

“CLIMATE CHANGE AND US”

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There is today robust scientific evidence that emissions from economic activities, particularly the burning of fossil fuel for energy, are changing the Earth's climate. The issue is serious and urgent, calling for a world-wide shift towards a low-carbon economy, on the basis of international collaboration of a degree never before known.

This is not just an environmental issue. It is also an economic issue, an energy issue, a foreign policy issue and a security and defence issue. And the biggest difficulty of all is political. It could well prove the hardest problem the modern world has ever had to face.

My own impression is that global warming is worse than most scientists had first thought. Very precise predictions are not yet possible. But, if things go badly (which is not certain, but possible), climate change could bring the demise of much we hold dear, before this century is out. And the British can't do much about it, alone. Only international action will be effective, with the Super Powers fully on board – the US, China and India ; but also Brazil ; and of course Europe and Russia. The chance of that happening, soon enough and in the right way, may well be not enormously better than 50:50. But there is still everything to play for.

From the final drafts which I have seen, such will broadly be the message of the International Panel on Climate Change (IPCC), when it delivers its Fourth Assessment later this year. Equally, it is the settled view of the competent British authorities. The Report of a government-sponsored scientific conference organised by the Meteorological Office's Hadley Centre, published last year, was entitled 'Avoiding Dangerous Climate Change'. In his foreword, the then Prime Minister wrote that "the risks of climate change may well be greater than we thought" ; and that "Greenhouse gas emissions need to slow, peak and reverse". Mr Blair couldn't have been clearer. Sir Menzies Campbell concurs. Mr Gordon Brown, too. Mr David Cameron is equally exercised. As for the Government's Chief Scientific Adviser, Sir David King, he is on recent record as saying that "climate change is the most severe problem we face today – more serious, even, than terrorism".

I personally endorse this view. But not everyone here tonight – whether members or distinguished invitees – will agree with me. Climate Change is controversial. Some deny it ; others decry it. Special interests are busy, lobbying away ; there are some discordant and disputatious voices ; Eco-Scepticism is chic. Public opinion, according to the latest poll, is not convinced and is anyway more concerned by other matters – such as housing and street crime.

Climate Change in a Nutshell

Man-made global warming is, admittedly, a complex process. Let me attempt to 'de-complexify' it a little. Eleven of the last twelve years (1995-2006) have been the warmest on instrumental record (i.e. since 1850). The greatest single cause of this

warming (as to around 50%) is the build-up of CO₂ in the upper atmosphere, as the result of comparatively recent industrial activity on the earth's surface, mainly through the burning of fossil fuels. The present level of atmospheric CO₂ has not been seen for over 650,000 years. Methane, nitrogen oxides and sulphur dioxide are also part of the picture. Taken together, these so-called 'Greenhouse Gases' (GHG) have had a screening effect. Infra-red heat from the sun which is normally reflected back out into space, is trapped in the atmosphere, thereby raising the earth's temperature. This, in turn, affects weather patterns, ocean flows, and the polar ice caps, with potentially adverse consequences for vegetation, marine life, sea levels and human life itself.

The problem doesn't stop there. The phenomenon can be progressive, when magnified by what are called 'positive feedbacks'. Thus, the more the ice caps melt, the less heat is bounced back into space, as the so-called 'Albedo' or reflectivity effect diminishes. The warmer it gets, the more methane and other gases get released from existing 'sinks', below ground and in the beds of the world's oceans, into the atmosphere. The acidity of the oceans increases to a point which affects algal growth and the chain of marine eco-systems. Tropical rain forests are destabilised and begin to get replaced by sand and desert. (I myself saw this at work in Rajasthan last year) In the worst scenario, a 'sudden discontinuity' or 'tipping point' can be reached, in which the warming becomes self-feeding and a runaway process is initiated which cannot be controlled and may prove irreversible for many thousands of years.

The Dawn of Understanding

All this is relatively new to human understanding. Certainly, the penny has taken its time to drop.

Climate change was first recognised as a major issue at the Stockholm Conference on the Human Environment in 1972. The United Nations Environment Programme was instituted. A series of climate research programmes were initiated. In 1979, the first World Climate Conference took place. Then came the report of the Brundtland Commission on Environment and Development in 1987. The following year, the UN's Intergovernmental Panel on Climate Change (IPCC) was set up – broadly based, scholarly and in itself a-political, although subject to oversight by national governments. Mrs Thatcher, as Prime Minister, addressed the UN General Assembly on the subject in 1989, and the World Climate Conference in 1990, the year of the IPCC's 'First Assessment'.

Thereafter, climate change moved smartly up the world's political and economic as well as scientific agenda. The Rio Summit Conference on Environment and Development in June 1992 saw the signature by over 160 countries of the UN Framework Convention on Climate Change. The Second Assessment of the IPCC followed, in 1995 ; the signature of the Kyoto Protocol in 1997 ; the Third Assessment of the IPCC, at the end of 2001 ; the fourth and possibly final Assessment is due out any time now.

A glance, now, at the underlying science. And it is best to begin by separating *natural* from *human-driven* climate change.

Natural variation

There has been a roller coaster of purely natural variations for hundreds of millions of years. Glacial periods have been interrupted by warmer, inter-glacial, periods. There was a mega warming in the Cretaceous Period, between 144 and 65 million years ago. Another, some 55 million years ago, during what is known as the Palaeocene-Eocene Thermal Maximum. The last 10 to 12,000 years have been warmish and relatively stable – but with wobbles. There were floods, then droughts, in Mesopotamia and Egypt and North Africa between 5,600 and 1,200 BC – causing the decline of the Indus Valley, Sumerian and Mycenaean Civilisations and the rise and fall of Pharaonic dynasties on the Nile. Droughts in Latin America in the 800s AD provoked the collapse of the Maya. Settlement and farming in Greenland in the X Century were snuffed out by extreme cold. In England, the so-called ‘Medieval Warm Period’ (900-1300) was followed by a ‘Little Ice Age’ (1300 – 1860), when bonfires could be lit on the Thames.

