THE CLIMATE DENIAL PROGRAM: WHAT IS IT?

" Scepticism is not believing what someone tells you, investigating all the information before coming to a conclusion. Global warming scepticism is not that. It's coming to a preconceived conclusion and cherry-picking the information that backs up your opinion. It *isn't scepticism at all".*
John Cook

This essay is about something strange and important. The strange thing is this: for at least fifty years, experts have known that putting carbon dioxide into the air will make the world hotter; for about half that time, there's been no real doubt that this is happening already and that a hot world will be a big problem and we don't have much time to avert it. This is very much a matter for experts to figure out - not something just anyone can discover - and the experts are in virtually perfect agreement and very worried about it. But they haven't persuaded the rest of us. Educated publics in the rich countries instead believe scientists are still arguing about whether it is real or if it will be serious, and this delusion is mirrored in the political process, with the consequence that nothing much has been done about fixing it.

What makes it important is that planetary warming is happening so fast that neglect is going to condemn our grandchildren and all the people who follow us for thousands of years to live in an impoverished and troubled world with greatly reduced comfort and security and a devastated natural heritage. Under some plausible scenarios, the warming might remove all the conditions for civilized life.

No one who understands this subject well holds the smallest doubt that this is an extremely severe problem. Yet in the public discourse and in the halls of power it is just as if we <u>didn't</u> know what we certainly <u>do</u> know. How could this be? Why are we being so careless with our grandkids' future? Why do we argue when we need to act?

It's an interesting story. I don't want to cover all of it here, but just focus on one part of it - how did it come about that there is such a big gap between what climate experts know and what everyone else knows? Or, if you prefer, how did we become so confused about the reality of this problem? Well, I can think of only four possible answers to that question:

1. Scientists are wrong, and there is, after all, much less certainty and more dissent than they said there was.
2. Scientists are right, but they didn't communicate well enough so we could see it the way they do.
3. They did communicate but we didn't want to hear.
4. We heard too much and have been fooled by clever propaganda and misinformation.

I'm going to try to persuade you that answer 1. is false - scientists <u>do</u> know enough to warrant alarm and concerted action; answers 2. & 3. are partly right; and answer 4. is wholly true and the biggest reason we have this strange state of affairs. I'll start by

showing you that the scientific project of diagnosing and understanding the human-induced climate problem is not new or half-baked, or something that any amateur or professor with a few ideas and a loud mouth can refute in the course of a lecture or popular book. It is a sturdy body of work built up over 150 years by steady accumulation of observation, theory, argument and invention - just like any other established field of enquiry. In this respect, it would take as much to refute its central claims as it would to contradict the germ theory of disease or plate tectonics.

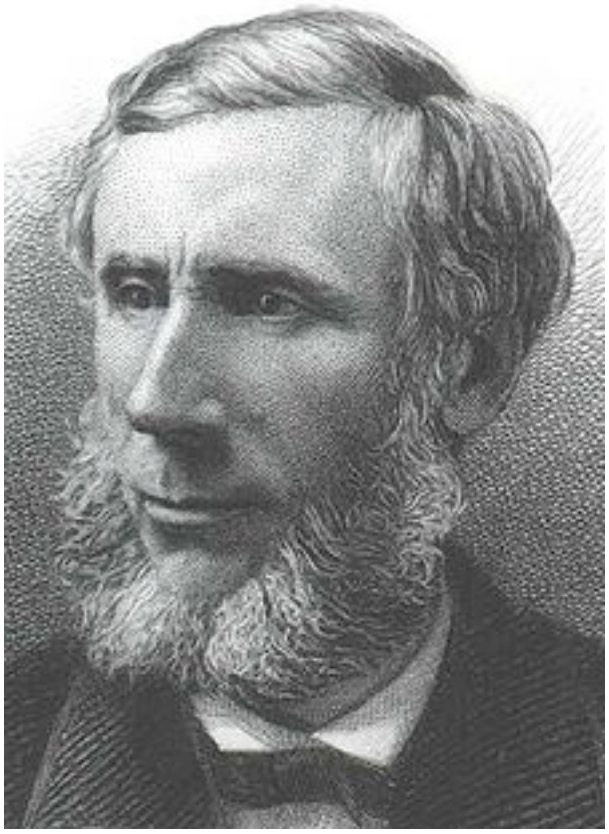
Then I'll summarize exactly what is claimed by this science about the state of the world's climate, and what can be predicted about the future with reasonable certainty, and I'll try to show briefly how each of these is upheld by evidence. After that I want to explain just how the campaign we call climate denial was created explicitly to cause confusion and delay or prevent meaningful action. I don't claim to understand all the motives of the people who did this, but whatever they were, from the point of view of our grandchildren, they are likely to have tragic consequences.

How did we discover the climate problem?

If you've read the papers much, or searched the internet on this subject, you could easily have received the impression that scientific concern with CO_2 and warming is very recent - a new sort of preoccupation, as yet undeveloped, all of its conclusions in turmoil, nothing settled. But that is completely untrue. Investigation of the atmospheric greenhouse has been pursued by outstanding scientists for more than 150 years, and the atmospheric physics and chemistry needed to understand it have been well worked out for the past 50. The idea that it is still in dispute is not due to any competent (and disinterested) scientist - but to a deliberate publicity campaign designed to cause this false impression. If you've felt any of the confusion caused by this, the best way I can convince you is to relate briefly something of the history of discovery. *[If you are specially interested there is a very fine website devoted to this here]*

The modern theoretical understanding of the greenhouse effect began in the 1850s with the work of John Tyndall. He, in turn, started with insights produced by a few others in the previous couple of decades. Tyndall published his work, full of basically correct ideas, in 1861. Nobel laureate Svante Arrhenius performed the first rigorous quantitative work on anthropogenic greenhouse gases in 1896. GS Callendar made a sound connection between observed twentieth century warming and rising CO_2 in 1938. Physicist Gilbert Plass gave us an essentially complete account of the relation between CO_2 and temperature in the context of both anthropogenic emissions and geological climate history in 1956. In 1957, Roger Revelle and Hans Suess explained why fossil fuel CO_2 could not all be dissolved in the oceans, as many people had believed, and correctly predicted that, in 50 years time the human contribution of the gas would be 100 times greater than all the world's volcanoes.

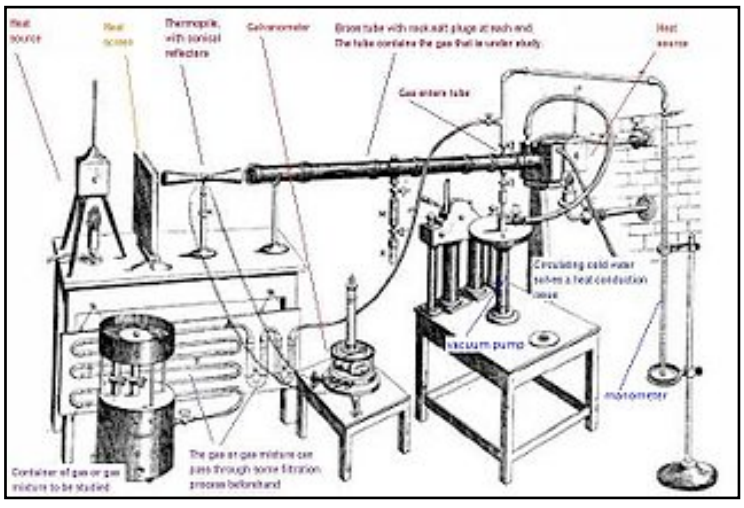
"... a large-scale geophysical experiment", they called it. "Within a few centuries we are returning to the atmosphere and oceans the concentrated organic carbon stored in sedimentary rocks over hundreds of millions of years."



In 1958, CD Keeling began documenting the inexorable rise in the atmospheric burden of carbon dioxide. In 1965, Revelle and others reported to the President on the probable effects on climate - advice the President duly noted. By 1981 Hansen and colleagues could make an accurate estimate of 0.4°C net warming for the twentieth century to that time, and predicted that the 1980s would warm further, and by the end of the century the evidence for its anthropogenic cause would emerge unmistakably. Both forecasts came true.

To give you a feel for the quality of work that's gone into this problem, let's go back to the beginning - to John Tyndall's paper in the *Philosophical Magazine,* September 1861. He called it *"On the Absorption and Radiation of Heat by Gases and Vapours, and on the Physical Connexion of Radiation, Absorption, and Conduction"*. At the time, no careful experimental work had been done on what we now call the greenhouse effect, although its existence had first been suggested over 30 years before by Joseph Fourier. Although Tyndall understood that "Earth radiation" - heat given off by the planetary surface - must be different to the solar radiation absorbed by the planet, the physical basis of that difference wasn't understood until later. In the mid-nineteenth century, nobody knew what caused radiation, or how heat was conducted. Both questions received some consideration during his experiments.

Tyndall wanted to measure the actual amounts of radiation absorbed by different gases, and succeeded in showing what was then an astonishing new reality - transmission of radiant heat could be blocked by perfectly transparent gases in minute amounts. He tested atmospheric air under different conditions, as well as water vapour, ozone, carbon dioxide, hydrogen sulphide, nitrous oxide, and several hydrocarbons, determining for each one the relation between pressure and absorption. He surmised correctly



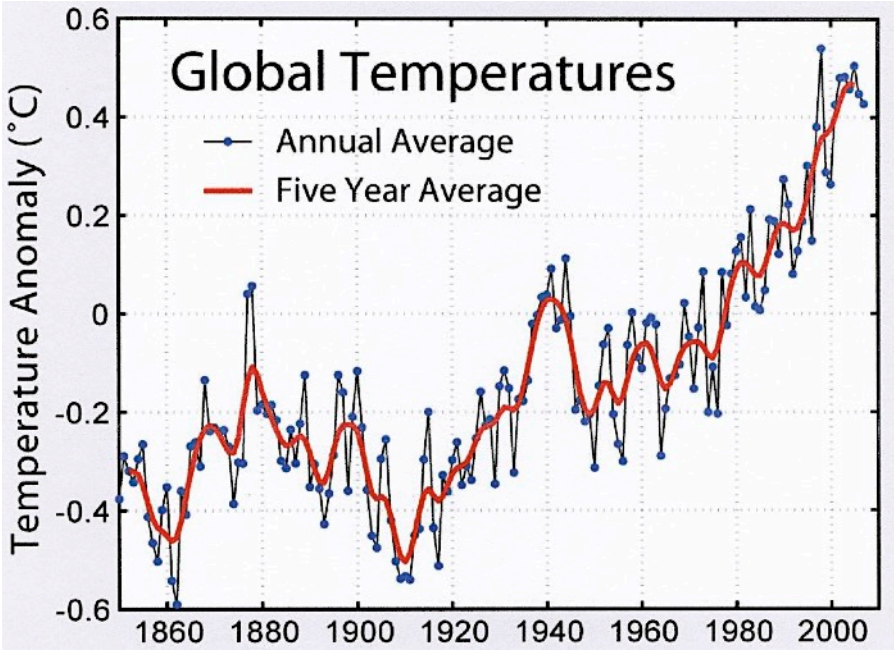
which constituents of the natural atmosphere exerted the effect, and to what degree, and which properties of the climate system were thus determined.

