**A Cool Look at Global Warming**

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I thank the Institute for giving space and time to an Honorary Fellow who is venturing into dangerous space, at least for him. The title of this paper gives a taste of its content, and I had better start with a summary. Australia is faced, over the next generation at least and almost certainly much longer, with two environmental problems of great significance. They are, first, how to manage water in a dry continent that may be moving into a long dry period, within a society that is used to having lots of good water very cheaply; and second, how to find acceptable alternatives to oil-based energy (which looks like getting much more expensive quite quickly) within a society that is used to cheap oil and lots of it. Global Warming, you will have realised, is not one of those two issues, at least for me, and I see it as a distraction from the two I have highlighted. This paper is about why it may not be such an important issue, and why we should get on with the others, which are unquestionably important, and closer to hand. I shall say something about the application to this issue of the precautionary principle at the end.

**Conventional Wisdom**

You will appreciate that I am going against 'conventional wisdom' in doing so. But Western societies like ours have the standard of living, the longevity and the creativity we have because we have learned that conventional wisdom has no absolute status, and that progress often comes when it is successfully challenged. Why am I doing it now, when everything we hear in the mass media, in politics and in the world, is about the catastrophe awaiting us if we don't change our ways? The answer is that I tend to be an agnostic about such claims (those of Paul Ehrlich, Rachel Carson and of the Club of Rome come to mind), and ask to see the evidence and the argument. If you listen hard to the Global Warming debate you will hear people at every level tell us that they don't want to hear any more talk: they want action. I feel that the actions I have seen proposed, like carbon caps and carbon trading, are likely to be unnecessary, expensive and futile unless there is much stronger evidence that we are facing a global environmental crisis, whether or not we have brought it about ourselves.

**The central Anthropogenic Global Warming proposition**

That is to say, I am presently agnostic about the central Anthropogenic Global Warming (hereafter AGW) proposition, which I would put like this.

> ***Human activity in burning coal and oil, and clearing forests has, over the past century, put an enormous amount of carbon dioxide into the atmosphere where it has combined with water vapour and other gases like methane to increase global temperatures in an unprecedented way. The evidence that this has occurred is clear-cut, and the increase in temperature will have, according to our computer models, dire effects on the planet, causing the melting of polar ice, the raising of sea levels, droughts, floods, storms and desertification. We must put an end to this prospect by changing our way of life lest catastrophe strike us. It may already be too late.***

I have tried not to caricature the proposition, though I would accept that the way I have put it is much more the language of lobbyists, politicians and the mass media than it is of science itself. But it is scary stuff, it is said to be based on science, and it seems to be scaring a lot of people.

Three things about the AGW proposition make it, in my eyes, an inadequate basis for far-reaching public policy. One is what I would call over-certainty in the absence of convincing argument and data. Another is what seems to me an over-reliance on computer models.

The third is what I would call the almost panicky media mood about 'global warming', in which human beings are pictured and some see themselves as evil actors in the destruction of their own habitation (through greed, arrogance and lack of will), and who deserve the punishment that will be theirs. I see no reason to think this way. While governments can never ignore what they see as popular feeling, good policy cannot be based on moods.

In this address I will consider what is known about the following:

(1) the extent to which the planet is warming;
(2) whether or not such warming is unprecedented;
(3) whether or not the warming is caused by our burning fossil fuels;
(4) the likelihood of polar ice melting in a major way;
(5) the use of computer models in predicting future climates;
(6) the reluctance to admit uncertainty;
(7) the extent to which we need to change our way of life to avoid catastrophe.

The first three issues are the crucial ones, and you do not need a PhD in science to understand them. You will see, however, that getting clear-cut answers is not at all straightforward. I will also spend time on what I see as the reasons for the stridency of the AGW claim, despite what I see as the lack of strong scientific support for it, and finish with a renewed plea for us to focus on real and imminent environmental problems, not on agonising about the probability that the sky will fall in.

So to the first of three prefatory remarks, which is about scientific method.

**Scientific method**

The 'scientific method' is one of our great legacies from the European Enlightenment of the 18th century, and it is the basis of much of our current civilisation. Its roots are much older, since the Greeks from Archimedes onwards and the cultures of Islam, India and China all added their contribution. Its point is the acquisition and use of reliable knowledge, available in principle to us all. At its heart is what Karl Popper called the 'contingent' nature of knowledge: statements of apparent truth lose their validity the moment they can be regularly controverted. So the notion that the sun revolved around the earth was controverted by the telescope and reasoning, some of Newton's laws of gravity were controverted by Einstein, the idea that ulcers were related to over-acidic stomachs affected by overwork and stress was controverted by the discovery of helicobacter, and so on.