Until recently, the experts assumed that all natural climate change was slow. Now, we know otherwise, from the evidence of cores from Greenland and Antarctic ice caps. In one case (10,000 or so years ago) the Arctic Ocean warmed up by 7°C in only 50 years. This in turn reached another tipping point and provoked a sudden thousand year cold snap (the ‘Younger Dryas’) in which the mean temperature of the North Atlantic dropped by 6°C. At the end of that, came another big melt and another massive rise in sea level. (It led, incidentally, to an almost overnight break-through of the Mediterranean, through the Dardenelles, into a landlocked Euxine Lake, to form what is today the Black Sea. The folk memory of the disaster which overtook lakeside human settlements is probably the basis of the Flood story in Genesis and in the Babylonian legends).

These historical ups and downs – as opposed to what is happening now – were due entirely to natural causes. Among them, variations in the eclipse of the earth’s orbit round the sun ; and shifts in the earth’s axis of rotation and angle of tilt. Volcanic eruptions, too, were part of the picture. Possibly sun spots had something to do with it. Also the impact on the planet of large asteroids from outer space. Conceivably even cosmic irradiation.

Man-made variation

But now we also have man-made complications to consider.

Since the Industrial Revolution, humanity has been using the sky as a waste unit. The process may indeed have started long before, when earlier humans first began to convert forest lands for agriculture. But today, the CO₂ in the atmosphere is a third higher than in pre-industrial times. Some of this is probably due to change in land use and to deforestation, but mostly it comes from fossil fuel.

Between 1970 and 2004, GHG emissions have increased dramatically. According to the latest IPCC report, the annual rate of increase rose to 2.6 parts per million in 2005 – faster than the 1.5 parts per million rise in previous decades. And there is now a proven relationship between atmospheric carbon and global surface temperature. During the Ice Ages, atmospheric CO₂ levels were at about 190 to 200 parts per million. For each intervening warm period, CO₂ levels were between 250 and 275 parts per million. Thirty years ago, this had risen to 330 parts per million. At the last reckoning, it stood at over 380 parts per million. The Government does not want to see this rise above 550 parts per

million, before seeing it seriously cut back. Most experts would like the peak to be lower than that.

Methane, while mercifully less abundant, is a far more effective greenhouse gas – 24 times more potent than CO₂. Its concentration in the atmosphere has more than doubled, since pre-industrial times. According to the latest research, the contribution of methane emission to Global Warming may now be much higher still – which is scary. Since as much as 20% of the global land mass is permafrost, and since global warming is predicted to be greater in Northern latitudes, we must expect more and more methane to be extruded from the Siberian and Alaskan peat bogs. (An increase of 60% is reported in Northern Siberia, since 1970).

A Warmer World

The ‘sensitivity’ of the world’s climate to GHGs is greater than scientists had previously thought. The planet has warmed, since 1970, by 0.7°C (by 1°C since 1860). A further 0.5° increase is predicted, for 2030. Some people (including the Government’s Chief Scientific Adviser) fear a global temperature rise of 3°C is likely, even if GHG levels are limited to twice pre-industrial levels.

What will a warmer world look like? The great land masses of Africa, Asia and Latin America – where the poorest and most vulnerable human beings live – will be the worst affected. But Europe will not be unscathed.

On a global scale, the effects of general warming are likely to include :

- new patterns of rainfall and drought and increasing frequency of extreme weather events (hurricanes, typhoons, floods) ;
- impacts on all natural ecosystems. Tropical forests will shrink significantly. (This is serious – there is more carbon locked up in forest eco systems on earth than is now present in the atmosphere). Biodiversity will diminish. The patterns of insects and micro-organisms will change, with knock-on effects about which we remain dangerously ignorant ;
- impacts on fresh water resources, and in particular increased shortages in many poor countries in Asia and Africa ;
- impacts on sea levels. The pace of change seems to be increasing, and estimates are being revised upwards. A rise of up to 3 feet – maybe much more – is anticipated, by 2100. Ultimately, at some future point, the rise could be as great as 20 feet.
- impacts on food supplies. There may be increased crop yields in high and mid-latitudes countries, but decreased yields in lower latitudes. Most farm animals in our present temperate climates will react badly to heat. (And it will be no solution to resort to the expedient reportedly suggested on one occasion recently by a Saudi Prince – to install air conditioning in cow sheds) ;

- impacts on human health. Micro-organisms respond rapidly to changes in temperature and moisture. Old diseases such as malaria could return and new diseases could arise ;
- impacts on human settlement, with increased numbers of refugees both within and between countries and the possibility of large-scale population movements. (I shall come back to this latter prospect, later on in my talk) ;
- impacts on business and industry, transport networks, insurance and banking, town planning, and even architecture.

Two jokers in the pack

There are two jokers in the pack of a warmer world. They relate to negative and positive feedback.

First, there is a possibility that an increase in fresh water in the North Atlantic and Arctic Oceans, caused by melting ice and increased river flow, may weaken the powerful North Atlantic Conveyor current – the Gulf Stream – that brings warmth to Western Europe. There are indicators that this process (which happened when the Gulf Stream stopped abruptly, some 12,000 years ago, and again 6,000 years ago) may already have re-started. Thus global warming could paradoxically produce regional cooling. (I shall say more about this too, later).

The other joker is represented by the possibility of a runaway greenhouse effect, nudged on by human activity. The planet is liable to this anyway. The last time it happened (at the Palaeocene/Eocene boundary) was 55 million years ago. Recent studies of ocean sediments have shown that the Arctic sea then reached a temperature of 20°C. There was massive die-back of marine creatures, as CO₂ levels soared. In each case, vast releases of methane, from melting tundra and the release of methyl hydrates from the ocean floor, may have been the cause.