The work yielded several important results:
• Each of the radiatively active gases has its own specific power of absorption;
• At low concentration, the relation between gas pressure and absorption was linear, but at higher concentrations, the gas behaved as if 'saturated';
• The capacity of a gas for absorption of 'obscure heat' (the term used by Fourier for what we now call infra-red radiation) was matched by its capacity as a source of radiation.
• Water vapour appeared to be the most active gas in the atmosphere, followed by 'carbonic oxide', and nitrous oxide;
• The major constituents of the atmosphere, oxygen and nitrogen, had no measurable effect;
• Very small changes in the atmospheric composition could, in principle, produce large changes in climate, as had been suggested by De Saussure, Fourier and others.
• From the behaviour of the component gases Tyndall believed he had demonstrated beyond doubt that the atmosphere is a *mixture* of gases, not a compound - a question then in dispute.
• Theoretical reflections on the results led him to some essentially correct suggestions about the nature of radiant heat - something that would be confirmed over the following decades.

This work was very much in the mind of the brilliant Swedish investigator, Arrhenius, when he undertook to calculate the actual quantity of heat retained in the atmosphere by varying burdens of water vapour and CO_2. Using the results of Samuel Langley's studies on IR radiation performed at Pittsburg in the 1880s, and what was then understood about the radiative (spectroscopic) properties of the gases, he worked out a remarkably robust estimate, and in so doing introduced for the first time, the concept of the planetary energy budget, and a firm theoretical framework for the idea of climate change, both natural and anthropogenic, including the essential notion of feedbacks. He understood what Tyndall had shown - that, counterintuitively, a tiny amount of radiatively active gas could produce a large climate effect, and that, for a range of low concentrations, IR absorption was proportional to pressure.

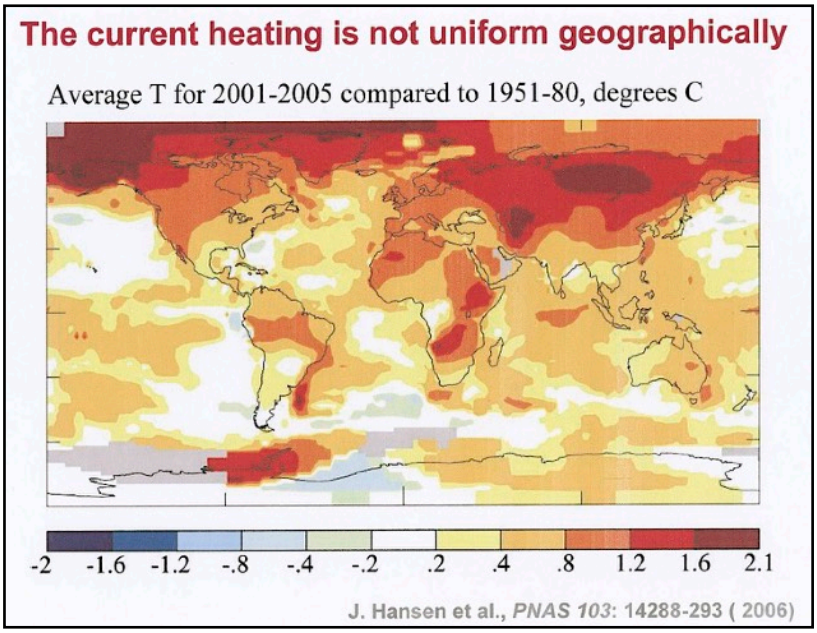
As it turned out, some rather hasty laboratory work done soon afterwards misled investigators for a while, and our detailed understanding of the greenhouse effect wasn't complete until the 1950s. The distraction came from a paper by Knut Angstrom in 1900 in which he reported that the absorptive capacity of carbon dioxide was 'saturated' at low concentration (adding more gas didn't cause warming) and that, since the more abundant water vapour absorbed in the same spectral bands, CO_2 must be an insignificant agency in the climate system. As descriptions of the real atmosphere, both findings were in error, and it took the work of Lewis Kaplan and Gilbert Plass in the 50s to show that H_2O and CO_2 are virtually independent absorbers, and that because of the vertical structure of the atmosphere, even if the lower layers were 'saturated' the

CO_2 greenhouse effect would still work. They also showed that in climate history, this gas must have been the primary agent of change, augmented by a powerful water vapour feedback.



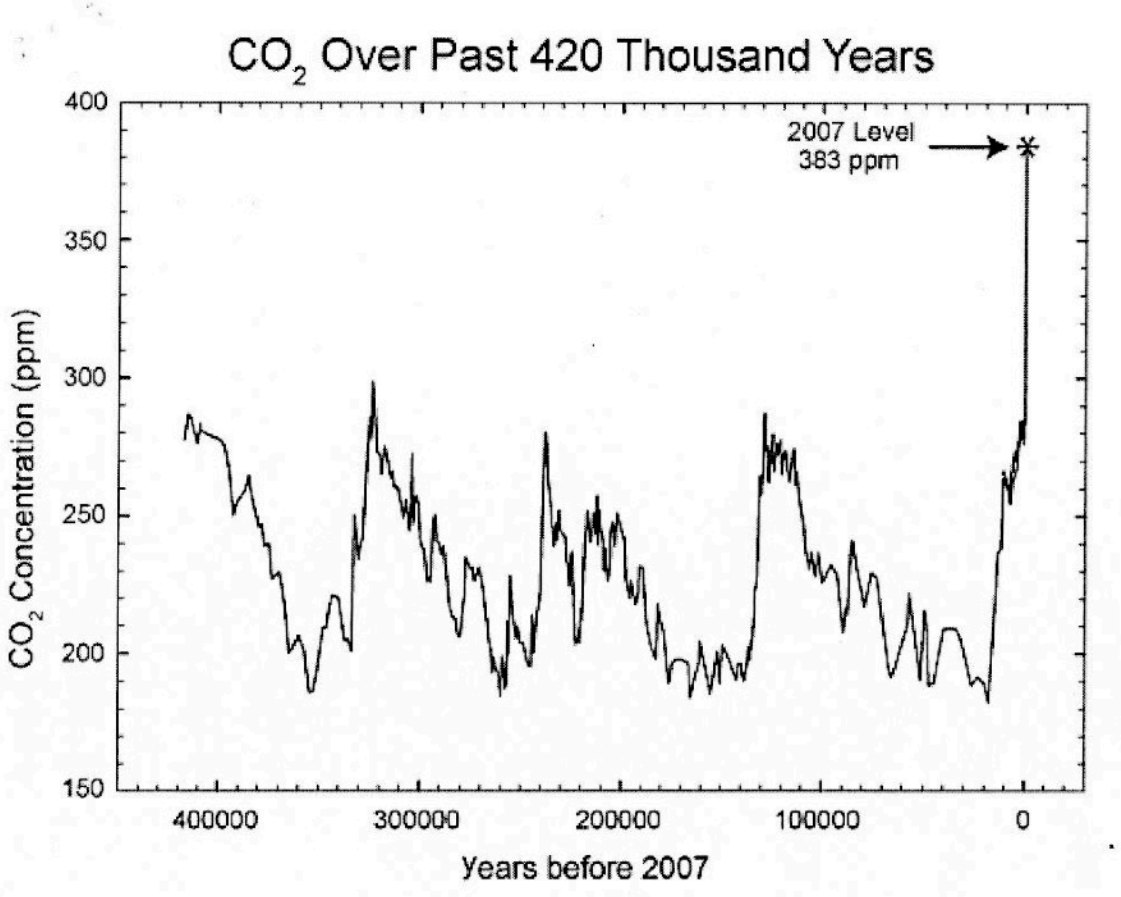
So we've understood that human activity could alter climate for a long time. What has changed in recent decades is not the basic ideas, but the detail and depth of that understanding. So whenever you hear someone make claims like these:
"CO_2 doesn't cause warming";
"Volcanoes make more CO_2 than people";
"CO_2 is sucked out of the air in a few years";
"Adding more CO_2 doesn't affect the greenhouse effect";
"Warming is all natural";
you are not hearing one side of a real scientific controversy, but ignorance. These statements tell you their author just doesn't know what has been learned about these things, hasn't bothered to find out, or is too prejudiced to care.

Of course, anyone is free to deny anything - but you can't plausibly deny propositions established on a large body of perfectly good evidence without providing accessible evidence of your own. That would be just like proclaiming that tetanus is caused by magic spells. You'd need a pretty good story to uphold that claim because the orthodox one is built on century-old solid work. Well, that's the way it is with CO_2 and climate change. There's nothing new or faddish or hypothetical about it - the story has been made rock-solid in the last 30 years after



many decades of earlier work. Just because all the complexities of the climate system haven't been unravelled doesn't mean the basic structure is shaky.