Apparent truths exist because no confounding experiment has yet been done. These 'truths' are controverted when new experiments cast doubt on some of the assumptions underlying the apparent truth, or when better instrumentation allows the experiment to be done in a more powerful way that shows up exceptions to what had been an apparent law. The general rule is that scientists are agreed to share a passion for truth, and to make their data and procedures public so that critics have an opportunity to show fault. I mention all this relatively uncontroversial stuff because the story about Anthropogenic Global Warming doesn't seem to stack up as the best science, despite the 'thousands of scientists' who are said to have 'consensus' about it. Indeed, the insistent use of word 'consensus' should at least start the raising of eyebrows among those who are knowledgeable about research because, as I have just said, research and science aren't about 'consensus', they are about testing theories against data. In any case, as I shall point out later, there exists vigorous debate throughout the climate change domain. For example, there is, as I write this, disagreement about whether or not the recently completed year 2007 was a notably warm year (it had a hot start but a downward cool trend). And all that is simply about measurement. In climate science I see no consensus, only a pretence at a contrived one. In any case, whatever consensus exists in science is always temporary only. As Einstein put it: 'No amount of experimentation can ever prove me right; a single experiment can prove me wrong'. Or as a later Nobel prize-winner, Richard Feynman, said, 'A scientist is never certain. We all know that. We know that all our statements are approximate statements with different degrees of certainty; that when a statement is made, the question is not whether it is true or false but rather how likely it is to be true or false.'[1]

**Climate science and climatology**

My second prefatory point is that the widespread use of terms like 'climate scientists' and 'climatology' implies that these terms are straightforward categories. But they are not. *Climatology* may be thought of as the discipline concerned with collecting, averaging and analysing local weather data over long

periods, and is several generations old. *Climate science* is essentially the study of the passage through the Earth's ocean/atmosphere system of energy derived from the Sun, a passage that is dominated by the transport of energy from the tropics to the poles. As a study it is comparatively new, since its development has depended upon the advent of satellites and computers. While there are a number of theories about how climate is generated ('climate' is often described as the average of the daily occurrence of 'weather') these theories are 'contingent' in the best Popperian sense, since they are plausible, fit more or less what we know about weather, and have not been disproved. But they have nothing like the validity and force of established theory in basic disciplines such as physics or chemistry.

The complexity of the knowledge surrounding climate change is reflected in the range of expert persons who currently contribute to its public debate. They come from virtually all scientific disciplines. Given their diversity of origin and disciplinary approach, it is not surprising at all that there exists great debate about what has happened in the earth's past and what caused it, let alone about what is happening now. Solar physicists, for example, are likely to see the sun as much more powerful in affecting our weather and climate than anything that happens on earth, while those interested in the oceans see them as the major control. The notion that 'the science is settled' is fatuous. If it appears like that you are seeing politics at work, not science.

Put simply, despite all the hype and the models and the catastrophic predictions, it seems to me that we human beings barely understand 'climate'. It is too vast a domain. Though satellites have given us a sense of the movement of weather systems around the planet, portrayed every night on TV, we still know little about the oceans, one of the crucial elements in climate processes, not much more about the atmosphere, another such element, a little about solar energy and the effect of the sun's magnetic field on earth, and only a little about the land. The earth is a big place. We are beginning to put these huge elements together, but have yet to develop a 'science' that does so satisfactorily.

**Data, measurement and uncertainty**

My third prefatory remark is about the matter of evidence. In the climate domain, evidence consists of a mass of observational and experimental data drawn from a wide range of disciplines, and for a huge time span. An awkward discovery is the lack of consistent data. The measurement of weather data (rainfall, temperature, humidity, wind strength, air pressure) is highly variable in where the measurements are taken, how many measuring points there are, and the reliability of those measurements. We need to remember that the human population rose from 1.5 billion to 6 billion in the 20$^{th}$ century, and that the growth of cities since 1950, and of their heating and cooling systems, has been extraordinary. How are these effects to be disentangled from a supposed global warming caused by the burning of fossil fuels? The Intergovernmental Panel on Climate Change (IPCC), about which I shall have more to say later, claims that the effects of 'heat sinks' and 'urban heat islands' have been taken into account,

but new evidence suggests indeed that the growth of cities itself explains a good deal of the apparent warming.[2]

One of the yardsticks of the current debate is 'average global temperature'. We can all imagine what it might mean — an average of the temperatures taken in a multitude of carefully plotted points around the globe, measured the same way, providing a single figure, a mean, which could be measured over time to show trends. The actuality is much less. NASA's Goddard Institute for Space Science, the National Climate Data Center and the Hadley Climate Research Centre in the UK produce the data. All use temperature data recorded a little above (1.3 to 2 metres) the earth's surface, and obtain an arithmetic average of the maximum and minimum temperatures over 24 hours. None covers the whole planet, and the Southern Hemisphere is not as well measured as the Northern. A recent study of one third of the sites in what is arguably the best temperature measuring system, that of the USA, showed that in a majority of the sites surveyed the instruments were inappropriately located — close to buildings, on tar or concrete, next to parking areas, on top of roofs, and so on. The majority of estimated bias errors (and the bias was always towards a higher reading) were larger than 1°C; many were 2°C. The sites were not even using the same instruments. In the last ten years thousands of measuring sites have ceased to be used (most of them rural and/or in the former Soviet Union, and covering a huge area), and the number for the world that are in continuous use has dropped from around 6000 to 2000.[3]

A second reason for the lack of good data is that we only have decent and systematic measurements of any consequence for the last hundred or so years. Further back we have to rely on what are called 'proxies' — ice cores, sea-bed cores, tree rings, lake-bed cores, pollen counts, carbon-dating, vegetation growth, paintings and the like. When we use proxies we are importing along with the proxy data a little contingency statement, such as: 'when tree rings are wider, we assume that there was more growth in that year, which means more water/less cold/better weather', or 'these paintings of snow and icy conditions were painted at this time because these conditions were unusual, and we have other, written reports that are consistent with that supposition'. There is a lot of current debate about all these proxies, and their meaning and relevance. To give just one example, if temperature rises slightly then, other things being equal, vegetation growth improves, but if it rises substantially the plants will suffer heat stress and growth then decreases.