Global Dimming

One previously troublesome little uncertainty has, however, happily now been resolved. This is the effect of so-called ‘global dimming’ – a 10% to 37% reduction in sunlight reaching some of the Earth’s surface since the 1950s, resulting from human air pollution. The brown clouds covering particularly South East Asia, and the cover of particles of various chemicals scattering over the industrialised world and reaching down into the Antarctic, kept the planet cooler than it otherwise would have been. But, eliminating the causes of ‘global dimming’ will, paradoxically, have the effect of an additional boost to global warming. It is not good, however we look at it. We can’t ‘win’.

Contrarians

When I began, I mentioned Eco-Scepticism. This scepticism is less robust than it was. Today’s so-called ‘Contrarians’ are smaller in number, if still persistent in denial. At times, I have been reminded of the fight which the tobacco industry put up, against growing medical evidence of the link with cancer.

The Danish scientist, Bjorn Lomborg, is one of the more respectable ‘Contrarians’ – arguing that global warming, while it exists, is less important than other problems. Another decent Dane, Henrik Svegsmark, has innovatory (if unshared) views on Cosmic Rays. On the other hand, the block buster pulp novelist, Michael Crichton, (in ‘State of Fear’), seeks to discredit the scientists of the IPCC – although his is avowedly a work of fiction and suspense. The ‘Global Climate Coalition’, set up by the big emitters in the US to campaign *against* GHG reductions, was officially disbanded in 2002. But curious bodies like the ‘Scientific Alliance’ in the UK and the ‘Centre for Science and Public Policy’ in the US, still function. Press articles have continued to appear – and even one major TV programme (‘The Great Global Warming Swindle’, Channel Four, 8 March 2007) – which are packed with contrarian data, and the views of dissident (even, occasionally, maverick) professors without benefit of proper peer review. (I particularly liked the full page article in the Sunday Telegraph of 9 April 2006, by Bob Carter, apparently a geologist in Queensland, under the banner head-line “There is a problem with global warming it stopped in 1998”). ‘Contrarian’ lobbyists are or have been financed by industries which believe they would be adversely affected. (Exxon Mobil is usually among those cited here, although they have reportedly since stopped doing this since Rex Tillerson became CEO). Other Contrarians are people – mostly American Neocons – who mistrust the UN as such and therefore view the IPCC with deep political suspicion. For them, climate change is a hallucination, imposed on the world by (muesli-munching) left-wing wimps, tree-huggers and Anti-Business Activists. James Inhofe, Chairman of the Senate Environment and Public Works Committee, dismisses global warming as rubbish.

In this country, voices within the opposite wing of the Conservative Party from Mr Cameron simply argue that the uncertainties are too great ; that US refusal to have any part in the Kyoto Agreement must be taken seriously ; that we should wait for low carbon energy technology to develop ; and meanwhile look to coastal flood defences, water conservation and other immediate needs. In other words, they accept minimum necessary *adaptation* ; but reject, at this stage at least, what they see as unwarranted, ill-directed and extravagant *mitigation*.

These last are distinctly arguable points, even if they take less than full account of the gravity and urgency of the most recent scientific reports. We should certainly distance ourselves from what Lord (Nigel) Lawson, in an article in The Spectator last year, called the ‘quasi-religion of green alarmism’. All will agree with The Times Leader this April, that “facts, not emotion, should inform discussion of climate change” (indeed!) ; and that “self-examination should ...not be debased by left-leaning fear-mongers whose social agendas are recipes for impoverishment and hardships” (quite so!).

More recently, Lord (David) Howell has made a good case for step-by-step practical moves rather than pie-in-the-sky policies ; but believes that we should concentrate more on the immediate threat to world energy supplies. A similar point was made last month, at a seminar at Chatham House, by oil company chief executives. I myself am not so sure about this, because it fatally defers ‘mitigation’ to an unspecified future date. Sir Nicholas Stern, of whom more below, believes that we need an integrated energy and climate policy, in order to address both issues at once ; and argues it a false dichotomy to separate ‘adaptation’ from ‘mitigation’ – the latter, too, need to run in tandem. Happily this is, in effect, what the EU has now decided.

Meanwhile, as scientific analysis has improved and expertise deepened, the margins of doubt about the major human contribution to climate change have undoubtedly narrowed. The degree of certainty is now over – perhaps well over – 90%, which is about as absolute a judgement as one is likely to meet in the applied, observational, Natural Science. It simply is not true, as the same Times Leader of April 2007 alleged, that “the world is in danger of being held captive by powerful lobby groups that have distorted data, made unjustified extrapolations and attempted to stifle debate on one of the most important issues of our time”. If anything, the boot has been on the other foot – it has been those in denial who have produced phoney statistics and engaged in Cold War KGB-style ‘disinformation’ activities. The genuine argument, these days, is more about the likely rates of change. It is no longer a question of *whether* global warming will take place, but *how* and *where* it will strike. And the plain fact is, as Mary Ann Sieghart put it recently, also in ‘The Times’ : “there comes a point at which you have to admit that 95% of the world’s scientists can’t be wrong”.

Five other factors

Climate change may pose an unprecedented threat to modern human society, but it does not come alone. There are five other things for us to think about. There is a dangerous potential synergy between them. They are : vertiginous human population increase ; global land degradation : growing shortages of water ; difficulties in the way of clean energy production ; destruction of biodiversity. I have no time to do more than flag them, this evening. Any one of them is a separate headache. Taken together, the combination could be deadly.

The first and greatest is the population explosion. The rapid growth of modern times began only around 1750, since when the global population has increased six fold. By the 1990s, the earth was having to support about 90 million extra people each year – an increase the same size as the total population of the planet only 2,500 years ago.

