

The improver of natural knowledge absolutely refuses to acknowledge authority, as such. For him, skepticism is the highest of duties; blind faith the one unpardonable sin.

Thomas Henry Huxley, biologist and educator
Aphorisms and Reflections, 1907

Why You Should be Skeptical About Global Warming or A Layman's Guide to "Smelling a (Scientific) Rat"

An address to 'The Australian Adam Smith Club'
8th December 2009

1. Introduction

When I started writing the introduction to this talk, two major events had occurred in the previous week. The first was the revelations of "Climategate." The second was the ructions within the Australian Liberal Party over the ETS. Politics is not the main topic of this talk. I have been around long enough however to realize that most politicians have no principles, save to retain power at all costs if they in government or to get power at all costs if they in opposition. All else is expedient. It is a rare politician indeed who would make a decision because it is the right thing to do. Of course in order to know what is the right thing, you need to understand the facts, that is the truth, about an issue. And as I am going to show you, it is not difficult to determine that the Anthropogenic Greenhouse Warming Theory is false.

The Climategate revelations are interesting for many reasons. For me, one of the most interesting revelations for the general public was that the scientists involved had sold their scientific souls to the devil and perverted the science they were supposed to practise. Indeed one might conclude that they had transmogrified into politicians.

2. Background

Before we get into the arguments I need to provide some background. The background is necessary to provide the framework to the skeptics' arguments and it may also give you some understanding of why I am a natural anthropogenic global warming skeptic.

Some of you may recall grandfather Berl Gross. He was a regular attendee of the Adam Smith Club functions during the 1980s. He spent much time in England during the 1950s and 60s where he attended the philosophical lectures at the London School of Economics by Sir Karl Popper. In a sense he came under Popper's spell as well as becoming life long friends.

One of Popper's areas of interest was the Scientific Method. The first book Popper wrote on the subject was "*The Logic Of Scientific Discovery*". Now when Berl came back to Australia every few years he brought back many books which were very dear to him and which he entrusted to me, his first born grandson, to look after. So in my bedroom from about the age of ten I had a bookshelf with books on philosophy and science and history. I tried to read some of them but of course most were way over my head. But that didn't matter as the discussion around the table was not about football or cricket but rather about "How do you know that you know?" or "What do you mean when you say god?" Without

realizing it at the time I had had drummed into me, from an early age, the importance of having a sceptical outlook on life and of continuously questioning my premises.

So when I entered Melbourne University to start my Bachelor of Science degree I did not realize how few of my fellow students had no idea of Philosophy of Science and the Scientific Method. When I left Melbourne University after completing my Master Of Science degree I had a much better idea. I can confidently say that none of my fellow students and very few of my teachers had any idea whatsoever.

I believe that one of the reasons we have got ourselves into such a mess today with Anthropogenic Global Warming (AGW) is that the world has created at least two generations of scientists with little understanding of scientific method and philosophy of science.

3. Popper's Scientific Method¹

Just under 75 years ago, an argumentative Viennese cabinet maker and schoolteacher wrote a revolutionary book about the philosophy of science. This came about by accident. After a night-long conversation a friend suggested that Karl Popper should organise his ideas into a book.

In Popper's words:

It had never occurred to me to write a book. I had developed my ideas out of sheer interest in the problems, and then written some of them down for myself because I found that this was not only conducive to clarity but necessary for self-criticism. Writing a book did not fit my way of life nor my attitude towards myself - my father was afraid that it would end in my becoming a journalist. My wife opposed the idea because she wanted me to use any spare time to go skiing and mountain climbing with her.

Logic der Forschung (translated 25 years later as The Logic of Scientific Discovery) appeared in 1934. It resulted in another happy accident when in 1937 Popper obtained a job as a philosophy lecturer at Canterbury College, Christchurch, New Zealand. This probably saved his life for he was born of Jewish parents and he might not have survived the Nazi regime that came to power in Austria in 1938. After the war he counted fourteen relatives who perished in the Holocaust.

I should point out here that both science and religion seek the same thing, to determine the "truth". This may be a non-PC concept in this day and age of deconstructivist post modernism but nevertheless I shall maintain this proposition for this talk because to propose anything else leads to meaninglessness and ultimately nihilism. The history of science and religion shows a growing tension developing from the time of the Renaissance through the Enlightenment and into the 20th Century. Both Science and the Church claimed to have the path to discovering Truth. The Church claimed a monopoly on truth through the principle of papal infallibility and a direct line to God through the bible. Science claimed it had a surer path through observation and rational thought.

