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CLIMATE CHANGE, RISK AND DANGER

Our understanding of the greenhouse effect, the origin of global warming in current times, dates back to the work of the French scientist Jean-Baptiste Joseph Fourier in the early part of the nineteenth century. Energy reaches the earth from the sun in the shape of sunlight; it is absorbed and is radiated back into space as infrared glow. When Fourier calculated the differential between the energy coming in and that going out as infrared radiation, he found that the planet should, in theory, be frozen. He concluded that the atmosphere acts like a mantle, keeping a proportion of the heat in – and thus making the planet liveable for humans, animals and plant life. Fourier speculated that carbon dioxide (CO_2) could act as a blanket in the atmosphere, trapping heat and causing surface temperatures to increase.

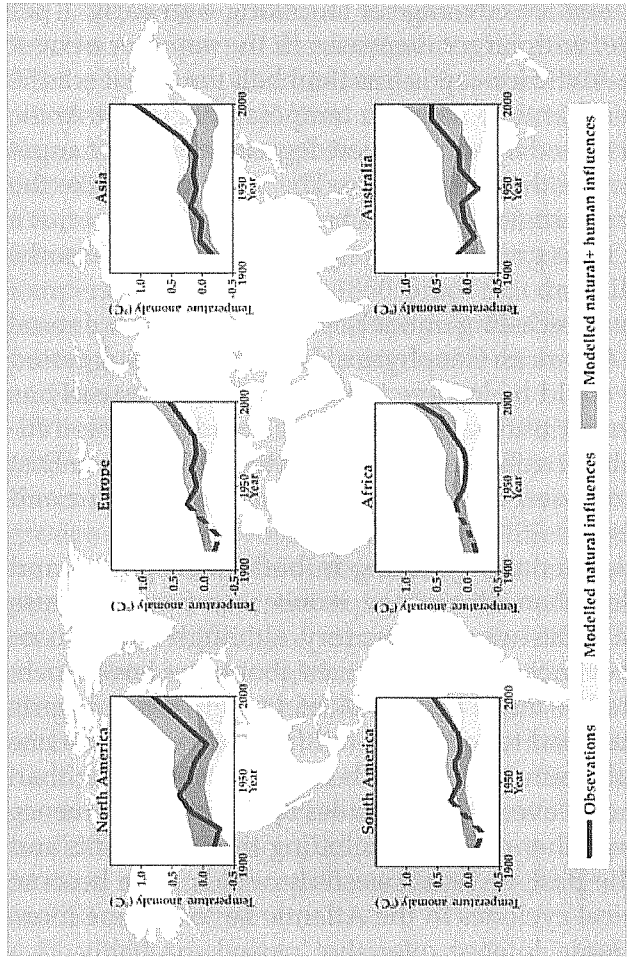
Later observers, most notably John Tyndall, a scientist working at the Royal Institution in London, worked out just which atmospheric elements trap infrared. The gases that make up most of the atmosphere, nitrogen and oxygen, offer no barrier to heat loss. Those producing what came to be called the greenhouse effect, such as water vapour, CO_2 or methane, are only present in relatively small amounts. Scientists use the calculation of 'parts per million' (ppm) to measure the level of greenhouse gases in the air, since the percentage figures are so small. One ppm is equivalent to 0.0001 per cent. It is because

a tiny proportion makes such a large impact that greenhouse gases created by human industry can have profound effects on the climate (CO_2 makes up less than 0.04 per cent of the composition of the air, and the other greenhouse gases even less). Since CO_2 is the most important greenhouse gas in terms of volume, it is sometimes used as a standard of measurement when assessing emissions. The notion of 'CO_2 equivalent' is also often employed. It is the amount of CO_2 emission that would be involved to produce the same output as all the greenhouse gases combined. It is usually written as CO_2e.

Over the past 150 years or so, greenhouse gases in the atmosphere have progressively increased with the expansion of industrial production. The average world temperature has increased by 0.74 degrees since 1901. We know from geological studies that world temperatures have fluctuated in the past, and that such fluctuations correlate with CO_2 content in the air. The evidence shows, however, that at no time during the past 650,000 years has the CO_2 content of the air been as high as it is today. It has always been below 290ppm. By early 2008, it had reached 387ppm and is currently rising by some 2ppm each year.