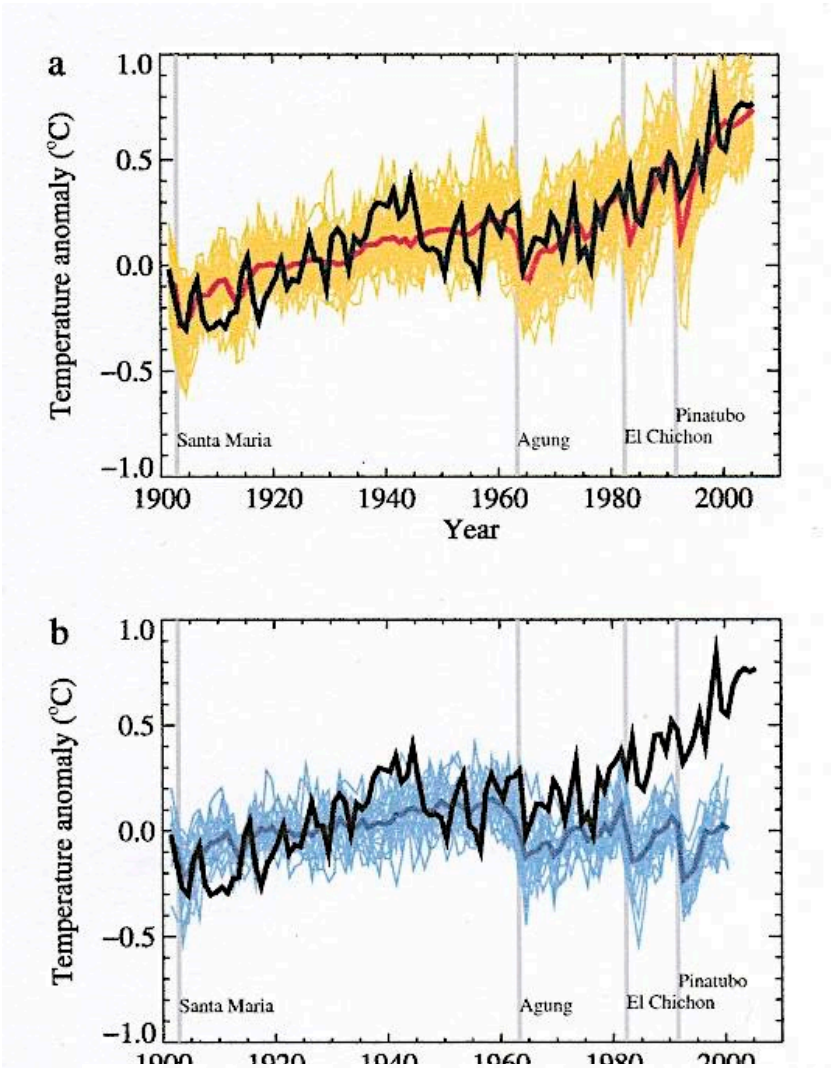
What do we know about global warming?
Here are some of the things we know beyond reasonable doubt. There are some other things we can say with less certainty; and there are things we'd like to know but don't. I'll come to these later - but for now, this is what we know, with a few words about how we know it.



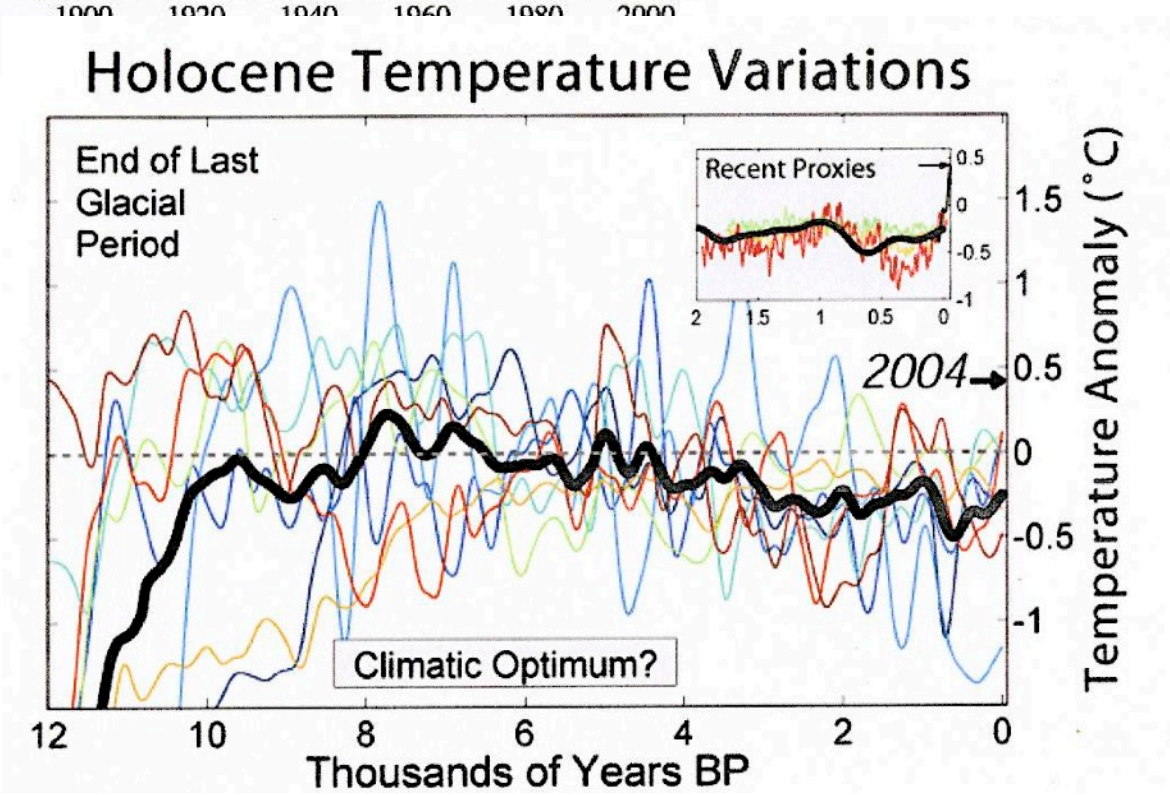
1. The mean global surface temperature has risen 0.8°C in the last century. This doesn't mean every place is hotter - some have warmed a lot more than this (especially the Arctic) and some tropical regions less or not at all.

Nor does it mean every year is hotter than the one before. It means if you look for a trend over longer intervals (a decade or more) you can find a more-or-less steady increase, with a 30 year pause between 1940 and 1970. The rate of warming since 1975 has been about 0.15°C per decade, with the decade 1999-2008 a bit less at 0.1°C. There is more than enough evidence to affirm this trend, and none to refute it. People who say meteorologists (who do the measurements and then work out the mean) have been fooled by the 'urban heat island effect' simply don't know anything about the corrective procedures used on this data, nor the careful cross-checking and error detection that

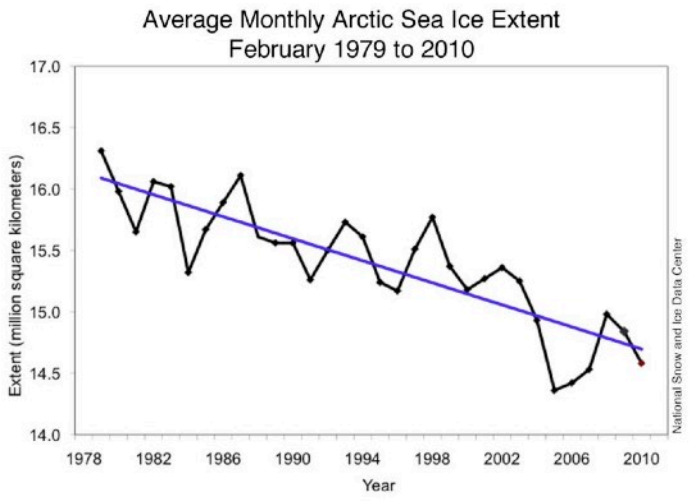
have long been routine. *[If you are interested in a good account of how this is done, look here].*



Two simulations using an ocean/atmosphere GCM. In both, the observed global temperature record is the solid black line. In the lower one, the model has been run with only natural forcings (solar irradiation & volcanos); in the top one, anthropogenic forcings are added. This kind of 'attribution study' has been performed many times using different approaches to confirm that human-induced change is the explanatory mode which best fits the observations. [IPCC 2007]



2. The warming is detectable over the whole planetary surface (including the oceans); it is more pronounced at higher latitudes; it has warmed winters more than summers, and nights more than days, and it has been more marked over the land than sea. The lower troposphere has warmed most; and the tropopause has risen. All these effects were predicted from greenhouse theory before they were observed. They are not produced by warming from other causes.



[Gt= 1 billion tonnes, or 1 cubic km]

3. In terms of Earth's geological climate history, the warming is very fast and severe. Study of ancient climate has discovered no comparable episode, even though abrupt natural climate change has emerged from this investigation as an unexpected property of the climate system.

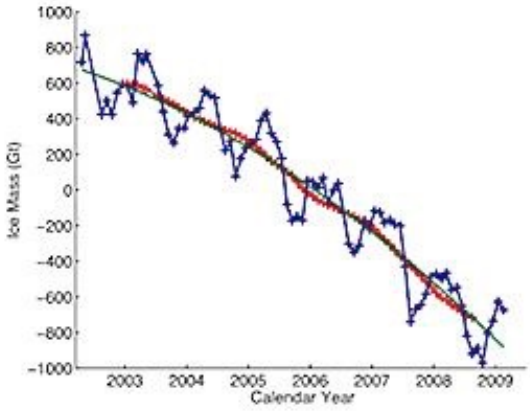


Figure 1. Time series of ice mass changes for the Greenland ice sheet estimated from GRACE monthly mass solutions for the period from April 2002 to February 2009. Unfiltered data are blue crosses. Data filtered for the seasonal dependence using a 13-month window are shown as red crosses. The best-fitting quadratic trend is shown (green line). The GRACE data have been corrected for leakage and GIA.

4. The rise in atmospheric CO_2 from 280ppm to 390ppm in 200 years is also without precedent, as far as we can tell. This rate of increase is thousands of times faster than the typical rise observed in past episodes of natural warming. The nearest natural analogue (the sudden catastrophic warming event known as the PETM) took place 55 million years ago, and seems to have evolved over several millennia (although it's possible it contained shorter episodes of more rapid warming). But we are on track to produce a similar flux of CO_2 in just a couple of centuries. The rise of atmospheric carbon dioxide has been documented scrupulously since 1958, and is incontrovertible.

5. The causal link between rising CO_2, human activity and warming has been made far beyond reasonable doubt. The principal lines of evidence are as follows:

- All the characteristics of greenhouse (but not solar or other) warming have been observed.

- The atmospheric ratio of the two carbon isotopes, C^{12} & C^{13} has declined over the last two centuries in exactly the manner that would be anticipated if the carbon added to the oceans and air had its origin in fossil fuel combustion.
- Calculations of the disturbance of the Earth's energy balance provide exact confirmation of observed changes of global heat transport in the climate system.
- Study of the relation between CO_2 and temperature during Earth's climate history demonstrate how the causation operates.
- If climate models are perturbed by simulated anthropogenic forcings, they reproduce recent climate change accurately - but not otherwise.

6. Current mean global temperature is the highest of the Holocene - the 10,000 year epoch since the end of the last ice-age & the period of human civilization. The last time the world was warmer than it is now was 120,000 years ago at the end of the last interglacial (the Eemian).

7. We know with a high degree of certainty, thanks to some recent work, that the last time the atmosphere held as much carbon dioxide was 15 million years ago. At that time, the sea stood 25-40 metres higher than it does now. *[You can read more about this here]*

8. Many observable consequences of warming are already happening:

• Arctic sea ice is shrinking in summer and melting from below. Most of the old, thick ice is gone; mean thickness of the ice cap during a recent ground survey was 1.77m.