In the *The Logic of Scientific Discovery* Popper rejected the traditional idea that scientific knowledge was based on a method called Induction whereby observations are generalized into laws. Popper argued that the logical process of induction simply does not exist. The problem of Induction was first described by David Hume in the 18th Century and in a sense Popper was developing the idea in a different direction. Popper suggested that scientific

¹ Much of this section has been taken whole from Rafe Champion's essays on Popper which can be found at <http://www.the-rathouse.com/writingsonpopper.html>.

theories are forever tentative and the most useful function (and the only logically decisive effect) of observations is to act as tests or attempted falsifications of theories.

Here is an example of Induction. One observes wherever one goes in Europe that every example of a swan is coloured white. One concludes that all swans are white. Induction is a process of drawing general conclusions from specific observations. But the statement 'All swans are white', cannot be verified by any number of observations of white swans, simply because you cannot be certain that you have sighted all the swans in the universe. And, of course, after observing a black swan in Australia, the absurdity of Induction as a logical process for determining truth is apparent. Yet until Popper it was considered to be the scientific method.

Indeed the exemplar of scientific Induction is Newton's Universal Law of Gravitation (Force between two bodies is proportional to the product of their masses and inversely proportional to the square of their distance apart.) Just think of it; Newton sees an apple fall from a tree and from this he generalized to his Universal Law of Gravitation. And it has to be said that for some two hundred years this law was verified time and time again. An example of its success was the prediction of the existence of the planet Neptune from the observation of the perturbation of the orbit of Uranus. To quote from Wikipedia:

The discovery of the planet Neptune remains notable because it resulted from theoretical prediction of the existence of a major solar-system body without having previously seen it. What led to its discovery was indirect evidence from the marginal disturbing effects which it produced gravitationally on the observed motion of its neighbouring planet (in order of orbital size) Uranus. The actual discovery was made on September 23, 1846 at the Berlin Observatory, by astronomer Johann Gottfried Galle (assisted by Heinrich D'Arrest), working from the mathematical predictions of Urbain Le Verrier which Galle had received just that same morning. It was a sensational moment of 19th century science and dramatic confirmation of Newtonian gravitational theory.

It made scientists supremely confident, indeed complacent, in their methodology. They believed they had the pathway to Truth, until an obscure patent clerk, (Albert Einstein) in Switzerland turned their perfect, clock-work world – their so called scientific consensus – upside down with his Special Theory of Relativity in 1905 and his General Theory of Relativity in 1915. In a parallel to today's global warming consensus, Einstein was the skeptic challenging a Newtonian consensus that had held sway for over 200 hundred years. Einstein already had a better grasp of scientific method than his contemporaries when he stated, "No amount of experimentation can ever prove me right; a single experiment can prove me wrong."

The rising Nazi movement found a convenient target in relativity, branding it "Jewish physics" and sponsoring conferences and book burnings to denounce Einstein and his theories. The Nazis enlisted other physicists, including Nobel laureates Philipp Lenard and Johannes Stark, to denounce Einstein. *One Hundred Authors Against Einstein* was published in 1931. When asked to comment on this denunciation of relativity by so many scientists, Einstein replied that to defeat relativity one did not need the word of 100 scientists, just one fact.²

So with the demise of Induction as a sure path to scientific truth what do we have to take its place? Popper suggested the following: We start with a problem, we propose a theory but as we cannot prove the theory by any number of verifying observations, the important thing to do is to try to disprove the theory by devising experiments to test it. If after many

² <http://www.britannica.com/EBchecked/topic/181349/Albert-Einstein/256586/Coming-to-America>

tests the theory is not refuted, then we may accept the theory as tentatively true. If the theory is refuted by a single test, then it is discarded and another must take its place.

To summarize, scientific knowledge and understanding grow through refuting existing theories and replacing them with better ones. However all our theories remain just that, theories – for one never knows when some observation will be found to refute them.

A crucial part of improving our understanding of the universe is the attempted refutation of theories. Thus it is clear that all scientists must be skeptics. Indeed it would be fair to say that a scientist who is not a skeptic is no scientist at all.

According to the New York Times, on March 21, 2007 Al Gore (former US Vice President), speaking to a joint session of the House Energy and Commerce Committee and the House Science Committee, called on Congress to put aside partisan differences, and accept the scientific consensus on global warming. But this is only one example of Gore repeating the same claim, originally made in 1992:

Only an insignificant fraction of scientists deny the global warming crisis. The time for debate is over. The science is settled.