The growth rate for 2007 was 2.14ppm, as measured by scientists at the Mauna Loa observatory in Hawaii. It was the fourth year out of the previous six to see a rise of more than 2ppm. This increase was considerably higher than scientists at the observatory had expected. It could indicate that the natural sinks of the earth are losing their capacity to absorb greenhouse gases. Most climate change models assume that some half of future emissions will be soaked up by forests and oceans, but this assumption may be too optimistic. Because CO_2 and most other greenhouse gases, once there, stay in the atmosphere a long time, and temperature takes some while to build up, an average surface warming of at least 2 °C, possibly more, may now be unavoidable, even were emissions to be cut back immediately – which of course won't happen.

Warming is greater over land areas than over the oceans, and is higher at northern latitudes than elsewhere. Very recent studies show that the temperatures of the oceans are rising several times faster than was thought likely a few years ago. Higher temperatures produce more acidity in the water, which



Average annual temperatures are rising on every inhabited continent. Computer studies indicate that the patterns seen can only be explained if they incorporate human-induced increases in greenhouse gases.

Figure 1.1 Rising temperatures

Source: Adapted from *Climate Change 2007: The Physical Science Basis*. Working Group I Contribution to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Figure SPM.4. Cambridge University Press.

could seriously threaten marine life. Warmer seas release more CO_2, accelerating the global warming effect. As measured over the period from 1982 to 2006, temperatures rose most in the Baltic Sea (1.35 °C), the North Sea (1.3 °C) and the South China Sea (1.22 °C).

Satellite data, available since 1978, show that the annual average Arctic sea ice coverage is shrinking by nearly 3 per cent per decade, with larger decreases in the summer of over 7 per cent. The Arctic ice-cap is less than half the size it was 50 years ago. Over that time, average temperatures in the Arctic region have increased by about seven degrees, a result of a specific feedback cycle that exists there. The sun's rays strike the Arctic at a sharper angle than elsewhere over the summer, at a time when the ice is giving way to open water, which absorbs more solar radiation.

Some of the forecasting models presented at the annual meeting of the American Geophysical Union in 2007 suggested that the Arctic could be ice-free in the summer by as early as 2030.[1] Commercial trans-Arctic voyages could then be initiated. It would be possible to go from Northern Europe to East Asia or the north-west coast of the US avoiding the Suez and Panama Canals.

Mountain glaciers are retreating in both hemispheres and snow cover is less than, on average, it once was. Sea levels rose over the course of the twentieth century, although there is considerable controversy among scientists about just how much. Warming is likely to intensify the risk of drought in some parts of the world and lead to increased rainfall in others. Evidence indicates that the atmosphere holds more water vapour than used to be the case even a few decades ago, a major influence over unstable weather patterns, including tropical storms and floods. Over the past 40 years, westerly winds have become stronger. Tropical cyclones in the Atlantic have become more frequent and more intense over that period, probably as a result of warming.

The most authoritative body monitoring climate change and its implications is the Intergovernmental Panel on Climate Change of the UN (IPCC), first established in 1988. It has had an enormous impact upon world thinking about global warming. Its declared aims are to gather together as much scientific data about climatic conditions as possible, subject it to rigorous review, and reach overall conclusions on the state of scientific opinion. In several authoritative reports it has mapped the changing world climate in detail, showing that the potential consequences range from the worrying to the disastrous. In the fourth of such reports, published in 2007, the IPCC says 'warming of the climate system is unequivocal'. It is the only part of the document where such a term is used. All the rest is couched in terms of probabilities. There is a '90 per cent probability' that observed warming is the result of human activity through the introduction of greenhouse gases into the atmosphere, these coming from the consumption of fossil fuels in industrial production and travel, and from new forms of land use and agriculture.[2] Records of global surface temperature date back to 1850. Since that date, 11 of the hottest years have occurred during the past 13. Observations from all parts of the world show progressive increases in average air and sea temperatures.