• Net mass loss from the Greenland ice sheet increased from 137 Gt/yr in 2002-3 to 286 Gt/yr in 2007-9. This rate has more than doubled in 6 years. In Antarctica, where the melting is not uniform, but mainly from the West Antarctic ice sheet, the loss has gone from 104 Gt/yr (2002-6) to 246 Gt/yr (2006-9). These findings are a big surprise. Most experts had anticipated much slower melting from the great land-based ice sheets; but they seem to be responding to warming positive feedbacks that were either unforeseen or underestimated.

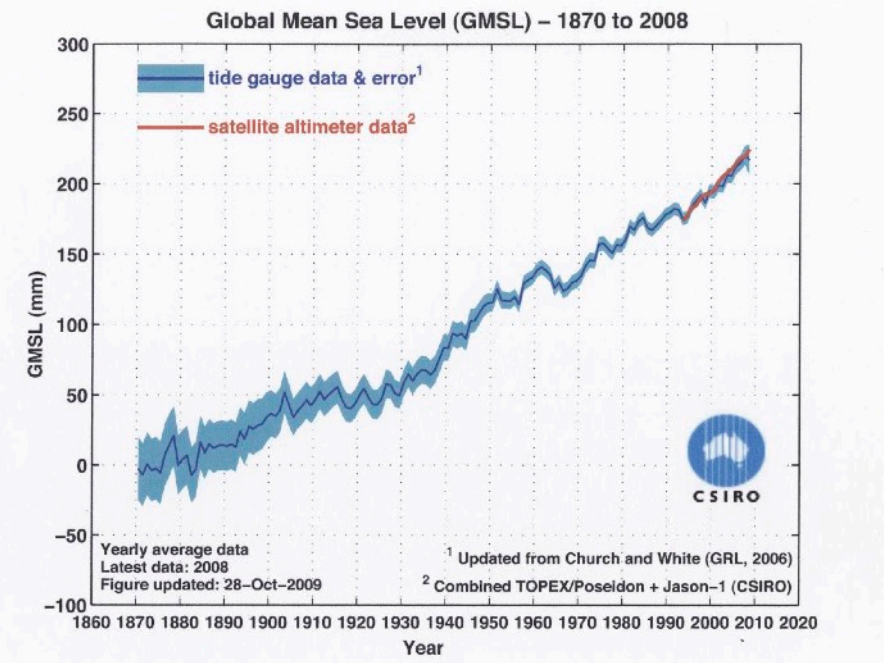
• About 95-98% of all the mountain glaciers on Earth are retreating - some very fast.

• Permafrost is melting in most Arctic regions and a feared consequence has begun - the release of frozen methane from Tundra peats, marshes and lakes, and from shallow deposits in the Arctic sea floor.

• All over the world, outside the tropics, winters (on average) have become milder, and the dates of first and last frost have been converging

• Plant and animal species have been migrating north and south as their optimum climatic zones have moved. Temperate isotherms have been migrating at about 50km per decade for the last 30 years. Loss of adaptive relations in the biosphere due to this are emerging in many regions.

• Global and regional scale dynamic systems in the atmosphere and ocean (*eg* the El Nino/La Nina cycle) are adapting to the addition of tropical heat.



• Patterns of precipitation have changed - heavier downpours, more powerful storms, increased rainfall in temperate zones, and drought in the dry sub-tropics. These are predictable consequences of an enhanced hydrological cycle: warmer air holds more water, so both evaporation and precipitation are exaggerated and extra latent heat is available for storms.

• The acidity of the world ocean has increased substantially. The quantity and rate of change are consistent with what is known about ocean response to carbon dioxide forcing.

• The global mean sea-level is rising, partly due to thermal expansion of the ocean surface water; partly due to the addition of melt-water from land-based ice. The current rate is 3.4mm/yr, but varies regionally.

9. Measurements of ocean heat content confirm the positive net energy balance of the planet to approximately 0.75W/m^2 solar flux equivalent.

How do we know?

This could be a very long story - but in a few words, these are the sources of some of our most telling findings.

• *Global temperatures* are the special responsibility of a small number of research Centres around the world which carefully collate and correct meteorological observations and other data, and then work out a mean for the whole globe. Remarkably, in view of the complexity of the task, their agreement has been very close over the time this has been a major concern. There really isn't any room at all for significant doubts about this observational record.

• Things get a bit more complicated for *historical temperatures* - that is, the Earth's climate history - a source of some of the most useful insights for understanding our present predicament. Good thermometer observations for inferring a global mean only go back to about 1860. For a couple of centuries before that, there are isolated records; before that there are things like harvest records, observations of bird nesting and flower

blooming, notes of monastery gardeners, chroniclers' accounts and so on. For really ancient temperatures (and other climate data), for millions of years, scientists have invented some astonishing techniques. At the heart of most of them is the isotope chemistry developed in the 1950s. A typical method starts with a tube of mud drilled from the sea-floor in a suitable place. Next, there's a search for tiny planktonic shells that might have been embedded in the mud for millions of years. Then very careful radio-chemical analyses are performed for the isotopes of interest; finally, inferences are drawn about climate conditions from the measurements. These techniques have been refined for decades so they are now extremely reliable - in the sense that we can know in advance how much error they entail.

• Direct measurements of *past atmospheric composition* can be made with very high confidence on the air bubbles trapped inside ancient ice. The oldest such specimens are about 800,000 years old, and from these we've learned in great detail about the climatic events of the recurring ice ages of the Pleistocene epoch - the one preceding the Holocene. And a fascinating story it has turned out to be. Before this record was assembled, no one would have guessed how sensitive the climate system has been, and how abruptly it could change - but so it is.

• The advent of remote sensing technology aboard satellites has provided an enormous new range of information, some of it unobtainable otherwise. For instance, the best *sea-level* estimates now come from the ultra-precise altimetry instruments on the TOPEX/POSEIDON satellites; measurements of *mass balance of ice sheets* are now done by the gravimetric sensors on board the pair of GRACE satellites. *Ocean surface temperature* and *upper tropospheric temperature* is supplemented by remote sensing; and of course imaging technology makes the analysis of all sorts of large scale surface changes possible.

• Last, *computer simulations* of parts of the climate system allow experiments to run that would otherwise be impossible. You will hear a lot of badly informed criticism of climate models - all of it a variation on the banal claim that no computer program can reproduce the complexity of this system. These critics apparently find it unremarkable that this truth is plain to them, but hidden from the people who spend their careers on the climate problem. Just like any other tool, models can be used wisely or not; but since the climate system is not something that can be taken to the laboratory for repeated experiments, they are indispensable for investigating hypotheses of many kinds, including predictions. No scientist ever claimed their model had captured everything - after all, they understand that complexity a good deal better than the rest of us.

What do we know about the future?

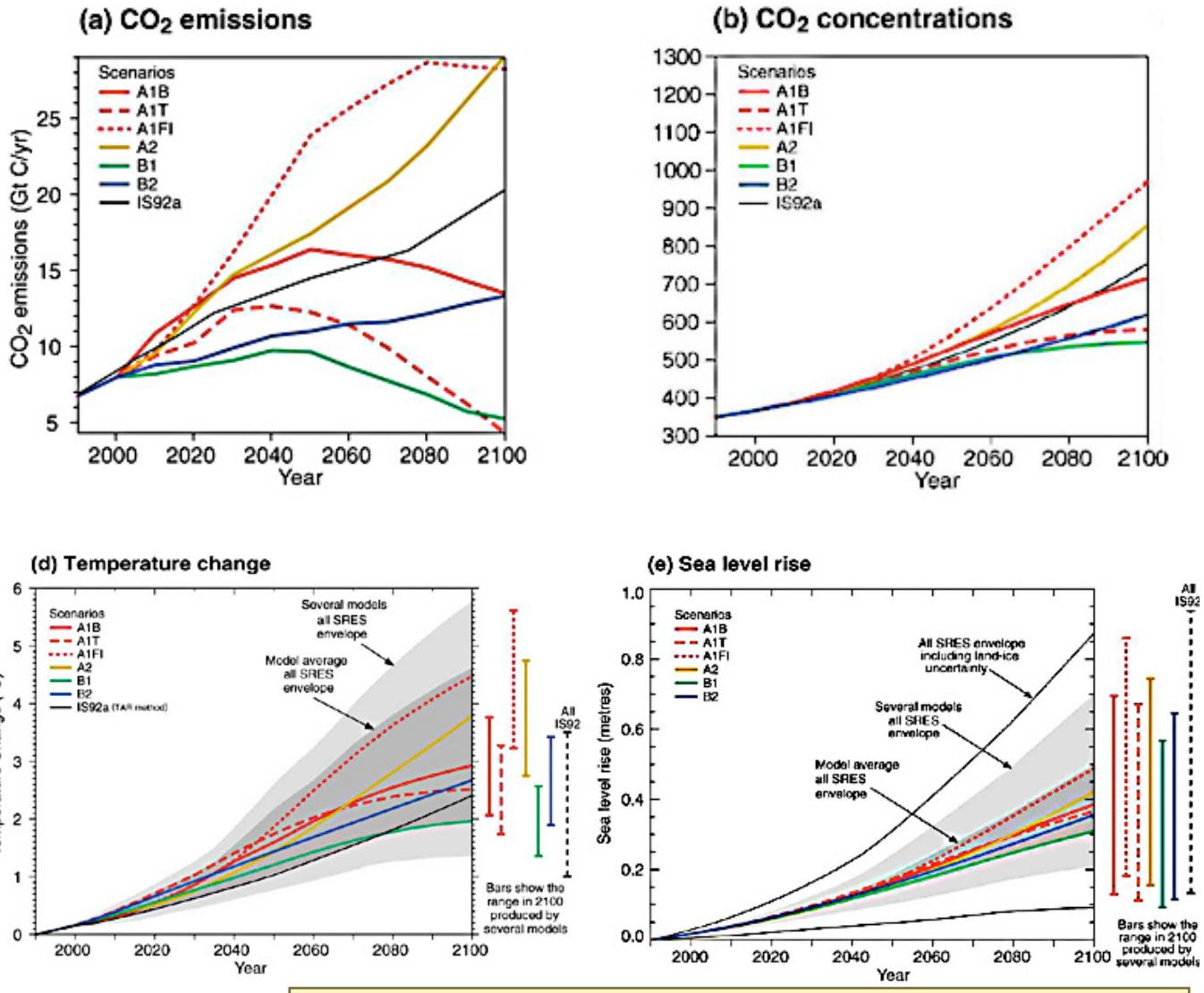
Here, climate science is at a real disadvantage. There are only so many ways to predict the future; each of them gives you a probability because of course the future is perfectly entitled to contradict us - we don't even have a guarantee the sun will rise tomorrow. In practice, three sources are useful when we're looking for something to say about the future of the climate: climate history (because this illustrates just what happened after what and thus gives us confidence in attributing causes); present trends, because they can, with care, be extrapolated into the future; and models - again used with due care.

