Lord Broers

Reith Lectures 2005: The Triumph of the Technology

Lecture 5: Risk and Responsibility

Almost exactly 93 years ago tonight, on 15 April 1912, over two thousand terrified and bewildered people found themselves with little warning drifting or drowning in the ice-cold North Atlantic. Only 712 of them survived that night. They were, of course, the passengers, officers, and crew of the White Star steamship Titanic, and they were in a sense victims of 'failures' of technology.

The Titanic disaster was in the main a result of over-reach, of a gap between the achievements of some technologies and the shortcomings of others; and of managerial failures on the part of those who used the available technology. Although Titanic had a radio communications system - and it was an important factor in directing rescue vessels to her - it was a system still in its infancy. Although the technology of shipbuilding already embraced double skins and water-tight bulkheads, these fell far short of the completeness that we now expect. Those navigating this huge vessel were in some important respects no further advanced than the Vikings who had sailed these same seas ten centuries before: they could locate themselves only by means of stellar observation and dead reckoning, and they had only their eyes to see what lay ahead - and this was less than a hundred years ago.

The managerial failures were perhaps worse. The ship's officers were warned of ice by radio messages, which they ignored. They hadn't carried out safety drills or trained the ship's company. The ship was speeding blindly into a known danger area in order to meet her scheduled arrival time in New York. Accidents, by definition, happen. But more diligent officers, properly-trained crew, and a sufficiency of lifeboats, could have saved the majority of those lost to the depths on that dreadful April night.

What does this long-ago catastrophe have to say to us today? Its from such appalling experiences, avoidable perhaps only with hindsight, that we learn how to progress more safely, and it is this process of trial and error by which medicine, aviation, safety in transportation have been transformed in the lifetimes of many of us here tonight.

If technology is to continue to triumph, ,however, and I am convinced that the future well-being of our planet and all its inhabitants requires that it should, then technologists must seriously address themselves to the fundamental issues bearing on their work What we must not do is either complacently to ignore risks, as the managers of the White Star Line did before 1912, or to submit unthinkingly to false terrors of their possible consequences. There has been great progress in making our lives safer, and my hope is that over the next century we may achieve as much progress for the planet we live in. After all our lives and those of generations to come depend on the health of our environment.

In this final Reith lecture I am making a green argument. As a technologist this should not be surprising, but because of the gap in understanding that has developed, it may be beyond the grasp of many people to realise that the solutions to the problems created by technology will themselves be technological. What we engineers have to

do is to be seen to have codes of acceptable behaviour and to be living up to those standards. And we must communicate more and better, be more transparent in what we do, and be prepared patiently to debate public concerns, even if we believe that these concerns are based upon prejudice or ignorance. It is time now as a matter of urgency and for the sake of saving our planet, and thus safeguarding the future of the human race, to move away from the old concept of 'the public understanding of science' to a new more dynamic 'public engagement'. We must work harder to understand what drives the public's concerns and anticipate the technological developments that are likely to be of concern, for example, the approach to nanotechnology was good, but we failed properly to join the GM debate.

It is not just the engineers and scientists that are to blame. Intelligent public debate demands a broader understanding on the part of everybody and standing in the way of this broader understanding is the specialization encouraged by our schooling system. It is still possible in England at least, for young people from the age of fifteen to study only mathematics and physics, or on the other hand to do no science or mathematics at all. This depresses me greatly . Let engineers and scientists learn their Shakespeare and play the violin; and arts graduates should be ashamed rather than proud to be ignorant of technology. And we still have much to do on gender balance.

I make no distinction between someone who does not know the difference between electric current and voltage, and someone who knows nothing of Byron. Why is it that we accept the former and despise the latter? Neither is satisfactory, we should strive for a cultural balance. We need those with understanding of history and the arts to enable technology to be used for good. And we still have much to do on gender balance. In our schools, girls now outperform boys in all subjects, and yet most girls are frequently brought up to assume that engineering and many of the sciences are male subjects. The wasted potential is vast.

In an earlier lecture I talked about the industrial revolution that occurred in the closing decades of the last century as globalization became practicable and products were assembled from the world's best components no matter where they were made. There was also a revolution in our understanding of the need to do things in a way that preserved our precious resources. Advanced instrumentation brought us data on the condition of the biosphere and we became aware of the damage that was being done to the ozone layer and the effects of excessive production of carbon dioxide.

Engineers reacted to these data with a plethora of potential solutions, just as they did in the 1960s when air pollution in the world's largest cities reached unacceptable limits and anti-pollution devices were needed for cars. But the situation now, as then, is not simply technological. Solutions require political decisions that depend on public debate and bring us back to the question of public engagement.