The IPCC assesses the implications of climate change in terms of a number of different possible scenarios for the period up to the end of the current century. There are six different scenario groups – in other words, future possibilities – depending upon factors such as levels of economic growth, resource scarcities, population increase, the expansion of low-carbon technologies and the intensifying of regional inequalities. Under the most favourable scenario, global warming will still occur, within a range of between 1.1 and 2.9 °C. Sea levels will rise between 18 and 38 centimetres by the end of the century. If, on the other hand, the world continues to run, as is the case now, on oil, gas and coal, and to strive for high levels of economic growth, world temperatures could increase by more than 6 °C by 2100. In these circumstances, the sea level might rise by between 26 and 50 centimetres.

The 'most probable' scenario distinguished by the IPCC, in which fossil fuels are quite widely used, but are balanced by cleaner forms of energy generation, and where population growth is brought under control, is still worrying. In this scenario, temperatures could rise by more than 4 °C, with an increase of 48 centimetres in sea levels. There would probably be a decrease in rainfall of 20 per cent in sub-tropical areas,

while more rain would fall in the northern and southern latitudes.

The IPCC and the European Commission have both stated that the aim of emissions control policy should be to limit global warming to 2 °C, and that to have even a 50:50 chance of achieving this outcome, atmospheric concentrations of greenhouse gases must be stabilized at 450 CO_2e. However, given the existing build-up of emissions, some regard this target as already impossible to achieve.

The effects of climate change are probably already being felt. The 2007 report of the IPCC states that we can assert with 'High Confidence' (an 8 in 10 chance or above of being correct) that global warming has led to more and larger glacial lakes, faster rates of melting in permafrost areas in Western Siberia and elsewhere, changes in some Arctic and Antarctic eco-systems, increased and earlier run-off from glacier and snow-fed rivers, earlier spring times in northern areas and a movement of some plant and animal species towards the poles.[3]

The IPCC says that resource-based wars could dominate the current century; coastal cities could become flooded, provoking mass destitution and mass migration, and the same could happen as drier areas become more arid. Given their location and lack of resources, the poorer parts of the world will be more seriously affected than the developed countries. Yet the latter will have their share of problems, including more and more episodes of violent weather. The United States, for example, has greater extremes of weather than most other parts of the world and these are likely to intensify further.

The sceptics and their critics

Scenarios are about future possibilities, so it is not surprising that there are those who question them, or who object to the very thesis that current processes of global warming are produced by human activity at all. Since the *sceptics* are in a minority, they see themselves not only as questioning a broad scientific consensus, but as tilting against a whole industry that has grown up around it.

Fred Singer and Dennis Avery, for example, advance the thesis that 'modern warming is moderate and not man-made'.[4] Their view, they complain, does not get much of a hearing, because of the attention that surrounds the claims made by the IPCC. 'A public relations campaign of staggering dimensions', they say, 'is being carried forward to convince us that global warming is man-made and a crisis . . . environmental advocacy groups, government agencies, and even the media have spared no expense in spreading [the] dire message.'[5]

For them, there is nothing new about the increasing temperatures observed today. The world's climate has always been in flux. A moderate but irregular 1,500-year climate change cycle, driven by shifts in sun-spot variations, is well documented by the work of geologists. We are in the warming phase of just such a cycle at the moment. The chief worry we should have for the long-term future is, in fact, a coming ice age, as our relatively mild period draws to a close.

Other climate change sceptics take a somewhat different tack, while also emphasizing that heretical views don't get much of a hearing, let alone research funding. Patrick Michaels, for instance, claims that the findings and projections of the IPCC are intrinsically flawed.[6] Too many individuals and groups, he says, have a stake in predicting disasters and cataclysms to come. Only about a third of those producing the IPCC documentation are in fact scientists; the majority are government bureaucrats. Facts and findings that don't fit the main storyline are suppressed or ignored.