This is the sort of thing we've learned:

• At about 1°C warmer than now (last time Earth was this warm, 120,000 years ago), the Eemian peak sea-level was about 6-9m higher than now. This suggests that if we allow that much warming and it's sustained or exceeded, we'll see similar rises due to ice sheet melting.

• About 3°C warmer than now, the Earth was in transition from a virtually ice-free state to the glacial world. This occurred 14 million years ago, when the Antarctic ice sheet became permanent. There was then no Northern ice & the sea was 25-40m higher. This much warming is very possible - in fact if CO_2 exceeds 450ppm for some time, it is probably inevitable in our grandkids' lifetimes. The actual rate of disintegration of the ice sheets is much harder to forecast - although it might not be the sluggish process we once thought.

• Looking around the world's mountain glaciers, most experts have decided that they are all doomed - eventually even the highest of them. This is a justified extrapolation from the observed trends specially over the last 30 years.



With thanks: The Union of Concerned Scientists http://www.ucsusa.org/global_warming/science_and_impacts/science/projections-of-climate-change.html

• Very sound modeling of future precipitation tells us that there will be severe loss of presently productive arable and pasture land from drought. It is less easy to say how fast this will come - but the afflicted regions are already feeling the effect.
• Severe heat waves will be much more common, though worse in some climate zones than others. This is a robust prediction from sound physical principles.
• There are positive feedbacks - the ice/albedo feedback and the methane/permafrost thaw effect especially - that have potential to greatly accelerate high latitude warming. This is something observations have confirmed in recent years.
• If you look at the issue of prediction a certain way, it is really all about how much carbon will eventually enter the air, and how fast - and this has been the subject of a lot of work. But we don't have any idea yet what we will end up doing about our production of CO_2, so all we can do is examine the probable climate consequences of several plausible scenarios.

These diagrams show (a) a set of 6 scenarios, ranging from urgent & drastic abatement [B1] to very little action [A1F1]; then (b) their consequences on atmospheric carbon concentration; (d) temperature; & (e) sea-level. However, of the three prediction sets, the CO_2 concentration is likely to be most accurate; temperature is next, and the sea-level ones least accurate. This is due to the state of our knowledge of these physical processes. Just the same. you can see clearly that, even with a big effort, we probably won't be able to avoid a CO_2 peak of 500ppm - and it might be sustained for some time. The chart of possible future temperatures is constrained by ignorance of some potentially powerful feedbacks - specially the release of methane in very large amounts from thawing Arctic permafrost and sea-bed. So it gives a lower, but not an upper realistic boundary for us to contemplate. Sea-level projections will be revised as we learn more about the behaviour of ice sheets under future warming; again, they are more likely to revise up than down.
• Finally, there is the issue of the biological fate of the Earth - what's going to happen to living things? Now it's easy to say animals & plants have survived warming before - that's true but misleading, because things are rather different this time. First, the climate forcing is much more powerful, and the warming much faster; second, human impacts on ecosystems have raised the background extinction rate hundreds of times higher than normal, so there's much less adaptive space than there has ever been; third, as resource competition intensifies, humans will inevitably capture an ever greater share. As for the fate of human society, about all one can say is that if the future is like the past, we'll fight.

What don't we know?
Most of the important gaps in our knowledge concern the *dynamics* of the climate system - the way one thing acts on another - and another, and another, *etc.* In other words, the complexity of the system is a real limit on our understanding. This word has a technical meaning which implies the necessity of a *chaotic*, or non-linear cause-and-effect relation in the system, so that changes (even small ones) can have essentially unpredictable consequences. The best approach to this difficulty (apart from trying to

unravel its parts) has been to figure out how it has behaved in the past. This enterprise has made enormous progress, but still has plenty to discover.

One of the most urgent bits of complexity to understand is the phenomenon of abrupt climate change revealed by the analysis of ice cores over the last 30 years. We simply don't know enough about how these dramatic cycles work to be able to say with confidence what it would take to start them again. Nor do we understand the physical behaviour of the big ice sheets well enough to predict how they will respond to polar warming - even though it is happening as we watch, and will be the main determinant of future sea-level rise. The atmosphere and oceans are full of sub-systems - semi-stable dynamic phenomena that are sure to change, but we only have a very incomplete handle on how, and how fast.

There are good reasons for thinking that our estimate of the climate sensitivity, (just how much heat will be added to the system by a given addition of CO_2) may be too conservative. The strongest reason is that the Earth appears to have behaved more sensitively in the past. This is something that can only be resolved by further work, but has enormous implications if we are going to try to manage the problem now.

Beside the issue of complexity, there are observational gaps too. For instance, we haven't studied the exact behaviour of clouds and aerosols enough, even though they have big climate effects; not enough is known about the deep ocean and the way it acts as the long-run heat reservoir of the planet.

Finally, there is the astonishing rapidity of human-induced changes in the atmosphere and terrestrial systems. Ecologists know only too well how extraordinary this is, but most folks don't appreciate that what we're doing has no precedent - as far as we know, there has never been an episode like this in all of Earth's history. Several retired geology professors who've taken up the denial cause like to tell us that we shouldn't worry - it's all happened before. But they're wrong. During typical eras of high tectonic activity, like the late Mesozoic, when atmospheric carbon built up to high concentrations, the rate of increase was something like 2ppm in 20,000 years. Now we add that much in a year. For this reason, our approach to prediction must always be provisional - we are in uncharted waters.

What do climate deniers say?

Every single thing that has ever been asserted about the climate problem has been denied by some contrarian or other. Some of them deny everything (which is pretty hard for a reasonable person, since awareness of a lot of evidence only requires that your eyes be open); others worry about one thing or another. A lot of denial takes the form of *'It isn't warming ... but if it is, we aren't doing it ... but if we are it doesn't matter ... but if it does, we can adapt'* and so on. This kind of inconsistency is very typical of denial literature. A few of these people come with credible scientific qualifications - but almost without exception they do not work professionally on any climate science problem. This

immediately raises an issue. How susceptible is this scientific field to criticism from 'outsiders' - or, if you like, amateurs?

If your first thought is, "well, how can criticism from outside be a bad thing? Fresh perspective and so on?" I answer - it all depends. Now of course it's conceivable that a scientific field can be ossified, incestuous, jealous, blind to something that lateral thought could make plain - it has happened before. The question is: "are we looking at such a case here?" How could you tell? I think there would have to be a number of signs:
• New evidence which does a better job of explaining what's observed. For instance, if you think you can explain warming better by invoking the sun, you'd have to provide testable evidence of just the quantity of solar radiation to do the job.
• Any proposed new dynamic phenomena (for example, cooling by interaction of clouds with cosmic rays) would need to be demonstrated by both observational evidence and conceptual rigour - in other words it would have to be shown that it is consistent with what is already known for certain.
• Straight contradictions of observational evidence would have to withstand tests of repeatability. If, say, you claimed that most glaciers are growing, not shrinking, it wouldn't be enough to just bring out a few photographs; you'd need to have a survey covering all the glaciers you're talking about, and invite anybody to confirm what you've found.
• Revision of historical evidence is a bit more problematic & brings us to a class of arguments that are really the province of specialists because of the technical details that are needed to resolve them. I could think of many examples, but a familiar one is the fuss about Michael Mann's "hockey stick", which has raged for nearly a decade. It's easy to find on the web confident statements like, "*the hockey stick fraud was exposed years ago"*, and yet the truth is exactly the opposite. Surely the reason this has had such a long and painful life is that no one except specialists can really understand what it was all about, and not many people want to spend the time following (as best they can) the twists and turns of the transformation of an issue about statistical methods into an ideological shouting match.

Here's a short list of some of the more common contrarian claims:
• *The current warming is not exceptional; it was hotter in the middle ages and plenty of other times.* This is an example of manufactured historical evidence
• *It's been cooling since 1998*. This is due to a deliberate distortion of the observational record. *[for a more detailed treatment of this issue see here]*
• *Warming isn't real; it's due to measurement artefact (the urban heat island effect).* This can only be claimed if you've refused to find out how the monitoring Centres deal with this issue.
• *Warming is due to the sun.* There is simply no evidence for this at all. What is sometimes offered is spurious or deceptive.
• *The greenhouse effect doesn't work like they say; CO_2 couldn't cause global warming because there's too little of it; the CO_2 comes from volcanoes.* These and many more are silly denials of established science equivalent to denying that there is an ozone hole (which some die-hards still do).

• *The CO_2 will all be taken up by plants which will grow faster - it's therefore going to be good for food production.* This is a little bit of truth made into nonsense. Plenty of work, both completed and on-going shows that the effect on plants will be mixed and quite complex. A hotter world will not be all good for agriculture.
• *The Arctic ice is growing & Antarctica is gaining ice.* Another example of a little bit of fact twisted into rubbish.
• *The sea-level isn't rising.* This claim presumably rests on the undoubted truth that, because of changes in the pattern of ocean currents and winds, sea-level is rising more in some places (Western Polynesia) and less or not at all in others - for the time being. This state of affairs has nothing to do with long-term rise.
• *Climate models are worse than useless & any prediction using them should be rejected out of hand.* To some contrarians, models appear to be regarded with fear and loathing. This kind of criticism simply misses the point - that employed inside their limitations they can be a very useful tool.

That ought to be enough. In my view, none of the contrarians' claims passes any of the tests. Many of them are foolish; lots are mischievous and deceptive; nearly all are ignorant; and as far as I can tell, each and every one bears a strong sign of prejudice - that is, of a prior conclusion disguised as an original scientific result. I say this because, in order for these claims to work, contrarians have to make another, implied claim - that the community of climate scientists is incompetent and corrupt - <u>all</u> of them. And this absurd idea is only plausible if you've decided beforehand that this is a <u>political</u> matter dressed up to look like a scientific one. That brings us to the story of how the denial business got started, and how it succeeded.

Climate denial is <u>not</u> a scientific debate or controversy
It is a <u>political</u>, or, if you prefer, an <u>ideological</u> campaign. How can we be sure of this? Because it isn't conducted the way scientific disputes are - as a kind of conversation between peers in conference halls, meeting rooms, laboratories and journal pages - but as a public campaign in the non-scientific media between undisciplined advocates using publicist's tricks, on the one hand, and practicing scientists who have no interest in, or skill at propaganda on the other. You might want to protest, "but how else should non-scientists (outsiders) announce their views?" But that is exactly the point I wish to make at the start of this section. Non-scientists' views are one thing, and debates between peers who are thoroughly familiar with the subject are another. I'll try to explain what I mean.