How does this sound in the light of our understanding of scientific method? Even if there were a scientific consensus (which there is not) would this mean there really were a global warming crisis? As we know, no number verifications of a theory can prove it right. How much less then can a universal belief by every scientist on the planet prove it right! In the words of the late Michael Crichton:

There is no such thing as consensus science. If it's consensus, it isn't science. If it's science, it isn't consensus. Period.

I smell a rat whenever I am told there is a scientific consensus.

4. Other Principles

Occam's Razor

From Wikipedia:

Occam's razor, is a principle attributed to the 14th-century English logician and Franciscan friar, William of Ockham. The principle states that the explanation of any phenomenon should make as few assumptions as possible, eliminating those that make no difference in the observable predictions of the explanatory hypothesis or theory.... When multiple competing hypotheses are equal in other respects, the principle recommends selecting the hypothesis that introduces the fewest assumptions and postulates the fewest entities. It is in this sense that Occam's razor is usually understood. Occam's Razor is more often taken today as an heuristic maxim (rule of thumb) that advises economy, parsimony, or simplicity, often or especially in scientific theories.

So if I have two competing theories that try to explain something, Occam's razor suggests that, all other things being equal, pick the simpler one. There are at least two competing theories explaining the late 20th Century warming. One is that it is caused by man's excessive generation of CO₂ and the other is that it is a continuation of the normal climatic cycles and is thus entirely natural. Unfortunately for the AGW proponents, Occam's Razor tells us, that unless we have very good reason, we should choose normal climatic cycles over CO₂. Later we will discuss how the AGW proponents tried to get around this problem.

I smell a rat when scientists try to defy Occam's Razor.

Principle of Transparency

When I went to university, it was emphasized over and over, that I had to record and retain all my raw data for any experimentation I conducted. This was so that it could be checked by others, if necessary or if desired and to allow others to reproduce my results. Reproducibility is very important to science. If a test result is reproducible we are confident in its veracity. If it is not reproducible it is dismissed.

An excellent example of this principle in action was the case of "Cold Fusion" almost twenty years ago. Some might call Cold fusion the holy grail of energy generation. It promises almost limitless amounts of energy for relatively little cost. From Wikipedia:

In the broadest sense, **cold fusion** is any type of nuclear fusion accomplished without the high temperatures (millions of degrees Celsius) required for thermonuclear fusion. In common usage, "cold fusion" refers more narrowly to a postulated fusion process of unknown mechanism offered to explain a group of experimental results first reported by electrochemists Stanley Pons of the University of Utah and Martin Fleischmann of the University of Southampton.

Cold fusion gained attention in 1989 when Fleischmann and Pons held a news conference in which they reported producing nuclear fusion in a tabletop experiment involving electrolysis of heavy water on a palladium (Pd) electrode. They reported anomalous heat production ("excess heat") of a magnitude they asserted would defy explanation except in terms of nuclear processes. They further reported measuring small amounts of nuclear reaction byproducts, including neutrons and tritium. These reports raised hopes of a cheap and abundant source of energy.

Enthusiasm turned to skepticism and scorn as a long series of failed replication attempts were weighed in view of several theoretical reasons cold fusion should not be possible, the discovery of possible sources of experimental error, and finally the discovery that Fleischmann and Pons had not actually detected nuclear reaction by-products.

Notwithstanding the failure of Fleischmann and Pons, this event shows science at its best. Other scientists demanded to know everything about Fleischmann and Pons' experimental set up so that they could try to reproduce their results. Fleischmann and Pons willingly provided all the required information. Their results could not be reproduced and their hypothesis of having discovered Cold Fusion was refuted.

I smell a rat when scientists refuse to disclose all their data or procedures, especially if it is done to try to prevent others from reproducing or testing their results.

This was a major issue in the so called "Hockey Stick" affair which we will discuss later.

5. The Anthropogenic Global Warming (AGW) Theory

The Basic Theory:

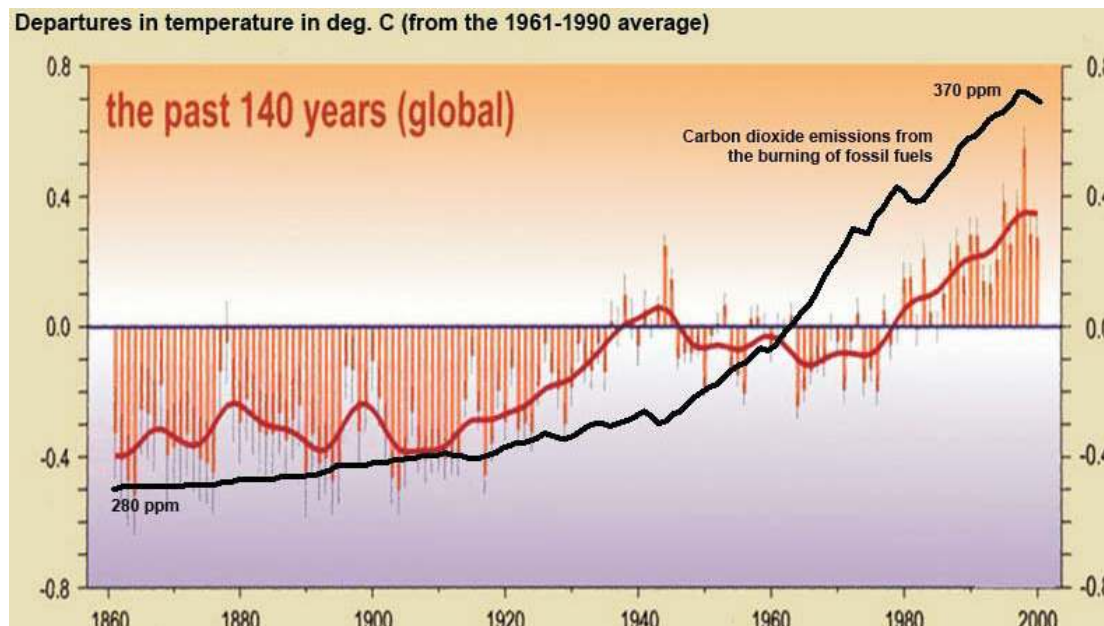
- Human CO₂ emissions are the main cause of global warming.
- If human CO₂ emissions are not curtailed (ASAP), catastrophic global warming will occur.

When I use the term “CO₂” instead of “greenhouse gas”, it is because the other greenhouse gasses are considered insignificant in comparison.³ Over time, this theory has changed somewhat. “Global warming” has morphed into “climate change”. This allows catastrophists to blame “everything” (hotter, colder, dryer, wetter, extreme weather) on CO₂. “Catastrophic global warming” has morphed into “tipping points” of no return. There are various reasons for this but mainly this is political rather than scientific, so it is a topic for another occasion.

6. Attempts to Verify the Theory

From Popper, we know that the best way to gain confidence in tentative theories is to subject them to as much and as stringent testing as possible but if one has no appreciation of scientific method or if one’s motives are political rather than scientific, then one seeks validation rather than refutation. So we will start by examining the attempted validations of the theory.

Correlation is not Causation



Combined annual land surface-air and sea surface global temperature anomalies (°C) for 1861 - 2001 relative to a 1961 - 1990-average baseline, and plotted with the estimated two standard error uncertainty (after IPCC, 2001, Figure 2). Also plotted, without error bars, is the estimated curve of atmospheric carbon dioxide values over the same period. Note the lack of correspondence between the two curves, and especially that cooling accompanied the marked increase in carbon dioxide emissions between 1950 and 1970.⁴

The above figure shows the change of global temperature and atmospheric CO₂ over the period from 1861 to 2001. At first glance the correlation doesn’t look too bad – after all, both the temperature and atmospheric CO₂ have increased over the period. However upon closer inspection how do you explain the period between 1940 and 1975 when global temperature decreased yet CO₂ increased most rapidly? The typical explanation given for temperature decrease was that other natural factors caused the temperature decrease. The problem with this explanation is: why aren’t these or other natural factors also the cause of the temperature increase?

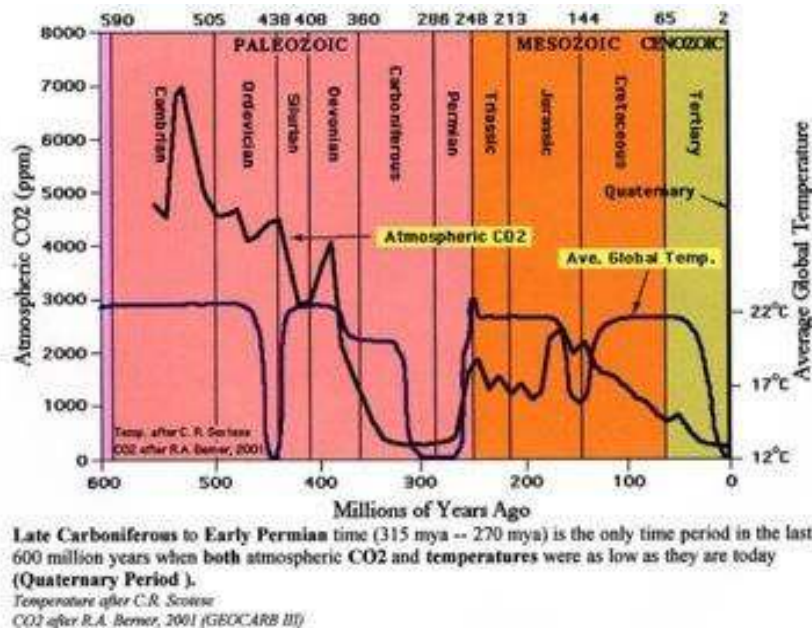
³ This is actually not true. Water vapour in the atmosphere is a far more significant greenhouse gas.