To which we can add that with all such measurement, even of rainfall, there is missing data, human error, variation around the mean, a thinner network of measuring instruments than would be ideal, and so on. Measurement nearly always comes with error, and we need to allow for it. Usually, when researchers make a statement about the meaning of measurements they qualify that statement with one about the likely error around it. Where there is error, and we know there is but can't be sure how important that error is, we should say so. I mention this because, to repeat, there is a great deal of uncertainty in the evidence relating to climate change, but in my view it is often brushed aside by the IPCC and its supporters, a point I shall return to later. We lay people learn

most of what we know about climate change from the mass media. Uncertainty does not make for a good story, and the media are in the business of story-telling. They too ignore the uncertainties, and give one side only on the issue. A large scientific conference in New York in March, for example, in which AGW sceptics gave paper after paper, went entirely unreported in Australia.

So to the first AGW proposition:

**(1) Is our planet warming?**

The IPCC has offered an estimated average increase in temperature for the planet over the 20th century of 0.6°C ± 0.2°C, an estimate based on a compilation of near-surface measurements. We need to recognise at once that an 'average global temperature' is not a real measurement but a construct. If we can set that objection aside, and if we can also suspend the worries about measurement reliability and validity that I have referred to already (many would be most reluctant to do so; see the McKitrick objection in the second footnote), there is no great argument about the *size* of the increase. Some sort of warming is consistent with, though not plainly the cause of, the evident melting of sea ice and the retreat of some glaciers. Most of whatever rise there has been seems to have occurred in two periods, one between 1910 and 1940 and the other from 1975 to 1998. There seems to have been no continued increase since 1998. Measurements can be based on a variety of data sources, including ground stations, ships, satellite observations of the atmosphere (which don't go back much before 1980), and instruments carried aloft in balloons. Juggling them to fit each other, and extrapolating back in time to areas where there were no recorded temperature measurements is always a mighty task. People pick and choose the ones they like best (in its latest report the IPCC, for example, discredits satellite-based measurements, perhaps because they are lower). But let all that pass too.

**(2) Is the warming of the 20th century unprecedented?**

By way of answering this question I would like to start with the recent history of our species, because I think it is directly related to climate change. You will know that some 15000 years ago the planet came out of a long ice-age, one of a number in the last million years. The ice began to melt, the seas rose (they reached their present level about 7000 years ago), and our species, *homo sapiens*, began its long trek around the world. I mention in passing that our Aboriginal people began arriving here in the middle of that ice age. By 10000 years ago the first small permanent settlements began to appear, as people assembled and domesticated animals, learned how to plant crops, and abandoned being hunter-gatherers. There were then, according to some estimates, about a million of our ancestors. It seems to me to be no coincidence at all that global temperatures had begun to level out. The evidence for these temperatures is based on Greenland and Antarctic ice-core data, and I need to say at once that what happened in Greenland or the South Polar regions may not have happened anywhere else.[3] Average temperatures seem to have remained within a narrow band of about two to three degrees Celsius ever since, save on a few occasions, such as the Mediaeval Warm Period, when English monasteries grew grapes and made

wine, and the later 'Little Ice Age', when the Thames froze in 1683 and a Frost Fair continued for two months on the ice. On the evidence, present average temperatures are similar to those in the first century AD. That doesn't mean that things were the same then. On the contrary, the city of Rome then drew the bulk of its grain from Libya, which today is much too arid to support such agriculture. It is the relative stability of temperature that has enabled our species to flourish. The trend in these temperatures has been gently downwards, though by perhaps a half-degree over ten thousand years.[4]

On the face of it, there is nothing especially unprecedented about the 20th century temperature rise, given its 'agreed' size. Shifts up and down of that magnitude and more seem to have occurred in the past, and will presumably occur in the future. Climate change is not new, and occurs for reasons that can have nothing to do with us. Orbital changes, sunspots, volcanic eruptions and meteorites have effects on the earth's climate, and these causes are external to us. We simply have to put up with the changes and adapt what we do to them. Whatever warming that is happening now, and whatever contribution we humans are making to it, have to be seen in that context.

In the last million years long ice-ages have been followed by much shorter 'inter-glacial' periods, but these relatively brief warm periods have been the times when animal and vegetable life flourished. On balance a shift in temperature downwards of a few degrees will be much more worrying to us than a similar shift upwards. Thirty years ago the climate worry in scientific circles was about the possible return of the ice age. What was it based on? Well, a decline in average Northern hemisphere temperatures of about half a degree Fahrenheit and an increase in winter snow cover. But listen to the language (this is from *Newsweek*, 28 April 1975):

> There are ominous signs that the earth's weather patterns have begun to change dramatically and that these changes may portend a drastic decline in food production… The evidence in support of these predictions has now begun to accumulate so massively that meteorologists are hard-pressed to keep up with it… Last April, in the most devastating outbreak of tornadoes ever recorded…

Does it sound familiar?