The world’s population will approach 10 billion by mid-century, from over 6 billion today. Only 1% of this increase will take place in the developed world. Some ecologists think the maximum viable population of the planet is 2.5 billion.

The four other factors are inter-related and render the population issue even more acute. On land problems, the soil is the skin of the planet, on which we depend for our life : it should be treated as an investment in our future, not dirt for short-term exploitation. Yet soil degradation is now estimated to affect 10% of the current world agricultural area and it is getting worse. As to water, global demand is doubling every 21 years ; yet supply, in a world of 6 billion, is the same as it always has been for thousands of years. So water tables are falling. Watch out for ‘Water Wars’, in regions like the Middle East, as the century advances. Then there is energy. How we generate it, while fossil fuel resources diminish or become ecologically too damaging to use, yet while consumer demand increases, remains an as yet unresolved conundrum. Finally, damage to the diversity of life, of which our own Species is an immodest part. The consequences are as yet unquantifiable, but are likely to be negative.

Gaia

One point is worth adding, at this point, about what is called ‘Gaia’.

The concept has been popularised by the distinguished British scientist and Fellow of the Royal Society, James Lovelock – recently made a ‘Companion of Honour’ and voted one of the top hundred intellectuals in the world. I commend his latest book : ‘The Revenge of Gaia’. Some of his ideas have been seized upon by ‘New Age’ religious folk, who endow the Mother planet with personality and offer her worship. Lovelock himself has a different angle. He argues that the Earth tends to behave as a single, self-regulating system, comprised of both chemical and biological, inanimate and animate, components. Together, its own natural regulators have latterly kept the Earth system in the more or less stable state, that has nurtured modern humans. Man-made climate change will destabilise these processes. So, we are pressing ‘Gaia’ hard, without understanding what may happen as a result.

‘Business-as-Usual’ no longer an option

Every politician, business person and decision-maker lives with uncertainty every day; and has to make policy, investment and planning decisions, despite that uncertainty. This has to be done by assessing alternative courses of action – and seeking to minimise risk and maximise gain.

And this is how it inescapably has to be, with climate change. The likelihood of very sudden, large-scale changes in climate over the next 20 to 30 years may not be massive. But the possible magnitude of their effects will be so great that they may cripple or even destroy society, as we know it. We cannot, therefore, put off ‘mitigation’ much longer, without huge medium-term cost to the planet.

Until recently, people were talking about what is called the ‘Precautionary Principle’. As enunciated in the ‘Rio Declaration’, at the Earth Summit in June 1992, this read :

“Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation”.

Today, the principle is beginning to be overtaken. The scale of the problem was brought out in a Declaration made by over 1,500 scientists from the four great global research programmes at Amsterdam, in 2001. They stated squarely that the Earth was currently operating in a ‘no-analogue’ state ; and that the ‘business-as-usual’ way of dealing with the Earth’s system was **not** an option.

Indeed, some scientists now suspect that we are already at, or across, the threshold into the Danger Zone. The national science academies of the G8, in an unprecedented move in 2005, in effect issued a challenge to their own governments. Thrusting in the knife of the ‘Precautionary Principle’ to the hilt, they said :

“The scientific understanding of climate change is now sufficiently clear to justify prompt action A lack of full scientific certainty about some aspects of climate change is not a reason for delaying an immediate response that will, at a reasonable cost, prevent dangerous anthropogenic interference with the climate system”.

This view is upheld in the official Stern Review of the Economics of Climate Change, published in 2006. The costs of confronting climate change are far outweighed by those of failing to act in time.

Two dangers in greater detail : Gulf Stream collapse and the Mass Migration of Peoples

Nobody likes too much doom and gloom. Human beings often just switch off. Ostriches go so far as to stick their heads in the sand. But, at the risk of spoiling your dinners, I do need to say something about the implications of a possible breakdown in the Gulf Stream ; and about security problems in a disrupted global climate on a grossly over-populated planet.

In doing so, I must emphasise how extremely vulnerable human society now is, as a result of the population explosion already mentioned. To remind you, at the end of the last Ice Age the sparse human population of the planet was no more than a few million – perhaps ten : today it is six thousand million ; by mid-century it will be close to ten thousand million.

In the distant past, when confronted with climatic ups-and-downs, human beings had the chance of being able to move on and adapt. Later in human history, agriculture and urbanism began to tie them down to particular locations. Today, our sheer numbers alone, and our tight territorial dependency, mean that movement and adaptation will be very difficult indeed, if not quite impossible.

And so, to the first “Joker in the Pack”. The Gulf Stream, (sometimes called the North Atlantic Thermo-haline Circulation or THC ; or, alternatively, the North Atlantic Meridional Overturning Circulation or MOC) presently keeps Western Europe much warmer (by 8-10°) than the same latitudes in other parts of the world. But it has not been reliable : it packed up, for a period, over 8,000 years ago ; and is capable of doing so again.

Unfortunately, ocean circulation in the North Atlantic region is beginning to be affected by injections of fresh water from the melting of polar ice, caused by global warming. A slow and limited reduction in the Gulf Stream might lead to only relatively modest cooling in Western Europe, and could even be outweighed by general global warming, albeit with severe storms and floods. But if, on the other hand, a complete and sudden cessation of the Gulf Stream were to take place, the impact on us could be disastrous.

New York, liable to severe snowfall in winter, is on the same latitude as Madrid, or a point on Portugal’s Atlantic coast half way between Oporto and Lisbon. The Central and Northern UK is on the same latitude as Newfoundland in Canada. In Goose Bay (on a latitude lying between Birmingham and Manchester), temperatures throughout the long hard winter fall to between -12°C and -22°C. The population of Newfoundland is less than a 100th of the British population, and has housing and infrastructure well adapted to extreme cold. The UK does not enjoy these benefits, and could not hope to acquire them – meaning that 50 million or more of us would be looking for somewhere to go, sharpish. Continental Europe would not be any better off and could not help us ; the Middle East and

Africa, unwelcoming and unattractive ; the US and Australia, unable and probably unwilling to oblige us – they would be facing problems of their own.

