* is this particular question so important? It is important precisely because there is now a widespread consensus from all shades of the political spectrum that the creation of a learning society is central to the economic well-being of our United Kingdom.

In an increasingly global economy there is a marked economic advantage for societies with skilled, adaptable and learning workforces. In today's world you can design a product in Milan, borrow the money to produce it in London, run it up in Taiwan, market it in Madison Avenue, and buy it in any city that you choose. Money and machinery can move anywhere, but on the whole people are less mobile – so in today's world, the skills of the workforce are a major factor in achieving economic success.

* Chief Executive, The Engineering & Marine Training Authority

The fact is that being able to *do* something with a particular level of competence requires a greater knowledge and understanding than simply knowing about it. In engineering, Finniston tried to begin a move away from engineering degrees which were primarily about engineering sciences, but had little relevance to engineering in the real world.

But the Finniston Report, influential as it was, and successive events, have not entirely cured some engineering degrees of academic remoteness. One of the EMTA's predecessor bodies, the EITB, sponsored graduates entering teaching to spend time in member companies and to develop work for the national curriculum based on applications of mathematics and science in industry.

Among those interviewed in a single year, there were three with First class honours from what most here would regard as one of the two top academic institutions for engineering. They also had 3-4 A's at A-level – exactly the people that the engineering institutions and the Engineering Council, in their latest SARTOR document, would regard as guarantors of engineering quality.

Senior engineers from industry interviewing them asked why they were not coming to an industry that needed people with such qualifications. All said much the same thing – “I have no idea about engineering and fear that with this degree I would be expected to have abilities I have never developed. I am very good at maths and physics so I think that I would be better matched to teaching those subjects in schools”.

That is a direct quote and very little has changed in the few years since it was made.

Standards

I now turn to the important question of standard setting, a subject which because of my BSI background is very dear to my heart.

In recent years, a great deal of progress has been made in developing occupational standards, training and people-related standards. These include standards which underpin NVQs, SVQs, Modern Apprenticeships and Investors In People.

A recent report entitled 'A Portrait of Management Development', published jointly by the Institute of Management and the Open University Business School, shows that British companies have almost doubled their level of management training and development in the past ten years. The amount of training undertaken by managers has increased from 3.1 days a year to 5.5 days a year over the past decade – and is expected to increase to at least seven days a year by the end of the millennium.

One of the main contributors to this has been external influences, like the development of occupational standards and Investors in People. It is heartening that in some areas at least real progress is being made.

Teacher training

Perhaps I could also say a word about teacher training. Fortunately, it has become fashionable both with the former administration and the present one to question some of the conventional wisdoms in this area. Now we talk of training teachers more openly and in the 'education industry' we have reduced the role of academics in training and replaced them with practitioners.

I use the term 'education industry' intentionally. That is where education is carried out, not merely learned about. In the sixties we created Industry Training Boards to cover almost all sectors of industry. We certainly had an Engineering Industry Training Board, a Shipbuilding Industry Training Board, and, of course, we still have a Construction Industry Training Board – I see its Chief Executive, Major-General Willmott, sitting in the audience.

Why did we never have an 'Education Industry Training Board', or more recently, as most training boards became unfashionable, an 'Education, Training and Development Lead Body'?

Why have NVQs not been adopted as qualifications for those in the education industry?

The programmes for intending teachers are increasingly, and belatedly, competence-based with the competences identified, de-

veloped and assessed in workplaces. Are there still relics of the stigma of training as being something more lowly than education in this strange omission?

Could there be a single greater influence on young people and their parents and associates if teachers had been through the processes of attaining NVQs and were proud to have succeeded?

But, like many new programmes introduced over the years, such things are introduced for other people or other people's children but not for people like us.

The research environment

I will give you another example from my own formation experience. When I worked for my PhD, I did so in circumstances which differed in no significant way from the subsequent research work that I undertook in industry. The university context was a training one with training outcomes and approved trainers controlling the process in which I was a trainee. There were instructor-assessors, internal verifiers and external verifiers, although they went by different names.

Quite a change, and quite a step up (for both trainers and trainees), from the educational academic process in the same university. The fact that some of the trainers had another role as teachers did not make them academics when training people in research models. A PhD programme could be well specified as an NVQ, and perhaps with advantage for the quality assurance of the processes and outcomes.

In fact, can you think of any occupation, for which proven and reliable competences are essential, whose practitioners are trained by academics?

- Surgeons, medical doctors, dentists? Like the PhDs the trainers are not mere academics even though they may have professorships in university hospitals.

- Pilots, public service vehicle, heavy goods vehicle drivers? Certainly not.

- Civil Servants? Any academic degree (or sometimes less) will do, but the training is by formal processes off and on the job.

- Politicians – Well, as we saw throughout the recent election, their training is certainly almost entirely an on-the-job experience.

- Performing musicians; fine arts students? Even in academic institutions their courses are heavily practically-oriented and rely on current practitioners more than on academics.

Is training really left to academics?

It is not too difficult to argue that training is, in fact, seldom if ever left to academics, even though it might superficially seem to be so. However, schools, colleges and other academic institutions now regularly claim to deliver training and, in fact, they provide so many vocational qualifications that the National Targets set by the government would be quite unachievable without their contribution.

Our organisation, EMTA, works closely with many colleges in the further education field. The content and quality and outcomes of work done for our awards in Further Education colleges must meet the same standards as in training schools and colleges in industry. The F E Colleges usually have staff with experience and competence similar to those of industrial trainers.

Some would argue that, in colleges, instruction can be better controlled and standards can be more securely achieved away from the pressures of the workplace. There is some substance in that argument but for many skills a real life situation is very hard to simulate. The reality is that in F E Colleges, the training approach has little in common with the associated education which has a different but complementary role in the formation process.

In fact, it's 'horses for courses'. For some skills, on-the-job training is essential. It is certainly hard to argue that one can acquire the skills necessary to weld steelwork hanging off the side of an oil rig in the North Sea in a force 9 gale in the comfort of a training college workshop.

Can we leave education to trainers?

Now this raises a related question: Is education too important to be left to trainers? The NCVQ, as it will be until the end of September, was established on the basis that it was not true and that the necessary education – in the jargon of the industry underpinning knowledge and understanding – could be acquired alongside training.

Many people from industry, including myself, have found it difficult to accept that thesis. The old EITB in setting the earlier generation of engineering vocational qualifications – highly praised in the De Ville report – had always discriminated between job knowledge, which could properly be gained in training, and education – which needed a related but separate development, though not necessarily in a college.

This principle has been re-established in the new engineering modern apprenticeship framework to which one of our later speakers, John Berkeley, has made such a significant contribution.

The education process develops knowledge and competence of a kind which prepares for progression to a range training and learning. It introduces concepts, materials, processes and tech-

niques which will be needed later but which could be more difficult to acquire at that stage.

Merging education and training

For a long time, many of us in industry called on the government to bring education and training under one roof. At long last this was fulfilled in 1995 when the last administration decided to merge the former Department for Education with the Department of Employment. A logical extension of that merger is the merger of the Schools Curriculum and Assessment Authority and the National Vocational Qualifications Council. When that merger has been completed, many of the problems implied in the questions that I have raised tonight will fall on the shoulders of Dr Nicholas Tate.

The merger decision certainly starts to address the dilemma that the question implied in this evening's provocative title poses.

In truth, there is, of course, no absolute right answer, but if attitudes are to change we should all work harder to achieve the 'parity of esteem' between the different routes to post-16 qualifications that was so strongly recommended by Sir Ron Dearing.

Dr Nicholas Tate*

Introduction

I agree with Michael Sanderson that it is an excellent idea to be given an essay title to answer. My Authority recently undertook a survey of how A levels have changed over time. One of our findings was that traditional "discuss" questions of this kind were very much out of fashion. We are hoping to revive them. They have certainly not gone out of fashion in France, as last week's *Le Monde* – which I have taken to reading – reveals. These were some of the questions in this year's baccalaureate philosophy papers: Is man the product of his history? (no political correctness here). Can men at the same time be both free and equal? Is one's sense of freedom illusory? This evening's question comes into the same category.

The advantage of being given a title of this kind, rather than choosing one's own, is that one's thoughts are forced down grooves in which they would not normally travel.

Academics and training

So, can we leave training to the academic world? My immediate response is: whoever thought we would or might? In many ways it is a redundant question. First, because in any normal sense of the word "academic" the answer must be a resounding "no". Second, because if one begins to define words the answer can only be that "it depends what you mean by training" and "it depends what you mean by the academic world". As Michael Sanderson has made clear, the training/education and academic/non-academic distinction is not clear. Training and academics both come in many different forms. I therefore propose, as all good speakers try to do, to redirect the question to the one I really want to answer. I shall abandon the terms 'training' and 'academic' and talk about what is appropriate for preparation for work and development within work.

But let me make two introductory points specifically about academics and training. First, to remind ourselves of the massive further and higher education involvement in vocational education and training. In further education approximately two-thirds of all students are engaged in what can best be described as "vocational courses". In higher education it is more difficult to come up with a figure, but no-one can be unaware of the growing involvement of HE – across all sectors – in direct vocational preparation.

FE and HE provision includes vocational training and study both prior to and in the course of employment. The 1996 *Skill Needs*

in Britain survey prepared for the Department for Education and Employment identified further education establishments as the second "outside organisation" employers were most likely to contact in order to meet their longer-term skill needs. 49% of the 4,000 medium- and large-sized employers involved in the survey had "met or contacted" further education establishments during the previous twelve months. Employers were also asked to what extent outside organisations had helped them to meet these needs. The level of satisfaction in contacts with both further and higher education was higher than for any other category of organisation (including Job Centres, TECs, Industry Training Organisations, employer-related bodies and Career Services). We need to remember how closely entwined the worlds of employment, further and higher education actually are.

Comment and criticism

Second, there are academics and academics. As well as those who train, there are those who comment – sometimes very publicly – on training. This is one of their duties. Any aspect of public life needs a strong blast of scrutiny from those whose job is to analyse it dispassionately and comment without fear or favour. However, the capacity for academics to be reported in the press far exceeds that of employers, especially when saying negative things about our training and qualifications system. Good news is no news, and bad news is much spicier if made to appear even worse than it actually is. What we end up with is what one writer has called 'the polemics of travesty' – a situation in which the dispassionate weighing up of pros and cons becomes extraordinarily difficult.

Over the last couple of years we have become particularly accustomed to criticisms of National Vocational Qualifications (NVQs). To this has recently been added some rather negative and ill-informed publicity for General National Vocational Qualifications (GNVQs).

There were a number of things wrong with NVQs. Most are being, and have been, put right as a result of Gordon Beaumont's searching enquiry into their future. Some, however, derive from a monolithic model, in the minds of critics, of what a qualification ought to consist of. That model requires all qualifications to be based on a syllabus, consist of a course which everyone has to follow and be assessed in a more or less traditional way. This is an appropriate model for many qualifications, but not for all. I have no wish to impose one qualifications model on all qualifications. Employers' needs, individuals' needs and the country's needs re-

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quire more flexibility.

I have no time for those who would force everything into a traditional course-based qualifications model. Nor do I have time for NVQ purists who feel they have found the Promised Land and want to drag everyone else into it. But more of this later.

My main point here is that independent academic comment on training and vocational qualifications is essential. But it needs to be responsible. It needs to be made with a view to putting right rather than tearing down. The rest of us also need to treat what we read with a pinch of salt. Academics can be badly wrong in their judgements. But so too sometimes can employers.

Preparation for, and development within, work

I said I would talk about what is appropriate preparation for work and development within work. This is what one chief executive, consulted as part of a recent report commissioned by the Foundation for Manufacturing and Industry, Coopers & Lybrand and Warwick Business School, had to say:

I think that behind development there is training, behind training there is education, but there is something behind all that. There are some fundamentals which have to do with the fact that there is no substitute for a good brain.

Putting aside debates about determinism, this is a useful common sense perspective from which to start. Preparation for work needs to begin with the earliest years of schooling. Indeed, one of the main complaints of employers concerns the basic skills of some of their recruits. That is why the government's current push to raise levels of literacy and numeracy in primary schools is such a crucial part of preparation for work. In any sense of the word "training", nothing could be more important.

Preparation for work also involves developing the attitudes, values and personal skills necessary to cope both with employment and with life. Next to literacy and numeracy, the absence of these attributes is the other main complaint of employers.

The big questions we need to ask about all of this are: "are we doing it right?", "are expectations high enough?" and "are we constantly improving on previous levels of achievement?" The answer to all of these questions, from many employers, has been, fairly consistently, "no". This is not to say that all is necessarily doom and gloom. International comparisons are often not what they seem. Average levels of attainment in certain aspects of mathematics do not necessarily correlate with levels of business success, as the USA's low ranking in many international tables reveals. Also, I am quite convinced that we are on an upward slope. There is a new culture of continuous self-improvement emerging in large numbers of schools – much of it based on the simple business idea that one's aim is constantly to improve on one's previous best performance. You may be surprised that it has taken so long to get to this point.

I would not, however, want to see either primary or secondary education as simply or mostly "preparation for work". If it isn't this, it is not serving young people, society or the economy in the way it should. However, it is much more than this. It is not just a utilitarian process. It is also about cultivating minds and sensibilities because we value these things for their own sake. As with qualifications, education is not monolithic. As ever, we need Aristotle's "golden mean".

Preparation for work during the school years also involves knowledge of the world of work and may involve the beginnings of specifically vocational preparation. We can all agree about the former as something all young people need. We are less clear where we are going on the latter. The direction in which we are currently moving involves increasing the range of vocational options open to young people from age 14, whether in schools, colleges or training provision. This was one of the main recommendations of Sir Ron Dearing's recent review.

The issue of balance

A key issue facing us is the right balance between general and vo-

ational elements in students' programmes. The general pattern across developed countries in recent years has been increased levels of participation in post-compulsory education. Young people are very clear that high levels of general education, and the possession of general qualifications, are the key to success. The decline of unskilled labour, the shift to service industries, the growth of small firms, the growth in temporary, part-time and self-employment – all these point to a growing need for high levels of general skills. A fifth of employers in the Skill Needs survey said that there was a gap between the skills that their current employees had and those needed to meet business requirements. Skills which were perceived to be lacking included general communication skills, computer literacy and personal skills.

The issue within 14-19 education and training is how best to develop these skills. Can they be effectively developed through traditional A levels? Is the new GNVQ, with its in-built key skills requirements, an appropriate form of general education? What should be the key skills requirements within NVQs in publicly-funded training programmes such as modern apprenticeships and national traineeships? If we can identify exactly what these key skills involve, and come up with effective and robust ways of teaching and assessing them, there is little doubt that we should be giving them much more emphasis than we have. That does not mean that traditional academic study is redundant, nor that vocational specialisation from age 14 or 16 should be ruled out. However, there is a strong case – as part of preparation for work as it now is – for broader programmes than many students currently follow. I am not persuaded that spending the years 16-18 studying simply English, French and German or Leisure and Tourism are the best kind of preparation for the society and economy in which we live.