> **(3) Is the warming caused by our burning fossil fuels, clearing the forests and other human activities?**

An increase in atmospheric levels of carbon dioxide over the past century is agreed. Some of it is due to the burning of fossil fuels, cement-making and agriculture. Unfortunately, we don't know what the 'normal' production of $CO_2$ is. Carbon dioxide currently makes up a tiny part of the atmosphere, about 385 parts per million though the proportion is growing slowly and steadily, at an annual rate of about 2 ppm — less in La Nina times and more in El Nino. Plants and the oceans absorb about half the $CO_2$ that is emitted, while the other half

remains in the atmosphere, for a period of time that is not certain; estimates differ greatly.[5]

Now 385 parts per million is plainly not a lot, and anyone might ask how it is that carbon dioxide causes air temperature to rise, when it is such a small component of the air. The broad explanation is that carbon dioxide is one of a number of greenhouse gases whose effect is to trap some of the outgoing heat from the earth and to re-radiate it in all directions. Indeed it is the greenhouse effect that allows us to live, since without it the temperature would be much too cold to support life as we know it. The principal greenhouse gases (about 98 per cent) are water vapour and clouds, with $CO_2$, methane and other gases contributing a very small amount. In terms of radiation $CO_2$ is more powerful, making up about 30 per cent of the greenhouse effect. Oxygen and nitrogen, the principal components of the atmosphere, are not greenhouse gases at all. The reason is that they have no effect, either positive or negative, on the extent to which energy is radiated out from the earth's surface whereas water vapour, clouds and $CO_2$ do have an effect. But how does a small increase in a very small component have such a large apparent effect?

The truth is that no one has yet shown that it does. The physics of the greenhouse effect is straightforward, so that such a relationship is theoretically there. But it seems equally true that the relationship is logarithmic and diminishing — that is, each increase of 50 ppm will cause much less warming than the last such increase.[6] Once again, the crucial problem is that we don't know a lot about the positive and negative feedbacks involved with water vapour and clouds, so that the outcome in modelling produces a very wide of possibilities. An assemblage of ice-core data in the mid 1980s seemed to show that $CO_2$ and temperature had marched together, up and down, for at least a million years. The data points were a thousand years apart, but over such a long time-period that seemed not to matter. On the face of it, if they rose and fell together they must be causally linked, and the obvious cause was $CO_2$. More recently gathered ice-core data, however, with closer data points, point to the opposite effect: temperature change seems to precede $CO_2$ rises — by about 800 years. Why would that happen? Well, cold seas absorb $CO_2$ while warm seas release the gas (the oceans are a great $CO_2$ sink and a great heat collector, too). As temperatures rise, the ocean releases more $CO_2$, so atmospheric concentrations of the gas also rise. As the earth cools the seas cool and absorb more of the gas. There is a net effect here because the two processes go on at the same time, given the wide difference in surface sea temperature levels in the tropics and at the poles. That, at least, is the proffered explanation, and it is no less plausible.

No dramatically linear relationship between increasing $CO_2$ levels and higher global air temperatures can be shown for the 20th century. Though $CO_2$ levels have been rising for a century, temperature has not done so: one of the warming periods in the 20th century seems to have been at the beginning of the century, when the human production of $CO_2$ was much smaller than it is now. You will also recall that temperatures seem not to have increased since 1998, though the concentration of $CO_2$ in the atmosphere has gone on increasing. Two other correlations are much stronger. One is the relationship between solar energy and

temperature, while the other is between ocean movements and temperature. Moreover, actual measurement of temperature does not support the greenhouse gas theory. According to the IPCC's global climate models there ought to be a 'hot-spot' in the troposphere at about 10km up. However, the data presently show no sign of it.[7]

On the evidence that is available, I think it has to be said that the assertion that the increase in carbon dioxide has caused the temperature to rise is no more than an assertion, however attractive or worrying the association may be. There is simply no evidence that this causal relationship actually exists. That does not mean that there is no relationship, only that so far it has not been shown to exist. There is no evidence yet that increasing concentrations of $CO_2$ are harmful to us; other things being equal, they certainly increase plant growth vigour.

**(4) Is the global warming likely to lead to a dangerous increase in sea levels?**

An accepted estimate is that sea-levels have been rising for the past few hundred years by about 1 or 2 mm a year – about 20 cm in a century. Sea levels can rise because the sea is warmer, and also because land sinks (Venice, for example, has been slowly sinking for several hundred years), so that local relative sea-level changes always have to be inspected for local causes quite apart from what is happening to the total body of water in the oceans. The IPCC currently predicts that there will be a rather larger increase in the 21st century, of perhaps 2-3 mm per year, an estimate based on satellite measurements and the ubiquitous computer models. Its middle estimate might lead to an increase (if there is to be one) of perhaps 30 cm over this century. Even if that is accepted, there is no warrant here for the claims that Tuvalu, the Maldives and other low-lying island micro-states, or coastal towns in Australia or Florida, will be devastated. As it happens, the sea-levels around Tuvalu rise and fall with the El Nino Southern Oscillation, itself the major influence on Australian climate. Puzzlingly, very recent evidence from a major project that uses robotic buoys to measure sea temperature suggests that there has been a slight cooling in the sea over the last five years.[8]

It is undeniably true that many people are scared at the prospect that the polar ice will melt, and that the seas will rise. There is simply no evidence that any of this is at all likely, at least not in the next several hundreds or thousands of years. About Antarctica, which contains about 90 per cent of the world's ice, the story is mixed, and there is much dispute. There is evidence that Antarctica is getting colder, and also evidence that it is shedding more sea ice (which could be simply an effect of the pressure within its abundant glaciers. Yes, there is warming in the northern hemisphere, but that has occurred in the past too, before there was the burning of coal and oil. We should remember, too, that the melting of sea-ice has no effect on sea-levels; it is only the melting of the ice-caps of Greenland and Antarctica (ice on land) that could have powerful effects.