⁴ From *The Myth of Dangerous Human-Caused Climate Change* by R M Carter (The AusIMM New Leaders’ Conference, Brisbane, QLD, 2 - 3 May 2007, p61-74)

After all, the correlation might just be accidental. For instance I know of a far better correlation that has existed for over a thousand years: the rooster crows just before sunrise without fail but we don't conclude from this correlation that the rooster causes the sun to rise.

I smell a rat when correlations are used to try to prove causation.

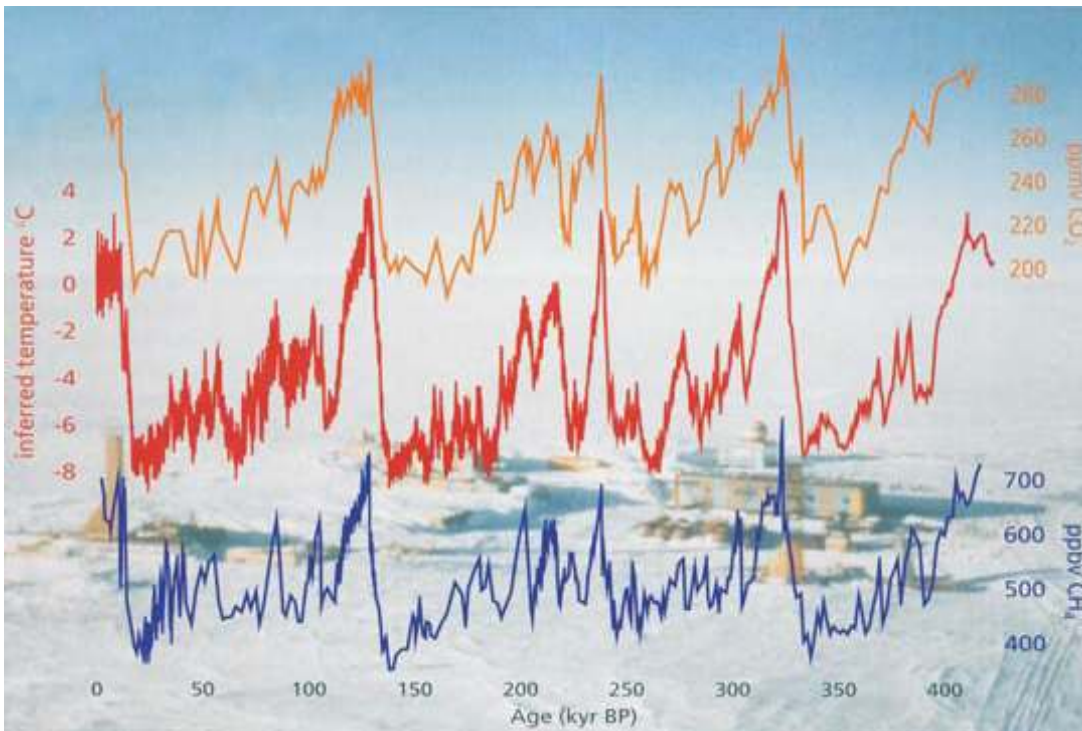
Let's consider the following figure which shows the relationship between global temperature and CO₂ over a period of some 600 million years:



From this figure, it is clear that global temperature and CO₂ are uncorrelated and therefore one can not be driving the other. One might argue that the time scale is so vast that there is no correlation but over a smaller scale there is a correlation.

Here is a similar graph to the one Al Gore is famous for using to great effect in his film and book *An Inconvenient Truth*:⁵

⁵ From *The Myth of Dangerous Human-Caused Climate Change* by R M Carter (The AusIMM New Leaders' Conference, Brisbane, QLD, 2 - 3 May 2007, p61-74)



Atmospheric carbon dioxide, temperature and methane levels for the last 420 000 years as reconstructed from the Vostok ice core, Antarctica (after Petit et al, 1999). Note the remarkable coincidence of timing of variations in atmospheric temperature (middle curve) and the two greenhouse gases. In terms of cause and effect, however, it is apparent at higher resolution that the changes in temperature precede the changes in carbon dioxide by about 800 years (eg Mudelsee, 2001).