Distinction between training and qualifications

However, let me move to what is normally regarded, more narrowly, as "training". My key point here is the distinction between training and qualifications which provide the underpinning knowledge, understanding and capability for work – preparatory qualifications – and training and qualifications based on development within work. Many of the arguments about vocational qualifications in recent years have been bedeviled by a failure to make this distinction.

In setting up the new Qualifications and Curriculum Authority, I have a marvellous opportunity to try and put all this right. My aim is to implement the vision, contained in the 1986 de Ville report on vocational qualifications, of a truly coherent and national system of vocational qualifications – a system, based on employer needs, that is transparent and comprehensible.

What we need is a pattern of qualifications for each sector which is quite explicit about the purposes of different qualifications and includes clear lines of progression from one level to the next. We need, therefore, preparatory qualifications – whether GNVQs or other vocational qualifications. We also need competence-based NVQs. Some people need to do qualifications while in work, as a way of improving their own performance on the job. Others need qualifications to *prepare* them for employment or for a change in employment; or, they may be out of work and therefore unable to pursue qualifications based on an assessment of what happens in the workplace. We need "horses for courses".

My job at QCA, with employers in the lead, will be to try and establish a more coherent pattern of provision sector by sector. We are at last able to do this because of powers given us by the 1997 Education Act to approve all qualifications used in publicly-funded provision (except higher education). I am also keen to clarify links with vocational provision in higher education and with the requirements of professional bodies. This, obviously, can only be done on a voluntary basis.

Meeting needs of modern economy

The outcome ought to be a slimmer and more coherent pattern of provision. Together with the inspection of training by the new in-

dependent Training Inspectorate and much more robust quality assurance of vocational qualifications (I am determined that QCA will be a tough regulator and come down heavily on awarding bodies that fall short of requirements), this should move us towards a training system that meets the needs of a modern economy. The likely expansion of training, following the government's plans for Target 2000 and Welfare to Work, makes this even more urgent.

My comments, however, have been assuming the effectiveness of training and, in particular, training on the job. There is a lot of evidence to this effect, at least as far as employer perceptions are concerned. 84% of employers surveyed for the Beaumont review felt that NVQs, for example, had led to improved employee performance. 90% said they would feel confident in employing someone with an NVQ obtained with another employer; 91% would recommend NVQs to another organisation.

The link with quantifiable business benefits, however, is not always as clear as it might be. The Middle Market report mentioned earlier drew attention to a frequent failure to link individual skills development to a company's business plan, the low involvement of managers in continuing training, the failure to impose hard-

nosed quantifiable indicators to assess the effectiveness of training and the lack of benchmarking of good practice. We cannot afford to be as casual about these matters as we sometimes have been.

Conclusion

So, in conclusion, can we leave training to the academic world? My clear – and I hope not trite – answer is that we need a partnership. This needs to involve: the government, whose prime responsibility is to maintain the skills base of the nation; employers, whose prime responsibility is to maintain and improve the skills base of their firms (including potential recruits); trainers, who include academics, whose prime responsibility is to find and apply the most effective ways of developing the relevant knowledge, understanding and skill; other academics, whose prime responsibility is to analyse, evaluate and comment dispassionately, but responsibly, on how the system is working; and, finally, regulatory bodies, and above all my own, whose prime responsibility is to maintain high standards in qualifications – within and across awarding bodies, over time and, very importantly, by comparison with those in other countries.

Mr John Berkeley OBE*

Introduction

I regret to say that we live in a society that is divided by learning and by the lack of it. There are those who have been educated, those who have been trained and regrettably those who have benefited from neither. Those who have experienced what we call higher education expect their achievement to count for more than that of those who have experienced what we misleadingly refer to as further education. Both look down on those who have only experienced vocational training and, all too often, are dismissive of those whose only experience is life itself.

As a society, we do most for those who can do most for themselves and we do least for those with the greatest need. We spend an entirely disproportionate amount of our post-16 education budget on the universities and we persist in our 'measles' approach to learning: have it when you're young and you shouldn't need to worry about it again for the rest of your life! And, if it didn't suit you to have it when you were young because you weren't ready for it or didn't realise how important it was, then you've probably missed your turn.

Our preoccupation with the distinctiveness of the various parts of what one might loosely call our education and training system go to the very heart of our society. Yet, just as a company will only survive and prosper if it can add value to the collective capabilities of its workforce and go on doing so at a faster rate than its competitors, so a nation state will only prosper in a rapidly changing world if it can release the potential of its citizens – *all* its citizens – to levels of achievement matching, or preferably exceeding, the best of its international competitors.

Sadly, we have not done so in Britain. Slowly but surely, we have de-professionalised training over the past 20 years. Seduced, no doubt, by the rhetoric of the so-called 'learning organisation', in which training is *everyone's* responsibility, it has been devolved, all too often, to those with neither the competence nor the time to do it. Preoccupied with the assessment of what has been learned, we have frequently lost sight of those other vital elements in the training cycle: identifying needs, selecting appropriate methods; delivering effective learning; and evaluating the results. We have launched countless new initiatives, in education as well as in employment, without any apparent concern that those responsible for their implementation have the necessary skills, knowledge or competence.

Most of us, if we are honest, have had no training whatsoever for much of what we do. You only have to watch the average academic struggle with an overhead projector, surely one of the basic tools of her or his trade, to know what I mean.

And, even more disturbing, it seems as if the next generation is no different. In a recent MORI poll of 11 to 16 year olds conducted for the Engineering and Marine Training Authority, pupils were asked which factors they thought would be most important to them in a job. 73% put pay first and only 20% thought training was important. What is more, there was virtually no change, year on year, from 11 through to 16.

Is *this* our world-class workforce for the 21st Century?

I can't help wondering what German students would have said in response to the same questions? In Germany, where around 60% of the age cohort leave school and enter an apprenticeship, it is regarded as a success. Here, leaving school at 16 to begin work-based training is more likely to be regarded as a failure, something to be regretted for all but those who we perceive as incapable of doing any better.

We still tend to think of training as something which others do to us. But we all know that the world is changing. Charles Handy and others have described our future, so-called 'portfolio' lives as being a combination of wage-work, fee-work, homework, gift-work and study work. Who is going to take responsibility for training us for *each* of those? Certainly not our wage-work employer.

The maze of qualifications

David Hall, in his introduction to tonight's discussion, referred to our present maze of qualifications.

"Action must be taken to reduce the confusion of present provision". "The unhelpful divide between so-called academic and so-called vocational qualifications should be bridged". Unfortunately, these are not quotations from some recent government or CBI report. They come from the *original* Review of Vocational Qualifications in 1986 that led to the introduction of NVQs and, indirectly, GNVQs. Far from reducing the complexity, we have increased it tenfold.

We urgently need a simple, coherent, easy-to-understand framework that is inclusive rather than exclusive, complementary rather than competing. The divisions that persist between education and training, and between the so-called academic and industrial worlds, are entirely outmoded. They do little for Britain or its

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people. Not long ago, the Toyota Chairman put forward just such a unifying vision for bringing together learning and earning.

At a recent World Economic Forum meeting, he argued that the *purpose* of national economic policy should be to enable each citizen to manifest his or her full potential in work for which they were well suited. A deceptively simple vision perhaps, but one that confronts head-on the divisions in our present system.

For all our talk of economic competitiveness, of the urgent need to drive up standards and upskill the workforce, there are still some rather confusing messages around. Whilst a financial services business can be quite heavily fined for not training its advisers properly, in our universities and colleges you don't have to be qualified or even competent to teach and dissatisfied customers have to resort to suing for damages, as several are at present. I must say that I am rather attracted to the so-called tuition warranty schemes introduced in some American colleges – a sort of sale or return arrangement – that, I am quite sure, concentrates minds most wonderfully. In Britain, you have to be licensed by the state to teach someone to drive a car but anyone is allowed to teach and train those who design and build the car in the first place.

Putting the pieces together

However, it is not all doom and gloom. Indeed, we probably have more pieces of the lifelong learning jigsaw than any other EU Member State. Our problem is how well those pieces fit together and whether we have a sufficiently clear idea of what the finished puzzle should look like.

For example, Britain is the only European nation to have a comprehensive framework of occupational standards, means by which we can not only rigorously define our work processes, specify training requirements and establish unequivocal benchmarks for individual performance, but also, where appropriate, formally recognise that performance by means of external certification. But we are simply not using those standards.

Instead of capitalising on this approach, we have instead concentrated on attempting to attract employers to the qualifications derived from those standards, largely ignoring the fact that it is individuals, not organisations, that are most likely to be motivated by qualifications.

We now have over 800 NVQs, each one constructed in the form of units, stepping stones that can help transform Britain into a genuinely lifelong learning society. But, instead of exploiting that step-by-step approach, we have used every means possible to promote 'whole' qualifications rather than units, inevitably reducing their impact and their appeal. 'Whole' qualifications do have an important role in initial formation, but for the majority of us already at work, or available for work, they are largely inappropriate.

Even where we have at least begun to release the potential of our people by the expansion of learning opportunities, such as in higher education, not everyone seems to be quite sure what to do with it!

Qualifications and work

I've heard many people, including a TEC Chief Executive, ask "what is the purpose of a degree if graduates don't get the jobs they expect", and others too seem to be having second thoughts. You may recall Simon Jenkins, writing in *The Times* a year ago, declaring that "no nation can afford to bless a third of its young people with three years of ungainful occupation totally at the expense of the State, nor has anyone ever proved that it is an investment".

Even some national Trade Union leaders seem unsure. Speaking on an *Any Questions* panel last October and discussing 'A' level standards, Rodney Bickers assured his listeners that the issue was not really about standards at all but the fact that, whether it is 'O' levels (yes, he did say 'O' levels!), 'A' levels or whatever, if there isn't a job at the end, it's all been a waste of time.

Our problem is that, traditionally, we've looked to education and training to perform two quite distinct functions in relation to

the world of work. Firstly, we have expected it to prepare us for long-term employment, providing both the general foundation of knowledge and understanding and the particular skills of our individual trade or profession. Secondly, however, it has also been expected to provide one of the most important means by which to differentiate us, one from another, controlling access to employment and subsequent progression and, to a very large extent, helping to define our place in society.

We do have an extremely deep-rooted cultural attachment to public examinations and qualifications, but the changing world of work forces us to fundamentally reconsider what purposes they should serve in future.

The world of work is undoubtedly changing. Enlightened employers have already abandoned the inflexibility of the clearly delineated work role, with the tasks of each employee defined in job descriptions, in favour of much more dynamic workgroup structures. Individuals are being encouraged to maximise their contribution to the achievement of team objectives, without being constrained by role or status. The notion of 'the graduate job' has gone forever, eroded by the expansion of higher education.

Education and training strategies in the new, flatter, leaner organisations must seek to promote much more self-managed learning and increased team-based development. In many larger organisations, employees are beginning to be encouraged to take on a matrix of responsibilities, both within and beyond their primary work group, challenging the entire concept of 'job', extending their personal repertoire of knowledge and competence and replacing the specialisation of the past with much broader roles.

However, the drive for quality performance is also much stronger and there is a greater need for all employees to have clear and unequivocal standards, ensuring that their contribution is at least as good as the business process and rising customer expectations demand. Overall, the focus needs to shift, from seeking to fit the individual into the organisation to striving to liberate the full potential of the employee for the mutual benefit of the organisation and themselves, and such a shift has very significant implications for education and training.

The extent and pace of change, in technology and workplace organisation, will make it increasingly difficult for organisations to predict with any certainty at all precisely what skills and knowledge will be required in future.

A new model needed

So, in place of a 'one-off' preparation for employment which was expected to last a lifetime, we now need an entirely new model. We have to encourage a more flexible approach to learning in which continuing, rather than completing, becomes the central focus. Too often, far from mobilising the full potential contribution of every individual, we have instead limited that contribution by the design of jobs, the absence of clear and unequivocal standards of performance and lack of positive encouragement for personal development.

Sadly, Sir Ron Dearing's emphasis upon three distinct 'paths' – the general or academic, vocational education and work-based – is wholly inappropriate. What he has sought to make more distinctive are merely qualification components which should, wherever possible, be combined, not separated. In Rover's Integrated Engineering Development Scheme, for example, all those with the necessary aptitude and motivation can continue through to degree level and beyond, *and* do so within the same timescale as if they had stayed on at school or college in a narrow 'A' level programme.

This is not only an infinitely more demanding approach to apprenticeships, which will produce a much more rounded and work-ready individual, but one which relies on effective collaboration between the Company and its FE and HE partners.

Yet nothing within the personal and professional experience of those upon whom these young people must depend for their initial guidance and counselling has prepared them for doing other

than choosing between academic, vocational education and work-based learning. The academic remains the most highly regarded, with work-based training all too often relegated to the status of a third-class choice of last resort. And, if that is the perception that is encouraged at 16+, it is likely to be the view that continues into adult and working life.

This must be changed. Our funding and inspection regimes for education and training must place a premium on collaborative rather than competitive provision. This is particularly important for work-based learning.

There should be positive incentives for colleges and universities to seek out alternatives to classroom-based delivery and appropriate funding and support, where necessary, to ensure quality in that work-based provision. The degree programme in Rover's apprenticeship scheme is 70% work-based, a much more sensible use of resources and, as the students will readily confirm, infinitely more demanding than that followed by other students on so-called full-time courses.

Even our present five-level structure of qualifications is, I believe, unhelpful, reinforcing as it does the idea that these levels are distinct and separate.

Already, a culture has developed in which work-roles and, worse still, people are being categorised, using the levels in our national qualifications framework. I hear repeated references to 'level 2 jobs' for which presumably Level 2 employees are required; yet much of our experience in Rover suggests that few, if any, work-roles can be fully described by means of a single 'whole' NVQ. Indeed, quite often it is necessary to draw upon several different standards frameworks in order to adequately reflect the full range of potential contribution we are seeking to release from our associates.

Britain urgently needs a more flexible approach, a national system of credit accumulation and transfer, across the three groups of qualifications that, mistakenly, Dearing has sought to make more distinctive, and across the levels in that system.

So, to recap, successful performance, in education just as in business, will increasingly depend upon mobilising the full potential of every individual, with everyone working to clearly defined quality standards and in an environment in which performance improvement and personal development are actively promoted and given appropriate support.