Let me start with travel. I travel a lot, as many of us do, probably too much for the sake of the planet. For example, I am conscious every time I fly to the Far East or Australia and back that one ton of aviation fuel is consumed for myself and each one of my fellow passengers - and that assumes that the plane is full. This is bad enough but at least the fuel is used to carry passengers to their destinations and is not wasted. The lack of planning that has left our airports in the overburdened state we find them today is another matter. Following last week's Reith lecture I flew from Glasgow to

Heathrow in the middle of the day, which is not a particularly busy time from the point of view of airline traffic. The flight took less than an hour, but because Heathrow could not handle the traffic, we were placed in a stack for 30 minutes before we could land. We were up there wasting fuel, polluting the atmosphere and getting increasingly annoyed. The next time I flew out of Heathrow, the plane was on the ground with its engines running for forty minutes before we were able to take off. This profligate waste is a result of the inability of our public decision making process to implement in time what our business and technical experts have been telling us for years about the growth in airline traffic. We have our heads in the sand on these issues, or at best are in denial about projections of growth. Technology is the great leveller. It is allowing more and more people to enjoy what was once only for the wealthy. Technology too can provide solutions to these problems but only if people choose to implement them. And this is why I decided to give these Reith lectures. Technology can solve our problems but only if the public engage with it.

The situation with our road traffic is even worse. It is estimated that the cost of traffic congestion in the UK is £15 billion per year, the highest cost per capita in Europe. But the cost is not the only issue. Almost all the road vehicles have their engines running while they are stopped in traffic jams, wasting fuel and polluting the atmosphere. This is another example of the lack of adequate planning and acceptance of the projections of experts. Several first world countries have built railways that are clear winners in terms of time and convenience for journeys up to about five hundred miles. According to Professor Roger Kemp of Lancaster University, domestic airline flights use more than three times the energy of a Shinkansen train running at 275 km/hour, and the train's energy can be produced by non-polluting sources, such as wind turbines and nuclear power, rather than fossil fuels. For a country that claims to be putting global warming high on its agenda, it is incredible that we allow air travel to expand especially as research has shown that emissions at a high altitude are much more damaging to the environment than emissions at ground level. And yet in this mad world, aircraft fuel is untaxed. Why on earth was it faster for me, even with the delay, to fly from Glasgow to London rather than take a train?

Our means of generating and consuming energy are also unnecessarily wasteful. Let me start with consumption. Our houses are inadequately insulated and sealed - both our houses and our building regulations are full of holes. Average householders have little idea how much energy they are using, nor how they could reduce their consumption. Many do not even read their consumption meters themselves and a huge number pay estimated bills because no one is reading the meters on a regular basis. Technology could supply simple solutions to this difficulty, for example by providing meters that could be located in kitchens, or over back doors, that gave the householder a real time indication of the amount of power they were using - in terms of money and green house gas production - and by enabling people to see immediately the effect of turning off unnecessary appliances. The installation of such meters could even be regulated, but the idea has been considered too expensive although such a meter would be trivial in complexity compared to a £50 DVD recorder.

When it comes to power generation we have at least made some progress. We have realised that global warming is real and that we need to switch to technologies that are sustainable. But a lack of realism remains in terms of how much this will cost, and how long it will take to implement. Much progress has been made with wind, wave

and tidal generators but these technologies are not free from controversy and it is unlikely that they can provide more than about a fifth of our power requirements in the next twenty years, and even then the cost is likely to be much higher than, for example, present natural gas fired generators.

We need not be in this situation. France already generates 90% of its power in a green house gas free manner - 77% nuclear and 13% hydro. We are going to have to reexamine the nuclear option. There has been great progress since we built our present nuclear plants, not only in the technology of generation but also in the disposal of nuclear waste. I am pleased that we are examining the options for nuclear waste in a process that does engage the public. But public assessment of risk, and trust, or lack of trust, in technologists has nevertheless brought us to an impass that endangers our planet. The growth of naive green politics is itself endangering future generations as we reject technological solutions that could perhaps save us. Which brings me to the whole subject of the public's understanding of risk and how this has changed in recent times.

We have only to consider the central role of electricity in our society to see how wide-ranging risks have developed. Our dispersed, personal use of electricity is dependent on a single, highly centralised system that may be victim to natural or malign attack and is jeopardised by the depletion of fuel reserves. The responsibilities on the shoulders of engineers are huge. Explaining and understanding those risks is, I believe, a paramount necessity. For who amongst us will accept power failures, which not only plunge us into darkness but shut down our heating, refrigeration and communications systems and put at risk most of our transport and medical support systems. And yet security of supply is seldom quoted as a primary need when we enter the emotional debates about sustainable sources of power.