The Danish author Bjørn Lomborg is often lumped with the sceptics, and indeed entitled his first book on climate change *The Skeptical Environmentalist*.[7] His is an unusual form of scepticism, however. He accepts that global warming is happening and that human activity has brought it about. What is much more debatable, he says, 'is whether hysteria and headlong spending on extravagant CO_2-cutting programmes at an unprecedented price is the only possible response'.[8] Lomborg questions the idea that climate change risks must inevitably take precedence over all others. For the moment, world poverty, the spread of AIDS and nuclear weapons pose greater problems.

Other authors, writing about risk more generally rather than only about global warming, have suggested that we live in an

'age of scares', of which climate change is one. Our worries and anxieties, as Christopher Booker and Richard North put it, mark the emergence of a 'new age of superstition', resembling episodes of mass hysteria in the past, such as the witch-hunts of the post-mediaeval period. Scares, nearly all of which have turned out to be unfounded, have become part of our everyday lives, 'from mysterious and deadly new viruses and bacteria in our food, or floating about in the environment, to toxic substances in our homes and workplaces; all culminating in the ultimate apocalyptic visions conjured up by the fear of global warming'.[9]

Should one pay any attention to what the sceptics say, given that they are a small, albeit vocal, minority? Many scientists believe their writings are irresponsible, since they convey to the public that there is extensive space for doubt about the origins, and probable consequences, of warming when in fact there is little. There was a furore when Channel 4 TV in the UK produced a documentary in March 2007 called *The Great Global Warming Swindle*, which featured several of the most prominent sceptics.

Yet the sceptics do deserve and must receive a hearing. Scepticism is the life-blood of science and just as important in policy-making. It is right that whatever claims are made about climate change and its consequences are examined with a critical, even hostile, eye and in a continuing fashion. There is no doubt that 'big science' can attain a momentum of its own. The IPCC is not simply a scientific body, but a political and bureaucratic one. The sceptics are right to say that in the media, and sometimes in the speeches of politicians, climate change is now often invoked as though it explains every weather episode: 'Whenever there was any kind of unusual weather event, heatwaves, storms, droughts or floods, some broadcaster could be relied upon to describe it as "further confirmation of climate change".'[10]

However the sceptics do not have a monopoly on critical scrutiny. Critical self-examination is the obligation of every scientist and researcher. The fact that the findings of the IPCC are almost always expressed in terms of probabilities and possibilities gives due recognition to the many uncertainties that exist, as well as gaps in our knowledge. Moreover, the

scientists contributing research findings to the IPCC have many differences among themselves about the progression of global warming and its likely consequences.

Risk and uncertainty cut two ways. The sceptics say the risks are exaggerated, but it is quite possible to make the opposite case. There are some who say we have underestimated both the extent and the imminence of the dangers posed by climate change. They argue that the IPCC is in fact something of a conservative organization, which is reserved in its judgements exactly because it has to cover a wide constituency of scientific opinion.

Fred Pearce, a writer for the *New Scientist*, says that the world's climate does not go in for gradual change, as the past history of climatic variation shows. The climate (as the sceptics also argue) has undergone all sorts of changes in the past, long before human beings appeared on the scene and well before the advent of modern industrial production. However, Pearce draws quite a different conclusion from this observation to that of the sceptics. Transitions from one climatic condition to another are often very abrupt, and climate change in our era, he argues, will probably be the same. We can make a distinction, he says, between Type 1 and Type 2 processes of climate change. Type 1 changes evolve slowly and follow the trajectories outlined in most of the scenarios of the IPCC. Type 2 change is radical and sharp – it comes about when a tipping point is reached, which triggers a sudden lurch from one type of system to another. Such change does not form part of the usual models for calculating climate change risk.[11]

The potential for Type 2 change today, Pearce says, is large. Some areas that were widely thought to be stable may in fact be dynamic and volatile – they include the ice sheets covering Greenland and Antarctica, the frozen peat bogs in Western Siberia, the Amazon rainforest and the weather pattern known as El Niño.