Connecting "learning and earning"

The separation between learning and earning, for so long a dominant feature of our society, has become increasingly inappropriate and we have to seek out new and imaginative ways in which to connect the two.

Individuals who are seeking employment, whatever their age, need the means by which to communicate what they know, understand and are able to do to those who may employ their services. At present, many graduates are not only unable to articulate for themselves what it is they have gained from three or four years at university but can offer little or no proof, from those who have supposedly been responsible for them during that time, of what they are now competent to do as a result. It is quite extraordinary that, after the most intensive and expensive period of state-funded education, the onus rests almost entirely with employers to create selection processes which succeed in eliciting what it is that graduates can do.

The workforce of the future also needs the means to identify their learning requirements and plan effective development and, hopefully, the successor to the present National Record of Achievement will succeed where the NRA has failed.

I would argue that a highly differentiated system which constantly emphasises the distinction between academic, vocational and work-based learning has no place in preparing the next generation for a future world of work. 'Whole' qualifications, with their inevitable emphasis on completion rather than continuation, are becoming increasingly inappropriate.

For all our talk of the need for so-called parity of esteem for academic study and vocational training, it will only be achieved if both provide parity of opportunity for progression, particularly to HE.

Conclusions

Finally, I suggest that if the next generation is to be better prepared for adult and working life, we had better agree now *what* it is they should know, understand and be able to do and *who* will be responsible for such learning, at school, college and university, at work and in the community.

If we are to change what I have called the 'measles' approach to learning, it will take more than political rhetoric, no matter how often that rhetoric is repeated. But there are also important structural, funding and other obstacles too, entirely of our own making, that we *can* eliminate if we choose to; that we *must* eliminate if we want to make a real difference to Britain's international competitiveness. We need to promote the *four* Rs, in which readiness for work is genuinely on a par with the other three.

Britain will only prosper as a trading nation if it can add value to its people resource, and go on adding value at a faster rate than its competitors. If not, we will continue to travel hopefully, but we are unlikely to arrive.

FOUNDATION NEWS

Associate Members

There have been several new members since the report in the last issue of the Journal:

University of Westminster
Contact: Professor Michael D Trevan, Provost Cavendish Campus & Director of Graduate School

The Sugar Bureau
Contact: Dr R C Cottrell, Director

Agenet
Contact: Dr David Metz, Director

University of Manchester
Contact: Professor Martin Harris CBE, Vice-Chancellor

Chantrey Vellacott
Contact: Mrs Helena Wilkinson, Audit Manager, Charities Division

Heriot-Watt University
Contact: Professor J S Archer FEng, Principal & Vice-Chancellor

EDS
Contact: Katie Gagen, Marketing Manager

Newly Accredited and Affiliated Societies

During 1997 the following learned and professional societies were accredited/affiliated to the Foundation:

Association of Clinical Pathologists,
Chartered Institute of Building,
Consortium of University Research Libraries,
Institute of Chartered Shipbrokers,
Society of Practitioners of Insolvency.

Shared Sponsorship Scheme 1998

Generous contributions are already being received from Associate Members towards the Foundation's Shared Sponsorship Scheme 1998, those having contributed at the time of writing are: Comino Foundation, Glaxo Wellcome plc and Esso UK plc.

The Scheme provides important flexibility in mounting the Foundation's programme of lecture and dinner discussions.

GENE THERAPY – CAN WE AFFORD IT?

The Foundation held a lecture and dinner discussion on “Gene Therapy – Can we Afford it? Potential Benefit, Ethics & Economics” on 12 June 1997 at the Royal Society. The Rt Hon The Lord Jenkin of Roding was in the chair and the evening was sponsored by Zeneca Group plc. The speakers were Professor Duncan M Geddes MD FRCP, Professor of Respiratory Medicine, Consultant Physician, Royal Brompton Hospital, Mr Nick Ross, BBC and, formerly, Gene Therapy Advisory Committee, and Professor Alan Maynard, Department of Economics, University of York.

Professor Duncan M Geddes MD FRCP*

Introduction

Gene therapy is a new technology with enormous potential for the treatment of disease. Although it is still in the early stages of development the technological challenges as well as its potential to alter human biology have led to concerns about its financial, social and ethical costs. I would like to outline what gene therapy involves, demonstrate its power to do good and try to show why I think its benefits greatly exceed any cost to society. To do this I want to use as a worked example the inherited disease of cystic fibrosis. First, because cystic fibrosis research is one of the pathfinders that is pioneering gene therapy, second because it is my own area of research and third because cystic fibrosis provides a stark illustration of the potential benefits and concerns.

Gene therapy

Gene therapy is defined as the use of genetic material for the treatment of disease. Re-stating it like that doesn't seem to me to mean very much and because for most people the concept of changing genes sounds like putting on a clean pair of trousers, I will start further back. Genes are the coded instructions which tell the body how to develop, how to grow and how to perform. Now we all know that genes programme the colour of our eyes and colour of our hair and are the mechanism by which we come to look like our parents, but not everybody realises how much more genes do than just this. They continue to instruct and control our bodies in everything they do, so that when the instructions are faulty or inappropriate, disease often results. For example, faulty genes can be inherited and then the disorder of their function leads to inherited diseases such as cystic fibrosis or haemophilia. Similarly, genes can be damaged by, for example, cigarette smoke leading to uncontrolled growth and therefore a disease such as lung cancer. Finally, genes can operate inappropriately, for example telling the body to attack innocuous grass pollen and so causing hay fever or asthma. In each case bad instructions lead to bad action. The aim of gene therapy is to correct or overwrite these bad instructions and so combat disease.

Now what it is *not*.

Gene therapy is not aimed at creating new species, modifying the environment or enhancing the human race. Gene therapy is not to do with cloning sheep, cloning humans or artificial immortality. It is intended to be a treatment strictly limited to the alleviation of diseases.

Cystic Fibrosis

Cystic fibrosis is this country's commonest lethal inherited dis-

Summary: Gene therapy was intended to be a treatment strictly limited to the alleviation of diseases, argued Professor Geddes. He went on to give details of its use in the treatment of cystic fibrosis, the cost benefits and ethical issues. Mr Ross supported this new medical technique, but warned there could be ethical problems when broader applications might be mooted.

ease. It affects one in 2,500 people and about one in 25 of us is a healthy carrier of the faulty gene. When two faulty genes are inherited – one from each parent – the child has nutritional difficulties and is prone to lung infections. Thirty years ago children with cystic fibrosis seldom survived beyond the age of 10 but with improved treatment the average survival is now around 30.

The cost of CF in terms of human suffering is enormously high, first for the individual who must dedicate many hours a day to treatment and often swallowing more than 100 pills a day, second for the parents who nurse a child into adult life always haunted by the certainty of inevitable decline, and third for any healthy brothers or sisters who grow up in a family distorted by illness, hospital stays and the ever present threat of death.

The financial cost is also high, starting at around £2000 per year and rising to £50,000 per year as the disease progresses. This adds up to over £250,000 for each person with CF. A shorter life would be cheaper. But within their shortened lives people with CF achieve a lot. For example, one of this country's top epidemiologists has cystic fibrosis and in the USA one of the foremost CF scientists himself has the disease that he is studying. People with CF can have good quality lives and contribute to society.

Gene therapy for CF means taking the normal version of the gene from a healthy blood donor and putting it into the lungs of somebody with CF. This is intended to over-ride the faulty gene's instructions and result in the lung reverting to normal with adequate defences against infection. The technological challenges are formidable. In chemical terms a gene is very large (about 10,000



▲ Sir Brian Neill (left) with Sir Philip Otton at the evening on gene therapy. Sir Philip, Chairman of the Royal Brompton Hospital, assisted over the organisation of the event.

* Professor of Respiratory Medicine, Consultant Physician, Royal Brompton Hospital

times bigger than an aspirin molecule) and is therefore difficult to insert into the right place in the lungs. At present there are two competing technologies. The first hijacks a virus, loads it with the gene and then orders it to fly into the lungs and deliver its payload into the correct. The second is less efficient, but may be safer and involves putting the gene into a fatty envelope which when sprayed into the lungs merges with the fatty membranes of the appropriate cells and so delivers the gene.

The USA favours the virus, the UK prefers the fat. So far we have been able to get a single shot of gene therapy to work to about 20-25% efficiency, and while this is enough to show that the concept is correct we clearly have to do very much better before we have something to offer our patients as treatment.

All of us working in the field hope to have a worthwhile treatment by the end of the century. Some of our more objective colleagues tell us that we are over-optimistic and that it will take at least five years more.

The Cost Benefit Debate

Now all treatments, whether based on a gene or a clinical, aim to alter the way in which the body works. So why is there a special problem? We accept, regulate and control chemical drugs, and so why should gene therapy be any different? Two concerns are commonly raised: first, the financial cost and, second, the wider ethical costs to society. These will both be discussed by the following two speakers. My job is to point out the potential benefits and to clear away some of the misunderstandings about gene therapy which can cloud the debate.

Naturally I am speaking as a doctor, not as a banker, and so I will tend to favour the benefits to the individual. These are very easy to define. The benefits of a new successful treatment to the person with CF and their family are obvious. Gene therapy promises to prevent the lung infections, the days in hospital, the inevitable decline and the early death. Gene therapy should improve quality of life, reduce dependency and need for other treatment and free up time for the individual to work and enjoy a full place in society. The individual stands to gain, the wider gains for society I will come back to.

The financial analysis is somewhat complex. First, the treatment itself. There will, of course, be some savings as gene therapy should replace rather than simply augment existing treatments and the use of hospital resources should be substantially reduced. Some of the above £250,000 will be saved. Nevertheless the person with CF will still need some treatment for the rest of his body, intestines, pancreas, liver and so on, and if gene therapy is only partly successful it may simply delay the decline and could even spread out the need for treatment over many more years, so increasing the final bill. Whatever the net effect of all of these an improvement in treatment should allow the individual to work and hopefully to give back to society more than he takes.

The main point is that in any financial analysis these wider considerations must be included. Much more difficult is the issue of priorities. Is gene therapy just another expensive technology with limited application which will divert resources from more pressing needs? Whether these be hip replacements in Britain or tuberculosis control in Africa, this is beyond my brief, but no doubt we will discuss this later.

Ethical Issues

The ethical issues have been widely considered and Baroness Warnock in "The uses of Philosophy" concluded about gene therapy that none of the questions is easy but at least they are not mind bogglingly novel. I would just like to mention two aspects of the ethical debate from my point of view before Nick Ross provides a wider discussion. Like the Welsh rugby football team I want to get my retaliation in first.

First, the slippery slope argument. Each new interference with the human race, and in this context its genetic make-up, leads, it is argued, inexorably and mindlessly to the next. After gene therapy



▲ Lord Flowers and Lord Butterworth with Mrs Jane Newell, Chairman of the Liverpool School of Tropical Medicine at the event.

for fatal inherited disease will come gene treatment for cosmetic reasons, for example, to prevent baldness, and this will lead on, so it is argued, to gene enhancement with the view to constructing super-intelligence and cloning of football players or even the unlikely combination of the two. To me these arguments seem to be far-fetched because I believe society is more than equal to regulating the new technology to prevent such excesses. In our research we need the approval of three independent bodies before we are permitted to proceed.

The second ethical issue is the fear of permanent genetic alteration, which could be either intentional or inadvertent. Intentional changes to the sperm or egg are the greatest fear and lead to claims that scientists are playing God or inviting the excesses of Hitler. All committees and legislators who have discussed germ line gene therapy have judged this to be undesirable, at least for the present, and such treatments are therefore illegal. If the situation changes we may want to come back and debate this issue some time in the future, but for now I do not want illegal germ line gene therapy to cloud the current debate and I will not consider it any further.

In contrast, inadvertent transfer of a therapeutic gene to the germ line does need discussion. This is the risk of unintentional alteration in sperm and egg which could be passed on to future generations. We already accept this risk for chemical treatments and there are many drugs, for example cancer treatments, which are already known to damage genes in such tissues. Gene therapies may share this risk, although, in my opinion, at an extremely low level. The very size of a gene makes it much less likely than a chemical to penetrate all the layers which protect sperm and egg from the outside world. We, and others, have therefore tried to estimate the risk of germ line gene transfer in our cystic fibrosis gene therapy trials. These estimates come out to a risk of about 1 in 10^{15} , a risk so low that it is very difficult to grasp. To try to put this in context, civil aviation accepts a risk estimate of 1 in 10^9 , which is one million times more. It is something like saying if everybody on this planet was treated a million times each then unintentional germ line gene transfer would happen once.

I would like to finish by widening the debate first for CF and then other diseases. For CF what might we do instead? What would be the ethics of not developing gene therapy now that the technology is becoming available? We could press on with conventional treatments and hope by slow attrition to improve control. I would suggest that this is both timid and in its own way unethical. Rationing treatment between hip replacements and CF I can understand, but failing to even develop a treatment because of its possible costs I cannot. The more difficult option is screening. Population screening could detect most carriers and CF could be prevented by a policy of selective mating and obligatory abortion. Financially better but ethically worse.

Now I would like to move from the hundred thousand people

with cystic fibrosis and consider the wider implications of the development of gene therapy. The main causes of death in both the developed and the developing world are infections, vascular diseases such as heart attack and stroke and cancer. These are also the main areas of gene therapy research. New genes are being discovered and characterised every week and many of these will be

suitable for development as treatments. At present the technology of transferring genes into the correct site of the body and controlling them when they get there is lagging behind these ideas, but when the technology is available an enormous new chapter of treatment for human disease will begin. These issues discussed for CF will then have much wider application.

Mr Nick Ross*

Introduction

Science stirs and chills the blood. We are in awe of it, impressed but fearful. It promises a brave new world and threatens the old one. The public's ambivalence is summed up by a mercurial response to certain words: "nuclear", for instance, conjuring up images of cerebral boffins but also of terrible danger, or "chemical" – now pejorative, especially as in "the chemical industry". But, surely, no word in the lexicon of scientific endeavour has more power to raise hackles than "genetics".

This, after all, is the stuff of Frankenstein. (In reality, of course, the Baron's monster was created not by a geneticist or scientist at all but by an artist, an author of fiction, but no-one cares about such nit-picking detail.) There is a widespread fear that Mary Shelley got it right: that, left to their own devices, various wild-haired Dr Strangelove figures will toil away in their laboratories and emerge with wild inventions that are their own (and our collective) undoing. Scientists are now widely regarded as demigods, but also mad and morally defective, and when they dabble in the very molecules of life they are perceived to be at roughly their most dangerous.

In fact, eugenics had a bad press before anyone had heard of Crick and Watson, chromosomes or DNA, let alone the Human Genome Project. This is all sensitive business, and anxiety over modified tomatoes – let alone cloned sheep – have shown how quickly widespread interest can be aroused.