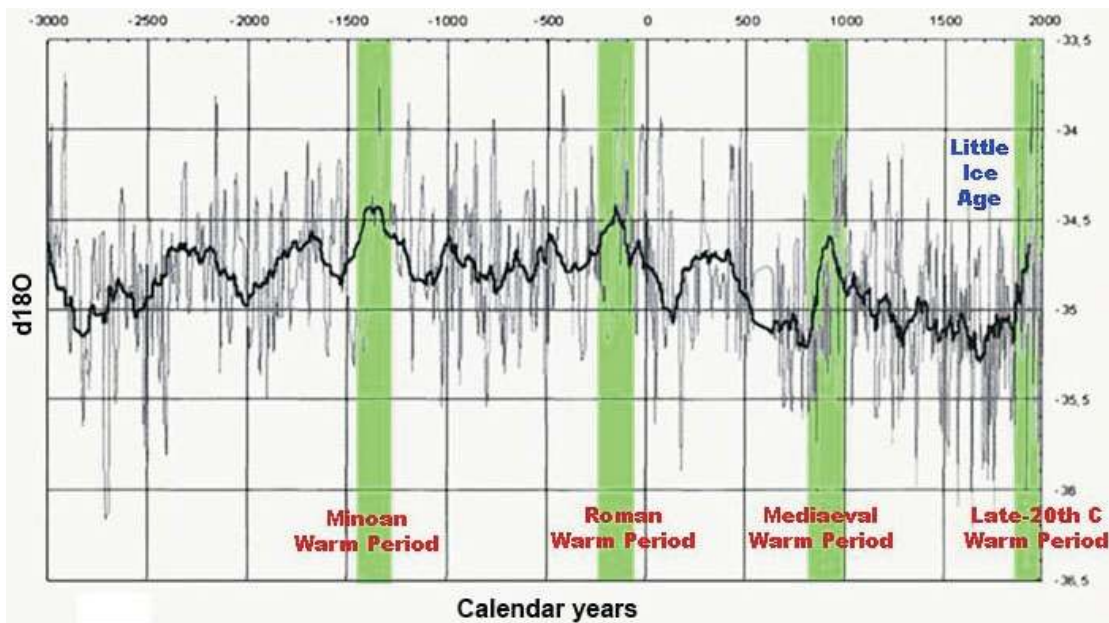
Again at first glance the correlation appears spectacular. However, there was one piece of crucial information that Al Gore knew but was very careful not to mention: the CO₂ change followed the temperature change by about 800 years. This shows that CO₂ change cannot possibly be causing temperature change. Although it does not show that temperature change is causing CO₂ to change, it does not refute that possibility. Indeed there are good physical arguments why this should be the case.

To summarize, the supposed correlation between global temperature and atmospheric CO₂ turns out to invalidate the proposition that CO₂ change is causing temperature change.

The Occam's Razor Problem

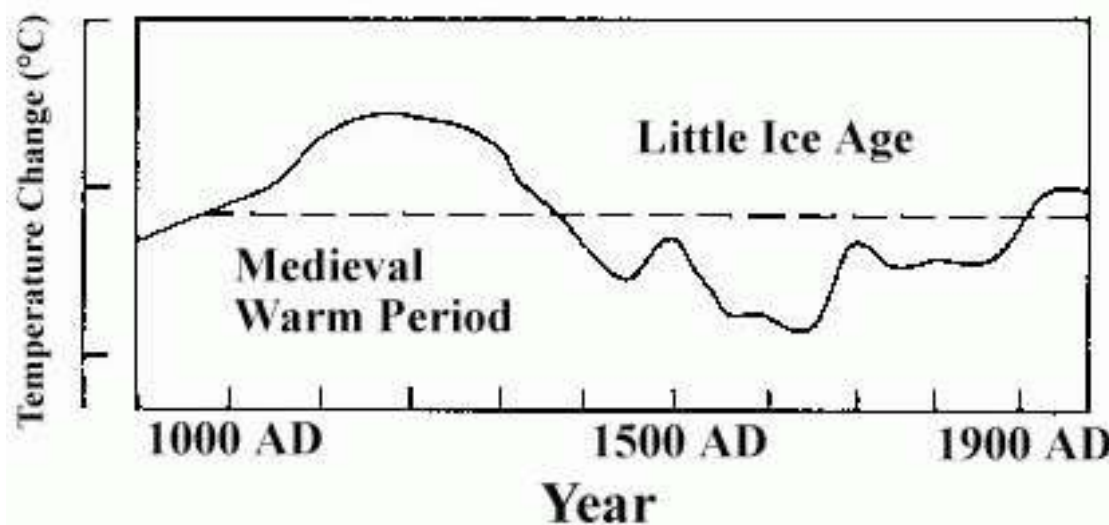
As noted earlier, Occam's Razor is a rule of thumb that advises we choose the simpler of two theories or the one with fewer assumptions. When choosing between the AGW theory and the natural cycle theory, it is clear that Occam's Razor would suggest we pick the natural cycle theory as it does not require the additional assumption of CO₂.