Let us move then to the modelling of climate.

### (5) The use of computer modelling to predict future climates

The computational power of big computers allows scientists and engineers to design and 'test' large structures like aeroplanes and bridges without having to build real examples and test them, as was once the case. Engineers now design a 'model', a simplified version of the real thing, and subject the model to tests by varying the assumptions built into it and the context surrounding it. There is, however, a world of difference between modelling an aircraft or a bridge and modelling an economy or a weather system. The problem lies in the number of variables, what is known about them, and the assumptions that have to be made. When learning about computing in the US forty years ago I discovered that if you made a mistake in your input the output from the computer was rubbish, notwithstanding the apparent precision of the numbers in the printout. There was a phrase for it: 'GIGO', or 'Garbage in, garbage out.' In the case of weather systems and the General Circulation Models (GCMs) that purport to describe them, the task can only be described as 'heroic', because the underlying science, the actual relationship of solar energy, oceans, atmosphere, winds, and so on is not known with any precision, a large number of estimates has to be made about, for example, solar energy, the curvature of the earth's surface, the latent heat of the earth, and so on, while the observed data, as we have seen, are not at all perfect. Any forecasts of what will happen in the 21st century in climate terms ought to be accompanied with an explanatory apologia that sets out the uncertainty. That doesn't happen enough. In fact, these GCMs seem to be invested with quite astonishing explanatory power, when you consider that we are not good at developing accurate predictions about weather over the coming few days, weeks or months. The response is that the GCMs are predicting climate, not weather. I would be happier with this argument if the IPCC would predict climate in, say, 2009, so that we could test the predictions. After all, the data would be a great deal more robust than those dealing with the world in 2050 or 2100.

Commonsense tells us that if our current knowledge of climate and weather cannot provide forecasts with much accuracy past 24 hours, we don't know enough about the inter-relationships inside the model, no matter how much data we have, even supposing it be perfect data. It is important that the work be done, and modelling is a valuable intellectual activity in its own right. Yet it is these contemporary, unvalidated models that are the basis of the Kyoto Protocol, carbon trading and the climate change policies put forward by our political parties. To repeat, models are models; they are highly simplified versions of reality, and cannot provide evidence of anything. Models will produce a wide range of possibilities, each of them having a kind of validity. One recent example, showing a truly catastrophic climate outcome in twenty years' time, was based on the assumption that the central global warming hypothesis is correct. It was then used to show why we must do something now about reducing greenhouse gas emissions. When I was a young undergraduate that kind of argument was known as an 'intellectual coup d'êtat': you assumed what it was that you had to prove, surrounded it all with words (or in this case, numbers), and laid it on the table in triumph. I was astounded that no one objected.

If in fact increased temperatures produce increased $CO_2$ concentrations some hundreds of years later, as the ice-cores indicate then these GCMs are fundamentally flawed if they assume the opposite relationship. And that leads directly to the second-last question.

**(6) The reluctance to admit uncertainty**

Dealing with this issue could produce an essay as long as the present one. A little organisational history is in order. The World Meteorological Organization (WMO), a body representative of government meteorological organisations like our Bureau of Meteorology, set up the World Climate Programme in the 1980s, Its purpose was to develop theories and, all being well, long-term weather and climate forecasts. In 1988 the WMO and the United Nations Environment Programme (UNEP) then set up the Joint Intergovernmental Panel on Climate Change (IPCC), and gave it the task of assessing the risks of human-induced climate change. That is to say, the very existence of the IPCC is based on the AGW proposition. Governments, particularly in Europe, gave some credence to all this activity because Mrs Thatcher, the UK Prime Minister from 1979 to 1990, and the only world leader to have a science degree, made much of the possibility of global warming during her premiership. The IPCC has so far issued four reports, in 1990, 1995, 2001 and 2007. Each is said to be a 'scientific' report in that the papers on which it relies are said to have been published and peer reviewed. Each IPCC is accompanied by a Summary for Policymakers, and these summaries set out the scientific findings that are relevant for policymakers. The language of the Summaries is much more political than it is scientific. Where IPCC reports are generally careful in their use of terms, the Summaries are forceful and urgent.

As a putatively 'scientific' body the essentially self-selecting IPCC has acquired an extraordinary profile within the world, as it seems able to put pressure on national governments (far more so than the United Nations itself). It has acquired that prestige through the standing that the natural sciences have. We have seen that there that is much more uncertainty about all of the science around global warming than the IPCC admits. Any study of how the four IPCC major reports have been produced suggests that there is an extreme reluctance on the part of those running the IPCC to admit that the CO2-as-climate-driver model has any flaws. I have been forced to the view that the IPCC relies on 'authority' rather than on inspection and criticism. People who write contrary pieces, no matter how able they are or how impeccable their science, are simply ignored. The refrain that 'the science is settled', 'the debate is over', is accompanied by what seems to me the demonisation of critics. The UN's special climate envoy has said that it is 'completely immoral even to question' the scientific consensus, while the executive secretary of the UN Framework Convention on Climate Change (UNFCCC), in similar vein, has said that it is 'criminally irresponsible' to ignore the urgency of global warning. IPCC statements claim the support of 'thousands of scientists' as though all of them are across all of it and that no one dissents. The assertion is simply not true. Among other things, the 'reviewers' are asked to review only the wording of the report constructed from the papers, not the

papers themselves. The peer-review process of the IPCC doesn't seem kosher to me, and I have spent a long time in the world of peer review.[9]