In my professional life, I was a medical practitioner. For better or worse, it takes some years to acquire the perspectives and conceptual equipment of a physician. The genuine purpose of that training is this: as a result of it, diagnostic problems can be analyzed using a framework that has been found fruitful during the long history of the discipline. In other words, when a patient tells the story of their illness, a physician hears something (or at least reconstructs something) quite different to what someone without training would make of it. This is as it should be. We have a system of diagnostic categories so that interpretations of illnesses will correspond closely to our best

understanding of their remedy (cause before cure). In a very real sense, the doctor inhabits an esoteric world, only accessible to those admitted through training: only they can manipulate the intellectual apparatus of medicine for the benefit of the sick. Ancient people knew this - that's why healers have always been close to magicians.

Now of course one wouldn't want to insist on this too much; the boundary between 'experts' and lay people isn't something rigid or incontrovertible - but it is there just the same. And it means that for most disputes in climate science you can only really fully participate if you've had the training and experience. We forget this when some scientists do a good job of communicating what they do (thank goodness for them!). Nevertheless, to be effective in any technically sophisticated discipline, a practitioner needs to have acquired (as well as a stock of esoteric concepts and the framework for deploying them) the developed intuitions you can only get from repeatedly solving actual problems. In a way, we all know this. That's surely the reason people who have a dim view of physicians still go to them when they're sick.

So wether we like it or not, it is strictly true that the last word in a technical dispute inside a field of established scientific enquiry has to be said by someone with competence to say it. 200 years ago, paleontology was an undeveloped field, with no explanatory theory covering its observations, no rational classification, just a big and growing collection of fossils that no one understood. Even the best scientists couldn't do much more than catalogue them. Just about anybody familiar with the phenomena was as entitled as anyone else to propose a theory - and many did. But after Lyell and Darwin, paleontology made sense, and before long, if you wanted to make a contribution, you had to master a much bigger body of facts and concepts, and the field became the preserve of specialists. Deniers behave as if climate science is in a state like early 19th century paleontology - but this is absurd; not even close to the truth. It is an incomplete science, certainly, but what is established is as solid as can be - as certain as, say, the study of plate tectonics or virology, both of which have some unsolved problems, but which we wouldn't dream of handing over to amateurs to refute.

I think one reason so many retired professors believe they have a perfect right to make pronouncements on a subject they never practiced is that it's a fairly new discipline, and an open one which, until recently accepted contributions from a dozen or more related fields of enquiry. Possibly, it looks to them a bit like a gentlemen's pastime, open to amateurs the way botany was 200 years ago. But I also think there's another, much more important over-riding reason - this scientific endeavour has been converted by zealots into a passionate, prejudiced, often venal, and sometimes vicious arena of pseudo-political thuggery. That's what I want to explain next.

But just before we begin, I want to give you one small example of an accomplished contrarian at work, so you'll know what I mean. Lord Monckton is a former science advisor to Mrs Thatcher. He's not a scientist, by training or experience, but uses a smattering of jargon to create an impression of competence for his audiences. He uses

scientific publications the same way religious fanatics use sacred texts - plucking little bits from here and there to make it look as if they support his case.

In his performances, he regularly uses a study by Johannessen and colleagues as evidence for the proposition that the Greenland ice sheet is not melting, but growing. Not only is this false, but the study he cites says no such thing, as you can see for yourself by reading it here.

What the scientists had done in 2003 was show that snowfall in the high cold interior of Greenland had increased due to a positive change in the North Atlantic Oscillation system- something that greenhouse theory had long ago predicted - but they explicitly disavowed any conclusions about the net mass balance of the ice sheet because their measurements of the low-altitude margins weren't good enough. The authors wrote this caveat into the concluding section of their paper just so that Monckton's false inference could not be made - but he made it anyway. This study which *affirms* the reality of greenhouse warming is blatantly used to *refute* it.

It's almost useless to speculate on the motivation behind dishonesty like this. His lordship certainly seems to enjoy the limelight, so perhaps he's prepared to do anything to get it; but still it's hard to imagine why he would commit so transparent a lie, so easily discoverable and so worthless to his cause (whatever that is). Each of his lectures is filled with many such foolish and deceiving things, and nothing of value. Yet people flock to hear him. In case you think real scientists wouldn't do this, I'm about to explain that in the contrarian business they do. This is the puzzle we move on to now.

I began with a warning - this is a strange story. Here we see just how weird and improbable it really is. Out of nothing more substantial than some lies, half-truths and P-R savvy, a small number of people created a cause, and a methodology which has had enormous influence over the conduct of our affairs, interrupting and delaying necessary public policy and filling the discourse of our open society with anti-scientific propaganda, distrust and hatred. Stranger still, these people were scientists. Of course this could not have happened without the leverage of cultural and political divisions already present, thus making the political process as intractable as the process of informing the public. What we're going to investigate is how this happened; who did it; why; and what can be said about the consequences.

"A thing most strange and certain"

Everyone has political commitments. Of course not everybody belongs to constituted political groups, or shares opinions with the established parties. Even if they do, not everyone wants to belong to a political unit. But because politics is essentially the conduct of our collective affairs, and no one can exist apart from the society of their species, we are all political. Once you admit this fact, there is an interesting corollary: the map of political possibilities must necessarily be traced from a template drawn on our human and social nature. So unless you think there is no such thing as innate humanity, it must be the case that politics is a scheme of alternative arrangements for governing

societies according to various understandings of formative questions like: what is the nature of collective power? what is the relation of individuals to society? what is justice & how is to be realized? what is human capacity? what is a good life? All questions about human and social nature.

The idea that there can be only a limited number of basic political stances is confirmed by study of the history of political thought and procedure. It is no accident that most jurisdictions in complex modern societies have converged on much the same axes of principle - authority *vs* participation; privilege *vs* equality - with many variants and combinations in practice.

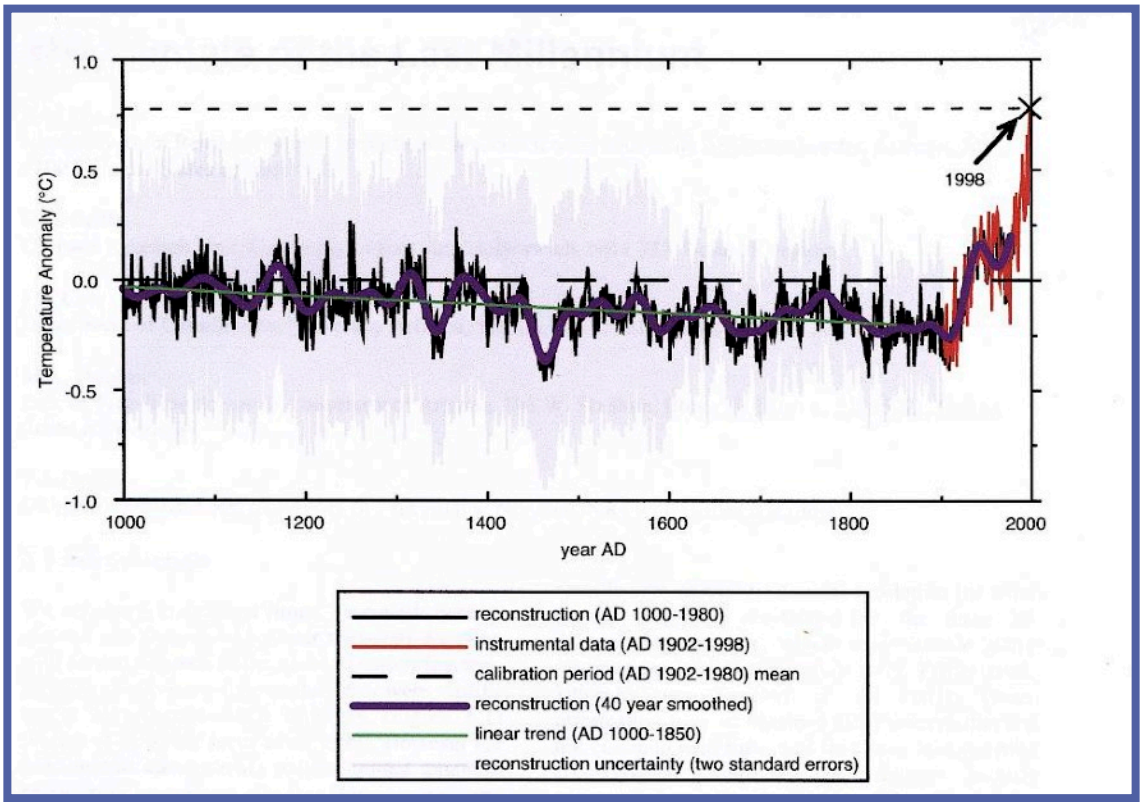
I say this because I want to persuade you that climate denial is the expression of a particular stance. Not a uniform or categorical belief system, but a set of commitments clustered around a position which can be disclosed and explained by an examination of those notions of human nature. For example, all deniers tend to believe that the less the government interferes with free markets the better - so they oppose anti-pollution laws. They mostly have very negative views about the environmental movement; they believe in progress - the idea that humans can continue indefinitely to act as they have done, because their inventiveness will surmount present and future problems, including environmental impacts. With respect to the nexus between individuals and society, they tend to see unrestrained freedom of action as perhaps the highest order political virtue - an essentially anti-egalitarian position; and they mostly understand *nature* as a medium for human action, an opportunity - which is a characteristic idea of settler societies and colonial ones. They are therefore impatient with the view which grew during the last century of nature as the condition, cradle and sustainer of human life.

The story may as well begin in 1979, ten years before the end of the cold war, when three men who would later lead the anti-global warming campaign first got together for the purpose of advocacy. They were Frederick Seitz, William Nierenberg and Robert Jastrow, all very prominent physicists with distinguished careers, and connections to the highest levels of government and society. They had all worked for most of their professional lives on scientific problems related to weapons development; they were fervent anti-communists, and at this time, they had become concerned about what they saw as an undesirable change in the direction of science in the US. In particular, they wanted to provide an antidote to the scientific opposition to President Reagan's SDI (Star-wars) initiative. So in 1984 they formed the George C Marshall Institute as a platform for articulating and promulgating their views.

They had some success. 'Star-wars' didn't die, as it might well have done without them. Their partial victory was both scientific and political. It preserved some of the large investment in weapons development, and the jobs of thousands of scientists; and it validated a hawkish view of the struggle against the communist enemy - a Manichaean view, with a categorical division of good and evil, admitting little or no compromise. When, however, the downfall of communism was imminent in 1989, instead of abandoning their crusade, the three men switched their attention and considerable

energy and dedication to another cause, which by then, they thought was just as threatening - environmentalism.