A dramatic future?

And yet the public still is unaware of the Pandora's Box of possibilities that genetics has opened up. Once people understand the code of DNA it seems likely we can rewrite sentences, re-program these instruction lists and turn them into different recipes. It may not be that easy – we may yet find our best theories break down, that genes don't cope with being tampered with in the way that we predict they will – but so far the evidence is that we're on the way to something quite dramatic. The biggest obstacles so far appear to be the technical ones of delivering modified sequences *in vivo* in sufficient quantity to work.

But assuming – and I think it's a quite reasonable assumption – that someone gets it right, assuming cleverly contrived lipids or tamed viruses can be made to shovel new genes into the nuclei of cells. If so, then it seems likely we can tell our bodies what to do. We can generate proteins and enzymes to our heart's content (and, come to think of it, into our hearts' contents too). Think about what genes control or influence – all our physical and behavioural characteristics – and you have some idea of how much we could modify. We could, literally, change our flesh and our minds.

This, of course, is science fiction for the moment, and there are many in the field who urge that the public needs to know only what is practical right now. Professor Duncan Geddes, keen to proceed with his admirable research into a horrible disease (cystic fibrosis), is concerned to limit debate to *immediate* issues where, he felt, the moral foundations were strongest. Let us, he urged, not obscure the waters by reflecting the glare of the future fantastic. Lewis Wolpert took this up with his characteristic vigour: why raise needless suspicion and thereby threaten valuable research; why foster anxiety with fanciful speculation about complex moral

issues that may or may not arise in years to come?

Ethical considerations

Let me make it plain. I share their enthusiasm for promoting gene therapy. I served on the Clothier Committee (on the Ethics of Gene Therapy) and was persuaded amply that this is science to be promoted vigorously. Later, as a lay member of the Gene Therapy Advisory Committee, I and colleagues encountered few moral dilemmas (though lots of safety problems) and came to see ourselves as promoters rather than restrainers of these new medical techniques. But make no mistake of the ethical problems to come.

Once we can re-program our genes to repair manifest disease, where will we draw the boundaries? Once people know how to halt or reverse ageing will they simply leave the formula on the sideboard? If we could make our children less prone to depression, addiction or obesity, or shorter, taller, more intelligent and better-looking, will we all shun the possibilities of intervening just that teeny weeny bit? Why should children be condemned to being unusually late developers, or bow-legged, or have any other perceived disadvantages? Come to that, why should adults not have perfect body shapes, or better brains?

At very least, new abilities to redefine ourselves will accelerate the demolition of distinctions between what is incontrovertibly disease, and perceived defects.

Maybe this much is common ground between the Wolperts and the Rosses. But when, then, should ordinary mortals who are not members of the media or of the scientific priesthood, when should they be bothered with all this? Will we worry about these huge dilemmas only on a Monday morning when the science is upon us, the doctors have been trained in the techniques and the clinic doors are open? My view is the broad debate should have started years ago, and indeed I lobbied health ministers (privately – and unsuccessfully) on this in years gone by.¹ Openness is next to cleanliness in matters such as these. Conversely, nothing feeds public suspicion more than a sense that we are being kept in the dark – especially in genetics.

True, dramatic predictions might prompt garish headlines (you can imagine the *Daily Mail*: "Scientists tinker with eternal life" – never mind the *Sun*) but any news like that which is published now will be about an issue so far removed from people's daily lives that almost all will take the story in their stride. In any case, the public has a right to be informed, and democracy cannot function properly when voters are kept in the dark. For example, it cannot be honest or wise to conduct debates on the principles of health rationing which avoid the prospect that parents will one day (and perhaps not in the distant future) demand the elimination of all genetic defects in their foetus.

Moreover, far from seeding unnecessary fears about the sort of work Professor Duncan Geddes is involved in, he will flourish in a broad debate – in the context of which current somatic gene therapy will appear strikingly modest.

Publish or be damned!

* *BBC and, formerly, Gene Therapy Advisory Committee*

¹ *As it happens, the Department of Trade & Industry has now set up a review procedure in the light of recommendations from a select committee.*

A FOOD AGENCY FOR BRITAIN?

The Foundation held a lecture and dinner discussion at the Royal Society on 6 November 1997 on the subject "A Food Agency for Britain?". The Rt Hon The Lord Jenkin of Roding was in the chair. The speakers were Professor W P T James CBE FRSE, Director, The Rowett Research Institute, Mr Michael P Mackenzie, Director-General, Food and Drink Federation, and Ms Sheila McKechnie OBE, Director, The Consumers' Association.

Professor W P T James CBE FRSE*

In March of this year I was asked to prepare a report on the most appropriate remit and structure of the proposed Food Standards Agency by the then Leader of the Opposition, Tony Blair. There then followed an intense seven weeks where I consulted widely on the nature of the problem that we were trying to address and the best approach to reform.

It seemed to me as I listened to the debate that we have forgotten the extent to which the food chain has changed in recent years. Consumers are somewhat bemused about this ever more complex food supply. We assumed that there was some authority up there looking after us. Yet there was growing concern that the 'authorities' were looking after the food industry instead of consumer interests. What is needed, therefore, is an authority which people can trust and which puts public health and consumer protection first. Such a body must be open and free from interference by vested interests.

This need to be protected from interference by vested interests applies just as much to nutritional issues as it does to matters concerning food safety. Exactly what constitutes a healthy diet and how to empower consumers to achieve such a diet is a highly sensitive issue politically. Time and again we have seen industrial and political lobbying to influence policy in this area. In short, although there are very substantial differences between the role of government in protecting from unsafe food and in promoting a

Summary: Professor James, introducing the background to his report, concluded that rather than operating in an adversarial way, a move towards more openness and more rational debate would be conducive to developing a coherent and sensible food policy. Mr Mackenzie said the food and drink industry broadly welcomed the establishment of a Food Agency. For its part, the food industry adopted a responsible attitude towards food safety; consumers had to adopt an equally responsible attitude.

healthy diet, the fundamentals are not so different.

For these reasons I proposed that the remit of the Food Standards Agency should include the full range of food standards issues – chemical food safety, microbiological safety, novel foods and processes, nutrition and food labelling.

In order to achieve real change I think we also need to challenge the traditional British way of working. In this country in the field of science or health policy we tend to operate in a very adversarial mode. This is particularly true in the food arena – where we often have pitched battles between the food industry and the public interest groups with many scientists finding they have to take one side or the other. It is my view that if we start moving towards more openness and more rational debate we will be closer to developing coherent and sensible food policy.

Mr Michael P Mackenzie**

Introduction

Practical politics and commercial experience suggest that few people like to be told what to do; especially what to eat.

People in this country want to be confident that the food they eat is safe; they do not want to be told what they can and cannot eat. Banning certain foods would almost certainly be counterproductive.

Retailers are in business to sell. Products which sell well are quickly restocked; products that linger on the shelf are reduced in price and are not replaced. No matter how wonderful a product may appear to its producer, retailer or advertiser, it is not viable as a business proposition unless there is a customer, and, realistically, many of them.

Exhortation to reduce consumption of favoured products, even to the point of prohibition, is also counterproductive. The "naughty but nice" philosophy has a perverse attraction to the human psyche.

Government suggestions to reduce consumption of certain foods have frequently been criticised and rejected, in some cases to the point of ridicule. Remember the three egg-sized potatoes

each day and the three boiled sweets each week, as recommended in the Report of the Cardiovascular Review Group, of COMA, a few years back? There was huge opposition, huge ridicule, right the way across the whole spectrum of population and media. Politics have to be practical!

Conversely, moderate persuasion to increase consumption as part of a change in lifestyle habits has a far better record of achievement: skimmed milk, wholegrain cereals, low fat alternatives, fruit and vegetables (remembering that it took 20 years to increase berry consumption in Finland from 4 kg to 6 kg per person) and, of course, increased physical activity. Education rather than legislation on what people *should* eat should be the focus of government action on diet and health.

In my view, people of this country want to be confident that the food they eat is safe; but people do not want to be told what they should, or should not, eat. I, personally, have heard these sentiments expressed by members of the present Government.

Food safety and the role of the food and drink industry

From the moment it is harvested, most food starts to deteriorate. It has been – and will continue to be – the role of the food industry

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** Director-General, Food and Drink Federation

to combat that inexorable process of decay and so transform the products of the farming community into foods that our urbanised society *wants* to eat.

Involved in this task are half a million people providing a population of 56 million with safe, enjoyable, affordable food, three or more times a day, spanning such a diverse range of recipes and tastes that all but the most extreme diets are catered for.

The safety of its products is the priority of every company within our membership. The legislation that bears down upon a food company is substantial. MAFF's recently revised (July 97) summary of "food law" runs to 60 pages. It confirms that the UK's food safety legislation is extensive, complex and hard-hitting. The food industry is *the* most regulated industry sector. Running a food business today, let alone seeking to establish a new one, is a daunting task, given the legal requirements not to mention the intense competition.

The industry does not complain about this legislation, seeing it as its consumers' shield and protection. Whilst we supported the principle of the previous Government's deregulation initiative, we rigorously defended all those measures put in place to safeguard food safety. In reality, there was little opportunity to swing an axe through the red tape: more the skilful use of a scalpel was required and, in fact, used.

Our main complaint is when the law is not enforced fairly and equitably, but inconsistently and pettily on some players in the food chain but not on others.

Of increasing concern to the food manufacturing industry is the onus being placed upon it for ensuring the integrity and safety of the entire food chain. How can food manufacturing companies in the UK be responsible for the actions and decisions of international seed companies and farmers in North America? Or, closer to home, for suppliers of agricultural chemicals, fertilisers and feeds to UK farmers and growers; or, for that matter, for UK farmers and growers themselves?

Likewise, as stringent controls should be exercised on the small manufacturer and retailer as on the large ones.

The Food and Drink Federation (FDF) has long held the view that, in terms of food safety, the food chain must be considered as a single entity. Recent experience of food scares has all too vividly served to confirm that view. With few exceptions, all the recent concerns – and genuine threats – to food safety have had as their principal and root cause inadequacies in the practices and procedures at points in the food chain before that at which responsibility might reasonably be deemed to pass to the food manufacturer: BSE; *Campylobacter*, *E. coli* 0157, *Listeria* and *Salmonella enteritidis*; pesticide and sludge residues on carrots and lettuce, and so on. Whilst it might be argued that a degree of environmental contamination is, in many cases unavoidable, it is not the food processing industry's role to clean up unfit food, but rather to stabilise perishable, wholesome products and so preserve the harvest for us all. Other countries in the European Union have achieved this, and so should we!

The role of a 'Food Agency'

It is against this background that, I suggest, the merits of establishing a Food Agency should be assessed. Much has already been written about experiences in other countries. From FDF's analysis, there is no single model which can readily be imported to the UK, but there are some important principles which can usefully guide our steps.

The decision to establish a Food Standards Agency in the UK was a political one: namely, the Labour Party's manifesto pledge to address its – and others' – perceived deficiencies in the existing system. A pledge to separate – but hopefully not to polarise – two essential roles of government: to protect consumers and to foster and promote the competitiveness of British industry.

Immediately prior to the General Election, calls for the creation of an independent Food Agency grew in volume, if not in sub-

stance. FDF stood back from this clamour, unsure what was on offer. There were too many questions which remained unanswered, not least, "what is meant by 'independent'; particularly of government, in a democracy?"

Within a week of the election result, the James Report was published and there was at least a set of proposals on which to initiate serious debate. In responding to this report, FDF focused on what it sees as the principal issues.

We fully support moves by the Government to restore consumer confidence in food safety and to ensure that the highest practicable standards of safety and hygiene are applied and enforced along the entire food chain. Indeed, FDF believes it is vital that the Agency's remit should enable it to address issues which have their origin in agricultural methods, including the impact on food safety of waste disposal practices.

FDF is therefore fully committed to support the Government in its decision to establish a Food Standards Agency, charged with overseeing the safety of all stages in the UK food production in the consumer's interest and operating in full view of public scrutiny.

We do not, however, support the inclusion of nutrition in the Agency's remit, in the sense of the nutritional quality of the diet. Though it must be said that it could well be appropriate for the Agency to cover certain aspects of nutrition such as labelling, health claims and so on.

We believe it is vital that the Agency is a streamlined and efficient organisation whose role, relations with government departments and operation are clear to the public and all other food chain interests.

We wish to play a full part in the Agency's work. The industry has a fundamental interest in food safety and believes that it can make a significant contribution to the Agency. It seeks involvement at the highest level in the Agency's deliberations.

I would now like to address some of these key issues in greater depth.

1. Food safety and diet

FDF has always distinguished food safety from nutrition and diet, and remains of the view that diet is a matter of choice for the individual, whereas food safety is a responsibility shared by all in the food chain. Moreover, as I have already explained, the principal issues which have collectively served to diminish public confidence in the safety of the food supply have been primarily linked to the first three of the main areas identified in the James Report, all of which are concerned with the safety of the food supply rather than its nutritional adequacy.

Microbiological and chemical hazards impacting on the safety of food affect the entire population and need to be managed expeditiously based on a structure which facilitates rapid response and decision-taking. No food is nutritionally unsafe and nutritional issues usually require extensive epidemiological and other long-term studies, coupled with consideration of the implications for population groups and individuals, linked to other and diverse lifestyle factors. It is entirely reasonable that all food should be free from unsafe levels of microbiological and chemical components, but it is entirely unreasonable, and unjustifiable, otherwise to restrict or dictate the composition of an individual food other than on safety grounds.

If the Agency's remit were restricted to food safety, in terms of microbiological and chemical risk assessment, this would ensure clarity of effectiveness, focus and purpose. For this reason, including nutrition, in the sense of the nutritional quality of the diet, in the Agency's remit would confuse its objectives, both operationally and in the consumer's mind.

FDF is concerned that the broader the Agency's remit, the more diffuse will be its focus, the more difficult its task, thereby potentially reducing the chance of success in any particular area and confusing consumers.



▲ Professor W P T James, one of the speakers, seen here with the Foundation's Chairman, Lord Jenkin of Roding.

2. Enforcement practice

Recent experience has shown the importance of enforcement activities being focused on ensuring compliance at the place where food, including raw material inputs, is produced, manufactured, distributed and sold. It is at the grass roots level where control and enforcement must be strengthened in partnership with industry; and large as well as small players in farming, manufacturing and retailing must be equally subject to even-handed and consistent audit and control. FDF believes that the Agency should have the capability of evaluating scientific advice and auditing enforcement practices.