The IPCC has suggested that, should the world warm any more than 3 °C, the Greenland ice pack could start to melt, a process which, once it gets under way, would be impossible to reverse. The IPCC sees this possibility as one for the distant future. Some specialists in glacial studies, however, as Pearce points out, warn that such a process could happen much

faster. As warming proceeds, and in conjunction with certain natural processes, lakes form at the tops of the glaciers. These set up water flows which drain down crevasses in the ice and, at the same time, widen them so that, instead of water taking many years to reach the bottom of the glaciers, it can do so almost instantaneously. The result, it is argued, might be the fracturing of large areas of ice, with profoundly destabilizing consequences. Were such effects to become generalized, large-scale melting could take place in a matter even of a decade.

The vast area of peat bog stretching from Western Siberia through northern Scandinavia, Canada and Alaska is covered by solid and seemingly permanent frost, but it has begun to thaw, a phenomenon 'that makes even the soberest scientists afraid'.[12] The Arctic permafrost holds down very large amounts of decayed vegetation, packed with carbon. As the frost melts, the leaves, roots and mosses beneath it start to decay, and release not only CO_2, but also methane. Methane is many times more potent a greenhouse gas than CO_2. One of the problems is that, so far, there have been relatively few studies of just how far these processes are advancing, largely because of difficulties of access to Siberia on the part of non-Russian scientists. One estimate is that the release of methane occurring from the West Siberian peat bogs is already equivalent to more than the greenhouses gases emitted by the United States in a single year.

And then there is El Niño, linked to the so-called 'Southern Oscillation'.[13] The term refers to unusually warm ocean conditions that can develop in the Pacific Ocean along the Western coasts of Ecuador and Peru. 'El Niño' means 'boy child' in Spanish, referring to the infant Jesus Christ. The name came from the fact that the phenomenon normally develops during the Christmas season. It happens every three to five years and can have a major effect on global climatic conditions. As El Niño moves across the world, following a path along the equator, disruptive weather follows in its wake, causing storms and heavy rainfall in some areas and droughts in others. After some 12–18 months it usually abruptly goes into reverse, causing unusually cold ocean temperatures in the equatorial Pacific, which also have disruptive effects upon weather conditions (moving this way around, it is known as La Niña).

Little is known about the long-term history of El Niño, but in recent years it has occurred more often, and with increasingly severe consequences. As with so many other climatic changes, we do not know how far global warming is playing a part. El Niño may act to moderate warming, but – at least as likely – could serve to accentuate turbulent weather conditions.

James Hansen, head of the NASA Goddard Institute for Space Studies, is one of the most influential authors to argue that the dangers from advancing temperatures have been under-estimated. It is a theme he has pursued for more than 20 years. He says that the goal of confining global warming to 2 °C, already very difficult to achieve, is not enough to prevent the dangerous consequences. The safe level of atmospheric carbon dioxide is 350ppm – below that which already exists.[14]

The authors who write about tipping points in climate change are not eccentrics, but mostly those who once believed that the effects of climate change would be un-dramatic and long drawn out. Fred Pearce, for example, like Lomborg, describes himself as a 'sceptical environmentalist' – by which he means someone who thoroughly investigates suspect claims wherever they are made. He recognizes that there are few or no certainties in climate change. The thresholds that he and others identify are sometimes called wild cards in the climate change pack.[15]

The three different positions referred to above tend to be linked to varying views of the earth and the impact of human beings on it. According to the sceptics, the earth is robust, and nothing that we do is likely to have any major impact upon it. To those closer to the mainstream, on the other hand, the earth – or at least its eco-systems – is fragile and has to be protected from the damaging intrusions we are making into it. Then there are writers like Pearce, who see the earth more as a wild beast, ready and able to react violently and precipitously once it is sufficiently roused. As Pearce puts it: 'She is strong and packs a serious counter-punch. . . . Nature's revenge for man-made global warming will very probably unleash unstoppable planetary forces. And they will be sudden and violent.'[16]

Gee-gees

Climate change comes with a doomsday literature attached. History has seen the rise and fall of many civilizations. According to the anthropologist Jared Diamond, civilizations become threatened with collapse when they burst the bounds of their environmental sustainability.[17]