Remember too, in this context, that UK social structures are not today as homogenous and disciplined as they were in 1914 or 1939. We live in a disputatious, anti-hierarchical, over-individualised, ‘celeb’- and ‘yob’ - culture, ethnically and now perhaps also confessionally divided and with a widening gap between rich and poor, between the super rich and the middle-classes. In this fractured and fractious society, there remains precious little that will hold it together, in a time of real national emergency. Magnus Linklater wrote in *The Times*, Christmas before last, about “unprecedented social dislocation and lack of respect for the authority of the State and its institutions”. And today’s British army is so small that it would be incapable of providing effective backing for the civil power, in a total national emergency. In the worst case, of massive climate change within a short period of time (one or two decades), there could be panic, chaos and outright civil disorder.

So what should we expect? The British and US Governments operate a joint Gulf Stream monitoring scheme, called ‘RAPID’. In 1992, everything was still more or less normal. The first signs of depletion in the flow of warm water was detected, by US scientists, in 1998. In 2004, our own oceanographers detected a 30% reduction in the warm water flow. They were slightly sceptical of this finding, which would have been enough to lower UK average temperatures by 1°C, of which there was thitherto no sign. But this may be due to the initially offsetting effect of rising global temperatures. In last year’s Met. Office report, scientists concluded that the probability of a collapse – as opposed to a gradual depletion – was “higher than previously believed”, if no preventative precautionary action was taken. The latest IPCC Assessment tends to the more sober view that nothing too drastic is likely, this century. But the jury is still out. The scientists are watching the situation like hawks. The trouble is that, if the THC is already now in the process of serious weakening or collapse, there is little we can do to save it, by CO₂ reduction, given the lags and lead times involved.

The Second Joker in the pack – runaway global warming – raises the prospect of large- scale, trans-continental migration.

Leaving aside crop failures, desertification, disease and erratic weather patterns, a reference to sea-levels will suffice. These have gone up and down by 120 metres and more, in geological time. At the height of each Ice Age, water is locked up in ice and snow and the seas descend or dry up altogether. In conditions of global warming, the ice and snow melt, and the seas rise, both from the run-off and from the expansion of ocean water in warmer conditions. For example, we have already observed, over the past 40 years, a decrease in the extent of Arctic sea ice by 10-15%, and by 40% in its thickness. Closer to home, much the same is happening in the Swiss Alps, where a loss is predicted of between 50% and 80% of the glacier ice within the next hundred years. Since there can be long thermal lags in oceanic response, as well as occasional rapid change, present sea-levels may well continue to rise for decades and even a century or more, almost whatever we do. According to the IPCC, partial deglaciation of the Greenland ice sheet could raise seas levels by 4 metres (or by 7 metres if it melted completed).

If that happened – as it might if global average temperatures increased very significantly over the next century or so – this part of London would be flooded out. You

would have to take a Gondola to Whites'. In Bangladesh, it would be no laughing matter. A rise of only half a metre would dispossess six million people of prime agricultural land. A rise of 5 metres would take one half the territory and $\frac{3}{4}$ of the habitat of a total population of 120 million Bangladeshis, presenting a problem of an order of magnitude unknown to human history. China is equally vulnerable. It has already been estimated in Whitehall that rising sea levels, taken with an increasing shortage of fresh water and declining agricultural productivity, could displace up to 200 million people by the middle of the present century. Working Party Two of the IPCC goes further, and argues that, by then, more than a billion people will be affected to some degree or other. Where are the environmental refugees to go? Will they be welcome?

The security and defence implications of any such development are considerable, even massive.

Advanced Western societies tend to feel, rightly or wrongly, that there is a limit to the number of people from other countries and cultures which they can absorb, without damaging social cohesion. The UK is already the second most crowded country in Europe (after the Netherlands), suffering from a chronic housing shortage ; yet net foreign immigration trebled between 1997 and 2004 (not counting illegal immigrants) and is expected to add a further six or so million to the total population over the next 30 years. Sir Andrew Green's 'Migrationwatch UK', an apolitical independent think tank which claims not to be opposed to immigration that is 'moderate and managed', nevertheless calls for 'an open and frank policy debate, based on the facts'. In doing so, Migrationwatch UK undoubtedly reflects genuine popular anxiety, albeit currently less than fully reflected in Parliament.

But such concerns could prove nugatory, in the context of major global climate change. Land frontiers can always be penetrated (as we have seen, across the long Southern frontier of the US). Sea crossings are not a real barrier (as the Spanish and Italian authorities are well aware). Within a host country, floods of refugees could represent a destabilizing element, in what would anyway be increasing difficulties of social and economic management. Between countries and regions, there would be still greater tensions. Desperation could push Africans into Europe, Chinese into the relatively empty parts of Russia, Indonesians into Northern Australia. Sheer numbers would swamp all efforts at control. Here too, it could mean the end of any civil order in the developed as in the developing countries – and ultimately perhaps the end of what we see as civilisation itself. We should be left with "war of every man against every man", as Thomas Hobbes called it. "No arts, no letters, no society, and which is worst of all, continual fear of danger and violent death".

Two examples of positive thinking : new life styles, new technology

Mr Gordon Brown is on record, at the beginning of his premiership, as saying that climate change offers an opportunity as well as a challenge. So, to balance these dismal prospects, let me nevertheless offer two countervailing and consoling reflections. Where global warming is concerned, it does lie within our present (and even more so in our predictable future) grasp, to find adaptive remedies, before it is too late. And it is possible to imagine new lifestyles of an acceptable and healthy kind in a greenhouse-free world.