The skeptics' argument was very simple the Middle Ages Warm Period, the Roman Warm Period and the Minoan Warm Period were all at least as warm if not warmer than today. This is seen in the figure below:



Oxygen isotope time series for the last 5000 years, GISP2 Greenland ice core, fitted with a moving average (dark line; after a slide by Andre Illarianov, 2004). The Late 20th Century Warm Period represents the latest of a regular millennial cycle of similar warm periods (grey stripes). The Late 20th Century Warm Period may have equalled the magnitude of the Mediaeval Warm Period, but it has not yet attained the warmth of either of the preceding Roman or Minoan Warm Periods.

As shown below, even the IPCC had to concede that there were periods at least as warm as today in the past.



Taken from the IPCC Second Assessment Report in 1995.

Therefore, if there is nothing unprecedented about current (20th Century) warming why do we need to introduce additional assumptions (i.e. man made CO₂) to explain it?

When the AGW proponents were confronted with these facts, they tried two approaches:

- They claimed that the current warming was unprecedented in both absolute temperature and rate of temperature increase.
- They questioned the existence of the previous warm periods.

As seen from the graphs above, the current warming is neither unprecedented in terms of absolute temperature nor rate of change of temperature. So the only thing left to the AGW proponents was to somehow question the previous warm periods. This could have been done in a number of ways. For instance it is possible to question the accuracy of the ice

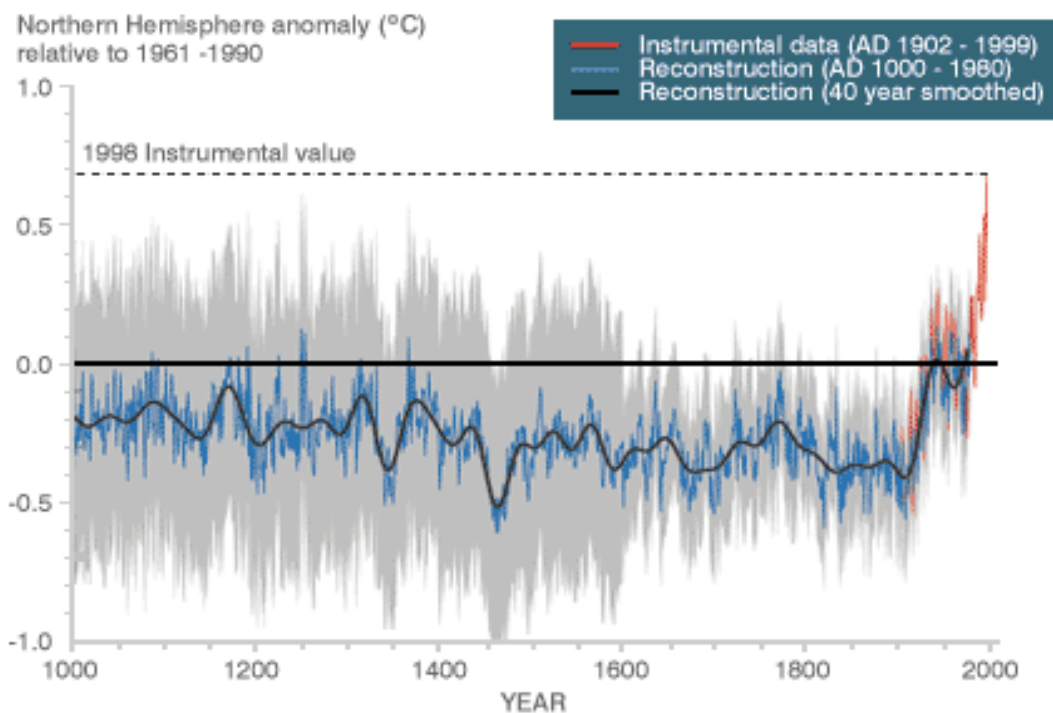
core measurements. The only problem with this is that it would also question the main evidence the AGW proponents had for their theory.

This is where we need to consider the famous Hockey Stick, which many skeptics claim to be one of the worst scientific frauds to have been perpetrated in history.