What I see, rather, is something that the political theorist Paul Feyerabend wrote about a long time ago in *Against Method* (1975): the tendency of scholars to 'protect' their theory by building defences around it, rather than, as Popper would wish, being the first to try to demolish their own proposition. As each new paper that proposes an alternative to one or other aspect of AGW appears, it is as though it has to be ignored, rubbished or noted but dismissed, rather than accepted as a valid contribution to the debate. Why does this continue? When the Royal Society in London has to issue a paper crushing anyone who asks inconvenient questions, or where the President of our own equivalent body issues a public statement saying that 'Those who deny human-induced global warming are in the same camp as those that deny smoking causes lung cancer and that CFCs deplete the ozone layer' you begin to shake your head. This is not at all in the tradition of the best science. It is the language of the boss.

At this point some of you might be wondering how all this can be true, given the near-unanimity of public discourse about climate change, given that most of the governments of the world, the UN, lots of NGOs, churches, lobbies, newspapers, TV stations and letter-writers all seem to think the same. I think that the most general reason is that we seem to be caught up in what a pair of social scientists has called an 'availability cascade': we judge whether or not something is true by how many examples of it we see reported.[10] Fires, storms, apparently trapped polar bears, floods, cold, undue heat — if these events are authoritatively linked to a single attributed cause, then almost anything in that domain will seem to be an example of the cause, and we become worried. I should say at once that 'climate change' has become the offered cause of so many diverse incidents that for me at any rate it ceases to be a likely cause of any. Why does this particular availability cascade have its evident force? I offer some reasons.

One is that some of the senior people in and around the IPCC — one might call them 'scientist-activists' — are convinced that unless the world wakes up to itself humanity will not have a future. I would call this a quasi-religious view, and it is the basis of the view that 'the end justifies the means', a doctrine that I think has no place in a democracy. It seems to me that 'environmentalism', broadly defined, has elements of a quasi-religious movement (with 'Gaia', the spirit of the earth, as the goddess), and the religious are rarely interested in argument or evidence. A second is that there are now thousands of people, not the least of them scientists, whose work depends on the AGW proposition and the large amounts of money that have flowed to institutes and universities because of it. National scientific academies are now in the happy position of being powerful, at least in this domain, and they have become political in an apparent attempt to protect that pleasant power, whatever its impact on science.

A third is that the Greens and environmentalists generally welcome the AGW proposition because it fits in with their own world-view, and they have helped to popularise it. Governments that depend on Green support have found themselves, however willingly or unwillingly, trapped in AGW policies, as is

plainly the case with the newly-elected Rudd Government. The hard heads may not buy the story, but they do want to be elected or re-elected. Democratic governments facing elections are sensitive to popular movements that could have electoral effect. I am sure that it was this electoral perception that caused the Howard Government at the end to move significantly towards Kyoto and indicate a preparedness to go down the Kyoto path, as indeed the Labor Party had done earlier and Kevin Rudd did as soon as he was elected.

A fourth is that even democratically elected governments are prone to use fear as a reason to induce their societies to accept government policies, and I see this occurring around the world. A fifth is that we human beings rather like scary stories, catastrophe films and horror stuff; we may not believe it, but we get some kind of kick from it. A sixth, if you are still counting, is that governments don't like uncertainty: they search for the one-handed economist and adviser, the one who ignores the other possibilities and plumps for action. Put them all together, and you have a seventh, which takes us back to the availability cascade: I have encountered several people, scientists and policymakers among them, who have made it plain to me that they do not agree with the AGW proposition. But they don't want to get involved: there are other issues at stake; anyway, people need a wake-up call (a mild version of 'the end justifies the means'). A eighth is that the media find it a wonderfully continual storehouse of visual and 'scientific' horror stories, much better than 'medical breakthroughs'. A ninth is that, given the temper of the times, business leaders and other notables who might want to enter the debate fear that to do so will be bad for their business or their reputations. So they are silent. And so on.

In short, AGW is now orthodoxy, and orthodoxy always has strong latent support. Because AGW is 'science', even well-educated people think it will be too hard for them. David Henderson, a respected British economist and former Treasury official, has called the orthodoxy in climate change a case of 'heightened milieu consensus', in which prime ministers and other leaders tell us that nothing could be more serious than this issue. These are not statements of fact; they are no more than conjecture. But they have become, in his phrase 'widely accepted presuppositions of policy'.[11] Intellectually, AGW is what is known in politics as 'a done deal'.

**(7) So, finally, what should we do about it all?**

Let me give a quick agnostic summary. The earth's atmosphere may be warming, but if so, not by much and not in an alarming or unprecedented way. It is possible that the warming has a 'significant human influence', to use the IPCC's term, and I do not dismiss the possibility. But there are other powerful possible causes that have nothing to do with us. If this were simply an example of scientists arguing among themselves we might recognise that this is how science proceeds, and move on. But if there is no true causal link between $CO_2$ and rising temperatures, then all the talk about carbon caps and carbon trading is simply futile. But it is worse than futile, because one consequence of developing policies in this area will be to reduce not only our own standard of living but the standard of living of the world's poorest countries. As someone who has worked

closely with Ministers in the past, I cannot imagine that I could have advised a Minister to go down the AGW path on the evidence available, given the expense involved, the burden on everyone and the possible futility of the outcome.