These are not only issues for our comfortable First World. The most idealistic amongst us will surely accept that application of some technologies is the likeliest, even the only, means by which the endemic poverty, disease, and desperation in which a majority of the world's population live can be alleviated.

But the risks of pollution and contamination are not straightforward. If we are to realise acceptable world-wide reductions in the production of carbon dioxide and pollution the developing world needs to join the developed world in changing to sustainable technologies. Without help they cannot do this - they have neither the technology nor the money and there is little sense in the rich world banning processes and procedures and imposing a heavy and expensive burden of regulation even if it had the power to do so.

The controversies I have mentioned involve established technologies. Ethical issues become still more complex when associated with new technologies and processes. The pace of innovation and change is astonishing. A celebrated reference in a history of science written in 1964 points out that 'if this book were planned according to the volume of scientific discovery, everything before 1800 would be contained on the first page'. Bearing in mind the developments of the last forty years, that first page of summary would now be reduced to one paragraph. New technologies provide immense opportunities, but also undeniable risks and open the question as to whether their development should be regulated.

In my opinion it is better for companies, institutions, universities to develop their own sets of ethical guideline rather than for governments to regulate. I recognize, however, that commercial pressures can lead to unacceptable behaviour and there are instances where governments do have to regulate. But they should do reluctantly and only after engagement with the public. We need fast advances to deal with our problems and over-regulation is itself a risk to our future.

And when it comes to risk, everyone would benefit from a better understanding. We should all think more about how we decide what is acceptable risk? Why are some afraid to fly but happy to drive a car despite its hugely higher risk of injury or death, and perversely to drive aggressively and dangerously? Why do we accept a greater likelihood of accident at home than we do at work? These are some of the key questions discussed in a series of reports of the Royal Academy of Engineering that have generated considerable debate.

One crucial recommendation emerges. That the investigation of accidents should concentrate on finding the cause of the accidents not the person or persons to blame. The latter only leads to defensiveness and cover up. The investigation should seek the cause of the accident so that it may be eliminated in the future. The airline industry's remarkable safety record is thought by some to be because the investigators seek the cause of accidents rather than hunt down the person to blame.

Now as I conclude my Reith lecture series, I want to indulge in the most dangerous of activities - the prediction of what technology is likely to achieve in the years ahead. And you should be aware that we technologists frequently overestimate what will happen in the next five years, while completely missing the revolutions that can occur in 20 years. I have chosen just three areas in which I believe and hope that technology will continue to triumph and to change our lives dramatically.

The first is in our ability to solve larger and larger problems, for example, to improve our ability to forecast the weather, better to control national or regional economies, to design better drugs, or to improve the management of more and more complex organisations, for example, hospitals or even health systems, or entire complex businesses, even to control and automate traffic flow. The challenge is to create even larger and more complex computer systems of the type that at present have such a mixed reputation, with many ending in fiasco as schedules slip and budgets overrun. I believe that slowly but certainly we are learning from our mistakes and are going to succeed in many of these endeavours - 95% accuracy in weather forecasting, hospitals in which mistakes are almost never made, the alleviation of poverty, further reductions in accident rates on the roads and railways. This is a glimpse of what we might be able to do.

Technology will increasingly be able to identify objects and people. Success with radio frequency tags may eliminate the manual check-out in our supermarkets and shops, keys and money as we know them will become curiosities of the past, and we will enjoy more security for ourselves and our possessions. These of course raise serious matters for public engagement.

The final area of advance will be in medical technologies, not an area in which I am expert, but one where I am confident that vast strides will be made - in the control of, and perhaps even in the curing of AIDS and some forms of cancer. The creation of prosthetics, such as hip and knee joints, that will last a lifetime, perhaps through the nanostructuring of their surfaces as I learned at Glasgow university when I was delivering the last Reith lecture there. All these and many more are giving rise to remarkable increases in life expectancy and this is expected to continue with significant social consequences.

No matter where we look, technology is changing and shaping our lives. I hope I have convinced you over the last five weeks that technology is our friend. We must engage with it as a society and use it to push forward. In the last century we learned a great deal from our disasters, and hugely increased the number of people enjoying the myriad benefits of technology. Now we are at risk of permanently endangering our planet. Our aim for this century should be to make comparable progress in protecting our environment. Technology will truly triumph if we succeed.