Let me begin with the lifestyle. It has been estimated that if the 39 million obese and 90 million over-weight men and women in the US walked or biked instead of using cars for short journeys they would not only become healthier but might save up to 10% of US CO₂ emissions as at 1990 levels.

More seriously, the International Energy Agency estimates that \$18 trillion will be invested in energy infrastructure between now and 2030. Other estimates go as high as \$20 trillion. If only \$1 trillion of that could be invested in new, renewable, technologies world-wide, to produce clean energy, the outlook would improve. Sir David King, the UK Chief Scientific Advisor, is on record as saying that “taking action to tackle climate change can create economic opportunities and higher living standards”. The Treasury’s former Chief Economist, Sir Nicholas Stern, in his detailed review of the economics of climate change, argues that the cost of confronting the problem (perhaps 1% of world GDP per annum) will be much less than failing to take action to mitigate and adapt ; but he is firmly of the view that it is possible both to be ‘green’ and to enjoy continued economic growth.

What can we see, down the line? We can hope for a reduction in net deforestation, through greater restraint and much more new planting. We may discover much cleaner ways of using coal. Safe, large-scale, underground carbon sequestration (on land, but perhaps also beneath the ocean bed, as Norway is already doing on a smaller scale) is surely feasible. In due course, the hydrogen fuel cell may replace the internal combustion engine. Nuclear fusion – still admittedly unharnessed – could give us unlimited pollution-free energy. Even with present technology, studies have shown that improvements in energy efficiency of 30% or more can be achieved at little or no net cost, or even at some overall saving. Market forces and business entrepreneurship have already latched on to this. BT saved £540 million between 1991 and 2004. DuPont, the American chemicals group saved £1.1 billion over the same period. Business leaders in the UK see advantage in our becoming the lead nation in this area and the bosses of fourteen of our leading blue chip enterprises have proposed a partnership between Business and Government, to that end. Potentially lucrative contracts are out, for cutting carbon emissions. Pilot projects are running. Embracing eco-values can be good for business, it seems.

So, even if we are in for a rough ride, we are also in with a chance.

The slow start on the path of action

I now go back, for a moment, to that interesting point at which science moved into politics and economics, with the Framework Convention on Climate Change of 1992. The broad objective was there defined as the stabilisation of ‘greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system’.

How this should be done has been discussed at numerous successive meetings of the Parties to the Convention, concentrating on the implementation of the Kyoto Protocol. This committed thirty-eight industrialised countries to a global CO₂ emissions reduction target of 5.2% by 2008-2012. It was not an ambitious target – GHG would still be up by 30% in 2010 over 1990. And we now know that even that target will not be met ; in part, because the US dropped out. But Kyoto was at least a start. And negotiations will start later this year for a more robust and comprehensive international agreement, for action in the period

after 2012, with the participation of all the major players. Let us take a look at who they are.

The US

The United States, with less than 5% of the world's population but well over 20% of its greenhouse gas emissions (the UK figure is 2%) , is a major villain of the piece. Its reluctance to accept binding treaty obligations is not new. With American society still based on cheap energy (gasoline prices have been lower than bottled water) and vested interests being close to the heart of the current US Administration, it is no surprise that President Bush has been slow off the mark.

Many in the United States are, however, already forging ahead. The nine North East states, including New York, New Jersey and Massachusetts, are working toward creating a regional greenhouse gas market. California, led by Governor Schwarzenegger, has agreed tough energy-efficiency and emission controls. These various State initiatives are important not only because they can help pave the way for federal action but also because American States are themselves large emitters of greenhouse gases. California's emissions exceed those of Brazil. Ohio's emissions exceed those of Turkey. Those from Illinois exceed those of the Netherlands.

The EU and the UK

The EU's strategic objective, confirmed by the European Council this March, is to secure international agreement to limit the global average temperature increase to 2°C above pre-industrial levels. As energy production and use are the main sources of GHG, the EU also calls for an integrated approach to climate and energy policy.

The European Union countries ratified the Kyoto Protocol in 2002 and will play a key role in the forthcoming negotiations for a global and comprehensive Agreement already referred to. Inside the EU, a whole raft of measures to reduce emissions have already been forthcoming. One is the European Emissions Trading Scheme which began in January 2005. Under the scheme, EU Member State governments are required to set an emission cap for all installations covered by the scheme, which include : the electricity generating industry ; oil refineries ; the iron and steel industry ; the minerals industry ; and paper, pulp and board manufacturing. Only aviation and bunker fuel are missing – so far, at least. It is still early stages. A Labour MP (Alan Simpson) derides what he sees as 'Mickey Mouse Economics and Donald Duck Accounting'. But the European cap-and-trade system is up and running ; others are following the European lead ; and the City of London is now at the centre of global carbon trading.

Others kids on the block

The other really big players are China and India and – to a lesser extent – Russia and Brazil.

The clearest and most present danger is China, which is industrialising full tilt and expected to overtake the US as the world's biggest polluter (albeit with four times the US population) within the next 10 years. The Chinese plan to commission 560 new coal-fired (and inevitably polluting – Chinese coal is notoriously dirty) power stations by 2012. The

authorities, in their Confucian way, are aware of the dangers, not least because of the vulnerability of their 1.3 billion inhabitants, if things go badly. And they have started to clean their act up. (The latest Chinese 5 Year Plan calls for a 10% reduction in emission of air pollutants). But do they have real choices, without major outside help with new technology? India is hard on China's heels. The authorities in Delhi can at times seem aloof and arrogant – even boastful of what they see as their budding Super Power Status. But India, too, will need help. The vulnerability is plain to see. The country is not as ethnically and culturally homogenous and as governable as China. And India faces a galloping population increase – she is expected to surpass China within 20 years and may by mid-century achieve a population of 1.7 billion, as opposed to 1.2 billion today (effectively, a doubling, in less than a hundred years). Russia, being likely to benefit from the early stages of global warming, will prove slow off the mark. But she knows she is at long-term risk. Unless Putin does a Stalin, Russia's relationship with the G8 and her general ambition to join the Club of the economically advanced nations will probably bring her along somewhere behind Europe. Brazil, on the other hand, tends to be insular and introspective ; the machinery of government, corrupt. The record on deforestation in the Amazon basin is lamentable. Where major and costly initiatives are concerned, don't expect too much from Brazilia.