At this point, it's hard to know what to say. If you are sympathetic to the environmental cause, you might find it incomprehensible that anyone could find in it a systematic evil; if you've seen some of the excesses of radical parts of the movement, you'll be less surprised. No one (certainly not Jastrow Seitz & Nierenberg) who opposes political environmentalism ever claims that they don't care about the environment; but they do care very much how society should act on environmental issues. At one pole of opposition is a view sometimes called 'cornucopian', which holds that human ingenuity can indefinitely sustain progress (including economic progress, or growth) so we will never have to worry about the limits of the Earth. A less extreme view is that while there are limits, the best way to manage them is to allow free markets to do it with a minimum of regulation (although people with this view would have a hard time agreeing on what would count as 'minimal').



To give you a better idea of how anti-environmentalists think, maybe the best thing I can do is let some of them speak for themselves. Here, for instance is Dixy Lee Ray, a very competent woman, a marine biologist with a PhD, an academic and an ex-Governor of Washington State. This is from an address she gave to the Progress Foundation International Economic Conference, in 1992.

In the name of environmentalism we must change, they say, from a society that believes in progress to one that is dedicated to sustainability. Now it is by no means clear just what this condition of

"sustainability" refers to, except that it is essentially a back-to-nature movement, and is outspokenly anti-industrialization.

Because of our growing knowledge, natural resources, whether they are forests or minerals, are more abundant and more available today at lower cost than at any time in the past. And yet the Earth Summit Conference [she was speaking of the summit in Rio de Janeiro in 1992, which she attended] *was based on the premise, the false premise, that natural resources are being depleted.*

The objective [of sustainable development] *clearly enunciated by the leaders of the conference, is to bring about a change in the present system of independent nations. The future is to be a World Government with central planning by the United Nations.*

In an interview for the Acton Institute after the Earth Summit, Ray said it "had become evident" to her there that,
"The International Socialist Party, which is intent upon continuing to press countries into socialism, is now headed up by people within the United Nations. They are the ones in the UN environmental program."

Very similar views have been expressed by many others. One of the more outspoken has been S Fred Singer, another physicist who's worked with the Marshall Institute and founded his own (SEPP). Singer wrote the text of the *Heidelberg Appeal*, a kind of perpetual petition bearing the signatures of more than 4000 people, some scientists, the most prominent of whom are used to give its ideas legitimacy. It too was a response to the perceived 'threat' of the Earth Summit. This is its preamble.

Neither a statement of corporate interests nor a denial of environmental problems, the Heidelberg Appeal is a quiet call for reason and a recognition of scientific progress as the solution to, not the cause of, the health and environmental problems we face. The Appeal expresses a conviction that modern society is the best equipped in human history to solve the world's ills, provided they do not sacrifice science, intellectual honesty, and common sense to political opportunism and irrational fears.

The author worries about *"the emergence of an irrational ideology which is opposed to scientific and industrial progress and impedes economic and social development,"* and asserts that *"humanity has always progressed by harnessing Nature to its needs and not the reverse."* Apart from the obscurity of thoughts like these, it should be easy enough to see where Singer and Ray are coming from. Progress is good; personal freedom is good; human exploitation of the Earth is good; science is good. However, in this catechism, all is not what it seems.

The three founders of the Marshall Institute (and many more since) have lent their powerful advocacy to several causes during the last 30 years, including the denial of harm from tobacco (specially secondary or environmental smoke), acid rain and the depletion of stratospheric ozone, as well as global warming. As advocates, they don't just deny that these things do any harm, but that, in each case the science is mistaken; it has been badly (sometimes fraudulently) done, and the scientists are incompetent or corrupt. In other words, they tend to deny the reality of these trends, and implicitly

impugn the scientists who labour to understand them. This is very strange indeed. How can it be that science is the source of our progress and our future hope, and yet also the fraudulent basis of an "irrational ideology"?

I have spent a lot of time wondering about this conundrum. But before trying to explain it, I want to give you an idea just how peculiar this is - the spectacle of very competent and successful scientists who manage to reject perfectly good science in order to uphold demonstrably false claims in the name of a political ideal - all the while asserting a scientific warrant for them.

On the subject of the ozone hole, Dixie Lee Ray told her audience that it doesn't actually exist. The thing reported as an anomaly is a natural seasonal phenomenon discovered in 1956 by Reginald Dobson. The amount of ozone in the stratosphere, she said, decreased sharply in 1961, then rose to a maximum until 1979, then declined until 1986 before rising again. CFC's are not responsible; UV radiation is decreasing, not rising as is claimed; and there is no health risk whatsoever from this cause. Banning CFC's, she said, would cost $3-5 trillion; substitutes would be ten times as expensive and would corrode the equipment they are used in. These claims have been made by many others who should know better, but who were no more expert in atmospheric chemistry than she. They are all nonsense, and easily shown to be so.

What's going on here? Probably dozens of very able scientists from several nations had been working on the ozone problem full-time for 20 years before she spoke. The details had been figured out by theoretical chemists and field scientists working together well before the Antarctic 'hole' was observed and reported in 1985; the chemical, and then the meteorological reasons were all pretty completely understood by the time the Montreal protocol was ratified in 1988. This wasn't an area of scientific controversy at all. It certainly wasn't something speculative that could be just flatly contradicted by someone who had never done any work on it, but got their information the same way as the general public. That would be like standing up and announcing that influenza isn't caused by a virus. The proper response should have been laughter - but not here. No one was laughing because the claimant was herself an eminent scientist and public figure, and the tale she told of the ozone fraud was set in a larger context - of ideological conspiracy.

What happened to the scientific judgement and integrity of the many scientists who urged false claims? From reading what they've written, I feel confident they were not insincere, at least not the way charlatans are - that is, telling lies in the clear and conscious knowledge of doing so, and very consciously pretending to be honest. Instead, it looks to me as if they were possessed - one might say stricken - by a conviction of a moral hazard or threat to values and beliefs so important that methods did not matter. In other contexts we call this zealotry, or maybe fundamentalism. Much of what the scientists did and said looks very much like that.

Fundamentalism? You can be forgiven for wondering wether it's very likely that seasoned scientific practitioners would fall for that; but there's something else we have to account for that might help you make up your mind. It is the practice of viciously attacking scientists with whom they disagree, using personal slander, innuendo, false evidence, political muscle, official censorship, threats, media manipulation and every trick in the publicists' book. Needless to say, this is *prima facie* evidence that these are not scientific disputes at all - but to me they show clearly that they are really *anti-scientific*, irrational, anti-intellectual contests about pure conviction - in other words, the opposite of scientific debate & much more like the ugliest kind of religious argument. Not everyone in the denial movement has been guilty of vilification, but to my knowledge no senior scientist has ever stood up and repudiated this obscene way of advancing their cause. This seems to me and many people to be a most disturbing turn of events. So you know what I'm talking about, this is briefly the story of just one scientist victim.

Fighting over the hockey stick

Paleoclimatology is the study of ancient climate states. Obviously, the more we know about how climate behaved in the past, the better we understand what's happening now. But it isn't easy to get exact data on things like temperature, precipitation & atmospheric composition from long ago - a lot of ingenuity has been invested to get this knowledge. There are two main sources: things like sea-floor sediment, coral limestone, stalagmites & tree-rings, that incorporate discrete layers which can yield direct information about conditions at the time they were created; and radio-chemical analyses - the study of isotopes. Mostly, the two classes of data are gathered together and are complimentary.

In 1998, these techniques had been developing for several decades and were producing results with fairly well known precision, but no one had attempted to put together the data from multiple studies (each of which gives information about a limited region) to provide a global picture. This is what Michael Mann tried to do in his paper that year. He gathered a large number of independent studies, then, using sophisticated statistical methods synthesized them to give a single result. On a graph, the result showed how the world's temperature had risen sharply in the 20th century above it's mean for the previous 600 years. The next year, Mann repeated the study extending the analysis back to 1000 years. This is the graph that later came to be called 'the hockey stick'. It was used in the 2001 IPCC report, and that's when things began to turn nasty. Two years later, a pair of authors, Ross McKittrick, an economist, and Stephen McIntyre, a mathematician, published a paper claiming that Mann's work had statistical flaws which invalidated his results.

The ensuing argument has never ceased. Only a couple of years ago McKittrick wrote a paper asking if there even existed such a thing as a global temperature. In the last decade, Mann has been abused, threatened and insulted; his professional competence impugned in the popular media so that he has no effective defense; he's been compelled by the climate-denying chair of the Congressional Committee on Energy and Commerce, Joe Barton in a sort of witch-hunt; and absurd claims of incompetence,

corruption, criminal neglect and scientific fraud have been circulated endlessly on countless websites, where you can still find them today. At the same time, a solid body of work has shown that the original study was basically sound, and independent investigations have produced more than a dozen new hockey sticks, all confirming Mann's findings. In 2008 he published a revised version, incorporating the new data and methods, now going back nearly two millennia.

The sort of work Michael Mann does isn't something you or I can follow. The results are plain enough - in fact it was no doubt the persuasive power of his graph that made it a target for everyone who didn't want this result to be credible - but the issues that triggered this very ugly fight are completely opaque to most people (including, it must be said, many who have weighed in with passion and confidence). Because of the importance of the issue, in 2006 Congress commissioned an expert committee of the National Academy of Sciences to review it. Concurrently, Barton convened his own review, with a hand-picked chair, statistician Edward Wegman, who's views on climate change were known to be hostile. The outcomes of the two reports should be enough to show that where there is prejudice, no amount of reason can prevail. The NAS found in favour of Mann; Wegman did not - and he went further, suggesting that Mann's scientific competence and integrity were at fault and that the entire community of climate scientists colluded in generating false findings.

Smearing Rachel Carson

This last theme has since grown into a cacophony, so that its sheer absurdity has disappeared for many people. You don't need to spend much time on the internet to see that the supposition of total corruption in the IPCC and its affiliates is bread and butter to countless raucous bystanders in this affair. But to see just how sinister the practice of populist attacks on scientists has become, you only need to enter "Rachel Carson" or "Silent Spring" in a Google search. In no time you will be reading how the scientist and the book have been responsible for millions of deaths by malaria; how the case against DDT was never sound, and its ban in the US an hysterical over-reaction; and how Rachel was more of a poet than a scientist (she was both) who valued birds more than people; and pesticides were (and remain) much safer than she claimed. And of course, the government regulators in the 1960 & 70s were leftist stooges - like Rachel herself. Many climate denial institutes, organizations and sites have adopted this campaign. The Competitive Enterprise Institute has sponsored a special site, *Rachel Was Wrong*, to promote it.