A microcosmic example is what happened on Easter Island in the Pacific. The island once had a luxurious ecosystem, and was able to support a developed, monarchical civilization. However, over time the status of the kings came to be marked by the size of the statues they were able to build, constructions that consumed substantial natural resources, including a large amount of timber. Any monarch who tried to halt the process would be outflanked by others who would then continue the tradition. The outcome was the deforestation of the island, as the environment became barren and inhospitable. 'The overall picture for Easter is the most extreme example of forest destruction in the Pacific, and among the most extreme in the world – the whole forest gone, and all of its tree species extinct.'[18]

The possible parallels with our own civilization, on a much grander scale, are not difficult to spot. Diamond calls them 'chillingly obvious':

> Thanks to globalization, international trade, jet planes, and the internet, all countries on earth today share resources and affect each other, just as did Easter Island's dozen clans. Polynesian Easter Island was isolated in the Pacific Ocean as the earth is today in space. When the Easter Islanders got into difficulties, there was nowhere to which they could flee, nor to which they could turn to for help; nor could us modern Earthlings have recourse elsewhere if our troubles increase.[19]

Global warming, other authors point out, is not the only danger created by humans that could wreak havoc with our way of life. Other threats come from nuclear proliferation, which could at some point converge with tensions initiated by global warming; from self-reproducing nanotechnology, particles of which could get through the skin, into the bloodstream and from there be carried to the brain; from a food

crisis, producing levels of starvation and mass migration on a massive scale; or from runaway population growth.[20] In *Our Final Century*, the distinguished scientist Martin Rees speaks seriously of the possibility that we – the human race – might not survive the twenty-first century, because of the quantity of dangers built up through our diverse interventions into (what used to be) nature.[21]

Some such 'doomsday books' concentrate on potential catastrophes in which human activities play little or no part. These happenings are extremely infrequent, but, by scientists, they 'are now very much regarded as part of the compendium of hazards that we have to consider' when thinking of the earth's vulnerabilities.[22] They have been labelled Global Geophysical Events – GGEs or, such is the human propensity for playfulness, 'gee-gees'. Gee-gees are catastrophes of sufficient scale either to impinge on the whole planet, or to cause regional devastation of such strength that it could severely damage the social fabric or the economy of the world as a whole.

An ocean-wide giant tsunami is one such catastrophe. The tsunami that occurred in December 2004 killed an estimated quarter of a million people, spread out in areas far from the source itself. The waves produced by the tsunami were mostly less than 10 metres high. Should a giant tsunami occur, it could generate waves several times larger. Such an event could be brought about – among several possibilities – by the eruption of the Cumbre Vieja volcano on La Palma, one of the Canary Islands. Scientists have been monitoring the volcano for some time; it has a series of long fractures along its seaboard side, the result of an eruption in 1949. In a further such eruption, the entire flank of the volcano could become violently thrust into the sea, triggering a mega-tsunami that would race across the Atlantic.

Another gee-gee would be an earthquake that strikes in the middle of a major population centre. Tokyo is a case in point. The city experiences constant tremors, although the last time there was a big earthquake was in 1923. In shaking that lasted only about a minute, 360,000 buildings were destroyed in Tokyo and its twin city of Yokohama. More than 70 per cent of the inhabitants of Tokyo and 85 per cent in Yokohama lost their homes. In all, more than 100,000 people died in the disaster.[23]

Three times as many people live in the Greater Tokyo area now than in the 1920s – over a quarter of the population of the country. Homes and workplaces are more solidly built than they used to be, but, because of the population density, another big earthquake would be likely to result in as many or more people being killed than perished 80 years ago. The property damage likely to be incurred is considerably greater than it was then, because the society is so much wealthier. A study funded by the insurance company Swiss Re calculated that the cost of the damage would be around $4.3 trillion.