The need for decisive, and rapid, action

Despite these difficulties and constraints, speedy and ambitious action is nevertheless now essential, given the long lead-times before we can expect good results.

The EU is right that **Global emissions** of GHG must be made to peak soon and decline rapidly thereafter. European governments are now committed to a 20% cut in the EU by 2020, rising to 30% if other advanced countries follow suit. The EU also argues that developed countries must do more than their quota to begin with, leaving the developing countries to catch up, in line with what the EU Council calls 'the general principle of common but differentiated responsibilities and respective capacities'.

I myself am convinced that the developed countries do indeed have the major responsibility for what has gone wrong, and must now lead by example. We really should transfer low-carbon technology to the poorer countries as fast as it develops.

On energy, we need to deploy a wide portfolio of technologies ; Sir Nicholas Stern, in his report, very properly proposes that "globally, support for energy on R and D should at least double".

The IPCC, for its part, is convinced that 'there is substantial economic potential for the mitigation of global GHG emissions, over the coming decades'.

A first requirement must be to expanding and unifying regional carbon trading schemes, to create a global market. The aim has to be, as Sir Nicholas put it, that "those generating GHG's, wherever they may be, face a marginal cost of emissions that reflects the damage they cause. This encourages emitters to invest in alternative, low-carbon technologies, and consumers of GHG-intensive goods and services to change their spending patterns in response to the increase in relative prices".

But that is only the beginning. We need to improve efficiency and conservation by means of some or all of the following :

- a) Increasing power plant efficiency, while drastically reducing pollution (the technology already exists to do this). Also making more efficient use of energy in the home. ('Standby Power' – leaving TVs, computers, etc. switched on in the US – accounts for up to 10% of total residential electricity consumption. In France, the figure is 7%).
- b) Increasing fuel economy in cars, including petrol/electric hybrids like Toyota's 'Prius'.
- c) Reducing reliance on cars, by means of better public transport, bike paths and urban design. (We all need to use Shanks's Pony more regularly).
- d) Doing without second houses. (Do the rich really need Kensington, and the Cotswolds, and Chianti-shire or the Caribbean?).
- e) Curbing the growth of unnecessary business and tourist air traffic. (Video-conferencing and IT generally can, for example, greatly reduce executive travel – and even thereby improve executive health!). Less food, too, will have to be flown round the globe to satisfy our taste for out-of-season gastronomic delights from Thailand, South Africa or Chile.
- f) Constructing more efficient and better insulated buildings.

In my view (which some will contest), we also need to recognise that the coming international energy crisis (an 'Oil crunch' by 2012, according to the International Energy Agency) will mean that there is absolutely no alternative to :

- g) Increased resort to nuclear power. (The IPCC sensibly foresee 18% of the world's electricity being generated in this way by 2030) as well as more use of natural gas).

But this is not a reason for not doing our best, on a 'belt-and-braces' basis, to develop, in parallel :

- h) increasing use of renewable sources of energy, such as :
 - Wind and wave-generated electricity.
 - Solar photovoltaics.
 - Hydrogen. (If it can drive an omnibus, it can also in principle fuel a power station).
 - Biofuels. (The EU aim is for them to meet 10% of transport requirements by 2020).

Thinking 'Outside the Box'

We need to look again at **economics** and the way we measure wealth, welfare and the human condition in terms of the earth's good health. The key question is how to establish the true costs. Failure to tackle climate change carries an enormous financial penalty. Governments have a particular responsibility to determine what is in the public

interest, and to use fiscal instruments to promote it. We need to get rid of perverse subsidies : those supporting the fossil fuel industries, would be a good start. Nowhere is this more true than in the field of **technology**. I do not myself think that Star-Trek style technical wheezes – mirrors in space and the rest – are likely to produce the answer, even if they create no more problems than they solve. But we do need to make much better use of existing technology and its myriad applications ; and move on from there.

More fundamentally, we need to do far more to **understand** the Earth system. I was intrigued by what Secretary of Defence Donald Rumsfeld reportedly said at a press conference in February 2002. It is paradoxical, even opaque ; but nevertheless highly intelligent : “As we know, there are known knowns. There are things we know we know. We also know there are known unknowns. That is to say we know there are some things we do not know. But there are also unknown unknowns, the ones we don’t know we don’t know”.

What Rumsfeld is saying is that we are too often ignorant of our own ignorance. The complexity of all living things and their mutual dependencies at present passes human understanding. Yet we damage them at our peril. Where climate change is concerned, I personally am concerned that we may be at risk of summoning monsters from the depths. Abrupt climate change has happened in the past. We must not, by human agencies, risk pushing the planet to such a point.

Finally, in a philosophical vein, we may need to look again at some of the **unquestioned assumptions** on which the Western World has been built – at the Consumer as King ; at the Divinity which hedges about the Market Forces ; at Sustainable Development, which is not sustainable ; at Greed as God. My friend and former colleague, Sir Crispin Tickell put this well in an address in Portsmouth Cathedral, four years ago. He said :

“The ideology of industrial society, driven by notions about economic growth, every-rising standards of living, and faith in the technological fix, is in the long run unworkable. In changing our ideas, we have to look forward towards the eventual target of a human society in which population, use of resources, disposal of waste, and environment are generally in healthy balance”.