This is a tissue of fabrications worthy of Dr Goebbels - so transparent and so full of malign intent it reminds one of psychosis. But the people who publish and promote this are not mad - they are zealous. Ben Santer, lead author of Chapter 8 of the 1995 IPCC report, Sherwood Rowland and Paul Crutzen, who discovered that CFCs damage the ozone layer, James Hansen, Director of the Goddard Institute, and many others can testify to the ferocity and hatred that fuels these anti-scientific attacks. Since there is no section of the climate denial movement that has openly repudiated this, it is fair to say that it is characteristic of the entire enterprise. It is a propaganda movement, freed from

ethical restraint by its zeal, and unconcerned by any questions about civilized conduct, our descendants' future, or the state of our planetary home.

A little reflection tells you that the attack on Rachel Carson is very revealing for anyone who wants to understand climate denial. Why would people who don't really care about the "millions of Africans" who are supposed to be her victims, pursue a campaign of slander against a dead scientist forty years in her grave, and thirty years after DDT ceased to be an issue in the USA? Why compose and defend a bunch of ridiculous lies and half-truths that are easily and often refuted by simple recourse to the record? Why bother?

The answer seems to be that Rachel touched a very sensitive nerve in 1962. She never advocated banning all pesticides, only more care and responsibility in their use; DDT was never banned globally, only in the US, where resistance had already made it problematic. She never advocated a "return to nature", or a rejection of industrial capitalism - but she did articulate a view of man and nature that was genuinely subversive. As a result of reading her book, millions of people understood in their own way that these two are not distinct categories that can relate by opposition, conquest, mastery or defeat, but are one; human occupation of the Earth is not exercised by power, but stewardship, and our use of the gifts of the Earth gives us a responsibility - to enjoin our sagacity and benevolence so that they are sustained for all time. From the torrent of personal criticism that followed her book, one can surmise that captains of industry were not the only ones to feel uncomfortable with this message.

I said before that all strong political stances have their sources in our human endowment - our powers and failings, dispositions and incompatibilities - in short, our nature. The first, and maybe the greatest philosopher to consider this was Plato. In the exercise of thought he loved freedom more than anything; but in the conduct of affairs of state, he wanted authority. He saw the Athenian democracy in its final phase - dysfunctional, chaotic, and eventually ruinous. He saw Sparta prevail and it must have seemed to him that popular rule was far too volatile an instrument to steer the ship of state in fair weather or foul, but people being what they are, they must have a Prince and law-giver. The problem of politics then was to make him wise.

It's often been said that Plato's definition of this problem was final, and that everything since has been about the same thing - how power can be devolved and still effective; and how to restrain and indemnify it where it is concentrated. The anxiety of the founders of the Marshall Institute and many other men and women who saw the great depression repaired by the New Deal, and the cultural upheaval of the late 60s & early 70s and the 'liberation' movements it spawned, was probably not very different from Plato's in 399 BC when he saw Socrates condemned by the popular assembly. Distrust of democracy can be perfectly rational - but also visceral and emotive. Whatever else it was, *Silent Spring* was a book against hubris - a book about humility. It spoke a message about the natural human condition - something so obvious we acknowledge it like a memory, not a conviction - that we *are* nature, and cannot be apart from it.

American conservatives, since the war have been of two minds whether to be pragmatic, moderate, progressive conservatives in the manner of Eisenhower, or reactive, libertarian conservatives like Coolidge - that is, until Reagan decided for them in 1980. Since then they have nurtured a vision of the state as the agency which makes it safe for individuals to pursue their lawful interest without restraint; and society as the fair product of that minimally regulated competition. This is not a vision that comprehends large common goods like the natural environment, and it is specially impatient of that demotion of man from his lordship over nature to humble stewardship.
"Mankind is considered (by the radical environmentalists) the lowest and meanest of all species and is blamed for everything", said Dixie Lee Ray. Here, at least, is one source for the climate deniers' passion. They are people who must sustain an internal inconsistency: on one hand, they wish for anarchic freedom; on the other they want, and use illegitimate force on their opponents. This is freedom-for-us-only - the litmus test for fundamentalism.

Silent Spring was not, as its detractors say, an hysterical diatribe - quite the opposite. Reading it today, one is struck by its reasoned moderation. Its argument is entirely grounded on evidence, copiously supplied and carefully verified; every bit is cited in the back of the book for anyone to follow. In this respect, the case for restricting the use of broad-scale pesticides was similar to the one for reducing greenhouse gas emissions - abundant high quality evidence, and a straightforward effective remedy. And the pattern of resistance was similar too. For example, Carson tells the story of the campaign against fire ants. These pests had been established in the South for 30-40 years but had never been viewed as an agricultural or health problem, though they could certainly be a nuisance. In 1958, in the face of reasoned opposition, the Agriculture Department began an enormous spraying program with the then new insecticides dieldrin and heptachlor in very heavy quantities to a total of 20 million acres, even though no impact studies of any kind had been done, and there was serious doubt about the need for it.

It became an environmental catastrophe. The circumstances strongly suggested corrupt collusion between the Department and the manufacturers, who profited hugely. When fossil fuel companies funnel money to PR people and right-wing organizations to do their ranting for them; when the war for public opinion and political influence is fought with the meanest of propaganda weapons; when a perfectly sound scientific enterprise is subverted, just so its findings can be denied; when unrepentant greed and selfishness is cynically disguised as ideology, and reputation, civility, honesty and truth itself is set at nought, we are not seeing the denial of global warming, the truth of which can stand on its own feet, but of human decency. That's the real casualty in this dreadful affair. That, and the right of our grandkids to live in a world full of wonder and vitality, and fit for human potential.

Sources

This isn't a scholarly essay & I've included only a few links to sources, but if you want to follow up this subject, here are a few more.

1. Naomi Oreskes & Erik Conway's new book, *Merchants of Doubt: How a handful of scientists obscured the truth on issues from tobacco smoke to global warming*; Bloomsbury, 2010, carefully documents the nature and development of the denial business ever since it began. It is excellent.
2. Clive Hamilton's new book, *Requiem for a Species;* Allen & Unwin, 2010, is devoted to explaining how we came to mess up our management of this problem.
3. A couple of scholarly articles: Myanna Lahsen: *Experience of Modernity in the Greenhouse: A cultural analysis of a physicist "trio" supporting the backlash against global warming;* Global Environmental Change, 18, 2008, 204-19 [available here]; and McCright & Dunlap: *Defeating Kyoto: The conservative movement's impact on US climate change policy;* Social Problems 50, 2003, 348-373 [available here]. These examine in detail aspects of how the denial movement functioned.
4. For really well-informed discussion of what is known, what is being discovered, and what deniers are saying, *Real Climate* is among the best. It's written by scientists for all of us.
3. The most widely read climate science blog is Joe Romm's. There's heaps of very good stuff there.
4. *New Scientist*, the British journal keeps a special issue on its website devoted to addressing the common denial claims.
5. Yale Environment 360 is a source of high quality articles on developments in climate science, climate change politics and related environmental issues.
6. If you have the patience to follow some of the most accomplished climate science work, all the publications of James Hansen and his GISS colleagues, both scholarly and popular ones, are on his website, here.

A note about prejudice

Although I've asserted in this essay that climate denial is a political phenomenon - not a scientific dispute - I haven't said much about the sources of that political stance; or, if you like, why it is that people have become polarized in just this way. It's a big subject. Students have shown clearly that, at least in the USA, people's beliefs about climate change can be used to predict a package of other commitments with quite high accuracy. In other words, climate denial has become part of a consonant ideological system. But that doesn't explain why beliefs follow each other, instead of the evidence. That's a cognitive problem, and the answer seems to be that we all construct meaning frameworks (sometimes called 'frames', or 'schemas') that anchor our understanding and loyalty, and which strongly affect how we process new information or facts.

Frames are neither rational nor emotive, but necessarily both. One of the most important discoveries of cognitive science is that this old distinction (reason *vs* emotion) is false. We cannot, in fact, reason without emotion; nor do we feel in the absence of

judgement. Our important frames of understanding are acquired partly by absorption during early life, partly by informal learning, reflection, emotional persuasion, trauma, personal growth, and a host of other things. They are absolutely indispensable to the process of making sense of the world, but they have another property - a sort of tenacity factor - which varies a lot between people. Accordingly, some people hang on to their convictions as if life depended on them; others yield to persuasion or new evidence more easily, and don't suffer much by changing their opinion.

I was thinking about this when, a while ago I gave myself the job of reviewing a strident contrarian book, Ian Plimer's *Heaven and Earth: global warming, the missing science [Connor Court, 2009]*. The book gives evidence of the author's commitments on every page, and despite it's sub-title, it is deeply anti-scientific. The overwhelming impression is that the writer saw everything through a kind of lens. Every fact, perspective, or interpretation which fell under his gaze was transformed; and (apparently) much that was unfit for transformation, just ignored. As it was treated, each controversy appeared like one of those little crabs that wave a huge claw to impress females - one side greatly enlarged for the purpose of combat; the other diminished, crippled, absurd.

I'll just give one example from hundreds, but one that struck me as rather telling. Towards the end of the book, Plimer discusses how science has been corrupted in recent times; how scientists don't know how to do their job; how science (specially environmental science) has been politicized; how the IPCC is a wholly political organization with a sinister secret agenda; and how dissenting scientists have suffered discrimination. He wants to show us that they are a big group, denied their rightful presence in public debate by a hostile media. And so he cites Naomi Oreskes' 2004 letter to *Science*, where she reports a simple study showing that the scientific consensus (about the basic claims of global warming among working climate scientists) is virtually complete. To refute this, he cites Benny Peiser's rather pointless response and his complaint that he couldn't get his objection published.

Introducing Oreskes, he calls her a "social scientist". This is an interesting slip. She is actually an historian of science, trained with a doctorate in geology - Plimer's own study. It is Peiser who is a social anthropologist. Presumably Plimer didn't know anything about Oreskes' work, but attributing a career to her, he unconsciously chose one of the despised 'soft' sciences, betraying his frame '*all climate scientists and their supporters are corrupt*'.

If you want to find your way through the awful maze of published stuff on climate change 'controversies' you really have to keep this in mind. If you come to the subject undecided, and have no idea that the arguments are phony, with all the scientific curiosity and reserve on one side, and all the passion and prejudice on the other, you will certainly be misled. My advice is to look for enlightenment where you would expect to find it - in the reported work of practicing scientists. If there are genuine disputes about published work, they will be there too. If some dispute appears only in blogs, contrarian

sites, Fox News, or in reports from Exxon-funded think-tanks, you can safely assume it is not even real.

A fascinating study of the distribution of beliefs about the climate problem in the US can be found here

Oreskes' paper can be read here

George Lakoff explains the idea of cognitive framing here