The possibility that the earth might be struck by a large asteroid or comet is a third gee-gee. It is only over the past 20 years or so, as a reult of advances in satellite and infra-red mapping, that the progress of foreign bodies through space has been able to be accurately mapped and monitored. An 11-point scale – the Torino scale, so-called because it was established in a conference held in that city – is used to assess the likelihood of newly discovered asteroids and comets posing a threat to the earth. Some 3,000 small rocks do in fact hit the earth every day, the large majority of which burn up in the atmosphere. About 100 get through and hit the ground as meteorites. Asteroids and comets are gigantic by comparison. If it were to collide with the earth, an asteroid one kilometre in diameter would generate an explosion equivalent to 60,000 Hiroshima bombs. Such an event is not quite as far beyond the bounds of possibility as one might imagine. On 13 January 2004, according to some calculations, for several hours asteroid AL00667 had a one in four chance of striking the earth. It measured 30 metres in diameter and would have had the capacity utterly to destroy a major population centre.

Why mention gee-gees in a book about climate change? There are several reasons. In the first place, awareness of such hazards contributes to the fears that tend to swill around in our consciousness today. Bill McGuire, whose work I have used extensively in the preceding few paragraphs, has written a string of doomsday books, including *Apocalypse*, *Raging Planet* and *A Guide to the End of the World*, before producing his most recent one, *Surviving Armaggedon*. These are all based on the latest and most advanced scientific findings and

research capabilities. We simply know more about the hazards described than we did even a decade ago.

Second, some gee-gees could intersect with dangers arising from climate change. For instance, tsunamis could become more lethal if ocean water levels were to rise significantly, making coastal cities more exposed than they had been before.

Third, some of the strategies that have been suggested to reduce threats from gee-gees could in principle be relevant when it comes to controlling climate change. At first sight, it might look as if nothing could possibly be done to influence them. However, scientists have some of the gee-gees in their sights. The National American Space Agency (NASA) is testing methods of altering the trajectory of a threatening asteroid, for example. It would take only a small nudge to deflect it from its path, and the further away the asteroid is when this is done, the smaller the deflection would have to be. One possibility being looked at is that a rocket motor could be landed on the asteroid, which, when activated, would provide the necessary thrust. Large-scale engineering has also been proposed to limit global warming, such as suspending giant mirrors in space to reflect back a proportion of the sun's rays. (See below, pp. 136–7.)

Enter the optimists

Discussing why doomsday thinking is apparently so prevalent today, Frank Furedi, who has written widely on risk and danger, argues that it is partly because of cultural change that has taken place over the past two or three decades. We have become preoccupied with safety and therefore tend to see threats everywhere – which translate into feelings of apprehension and powerlessness. Furedi sees writers on climate change as having a key role in getting all this under way – they are writing the pre-history of disasters and catastrophes to come, stoking up anxieties that invade other areas of life. Our current feelings of vulnerability are, he says, 'unprecedented'. They stand behind our – largely irrational – 'attitude of pessimism, dread and foreboding'

towards the future.[24] Furedi joins those critics of doomsday thinking who say, as one of them puts it after a lengthy survey of risk, 'There's never been a better time to be alive.'[25]

One such critic, Dan Gardner, offers a cogent analysis of some of the incoherent or inconsistent views that the public have about risk. People tend to worry much more about some risks than about others, even though the probability of their occurrence is lower. For instance, after 9:11 many people in America for a while gave up flying in favour of driving. In fact, driving is more dangerous to life and limb than flying. Many more people die on the roads each year in the US than were killed in the attack on the Twin Towers. If terrorists were to hijack and crash one passenger jet every week in the US, a person's risk of dying that way would be a fraction of the risk of being killed in a car journey covering the same mileage.[26]

Risk perception, Gardner goes on to show, is influenced by many factors, including especially the ways in which messages are framed. For instance, in one experiment people were asked to imagine they were patients with lung cancer who had to decide whether to opt for surgery or for radiation treatment. They were divided into two groups. One group was informed that they would have a 68 per cent chance of being alive a year after surgery. The other was told that there was a 32 per cent chance of dying before that date. Of the first group, 44 per cent chose surgery over radiation; the proportion making that choice in the second group was only 18 per cent. Similar results have been found in many other similar studies.