Conclusion

Will these changes come about, and if so, how? Change usually takes place for three main reasons. First, through leadership from above, by institutions or individuals ; secondly through public pressure from below ; and thirdly – however regrettably – through catastrophes which jerk us out of our inertia into more sensible courses. But will leadership emerge, and public pressure assert itself, too late in the day?

Lord Rees, the Astronomer Royal, shortly after his election as President of the Royal Society, rated the chances of our present civilisation surviving until the end of the century as no more than 50%. (Read his book “Our Final Century. A Scientific Warning : How Terror, Error and Environmental Disaster Threaten Humankind’s Future in This Century – On Earth and Beyond”, published in 2003). He was right to put down the marker. The stakes are indeed high. All over the world, people will have to change their

ways and remodel their thinking. Otherwise, Nature will do what she has already done to over 99% of species that have ever lived – and do the job for us.

James Lovelock, in his ‘The Revenge of Gaia’ already mentioned, says that the world is like a smoker who knows he should kick the habit, but postpones and prevaricates, awaiting clear proof of the onset of lung cancer. For good measure, Lovelock continues as follows :

“But we are sufficiently aware of the physiology of the Earth to realise the severity of its illness. We suspect the existence of a threshold, set by the temperature or the level of CO₂ in the air ; once this is passed, nothing the nations of the world do will alter the outcome and the Earth will move irreversibly to a new hot state. We are now approaching one of these tipping points, and our future is like that of the passengers on a small pleasure boat sailing quietly above the Niagara Falls, not knowing that the engines are about to fail”.

To conclude, the science, as far as it goes, is now reliable enough. That is why both ‘mitigation’ (cutting back greenhouse gases) and ‘adaptation’ (finding better ways to run the planet) are concomitant essentials. We have a choice, about the future. And the choice we make will carry major consequences for human society. It is probably later than we think. Almost all environmental problems are currently getting worse. And there is always the risk of waking the giants and precipitating something irreversible and destructive. But the odds in our favour will improve, as public understanding increases. It is not in the least Panglossian, not any suggestion of whistling in the dark, to say that – with a bit of luck – the earth and its inhabitants can still make it.

What we now need is both an ethical (I myself would add, a religious) sense and also, obviously, leadership – if possible, statesmanship of the highest order. But without waiting for a political hero to step up to the footlights, we each of us need to give expression to our own personal conscience ; we each have an individual voice to add to the chorus. There *is* such a thing as Society. But that Society only works where we each take our individual responsibility to the whole. Otherwise, our own urban civilisation will end up like its thirty predecessors, all now largely or entirely forgotten, buried under the earth or commemorated only by crumbling ruins.

For, ultimately, we need to face up to a basic, stark reality. Our whole existence, as humans, is confined within, and is dependent upon, a wafer-thin atmosphere. The system is fragile and vulnerable. The human impact on the earth and its atmosphere, evident for the last 40,000 years, is now increasing rapidly. Where the effects of human activity were, in the past, local and nugatory, or at most regional and marginal, today they are global and decisive.

Let me conclude this lecture by taking you back 400 years, to the Anglican Metaphysician, John Donne. He famously wrote, and we do well to remember, that :

“No man is an Iland, entire of itselfe ; everyman is a peece of the Continent, a part of the maine Anyman’s death diminishes me, because I am involved in Mankinde ; and therefore never send to know for whom the bell tolls ; it tolls for thee”.

And so, Good Night

I said “conclude my lecture”. But you are probably dying to ask – and inevitably will ask, in the question-and-answer session which follows – what I myself really, *really* think about our prospects. Well, I’ll tell you, even though I may well be mistaken.

As someone who has followed the debate this past 20 years, and operated abroad as a professional diplomat for much longer than that, what I feel in my bones is the following.

Human nature being what it is, and governments and politicians round the world what they are, and the means at our disposal being in their present and predictable range, it will be, at best, a very close call. The Rev. Thomas Robert Malthus may well end up by having the last laugh!

An academic historian whom I have consulted writes that “I have always argued that we humans were clever enough, invariably to avert the ultimate catastrophe, if at the last minute, and not without casualties”. I wish I could think that. In my view (and that of at least two senior former diplomatic colleagues of mine whom I have equally consulted), the trouble with climate change is that the international political will and readiness to make sacrifices simply is not yet there. (You have only to look at the current moribund state of international trade liberalisation negotiations in my old stamping ground, the WTO, to gauge that). The technological alternatives are as yet far from fully convincing. Time is running out, for minimum remedial action. Much will depend on what precisely Mother Nature throws at us, and when. If we are unlucky enough to encounter a major ‘tipping point’, within the next three or four decades, I do not expect Western civilisation to survive the shock. Even short of such a ‘tipping point’, I privately doubt whether international action will be sufficient, and come soon enough, to prevent serious global disruption.

But I don’t **know** this ; and I’m always open to being agreeably surprised.

In 1952, Bhurtpore (Mule) Battery, Royal Artillery, were firing air-bursts, using an experimental, proximity-fused, phosphorous shell, on a remote firing range up in Northumberland. We succeeded in setting light to half the County. The scene was like the San Francisco earthquake, in the old Clark Gable movie. So, I sauntered off with the men, to help to put it out, before Mess Night. The Troop Sergeant was a soldierly and normally unexcitable Scotsman. He said to me, translated into civilian English suitable for this audience, something like the following : “Gosh, Sir! Golly Gumdrops!! We seem to be up ‘whatnot’ creek, without a paddle!!!” In the event, we more or less got the fire out, after some modest exertion and having missed our dinners. Tonight, this time round, I’m not sure we’ll be so lucky.

Do enjoy your dinner!

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