3. Membership of Agency

The Agency's governing body should be multi-disciplinary and its members selected by government for their expertise right the way across the food chain. This governing body should reflect a balance of all food chain interests so that it can gain public respect and credibility, and operate effectively.

4. Consultation process

The Agency will need appropriate mechanisms for consultation so that it can take full and fair account of all properly representative interest groups. In particular, the Agency's consultation process must take account of the industry's need to compete and the benefits which this offers consumers in terms of choice and prices. FDF believes that partnership between the authorities and the food industry is crucial to the success of the Government's objectives.

5. Direct involvement

The food manufacturing industry fully accepts its share of the responsibility for ensuring the safety of the food it produces and

supplies, via retailers, to the public. It has substantial investment in people and jobs and takes this responsibility very seriously. Companies within the industry have a wealth of experience and knowledge.

The industry wishes to, and believes it should be enabled to, make this expertise available to the Agency. It would therefore welcome the opportunity to be directly involved in the deliberations of the Agency at the highest level. The industry is fully committed to supporting the Government's intention to create an Agency and to making it work effectively for the benefit of consumers and everyone else in the food chain.

In summary, FDF sees the essential role of the Agency being:

- to monitor and evaluate the scientific issues;
- to assess risks and make policy recommendations to government, including on research requirements, but not to allocate and manage the publicly-funded expenditure on the research itself;
- to ensure that food safety and hygiene rules are fully and properly applied and enforced at every stage of the food chain;
- to give advice on the implementation of legislation; and
- to communicate its conclusions and recommendations to the public both direct and via the media.

Conclusions

In lending our support to the creation of a Food Standards Agency, we believe we have an important role to play and contribution to make. The raw material processors and food manufacturers represented by FDF have an outstanding record of achievement in maintaining high standards of food production. Most member companies operate hazard analysis systems and many have quality assurance arrangements accredited to the international ISO 9000 standard. Investment in high specification facilities has been significant and the industry believes it operates to high standards and procedures, which it is continuously striving to improve. Mistakes are occasionally made, but the systems are in place and responsible attitudes prevail, for example, towards product recalls, and provide substantial assurance for the industry's customers.

For their part, consumers, and especially those who purport to represent their interests, must also adopt an equally responsible attitude. Constructive criticism is a valuable commodity and always appreciated. Pious preaching and biased, intemperate, unrealistic and unrepresentative reproach is divisive, destructive and more than just commercially damaging.

If the whole food chain, including consumers, can identify shared objectives and each accept their share of the responsibility for ensuring the safety of the food that all of us must eat, the creation of the Food Standards Agency will have provided the catalyst for change in our food culture that has, for so long, been elusive, thereby making a substantial and lasting contribution to public confidence in the safety of the food supply.

FOUNDATION NEWS

Recent Lecture and Dinner Discussions

"Information technology: towards an integrated criminal justice system". On 12 November 1997 Mr Geoffrey Hoon MP, Parliamentary Secretary, Lord Chancellor's Department, gave a view of the progress and issues as a member of Government, followed by The Rt Hon Lord Justice Brooke, Chairman of the Judges' Standing Committee on Information Technology. Finally, Professor Richard Susskind, author of "The Future of Law", gave his view of the future of IT and the way it should be used to good effect in the criminal justice system. The evening was sponsored by EDS.

The Dearing Report

The Dearing Report has been widely discussed, but it was a subject for a lively lecture and dinner discussion on 25 November 1997, sponsored by the British Council, the British Petroleum

Company plc and The Royal Society, when Sir Richard Sykes, Professor David Watson and Professor Martin Harris gave short talks followed by the discussions.

The subject of the Dearing Report was also a topic for a seminar for learned societies on 17 December 1997 when some 20 representatives joined discussions after hearing from Sir Ronald Oxburgh, Dr Thomas Inch, Professor Stephen Holt and Professor Robert Freedman.

The Foundation held a lecture and dinner discussion jointly with CBI Scotland, and sponsored by Scottish Power and Scottish Enterprise on the subject of "Success in Technology Ventures" on the topic of commercialising Scotland's science and technology. The event was held on 3 December 1997 at The Royal Society of Edinburgh who, as always, greatly encouraged and helped the Foundation over the event.

CO₂ EMISSIONS: CAN THE UK MEET ITS TARGETS?

The Foundation held a lecture and dinner discussion on 30 September 1997 on the subject "Carbon Dioxide Emissions: Can the UK Meet its Targets?". The Lord Butterworth CBE DL was in the chair and the evening was sponsored by the British Nuclear Industry Forum, the Department of the Environment, Johnson Matthey plc, The National Environmental Technology Centre (NETCEN) – owned by AEA Technology plc – and Westlakes Research (Trading) Ltd. The speakers were Mr Andrew Warren, Director, Association for the Conservation of Energy, Sir John Houghton CBE FRS, Chairman, The Royal Commission on Environmental Pollution, and Dr Mary Archer, Chairman, National Energy Foundation.

Mr Andrew Warren*

Introduction

I congratulate the Foundation upon choosing today of all days to organise this important meeting, to consider how best we can seek to address what is acknowledged to be the world's most pressing environmental problem: the impact that the excessive burning of fossil fuels is having upon carbon dioxide emissions, and hence the potential destabilisation of our climate.

My Lord President, you have just made reference to the speech made today in Brighton by the Prime Minister, in which he spoke about precisely this issue, and reconfirmed that he was "passionate in commitment to action". As he went on to say, there is "so much to do, so much to change". It shows remarkable perceptiveness for the Foundation to have chosen the same day as this important speech was made, to hold this meeting.

If I may, I will begin by trying to place this enormous issue into time horizons which are more easily understandable to human beings. I should like to take the earth's history as if it were compressed into just 100 years. In this circumstance, the dinosaur came and left about one year ago. Man arrived only two weeks ago. We began the widespread use of fossil fuels at the start of the industrial revolution only five minutes ago. But the legacy of those five minutes is large. In these brief five minutes we have upset more than 99 years of development of the earth's environment. If we are to protect the predictability of our climate for future generations we must act in the next four seconds.

The rest of this evening is dedicated to establishing precisely what we need to do during the course of those four remaining seconds.

The recognition of pollution

At the National Theatre one of Britain's most distinguished contemporary actors, Sir Ian McKellan, is playing the title role in a sadly seldom performed Norwegian play, written at the end of the last century. The author of the play is Henrik Ibsen. The name of the play is "The Enemy of the People". I imagine that the plot is familiar to many. But I know that there are some who are disinclined to watch plays other than in the original language, and who may yet find their vernacular Norwegian a little wanting. For them, may I just sketch the plot?

The play takes place in a prosperous, contented town. A scientist arrives in the town. He becomes concerned about pollution levels from the water supply. Initially, he is treated as a harmless eccentric. Then concern grows that tourists are listening to him and ceasing to visit; concern also grows that confidence in the town is diminishing as a consequence of his warnings. This is a substantial threat to business as usual. The consequence is that the scientist is declared an "enemy of the people" and is thrown out of the town. And the pol-

Summary: Mr Warren emphasised the urgency for action on global pollution. He discussed the setting of targets (many of which had not yet been achieved), who should be responsible for achieving them and important new initiatives. Sir John examined the position regarding transport, giving statistics and possible ways in which the problems brought about by ever-increasing car usage and freight transport might be overcome. He argued the need for a fully co-ordinated and integrated package of a large number of measures to enable targets to be met. Dr Archer commented on the contribution the domestic and renewables sectors could make. In her written contribution she took account of the outcome of the Kyoto meeting held in December 1997.

lution continues.

That is precisely the way in which many regarded those climatologists who ten years ago were starting to warn about the dangers of pumping more and more carbon dioxide into the atmosphere. I think the first time that this issue became at all common currency, beyond specialist papers and into the daily newspapers, was at the 1988 Toronto conference "Our Changing Atmosphere". Those attending were entirely self-selected, and were a fairly eclectic selection of people. Like many such gatherings, a final communiqué was issued at the close. Its apocalyptic language led to much contemporary amusement, particularly when it described the enhanced greenhouse effect as "an unintended, uncontrolled, globally evasive experiment whose ultimate consequences could be second only to a global nuclear war". Impassioned words indeed!

Shortly after, the House of Commons Environment Committee produced a report on 'Air Pollution', which reinforced the concerns expressed in Toronto, albeit in more measured tones. It emphasised "the serious environmental consequences of the excessive emissions of carbon dioxide, owing to fossil fuels, its main source". It used the theme "prevention is always better than cure", and argued that "it is obvious that any reduction in the demand for energy will lessen the need to burn fossil fuels, and consequently the total emissions needed to be treated in one way or another. Hence all practical means of energy conservation are of prime importance ... our evidence on the pollution caused, in our view, adds weight to the economic strategic argument for enhanced energy conservation".

At the press conference launching this Select Committee Report, Sir Hugh Rossi warned that, with this issue in particular, a new acronym might become appropriate for politicians. This was a variation on a well-established and familiar acronym called 'NIMBY'. But this time entitled 'NIMTOO', or 'Not In My Term Of Office'. It is one which inevitably less responsible politicians have continued to adopt regarding this particular issue.

* Director, Association for the Conservation of Energy

However, in 1989, speaking to the Royal Society, the then Prime Minister, Margaret Thatcher, formally committed herself to placing this issue on the world political agenda. She reiterated this commitment with a powerful speech at the second World Climate Conference, and by doing so ensured that not only did Government take possession of the issue via the formation of the Intergovernmental Panel on Climate Change (IPCC), but that Britain would play a leading role in its work.

Meeting targets

Around this time, the first of the specific commitments on emission reductions was made by individual countries, most of whom were European countries, and culminated in the Luxembourg Agreement 1990 to ensure that Europe would emit no more carbon dioxide in 2000 than in 1990. It was a commitment repeated again at the Earth Summit in Rio in 1992. It was, however, not legally binding, but merely a mutually agreed target.

Most other OECD countries also adopted precisely this target. And a vast majority of them will not meet the target. The exception will be the UK and Germany – the latter in large part because of the inclusion of the former East Germany. There, emissions have fallen heavily since 1990, as they have in many of the other former Communist countries. The reason for that is not hard to find: it is de-industrialisation. And it simply proves that any fool can set about saving carbon dioxide; you simply turn out the lights, and close down industry. It is not really a very sensible way to proceed, and is one of the reasons why I prefer to measure progress on climate change as much by looking at energy intensity trends as by examining year by year carbon dioxide emission output.

Energy intensity is a measurement of the amount of wealth created, divided by the amount of energy consumed. During the first decade of the last twenty years, immediately after the first oil shock following the Yom Kippur War of late 1973, Europe managed to improve its energy efficiency and hence energy intensity by 20% across ten years. Whilst this was a source of some satisfaction, it should be noted that during the same period Japan managed an improvement of 34%.

We set ourselves a target of a further 20% improvement across the ensuing decade. For some while now the position has been worsening rather than improving. And that is the underlying message about the lack of real progress in the first of our four remaining seconds.

It has now been agreed that, despite this experience, following the ministerial mandate given in Berlin last year, binding reductions will be the target for agreement at this December's conference in Kyoto, Japan, for the period after the millennium. The probability is that any eventual agreement will not tie individual countries to specific years to meet emission reductions, but will prefer to look at an average of three to five years. This obviously does cause some complications for monitoring, but is on the whole more rational.

Last night, speaking in Brighton, the Foreign Secretary, Robin Cook, expressed his pessimism concerning the likelihood of the American Government agreeing to reductions on a realistic time-scale. Certainly, the US Senate has made plain that it wishes to involve developing nations for the first time in making commitments, and on the same time-scale as developed nations. The USA is also pressing hard for the concept of joint implementation, whereby developed nations obtain credits for investing in improvements in developing nations. There are in my view a couple of significant problems which have to be addressed regarding this (otherwise utterly logical) concept.

The first of these is called "cream skimming". Ultimately, developing nations will be required to have target emission reductions of their own. If all the easy savings have been taken by developed nations and "scored" to their benefit, it is going to leave developing nations with an infinitely more difficult task.

My second concern is that it is not countries which will under-

take these overseas investments: it is companies, usually multinational companies. Then the question is: where are these multinationals to be deemed as being based? Is it where their finance comes from? Where the majority of their shareholding is? Or where their headquarters are? Unless this is sorted out, we may end up with Liechtenstein appearing to be the most climate-aware country of the lot.

As we now stand, no developing countries have yet agreed to any specific savings targets for themselves. The Association of Small Island States (AOSIS) is calling for a 20% worldwide cut by 2005, and a 40% one by 2010.

Energy policies

Most of the early discussion relating to climate change related to the desirability of undertaking purely "no cost" measures – in other words ones that were cost effective already. The concept of utilising the precautionary principle, and appreciating the investment needed to cover "risks", has only really emerged recently. There is a growing realisation that there is no no-cost option. What has to be compared is the real cost of adaptation against the cost of amelioration. And the question is: who pays for this? The polluter? Or, as now, society at large?

In the last twenty years, the marketplace has increasingly ruled energy policy in the United Kingdom. Whereas Government used to own practically all energy sources, it now owns none. Deregulation has delivered a continuing fall in prices. The ensuing growth in efficiency of supply brought about by market liberalisation must be contrasted with the impact of lower prices upon consumption levels. The old grocery trade maxim of pile it high, sell it cheap, has become the norm.

There are a number of substantial vested interests concerned to keep business as usual, to keep out the "enemy of the people". For many of the fossil fuel providers, the more they sell the more money they make. There is a slightly perverted belief that customers want to buy energy; they don't. They wish to buy energy services, which can be better supplied with fewer not more energy resources.

There is one major business interest now becoming directly involved in the climate change debate. Insurance is the world's third biggest industry, and its financial base is predicated upon actuarial experience of past activities. When – as is increasingly happening – the past weather systems offer no guide to likely future occurrences – it means that the insurance companies themselves are placed at far greater risk than before by the vagaries of the climate. This leads to two results: substantial losses, followed by withdrawal of options for insurance cover.

New initiatives

Over recent days there have been a number of important initiatives made in this area. One of the most important of these happened just today, when the Chief Scientist Sir Robert May's report was formally published by the Prime Minister – who commissioned it earlier this summer; it details what needs to be done on the whole issue of climate change. The Prime Minister has stated that the 20% reduction on 1990 levels by 2010 of carbon dioxide emissions in the UK is not conditional, not negotiable – and for that matter it is not unique amongst developed nations.

Also today in Germany, the Chief Executive of Britain's second biggest company, John Browne, and the largest fossil fuel vendor, BP, has made a second important speech on climate change. Earlier this year at Stanford University he conceded the issue of cause and effect, acknowledging the link between the products his company sold and climate change. Today, he has called specifically for higher fuel prices via taxes in order to dampen demand for excessive energy consumption.