Some readers of drafts of this paper have raised the precautionary principle as an indication that we should, even in the face of the uncertainty about the science, take AGW seriously. Unfortunately, as I see it, the precautionary principle here is very similar to Pacal's wager. Pascal argued that it made good sense to believe in God: if God existed you could gain an eternity of bliss, and if he didn't exist you were no worse off. However, if you didn't believe in God and God did exist, you risked an eternity in Hell; if he didn't exist you were no worse off. Looking at the risks and benefits, the sensible person would believe in God. Alas, Pascal didn't allow for the possibility that God was in fact Allah, and you had opted for belief in the wrong religion, or that God was a woman with a different set of values, or that an almost infinite set of possibilities existed about the nature of the universe. I am an agnostic about the existence of God, too. The IPCC's account of things seems to me only one possibility, and the evidence for it is not very strong. For that reason, I would counsel that we accept that climate changes, and learn, as indeed human beings have learned for thousands of years, to adapt to that change as rationally and sensibly as we can.

I ought to say that in any case I doubt that the proposed extraordinary policies will actually happen. China and India will not reduce their own use of carbon. Their own Ministers have pointed out that all the West has to do is reduce its own level to that of the developing countries. Attempts to set carbon use levels in the EU have been laughable both in the absurd errors involved in allocating quotas and the potential for real fraud in the outcome. Carbon trading will lead to rorts — there is no help for it.[12] I believe that the AGW bubble will burst, as those responsible for formulating policy in our country and others come to look hard at the evidence supporting AGW, given the consequences staring at them in imposing carbon quotas or developing a carbon trading system that is workable, efficient and fair.

But, because I am still agnostic, and do not dismiss the possibility that the unchecked emission of carbon dioxide may have unexpected and even adverse effects for the environment and for ourselves, I ask for a public inquiry into this matter in which scientists openly argue about the data. I would want it chaired and managed so that it represented what someone has described as 'an exemplar of Archimedean science: careful reasoning, humility before nature, understatement, respect for inherent uncertainties, care with language and definitions, grounded in evidence, presentation of theoretical frameworks, respect for contestability, and so on'. The Garnaut Inquiry, set up by the State and Territory Governments on 30 April 2007 and continued by the Rudd Government, is plainly unable to do this work, because it is based on the supposition that the AGW proposition is truth. A Royal Commission has been suggested; if it followed the criteria I have set out, I would be happy with that. We are, after all, an educated society, and these issues affect every one of us. I would also ask our government do three things: develop a professional approach

to the preparation and publication of basic observational data about weather and climate; ensure that the funding directed to climate science research be allocated in a disinterested way (that is, without any presupposition that AGW is 'settled science'); and wait until there is convincing evidence and argument before it goes ahead with what seem to me draconian public policies. Finally, I would ask that all our governments, as an exercise in much-needed due diligence, look at the existence of the IPCC itself, and ask whether or not it is in Australia's interest to take special notice of its output. For ourselves, if the earth is warming, then we will learn to adapt to that, as human beings have done throughout their history. But it will be important for us to do it rationally.

And, to repeat, there are major environmental questions facing us. There is some evidence that we may be going into a another long dry period (the first half of the 20th century, in inland south eastern Australia, was drier than the past ten years).[13] We are an energy-dependent society whose sources of cheap oil are declining. We really do need to develop energy-sensitive ways of leading our lives. No doubt we will do so more urgently when we are paying $4 a litre for petrol. Like most of this audience, I should think, I would like to see the rest of the world enjoying an Australian standard of living. But will there be enough space for the roads, enough cement to build them, enough metal for the cars and enough petrol to run them? Because of my upbringing, by thrifty parents who re-cycled as a matter of course, I dislike unnecessary waste, and believe that as a matter of public policy we need to make much better and more thoughtful use of the resources available to us. We have a long way to go.

Water and energy present real problems for us, whereas Global Warming, in my view, is the Great Distractor that gets in the way. Yet the paradox is that if we dealt with water sensibly, and started to think through how to find alternatives to oil, the outcome of these efforts would be consistent with some of what the AGW people want us to do. But we would then be doing things more sensibly, and for the right reasons.

I finish on what to me is a sad note. I have been urged not to write or present such an address, mostly because I am likely to be attacked and demonised. I cannot accept such advice, however well meant it is. I am proud to live in a well-educated democracy, and it is central virtue of our kind of society that informed public debate occurs and should occur on all questions of importance. The issue of global warming is surely such an issue. What you have heard is my contribution to the debate. I do not claim that everything I have said is absolutely correct (given the uncertainty, that could hardly be the case), but I do claim that I have been careful and systematic in finding out for myself what is involved. I urge you all to do the same, and to make your decisions about climate change and what you think our governments and you yourself should do on the basis of your reading, thinking and discussion.

**References**

Those interested in pursuing the issues in this paper will find that they spend a long time on the computer accessing websites, where the main discussions occur.

The Australian media, like those of the rest of the world, assume that AGW is 'correct' and report from that standpoint. I am enormously grateful to Ian Castles, former Australian Statistician, and Professor Bob Carter, former Chairman of the Earth Sciences panel of the Australian Research Council, for pointing me in useful directions, and for the work they did in their critiques of the Stern paper. Many others have read drafts and commented. None bear any responsibility for the argument or the conclusions of this paper.