Public perceptions of risk are quite often at odds with reality, for example in the area of crime. Gardner cites the instance of the wave of anxiety about child abduction which swept through the US in the 1980s. In response, the government commissioned research to find out the extent of the problem. The total number of cases each year in which children under the age of 14 were abducted by a stranger turned out to be 90, giving an annual risk factor of 1 in 608,696. More than 2,000 children die every year in the US in car accidents – a proportion of whom were not wearing seat-belts, a simple enough precaution to take. The extent of public agitation about abduction bore no real relation to the risk factor, compared to the relatively relaxed attitudes people hold towards other dangers.[27]

Most of those who have studied the evolution of contemporary attitudes surrounding risk trace the beginnings of a preoccupation with safety, and a stoking up of fears, to the 1970s – the time at which, as has often been pointed out, the expansion of electronic media really got under way. Are the two trends causally connected? It would be difficult to deny some kind of relationship, especially given the core precept of media presentation, that 'bad news is good news'. There is a great deal of research demonstrating that the media give far more coverage to dramatic and/or violent causes of death than to more mundane ones, thus conveying a false impression of risk to the public.[28] Even when serious crime rates are going down, the public can come to believe that they are in fact going up.

The reporting of risk, studies show, rarely puts risk calculations in context. Thus a newspaper might report that the number of people murdered over the past 10 years in London has increased by a quarter, giving the impression there is mayhem on the streets. Yet since the overall numbers are so low, amounting to fewer than 30 a year, the true level of risk of dying in such a way is 0.0001 per cent; with the rise in question, the risk would still be absolutely minimal for each member of the public.[29] The media are one of the main filters through which scientific findings and discussions are disseminated and there have been many instances when sensationalist reporting displaces caution.

The political management of risk has to tread a difficult path between alarmism and reassurance. I don't think we should take doomsday thinking at face value. Rather, we should see it as a set of cautionary tales. It is about what could go wrong if we aren't on our guard and if we don't take appropriate remedial action. The dangers that Martin Rees talks about, for example, are on the border between risk and uncertainty – it is difficult to attach more than extremely loose probabilities to them.[30] In the case of new-style risks – those related to the advance of science and technology – we struggle to decide how seriously to take them, because of the way they shade off into uncertainty.

It is hard to keep a given risk – including global warming – in the public consciousness in the context of other perceived dangers that come and go. The phenomenon of attention fatigue has been well documented in research studies. Already,

opinion polls reveal that, even when they accept the risks of global warming as real, some respondents report that they get fed up with hearing so much about it. That reaction is also coupled to an inclination just to 'forget about it all and get on with ordinary life'. There is a similar reaction to perceived alarmism – 'if the situation is as bad as you say, we might as well just give up worrying'.

All the above factors are relevant when we consider what the response in public policy should be to those who claim that climate change is advancing more quickly than the majority of scientists think. We should be careful about what the implications of such views are for practical action. How does Pearce know that 'nature will take revenge' for our influence on the climate? What is the force of 'very probably'?[31] Concentrating on worst-case scenarios is rarely, if ever, the best way to deal with risks. On the contrary, it can provoke exaggerated reactions which paralyse policy rather than furthering it.

Some of the 'competing risks' in world society which Lomborg quite rightly says we also have to focus on are every bit as dangerous as climate change if we only take worst-case possibilities. Failure to contain the spread of nuclear weapons, for example, could lead to conflicts in which millions could die. I don't believe it would be appropriate to respond with a panic stations call. 'There's never been a better time to be alive' – it may not be literally true, certainly for large numbers of people in the world, but it is a sentiment to be taken seriously. We have an obligation to take as balanced and nuanced assessment of risk as possible, an issue I shall come back to later.

In the next chapter, I move on to another set of risks – those connected with energy security. At first sight, they have quite a different feel and texture from those connected to climate change. A short historical perspective is needed to introduce them. Who says oil says geopolitics. Maintaining a constant flow of oil has been, and remains, one of the main objects of the foreign policy of the developed countries over the past 60 or 70 years. For a long while, guaranteeing supply seemed wholly a political problem. It used to be thought that there was sufficient oil to go round to meet the world's need for many decades into the future, so long as the producers continued to supply it. This assumption is now in serious doubt.