There is no doubt that blueprints now exist which will enable us to meet convincingly the Prime Minister's challenging target. Last week the Liberal Democrats, in their conference in Eastbourne, adopted unanimously their "Living in the Greenhouse" report

which sets out in comprehensive detail how reductions of 30% can be made in carbon dioxide emissions by 2010. The association which the Foreign Secretary was addressing yesterday, the Socialist Environment and Resources Association, also has a comprehensive document available showing how the Government's 20% targets can be reached. And, indeed, I would anticipate that even before Kyoto outline details will be made available formally by the Government on how they intend to achieve this target, with a more comprehensive paper issued in the Spring.

Let there be no doubt, achieving this target will not be easy. It

will require major shifts in our industrial activities. It will require investments in new technologies – and most particularly new techniques – on energy consumption. But most of all it will require a cultural shift of a kind that we have seen before, albeit on a smaller stage. Look, for instance, at what has happened with attitudes towards drinking and driving in just the past decade.

But there is no question that urgency is required. Already at least one of our four seconds has ticked away. Advocating delay on addressing climate change is an invitation to be a spectator at our own destruction.

TRANSPORT CONSIDERATIONS

**Sir John Houghton CBE FRS* and
Ilga Nielsen****

Introduction

Emissions of carbon dioxide arise from many activities and I intend to concentrate this evening on the contribution that transport as a sector – in particular road transport – makes to overall emissions and the consequent need for transport to contribute to meeting national, European and international targets for carbon dioxide reduction. The impact of transport on carbon dioxide emissions has been a major concern of the Royal Commission on Environmental Pollution and was covered by its Eighteenth¹ and Twentieth² Reports on *Transport and the Environment* in 1994 and 1997 respectively.

Massive increases in the movement of people by car (about tenfold) and of freight by road (about fourfold) have been responsible for the overall growth in surface transport that the UK has experienced since 1950. In line with this growth in surface transport, emissions of carbon dioxide from transport have increased during the second half of this century to the extent that, when emissions from electricity generation for transport and production of transport fuel are also included, they now represent about 25% of the national total.

Road traffic growth is forecast to continue – the National Road Traffic Forecasts produced by the then Department of Transport in 1989 implied an overall increase in road traffic of between 55% and 87% from 1995 to 2025. In October 1997, the Department of the Environment, Transport and the Regions produced revised forecasts which suggest a slightly slower growth in road traffic – the central estimate is still, however, one of 60% growth between 1996 and 2031.

One measure of the efficiency of a country's transport system may be provided by considering the *transport intensity* of its economy – this can be measured by relating changes in mass movement (both people and goods) to changes in economic activity. Although between 1952 and 1992 the *net transport intensity* of the UK economy remained fairly constant at about 0.7 tonne-kilometres equivalent for each £ GDP, the *gross transport intensity*, taking into account the movement of the carriers as well as the people and goods moved, increased by a fifth from 2.6 to 3.1 tonne-kilometres equivalent for each £ GDP. The transport system had thus become increasingly inefficient with time. This is in contrast with the 40% decrease in the *primary energy intensity* of the UK economy over the same period.

The Royal Commission's analysis in 1994 led to the conclusion that the UK transport system was already unsustainable in many respects – not least in terms of increasing congestion on our roads and increasing pollution in our cities and countryside – and would become progressively more so if the trends identified continued.

Our more recent analysis this year shows, regrettably, that the trends we wished to see halted or reversed are for the most part still continuing.

Returning to carbon dioxide, the increase in emissions of this greenhouse gas from road transport was one of these unfavourable trends which we wanted to see addressed. Like the many problems associated with the transport system, it needs to be addressed by a series of measures and concerted action in different areas.

Reducing carbon dioxide emissions from transport requires:

- more efficient engines
- planning so that there is less need for travel
- better facilities for walking and cycling
- improved public transport
- movement of freight by less polluting modes.

Greater fuel efficiency

Looking at the private car, use of which has shown the greatest growth and has contributed most to the overall increase in surface transport movements, fuel economy has changed little in recent years. A significant improvement in fuel economy occurred between 1970 and 1991, a slight deterioration was evident to 1993 and since then the sales-weighted average fuel consumption of new petrol cars has improved slightly by 2.5% to 1995. Despite improvement in engine technology there are contrary influences at work, as customers show a continuing tendency to choose larger vehicles with bigger engines – the proportion of cars sold in the UK with engines under 1400 cc has fallen from 46% in 1994 to 40% in 1996. In addition, the average figures reported above do not include four-wheel drive vehicles – the addition of which would probably have an adverse effect on fuel economy figures.

Fuel economy can be improved significantly using existing technology. A study in 1995 by the Organisation for Economic Co-operation and Development concluded that there are many technical options which have been ready for production for some time but that in current regulatory and market conditions most of them will probably remain unexploited. It estimated that combinations of such options could produce reductions in fuel consumption of 37.73% by 2010. More recent evidence of the vehicles and associated fuel economy that technology can deliver was provided by the Greenpeace 'SmILE' (Small, Intelligent, Light and Efficient) car, which claimed a fuel consumption roughly half that of its conventional counterparts.

Despite these estimates and achievements, the European Commission is currently seeking a reduction in fuel consumption of only a third from European car manufacturers – it is having difficulty in securing a voluntary agreement from them on even this level.

* *Chairman of the Royal Commission on Environmental Pollution*

** *Secretariat, Royal Commission on Environmental Pollution*

More radical means of reducing carbon dioxide emissions could involve the following:

- new engine technologies – such as the direct injection petrol engine, already available in Japan;
- hybrid vehicles – there has been increasing interest in the use of batteries as part of hybrid systems;
- fuel cells using either hydrogen or hydrogen-rich fuels – although trial vehicles, for example the Canadian Ballard bus, exist, further basic research is still needed to bring about substantial improvements in fuel cell performance, as well as the developments necessary to reduce costs.

It is apparent that more fuel efficient vehicles could be made available fairly readily and that there is considerable scope for further improvements in fuel economy via the more radical routes outlined above. However, this is not happening for a number of reasons. Perhaps the most significant of which is the price of fuel.

It is important to give vehicle users appropriate price signals; increases in the price of motor fuels have been the central element so far in government policy for achieving reductions in carbon dioxide emissions from transport. There have been successive increases in duty on motor fuel since 1993. Since 1994 these have been on average more than 5% a year in real terms, the previous government committed itself to maintaining the average year-by-year increase at this level until 2000. This commitment implied an increase in pump prices approaching 4% a year in real terms, if the market price of fuel before tax were to increase in line with the prices of other goods. In recent years, however, the market price of fuel has fallen. That has not affected the value of the increases in fuel duty, as fuel duty is expressed in cash terms rather than as a percentage, but it has considerably offset their effect on pump prices. For example, in the two years from April 1994 to April 1996 duty on unleaded petrol increased by 21%, but the retail price before duty and value added tax fell by 17%. As a result, the pump price increased by only 8%. During that time the retail price index increased by 5%; so, despite increases in duty at more than the committed rate, the pump price of petrol increased by only about 1.5% a year in real terms.

The fuel duty strategy has been strengthened slightly by the present administration to provide a guaranteed annual increase in fuel duty of 6% until 2002. However, we do not believe that price increases on this scale will by themselves have a big enough effect on consumer demand or manufacturer response. They need to be accompanied by either voluntary agreements or legislation to accelerate the development by manufacturers of more efficient road vehicles. We believe that this should be accompanied by a concerted campaign to change public attitudes to cars. There must be much greater awareness of the fuel consumption of different models and their potential to cause air pollution.

I have mentioned the European Commission initiative which is aimed at producing a voluntary agreement with manufacturers to improve fuel economy by a third by 2005. If it proves impossible to secure voluntary agreement in this way, the UK government should be prepared to support European-wide legislation to limit carbon dioxide emissions from cars.

In addition, we have advocated steep graduation in vehicle excise duty for cars, based on certified fuel efficiency when new, in order to provide a strong additional incentive for manufacturers to develop and market, and users to purchase, vehicles with lower fuel consumption. The House of Lords Select Committee on Science and Technology recommended abolition of vehicle excise duty on private and light goods vehicles with an engine size of less than 1500 cc, with the lost revenue being recovered through increased fuel duty. However, we believe that the policy we advocated would achieve a more direct relationship with fuel consumption and influence decisions over the full range of car models, thus averting attempts to avoid duty by marketing cars just below any threshold that might be set.

Transport and planning

The measures discussed above must also be accompanied by policies to improve the management of traffic and encourage people to switch to modes which are less damaging to the environment. The Royal Commission's Eighteenth Report concluded that a sustainable transport policy will require a thorough-going integration of transport (in all its modes) and land use policies, at national, regional and local levels.

Over the years the UK has developed a particularly car-intensive lifestyle, which, as in other developed countries, has contributed to the rapid growth in travel by car. There is no simple relationship between car use and ownership and GDP per head of population. Britain had the lowest per capita GDP of a group of ten developed countries considered in the Royal Commission's Eighteenth Report¹ and came seventh in terms of car ownership per thousand people, but third in terms of the average distance travelled by car annually. Although the USA had the most car-intensive lifestyle, the British had a more car-intensive lifestyle in absolute terms than people in Belgium, France, Germany, Italy, Japan and the Netherlands, and a more car-intensive lifestyle in relation to their wealth than people in Denmark and Sweden.

Uncoupling car ownership from car use would contribute to reaching our target of a sustainable transport system but, as well as being sustainable, a transport system must satisfy people's need for travel in order to maintain their livelihoods and for leisure. One of the objectives the Eighteenth Report identified was to ensure that an effective transport policy at all levels of government is integrated with land use policy and gives priority to minimising the need for transport and increasing the proportions of trips made by environmentally less damaging modes.

Satisfying in a sustainable way people's need to travel is the responsibility of the planning system. Transport and development must be planned together. The recent creation of the Department of the Environment, Transport and the Regions, which combines responsibility for transport with responsibility for land use and other aspects of environmental policy should facilitate this.

Walking and cycling

Although the statistics available are limited, the increased use of cars, especially for short journeys, has greatly reduced the distances many people walk or cycle. In terms of carbon dioxide emissions, and other polluting emissions, walking and cycling are the most environmentally-friendly modes of transport available. However, the downward trend in walking and cycling is of greater concern in a health context. Physical activity contributes to the prevention and management of weight problems and protects against coronary heart disease.

One area to which the Royal Commission has drawn attention is the journey to school. As a result of many factors, not least the real and perceived risks to child safety from people and other road users during the, possibly unaccompanied, journey to school, the statistics show a sharp decline over the last few decades in the number of children walking or cycling to school. For example, the proportion of children aged 7-11 taken to school by car increased to 30% in a 1990 sample from 1% a generation earlier, the proportion walking dropped from 87% to 67% over the same period.

Experience in other European cities, such as Delft in the Netherlands where over 40% of journeys to work are made by bicycle, has shown that these trends are not irreversible. It is, however, undeniable that the UK has fallen behind the rest of Europe in provision of such high quality facilities for cyclists and walkers. The challenge here is to make walking and cycling safe, by providing well-lit, dedicated facilities which are physically separated from other road users.

We are encouraged by the development of the National Cycling Strategy and the continued efforts of Sustrans – boosted by Na-

¹Belgium, Denmark, France, Germany, Great Britain, Italy, Japan, the Netherlands, Sweden and the United States of America.

tional Lottery money – to provide long-distance cycle routes in the UK.

Improved public transport

The provision of an improved public transport system would help to reduce reliance on the private car. However, the attractiveness of public transport needs to be improved before people will use it in preference to their cars. Public transport needs to be reliable, punctual, connected, comfortable, at the right price and easy to use.

Public transport has been subject over the years to a spiralling circle of decline. As use of public transport declines, often because of the lack of many of the above attributes, services are reduced. As service frequencies and the quality of service decrease, public transport is used less, and so on.

When tackling the improvement of public transport, it is important to realise that the effect of a package of measures can be much more than the sum of the parts. This is demonstrated by the results of research carried out for the then Department of Transport assessing the effectiveness of public transport improvements and other measures in solving urban transport problems. Several possible policy measures were tested against a base case forecast (assuming the continuation of existing policies) for a large provincial city in the year 2000. The results were expressed in terms of carbon dioxide equivalent reductions compared with the base case.

The first set of options comprised improvements to public transport including bus priority measures, light rapid transit networks and substantial fare reductions. A 50% reduction in all public transport fares reduced carbon dioxide equivalent emissions by 3.5% compared with the base. Introduction of a light-rail network reduced carbon dioxide equivalent emissions by 3.1%.

A second set of options considered car restraint on its own. Specific measures involved were pedestrianisation, reductions in the supply of car parking spaces and increases in public parking charges. Although the impact was lessened by the provision of free parking spaces at work and on the streets, a doubling of parking charges reduced carbon dioxide equivalent emissions by 3.6%.

Finally, a combination of car restraint and improved public transport was considered. Here, cordon charging, reduced parking provision and light rail construction affected emissions significantly reducing carbon dioxide equivalent emissions by 23% compared to the base case. The results were largely due to a reduction in the traffic entering the central area and the resulting increase in peak central area car speeds. The Department concluded that, taken separately, extensive car restraint measures are more cost-effective than measures to enhance public transport. This study highlights the need for a multiplicity of measures in a number of areas and the importance of a balanced approach, comprising both carrots – improved public transport – and sticks – direct restraint on cars.

The value of an integrated transport system is also more than the sum of its parts. We welcome the government's commitment to an integrated transport system and hope that the conclusions we have reached as a result of our work on transport and their implications will be given full weight in the fundamental review of transport policy which is now in progress.

Freight transport

There is considerable variation in the amount of carbon dioxide emitted from different modes of freight transport. In terms of specific total emissions of carbon dioxide expressed in grammes per tonne-kilometre of freight moved, the Eighteenth Report gave the following figures for five modes of transport:

- by pipeline 10 g/tonne-km
- by water 30 g/tonne-km
- by rail 41 g/tonne-km
- by road 207 g/tonne-km
- by air 1,206 g/tonne-km.

For many reasons – not least to reduce carbon dioxide emissions – the Royal Commission wished to see increased movement of freight by less environmentally damaging modes, namely rail and water and set targets for the desired inter-modal shift.

Our target for rail freight, to increase the proportion of tonne-kilometres carried by rail from 6.5% in 1993 to 10% by 2000 and 20% by 2010, was dismissed at the time for being far too optimistic. We did, and do, not accept this and we are not alone. The UK's main rail freight operator – English Welsh & Scottish Railway – has set an even more ambitious target of tripling rail's share of the freight market in the next ten years. We, and obviously they, believe that change really can occur. What is needed is commitment and drive and appropriate investment.