The IPCC's voluminous papers are available at its website ***www.ipcc.ch/***, while a sceptical scientific response *Nature, Not Human Activity, Rules the Climate*, published by the *Non*governmental International Panel on Climate Change, can be downloaded from ***http://sepp.org./publications/NIPCC-Feb%2020.pdf***. The best place to start to come to terms with the debate is a New Zealand website whose organisers come from the University of Canterbury at Christchurch. Their site ***www.climatedebatedaily.com*** attempts to give a 'balanced' perspective, but it does list all the most active websites on both side of the issue. Good surfing!

[1]The Einstein quotation is familiar, though I have yet to find the real source. The Feynman quotation is from 'The Role of Scientific Culture in Modern Society' in Richard P. Feynman, *The Pleasure of Finding Things Out*, Basic Books, New York, 1999, p. 111. This theme is repeated in other Feynman speeches. See also 'The Uncertainty of Science', in his *The Meaning of it All,* Perseus Books, Reading, Mass., 1999.

[2] Ross McKitrick, *Toronto National Post,* 5 December 2007. This is a more accessible report of an article by McKitrick and Michaels in the *Journal of Geophysical Research*, 112, D24S09, December 2007.

[3]For the placement of weather stations, go to ***http://gallery.surfacestations.org/UCAR-slides/index.html***. It is worth noting that the use of maximum and minimum temperatures assumes that a day's weather is reasonably homogenous. This assumption is criticised forcibly in a paper by John McLean; see ***http://mclean.ch/climate/CCA_review.pdf***. The validity of many of the stations' reported measurements has been called into question in a formal charge of academic fraud against one of the authors of a 1990 paper on which the IPCC has relied, The case is still in progress. See ***http://www.informath.org/***.

[4]For the emergence of settlements, see Steve Mithen, *After the Ice. A Global Human History, 20,00—5,000 BC*, Phoenix, London, 2003; for the long-term temperature data, see Davis J. C. and Bohling G. C. 2001, 'The search for pattern in ice-core temperature curves', AAPG *Studies in Geology* 47, 213-229. The caveat about the general applicability of Greenland and Antarctic data is offered in order to indicate what should happen all the time when such proxies are used. In fact, such caveats are quite rare.

[5] All aspects of this central issue are canvassed in a splendid summary paper by Arthur B. Robinson, Noah E. Robinson, and Willie Soon, 'Environmental Effects

of Increased Carbon Dioxide', *Journal of American Physicians and Surgeons*, (2007), **12,** 79-90. It is also relatively accessible to a non-scientist.

[6] *Ibid*. See also John McLean's masterly submission to the Garnaut Climate Change Review, where this point is set out clearly.
*http://mclean.ch/climate/Garnaut.htm*

[7] *Ibid*., pp 22-23

[8] The site ***http://www.npr.org/templates/story/story.php?storyId=88520025*** is a good place to go for sea-cooling. For a more general account of the importance of the sea in assessing whether or not the planet is warming, see Pielke Sr., R.A., 2003, 'Heat storage within the Earth system', *Bull. Amer. Meteor. Soc*., 84, 331-335. The evidence about sea-levels and sea temperatures is, to say the least of it, mixed. And the same is true of Antarctica. Garth Paltridge, who was the head of the CRC for Antarctica and the Southern Ocean Environment, thinks that the idea that there has been a loss of ice over the last ten years is likely to be roughly correct, and that equally Antarctica may have been cooling over the same period, with more snow. The loss of ice may well be due to increasing pressure in the glacial system, and have little or nothing to do with global warming (personal communication).

[9] It needs to be emphasised that the IPCC is not an independent committee of scientists, but a rather self-selected international group whose members are appointed by national governments, as its name implies. The best peer review is disinterested. The way that the IPCC appears to have its work 'reviewed' borders on the partial. See McLean, *op. cit*., pp 12-13 for an analysis of one aspect of the 'consensus'. For demonisation by the UN's special envoy, see ***http://www.upi.com/International_Intelligence/Analysis/2007/05/10/analysis_un_calls_climate_debate_over/6480/,*** and by the UNFCCC executive secretary, see ***http://www.usatoday.com/weather/climate/globalwarming/2 007-11-12-united-nations_N.htm***

[10] Kuran, Timur and Sunstein, Cass R., 'Availability Cascades and Risk Regulation', *Stanford Law Review*, Vol. 51, No. 4, 1999.

[11] David Henderson, 'New Light or Fixed Presumptions? The OECD, the IMF and the treatment of climate change issues', *World Economics,* Vol.8, No. 44, October-December 2007, p.212

[12] There are many stories of this kind, the alleged villains tending to be EU experts and commissioners. See, for example, ***http://www.businessgreen.com/business-green/news/2204331/emissions-tradingslammed***. One could add that the purchase of very large passenger aeroplanes, and the extension of major airports, proceed as though fuel and $CO_2$ are not problems. Even in the EU, business and union opposition to carbon policies seems to be increasing rapidly. Public opinion in North America and

Europe is not on the side of carbon tax and similar policies; see ***http://tomnelson.blogspot.com/search/label/polling.***

[13] The ten-year period 1997 to 2006 (the time of the recent 'great drought'), saw greater average rainfall in the Murray-Darling basin than the average for the period 1901-1950. For the Bureau of Meteorology data, go to ***http://www.bom.gov.au/cgi-bin/silo/reg/cli_chg/timeseries.cgi***. I am indebted to John McLean for this insight.

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