In addition to increasing rail's contribution to freight transport, the environmental impact of freight movement can be further lessened by reducing the distances over which freight has to be transported through better planning by the industry and local sourcing of supplies. Moves towards internalising the external costs imposed by road freight will be a stimulus in this direction.

Many commentators have remarked on the long distances over which goods are transported during the manufacturing and retailing processes. For example, in its Food Miles project, the SAFE (Sustainable Agriculture, Food and Environment) Alliance points out that "the transport of foods is responsible for over a quarter of the distance travelled by heavy goods vehicles in the UK, more than for any other major commodity group". The SAFE Alliance also claims that "the same amount of food is travelling 50% further around the UK by lorries than fifteen years ago – supermarkets' centralised distribution systems and just-in-time deliveries are major culprits".

The SAFE Alliance has noticed some change in policy by a few major supermarket chains towards more local sourcing since the Food Miles campaign was launched in 1994. Initiatives which reduce the distances over which goods are transported are to be commended and we would like to see their wider adoption.

Conclusions

The government has set a target for the UK of a 20% reduction in carbon dioxide emissions by 2010 from 1990 base levels. This is an extremely challenging but achievable target which, however, can only be attained if action is taken now and is reinforced by long-term policy.

Several analyses of the contribution that transport could make to meeting this target have been carried out. Two recent studies reached roughly the same conclusions on the size of this contribution.

In June 1997 the Socialist Environment and Resources Association estimated that the transport sector could contribute 44% to the reduction in carbon dioxide emissions required by 2010 to meet the government's target. Measures to increase road vehicle efficiency would contribute 24% and measures to reduce road traffic 20% to the overall reduction required from all sectors.³

Also in 1997, ETSU (the Energy Technology Support Unit) estimated that transport could contribute 43% to the overall reduction in carbon dioxide emissions needed by 2010, the reductions coming from measures to improve vehicle fuel efficiency (24%), to encourage modal switching (5%) and to reduce the demand for travel (14%).⁴

Reducing carbon dioxide emissions from transport presents a considerable challenge on many fronts. It presents the technological challenge of improving the fuel efficiency of the vehicles we drive, it presents the challenge to the policy makers of effectively internalising the environmental costs of transport and providing a combination of economic incentives and regulations which will enable transport users to make informed decisions which take these environmental costs fully into account. It also presents the challenge of increasing the use of public transport and of the railways in the UK so that the shifts to less environmentally damaging modes of transport which the Royal Commission has recom-

mended occur.

We have stressed in our reports on transport that there are no simple solutions. We have stressed the importance of a fully coordinated and integrated package of a large number of measures to enable our targets to be met. However, I will close with a quotation from Edmund Burke:

"Let no-one make the mistake of doing nothing because he could do so little."

Small steps taken at a local and individual level are also of significance on the road towards a sustainable transport system.

Dr Mary Archer*

Summary

The UK Government is committed to the challenging internal target of reducing carbon emissions by 20% on 1990 levels by the year 2010. This paper comments on the contribution that the domestic and renewables sectors could make. The domestic sector could make a significant contribution but will not approach its 20% share without a greatly expanded programme of assistance for improvement of the country's housing stock. Renewables could expand rapidly over the next twelve years to produce 10% of the UK's electricity supply, but this could not be a 'least cost' option. This talk was given in September, but the written version was prepared in December after the Kyoto meeting, and takes the outcome of that meeting into account. Whether the UK should adopt a more ambitious national target than is required under the Kyoto protocol is debated.

Introduction

Leading up to Kyoto, there has been much discussion of what carbon dioxide (CO₂) emission reduction targets should be adopted, both nationally and internationally. The new Labour administration has, however, already nailed its colours to the mast, making it clear in its manifesto and several subsequent statements that it is committed to a domestic target of reducing UK CO₂ emissions by 20% below 1990 levels by the year 2010, irrespective of what international targets may have been agreed at Kyoto. The feasibility of achieving this challenging target is what has brought us here this evening. I have been asked to comment in particular on the contributions that the domestic and renewable sectors might make.

The Intergovernmental Panel on Climate Change has determined that anthropogenic global warming is a real effect which is already discernible in recent climate patterns and is likely to cause an unprecedentedly rapid rise in surface temperature over the next decades. I accept this conclusion, reinforced by Sir Robert May's note,¹ but we should bear in mind that global climate modelling (GCM) is still in its early stages and substantial uncertainties remain about its predictions. While it is certain that increasing the atmospheric concentration of greenhouse gases (GHG) traps more heat in the atmosphere, this extra heat is small compared with some natural inputs into the Earth's radiative balance, and even the uncertainties in some of these. For example, doubling the atmospheric CO₂ concentration from its present level of ~360 ppm would increase the heat retained in the atmosphere by 3-5 W m⁻², but this is less than the uncertainty (± 10 W m⁻²) in the most important heat input to Earth's surface, namely the average annual flux (about 168 W m⁻²) of solar energy absorbed by the surface. Moreover, increased GHG levels have secondary effects such as increased atmospheric moisture content and changed cloudiness, and these have larger and in some cases opposite effects on predicted surface temperatures.

We probably need at least ten more years of observations and modelling to be confident about quantitative GCM predictions. Nationally and internationally, we should weigh the costs and effectiveness of abating GHG emissions beyond what is required

¹ *Eighteenth Report. Transport and the Environment.* Royal Commission on Environmental Pollution. Cm 2674. HMSO, October 1994.

² *Twentieth Report. Transport and the Environment – Developments since 1994.* Royal Commission on Environmental Pollution. Cm 3752. The Stationery Office, September 1997.

³ *Taking a Cool Look – policies to reduce UK carbon dioxide emissions by 20%.* Socialist Environment and Resources Association, June 1997.

⁴ *CO₂ Reduction Policy Options: An ETSU Viewpoint for the UK.* A.C. Smith and G.P. Marsh. ETSU, 1997.

under the Kyoto agreement against the costs of possibly needing to do so more abruptly at a future date, and also the costs of simply coping with altered climate patterns or developing strategies to offset them.

Projected emissions under the 'business as usual' scenario

The UK, unlike nearly all other OECD nations, looks set to beat its Rio carbon reduction target, that of holding CO₂ emissions in the year 2000 to 1990 levels. In 1990, the UK emitted 158 MtC (million tonnes of carbon) and in 2000 it is forecast to emit 149 MtC CO₂. However, much of the credit for this must go to the switch from coal to natural gas in power generation, rather than to any deliberate CO₂ abatement policies. The high efficiency of combined cycle gas turbine stations, together with the lower carbon content of gas, have caused CO₂ emissions from power stations to drop sharply, from 54 MtC in 1990 to a forecast 37 MtC in 2000. Decreasing help from this switch can be expected beyond 2000, particularly if the Government moves to protect the remainder of the coal industry following its December 1997 announcement that it is to review energy sources for power stations amid expressed concerns about future over-reliance on gas.

Beyond 2000 it becomes more difficult to forecast what carbon emissions would be in a 'business as usual' scenario, but most analysts have assumed the central projection from Energy Paper 65,² which is that the UK will emit about 161 MtC in 2010. Far from being a 20% decrease on the 1990 level, this would be a 2% increase. The 20% target would require emissions in 2010 to be only 126 MtC, a difference from the 'business as usual' case of about 35 MtC per year. (Changes in carbon stored in sinks such as forests and soils are ignored in these figures.) Finding ways of avoiding the emission of 35 MtC per year in the next twelve years will be a real challenge, the more so because emissions from the transport sector will continue to grow unless radical action is taken to curb the use of cars and decrease their fuel consumption.

The UK domestic sector

According to recent UK Climate Change Programme figures, the domestic sector accounts for 25% of current CO₂ emissions, the transport sector 25%, industry 28%, business, commercial and service 16%, with agriculture and others making up the remaining 6%. The domestic sector is therefore a worthwhile one in which to seek reductions. A number of studies have shown that there is the potential for very substantial energy savings of some 25-30% to be made in this sector by cost-effective means with pay-back periods of no more than a few years, chiefly by improving insulation and the efficiency of heating systems. However, the sector has shown itself very resistant to acting on this message when delivered through programmes of information and advice. Money talks louder, and financial incentives and grants are effective in securing domestic energy efficiency improvements, but the current rate of expenditure will not deliver anything like 20% CO₂ savings from the domestic sector by 2010.

There are currently about 23.3 million homes in the UK, two-

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thirds of them owner-occupied and the rest rented. The amount of energy used, and CO₂ emitted, per household is falling, because of improved insulation and improved efficiency of heating systems and electrical appliances. However, the average number of people per household is also falling. The projected future increase in the number of households outweighs the decreasing energy intensity per household, so total domestic energy consumption is expected to continue to rise, probably at much the same rate as in the past (16% between 1970 and 1995). Despite this rise, end-user carbon emissions from the domestic sector are falling slowly (from 42 MtC in 1990 down to a forecast 37 MtC in 2000). 'End-user' figures parcel out the CO₂ emission from power stations among the various consuming sectors, according to the proportion of electricity in their overall energy demand, and the fall in end-user carbon emissions from the domestic sector is, like the fall in overall emissions, largely due to the changed pattern of electricity generation. Beyond 2000, the central scenarios in EP65 indicate that carbon emissions from the domestic sector are likely to remain flat to 2010, but to rise thereafter as the proportion of nuclear in electricity generation falls.

Since 1990, true energy efficiency gains in buildings have been modest, saving perhaps 2 MtC per year in all, because the investment in them, and the incentives to invest in them, have been modest. At the top end of the housing sector, energy costs are only a small fraction of total household outgoings (3% in the top income decile), and householders have no particular incentive to reduce them further. The provision of home energy ratings when a property is offered for sale, showing how much it will cost to maintain the property to standard conditions of warmth, should provide a stimulus to the private sector to invest in energy efficiency improvements, and this is proposed in the private members' bill sponsored by the Liberal Democrat MP John Burnett.

At the lower end of the housing sector, energy costs are a more significant fraction of total household outgoings (8-10% in the lowest three income deciles), and reduction of energy bills is accordingly perceived as more important. However, both tenants and householders at this end of the market lack the capital to make improvements to their property and are reliant on grant-aided schemes. These tend rightly to concentrate on the properties of poorest energy efficiency where a major proportion of the benefit is taken as improved warmth rather than reduced energy bills. Programmes aimed at eliminating fuel poverty (a high priority of this administration) will therefore not deliver much in the way of CO₂ savings.

Nevertheless, some progress is being made in the social housing sector. Most of the new building has been undertaken by housing associations, which have made extensive use of energy rating tools to build new homes to an efficiency standard exceeding that required by Building Regulations and provide "affordable warmth" to their tenants. Local Authorities own most of the older social housing stock, and they have recently been required to profile the condition of their stock (both publicly and privately owned) as part of their Home Energy Conservation Act obligations. Some improvements are following from this, where funds have become available under the Housing Improvement and similar programmes.

How much CO₂ could the domestic sector save by 2010?

New homes built to current Building Regulations are much more energy efficient than the existing housing stock. However, only about 130,000 new homes are built every year, and very few (about 5000 in 1996) are demolished. Delivering substantial CO₂ savings from the domestic sector must therefore involve radical improvement of the existing stock, half of which was built before 1945 to generally low standards of energy efficiency. About 80% of the energy consumed in existing housing goes on space and water heating and the rest on cooking, lighting and appliances. Improving insulation and heating system efficiency must therefore re-

main the priority. Increasing the electrical efficiency of lights and appliances is also important, given the high carbon intensity of electricity, and the UK should play a more vigorous role in standards and energy labelling for domestic appliances.

In 1990 end-user emissions from the domestic sector were 42 MtC. If this sector were to contribute its own 20% share to the overall 2010 carbon reduction target, annual domestic emissions would have to fall by some 8 MtC per year by then. This figure is close to the 7.6 MtC savings attributed to the domestic sector by ETSU in their study of the most achievable way of reaching the 20% target.³

Carbon reductions of this magnitude will not be achieved from the domestic sector on a continuation of current policies. The Energy Saving Trust (EST), which since its formation in 1992 has amassed some hard evidence of the costs of abating household emissions, has recently published a study of what they think could be achieved by 2010.⁴ They concluded that emissions of 5.6 MtC, equivalent to 14% of current domestic emissions and 4% of current total emissions, could be saved by 2010, but only at the considerable cost of £2 bn spread over the next 14 years. This would require overall (public plus private) investment in domestic energy efficiency improvements to rise from its present level of £320 million per year to about £800 million per year, and the public component of this to rise from £100 million per year to £170 million per year, whether through an e-factor levy or general taxation.

There is no present indication that these increases in funding will be forthcoming. The anomaly which levied VAT on energy conservation equipment at over three times that on domestic fuel has recently been removed for work carried out under the HEES and HIP programmes, but it remains for private work. Moreover, funding of the EST – which many regard as a bellwether of Government intent regarding domestic energy efficiency – has fallen from £25 million in 1996/97 to £20 million in 1997/98, and is set to fall to only £14 million in 1998/99. Meanwhile, the reduction in UK energy prices over the past few years, while generally helpful to the economy, has decreased the interest in, and financial return from, making energy efficiency improvements in the domestic sector (and other sectors). The regulators who have achieved these price reductions, in particular the gas regulator, continue (reasonably) to argue that delivery of environmental objectives lies outside their existing remit. In its current review of utility regulation, the Government should clarify what future role the regulators are to play in implementing domestic energy and environmental policy objectives.

The contribution of renewables

Turning to renewables, these contribute to CO₂ abatement because some, like wind power, generate none, and others, like bio-fuels, recycle it. The commercial use of renewables, except for large-scale hydroelectricity, is still in its infancy, but they are just starting to register on the pie charts of energy supply and consumption in developed countries. In the developing world, the non-commercial use of renewables such as wood is considerable, but not sustainable. Some renewables (wind, hydro, photovoltaics) supply only electricity, some (active and passive solar) only heat and some (biogas, biofuels, biomass) can supply both, and transport fuels as well.

The UK government has maintained small RD&D programmes in selected renewables since the early seventies, chiefly through ETSU (the DTI Energy Technology Support Unit). More recently, the position of those renewables from which electricity can be generated has been transformed by the creation of the Non-Fossil Fuel Obligation (NFFO) under the Electricity Act 1989. The NFFO, proposed to protect the position of nuclear power following the privatisation of the electricity supply industry, requires the Regional Electricity Companies to pay premium prices for specified amounts of electricity from non-fossil fuel sources, the extra cost being reimbursed to them through a levy on pool electricity

sales. In 1996/97, levy payments totalling £111 m flowed to renewable electricity generators under the NFFO.

In the UK, use of renewables is currently up ~50% from 1990, and growth will continue as contracted and yet-to-be-contracted NFFO projects come on stream. As of September 1997, 476 MW DNC (Declared Net Capacity) of renewable electric power was available under NFFO contracts, and a further 800 MW is contracted but not yet in place. The previous administration's target was to "work towards" 1500 MW DNC of power from renewables by the year 2000, which would represent 3-4% of projected UK electricity supply and avoid the emission of ~2 MtC. While this total may not be reached by 2000, it should be shortly thereafter with the further NFFO orders that are planned.

NFFO projects have had such a high profile that it is easy to overlook the provision of heat and CHP from renewables. In 1996, UK renewable energy use totalled 1.7 mtoe (million tonnes oil equivalent), of which 0.5 mtoe went to heat and the remaining 1.2 mtoe to electricity (providing 5.8 TWh, or nearly 2% of UK electricity supplied in 1996).⁵ Biofuels (refuse, wood, straw, landfill gas and sewage gas) were the major renewable energy source, accounting for about 80% of the 1.7 mtoe, with most of the remainder coming from large-scale hydro. On-shore wind, for all its high profile, contributed only 2.4%.

The new administration has proposed the further target of meeting 10% of the UK's electricity needs from renewables by 2010, and is currently reviewing what would be "necessary and practicable" to achieve this. This target would require an additional 2500-3500 MW DNC (over and above the 1500 MW) to be commissioned before 2010. This would supply 38 TWh per year of renewable electricity and reduce carbon emissions from the electricity sector by some 3.5 MtC (this figure depends on what fuels are assumed to be displaced). This would mean that renewables would be contributing a useful 10% towards the overall 2010 carbon savings target of 35 MtC, at the same time as making a real contribution to sustainability and diversity in the energy supply industry.

The Government has provided support for renewable energy, mainly through ETSU, totalling £310 million to March 1997, and the private sector has probably put in rather more than this to date. The charge to the levy under NFFO arrangements for renewables has totalled £415 million to March 1997, and average prices paid have come down encouragingly (from 7.0p/kWh in 1990 to 3.46p/kWh in 1997, as compared with a pool price of 2-2.4p/kWh) as some technologies have matured. Accelerating the pace of installation of renewable plant would mean changing the policy emphasis from one of price convergence to one of volume deployment, which might keep unit prices up. On the other hand, if electricity system costs were redistributed to reflect the benefits and costs of embedded as opposed to centralised generation, as the green lobby has argued they should be, it is generally thought this would work to the advantage of renewables.

There are too many uncertainties to make it possible to estimate the total cost of providing 10% of electricity from renewable sources by 2010. We can, however, find a ballpark annual cost quite simply. By 2010, levy payments under NFFO 1-5 projects will have ceased, and these projects should be supplying about half of the 38 TWhc per year total. If future renewables orders secured a levy premium contribution of 2p/kWh, providing the other half would cost an 'extra' £380 million per year. Sums of this magnitude could be found by diversion of capital from the construction of conventional power plant, although the diversion would be unlikely to pass a conventional cost benefit analysis test. Renewables capable of delivering large amounts of power, such as off-shore wind and energy crops, would have to be developed, and a 'must take' obligation to purchase renewable-sourced electricity would have to be imposed on distributors.

The NFFO has proved to be an efficient stimulus of the delivery of electricity from renewables. In its review of the future of NFFO, the Government should consider what support should

now be offered to encourage the delivery of heat and CHP from renewables. Given the inefficiency of thermal electricity generation, it is worth considering whether "green gas" should be stimulated alongside "green electrons" and "biodiesel" in the nascent European green energy markets.

Conclusions

It is technically feasible to achieve significant contributions to the UK's proposed '20% by 2010' carbon reduction target from both the domestic and renewables sectors, but neither will be achieved on a continuation of current policies. The additional costs involved are substantial, although small compared with overall levels of expenditure in the housing and energy sectors, and the policy changes that would be required are considerable. The benefits, apart from a reduction in carbon emissions, would include warmer housing, less congested cities, cleaner air and new business opportunities. Other sectors (notably the transport sector) not considered in this paper would have to play an equally or more important part.

The Government has described its unilateral 20% target as "challenging but necessary and achievable". Challenging it certainly is, achievable it may be, albeit at substantial cost, but whether it is necessary or even wise for the UK to impose this stringent target on itself at this stage is a more difficult question. The UK provides only 2% of global CO₂ emissions, and this percentage will fall further as population growth and increases in per capita energy consumption eventually result in greatly increased energy consumption in developing countries. Strange and pleasant though it is to find ourselves casting off our image as the dirty man of Europe, global warming is truly a global issue, and can only be addressed by global action. The Kyoto protocol has at least bound three major blocs or countries – Europe, the US and Japan – into formal reduction targets beyond the millennium. Although it is certain that the US Senate will not ratify the treaty if the developing countries are not bound in by subsequent negotiations, it is equally certain that Europe will address its 8% reduction target seriously. In sharing out this 8% among member states, the basis of apportionment – per capita limits, sectoral limits, growth-based limits – should be carefully considered, because the system adopted should be capable of expanding to embrace other nations in time.

We also need to think seriously about other options for reducing the accumulation of CO₂ in the atmosphere. The case for nuclear power is weakened by the current low cost of fossil fuels, and substantial new nuclear generating capacity will not be created unless and until the world becomes more frightened of global warming than it is of nuclear radiation and accidents. Nevertheless, it will in my view be all but impossible to achieve long-term CO₂ reduction targets without a very large programme of new nuclear build. In the UK, nuclear currently avoids the emission of about 10 MtC per year as compared with the likely alternative (gas-fired stations), but this contribution will decline after 2010 as most of our nuclear stations reach the end of their operational lifetimes.

Other approaches include sequestration and absorption in biomass. Sequestration (the large-scale storage of CO₂) is technically feasible, and the capacity of depleted North Sea oil and gas reservoirs is sufficient to store European emissions for a substantial time. Considerable incentives would be needed to stimulate development work on this option, but it could well be less costly than emissions abatement. As for biomass, a global reforestation programme could offset a substantial portion of the expected future increase in CO₂ emissions. Even far-fetched solutions should be evaluated at this stage, for example Edward Teller's proposal that an inert scattering agent could be injected into the stratosphere to reduce ground-level insolation just enough to counter global warming. The cost of global CO₂ emissions abatement will be enormous; we should be very sure we get the best price as we embark on the purchase.

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PROFILES OF COUNCIL MEMBERS

SIR DAVID DAVIES CBE FEng FRS

Sir David Davies has been Chief Scientific Adviser to the Ministry of Defence since 1 October 1993. As Chief Scientific Adviser, he advises the Government on its largest single research and development programme outside the Research Councils and universities. Each year the MoD spends more than two billion pounds on science, engineering and technology.

Sir David was born in 1935 in Cardiff and educated at the University of Birmingham whence he graduated in electrical engineering and subsequently undertook research for a PhD. He joined the staff at Birmingham University and, during part of that period, held a part-time post as Senior Principal Scientific Officer at the Royal Radar Establishment, Malvern, via a staff interchange scheme. Thus he began his professional life with a divided role and a variety of activities, and this range of interests plus his desire to be involved in more than one activity has marked his professional career.

As a youngster, Sir David did not know that he wanted to be-

come an engineer. He said that he applied to a number of universities for a number of different subjects including physics, mechanical engineering and electrical engineering, and it was electrical engineering that he ultimately found himself reading at Birmingham. After graduating, he considered going into industry but was persuaded to stay on at university to do research on antennas. He was then offered a lectureship and so was, as he describes it, 'sucked into the academic field'. His part-time appointment at Malvern was a bonus in that it enabled him to work with those outside the university field while enjoying academic life to the full. However, in 1968, he left academic life for the post of Assistant Director of Research to the British Railways Board at Derby but returned to the university world three years later in 1971 when he became Professor of Electrical Engineering at University College London. During his period at U C, he served also as Vice Provost for two years. In 1988, he became Vice-Chancellor of Loughborough University, by which time one imagines he saw himself as much more a manager and administrator – albeit once an engineer, always an engineer!

He was elected to the Royal Academy of Engineering in 1979 and elected Vice-President in July 1995 and President in July 1996. He was elected Fellow of the Royal Society in 1984 and was awarded a CBE in 1986 and appointed Knight Bachelor in 1994.

Sir David was President of the Institution of Electrical Engineers in 1994/5 and is a Past President of the Institution of Electronic and Radio Engineers. He has been a Council member of various bodies, including the Royal Society, the Council for National Academic Awards and the Open University. He has also served on various government and private sector advisory boards and committees, including the Science Inquiry Committee of the Royal Society, the BBC Engineering Advisory Committee and the British Rail Research and Technology Committee. He was also Chairman of the Defence Scientific Advisory Council prior to taking up his post with the Ministry of Defence.

He has researched and published in the fields of antenna arrays, radar systems, signal processing and optical fibre sensors. He received the Rank Prize for Optoelectronics in 1984 and the Faraday Medal of the Institution of Electrical Engineers in 1987.

He says that engineering is fun and he believes that it is vital for engineers to spread the message that engineering is about excellence, wealth creation and the quality of life, factors that now underpin the strategy of all government-funded research. He wishes to convince young people that engineering is a rewarding profession that deserves their consideration as they think about future careers, but he also wants the public to understand that engineering is essential if society is to solve many of its problems and to meet its aspirations. He says that, in recent years, there has been much debate about the environment and while people want a greener society they do not want to give up their comfort and free-



dom of choice. Whatever laws politicians may pass, he thinks it will be the engineers who make the major decisions on how society moves forward and fulfils its seemingly contradictory ambitions.

Sir David believes that the traditional view that engineering just deals with hardware was never really true. Engineers have to take a much more active role in looking at the social impact of their work, and he quotes as an example the fact that the Royal Academy of Engineering has been talking to the Economic and Social Research Council about common interests. The Academy recognises, as does the ESRC, that many interesting social issues are related to engineering and its impact, and Sir David is pleased that the Academy is keen to assist the ESRC in its good work in those areas and to contribute to its studies. He says that engineers today live in a fascinating time: they are part of the information explo-

sion and they are contributing at a time of revolution in the relationship between broadcasting, communications, transport, publishing and information technology; the boundaries between these areas are increasingly soft, the areas are interacting with one another and, together, they are going to change engineering no less than other aspects of life. The effects of new technology on the manufacturing sector have been particularly dramatic.

Sir Denis Rooke, speaking as a colleague and friend, described Sir David as an absolutely top class engineer with a wide interest and experience in most branches of the subject and certainly not someone who was a closet researcher. He is not a man afraid to take on new responsibilities and was particularly successful in encouraging and motivating his colleagues.

The Foundation's Mission

A review by the Chairman, The Rt Hon the Lord Jenkin of Roding

On my election as Chairman of Council in May, I initiated a review of the Foundation's mission and activities. I wanted to satisfy myself that what the Foundation is doing matches both the objects clause of our Constitution and the overall purposes for which we exist. The Foundation has developed considerably since its establishment in the early 1980s and I felt it important that we should have a mission statement which reflects our role as a neutral platform for the discussion of issues where the common thread is always science, engineering and technology and its effect on society. I felt it important that we should retain our position as a neutral platform.

I visited a number of stakeholders from different sectors of our membership and a paper was prepared for discussion in Council. In addition to the usual criticisms ("there are too many of the same faces at the Foundation's meetings", "there are too few young in the audience", "more leaders of industry are needed in the audiences"), I heard some interesting and worthwhile comments. Some said that the Foundation serves well with its events but that at the end of some particularly good meetings people went off with a feeling of "what can we do next?". Hitherto, the view has been held that it was up to those present at meetings to take action themselves to follow matters up. It was suggested to me that this would be helped if, after each meeting, a summary paper could be produced and circulated not only to those who attended but also to others who were invited but could not attend. Council has agreed this suggestion and steps are in hand to do this. It is, of course, crucial that any notes produced and circulated should fully reflect the Foundation's principle of providing a "neutral platform". We must not be seen to be taking sides. We must also strictly observe the Chatham House Rule.

Questions had been raised about the relevance of the Foundation's overseas events. Some years ago, Dr Richard Haas, a Vice President, had advised Council that while the Foundation has speakers from Brussels from time to time, we should initiate discussions with other EU members. Hence, the Foundation has held events in Frankfurt, Paris, Berlin and Brussels. Council agreed to review this programme of overseas events and a small group will examine how to achieve the best value from visits and provide some guidance over their frequency, the countries to be visited and the bodies which should be involved.

A proposal was put forward that plans should be made for a possible series of related events around a particular theme. We might involve a number of other organisations in the planning of such a series, including industry, academia, government and appropriate NGOs. Each event in the series could constitute a "stand alone" seminar on the usual pattern, but there would be a common theme which might form the basis for a report to be agreed by a committee of Council which might be sent to government and relevant organisations. In this connection, Council has agreed that it would be right to involve younger engineers and scientists in the work - perhaps inviting groups to hold preliminary workshops and then take part in the relevant evening events.

Council will also be looking at suggestions that we might occasionally hold "technology debates", but this needs further examination.

I hope that members will feel that this review, while underpinning and confirming the essential nature of the Foundation's work, will help us to fulfil our main purposes more effectively in the future.

FOUNDATION NEWS

Engineers & Enterprise - A Joint Meeting

The French Embassy, the Engineering Council and the Foundation for Science and Technology organised a conference on Engineering and Enterprise which took place on 20 and 21 October 1997 at three centres: the Institution of Civil Engineers, l'Institut Français and Imperial College. Attended by 195 French and 92 British, papers were presented and discussions took place on matters concerning engineering in the two countries, with emphasis on professional engineers. After opening addresses by the Rt Hon the Lord Jenkin of Roding, Mr Robin Wilson, Chairman of the Board for Engineers' Regulation, Engineering Council, and by M. Gilbert Rutman, President du Conseil National des Ingenieurs et Scientifiques de France (CNISF), the differences in the acquisi-

tion of qualifications was the principal theme for the first day. There was much agreement over the qualities required of the future engineer. The second day was largely devoted to the needs of industry, with a final session chaired by Sir Anthony Gill at Imperial College with the French Ambassador giving the final address just before a formal agreement was signed between the Engineering Council and the Conseil National des Ingenieurs et Scientifiques Français (CNISIF) as a fine climax to the two-day forum.

Nearly one hundred young engineers joined the meeting for the second day, with detailed arrangements made for representatives of companies to meet and interview them.

The event was sponsored by Elf Exploration UK plc, Eurotunnel and Credit Lyonnais.

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Whose support of, and involvement in, the affairs
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