7. The Hockey Stick

This a long and involved story and unfortunately one that involves politics.

Michael Mann et al published two papers in 1998⁶ and 1999⁷ that purported to show for the Northern Hemisphere that the average temperature remained relatively constant from approx 1000 AD to 1900 AD. Then at about 1900 AD an apparent unprecedented warming started. Here is the famous graph published by Mann et al:



There is something else that is interesting about this graph. It mixes proxy data with thermometer data. What is obscured in the graph is what would happen if the proxy data were extended to the 21st Century.

One of the interesting email topics that has arisen recently out of the Climategate treasure trove is called "Hide the Decline."

In the abstract to the 1999 paper, Mann et al claim:

... our results suggest that the latter 20th century is anomalous in the context of at least the past millennium. The 1990s was the warmest decade, and 1998 the warmest year.

⁶ Michael E. Mann, Raymond S. Bradley & Malcolm K. Hughes, *Global-scale temperature patterns and climate forcing over the past six centuries* (Nature, v392, p779-87)

⁷ Michael E. Mann, Raymond S. Bradley & Malcolm K. Hughes, *Northern Hemisphere Temperatures During the Last Millennium: Inferences, Uncertainties, and Limitations* (Geophysical Research Letters, v26, p759-62)

To quote from an article by geophysicist David Deming:⁸

This conclusion was greeted like the triumphal return of Jesus Christ. Decades of work was overturned by one journal article. The MWP had been reinterpreted out of existence. Within a few days, the research by Mann and his colleagues passed from analysis to fact. On March 3, 1999, the University of Massachusetts issued a press release with the headline *1998 Was Warmest Year of Millennium...*

In comparing this graph with the 1995 IPCC graph it is clear both cannot be correct. So how did Mann et al and their supporters explain the difference? They claimed that their graph was global (or at least represented the whole of the Northern Hemisphere) whereas the IPCC 1995 graph only applied to a limited region of Europe. The first refutation of Mann et al that I read appeared on a web site in Australia and was published on the 12th of November 2000 by a retired merchant seaman, the late John L. Daly.⁹ To quote only a little of Daly's article:

To disprove the 'Hockey Stick', it is sufficient to merely demonstrate conclusively the existence of the Medieval Warm Period and/or the Little Ice Age in proxy and/or historical evidence from around the world. According to the 'falsifiability' principle of science, substantial physical evidence that contradicts a theory is sufficient to 'falsify' that theory. To that end, 'exhibits' of physical evidence are presented below to prove that not only is the 'Hockey Stick' false, but that the Medieval Warm Period and Little Ice Age were not only very real - but also global in extent.

Daly goes on to provide 14 exhibits from all over the globe, all peer reviewed scientific papers that demonstrate the existence of the MWP and Little Ice Age (LIA).

To quote again, from the end of Daly's article:

It is now clear that the climate history of the northern hemisphere and the globe as a whole bears no similarity whatever to that portrayed by Mann's 'Hockey Stick'. It is inconceivable that two major climatic events of the last millennium, the Medieval Warm Period and Little Ice Age, could be observed at the same points in time in such varied locations and with such a variety of proxies, around the world and yet be missed by Mann's study. One possible explanation for this discrepancy is that tree rings are inappropriate as temperature proxies, something most dendrochronologists are reluctant to acknowledge.

The question must then be asked, why do people who claim scientific credentials in the field cling so tenaciously to a characterization of past climate that is so patently false? Why was there so little challenge to the Mann theory among his peers? ...

Daly continues:

The evidence from the 'exhibits' is overwhelming. From all corners of the world, the Medieval Warm Period and Little Ice Age clearly show up in a variety of proxy indicators, proxies more representative of temperature than the inadequate tree rings used by Michael Mann.

What is disquieting about the 'Hockey Stick' is not Mann's presentation of it originally. As with any paper, it would sink into oblivion if found to be flawed in any way. Rather it was the reaction of the greenhouse industry to it - the chorus of approval, the complete lack of critical evaluation of the theory, the blind acceptance of evidence which was so flimsy. The industry embraced the theory for one reason and one reason only - it told them exactly what they **wanted** to hear.

⁸ *Global Warming, the Politicization of Science, and Michael Crichton's "State of Fear"* (Preprint, to be published in the June, 2005, issue of the Journal of Scientific Exploration, v.19, no.2 <http://www.scientificexploration.org/jse.php>)

⁹ *The 'Hockey Stick': A New Low in Climate Science*, (<http://www.john-daly.com/hockey/hockey.htm>)

To quote again from an article by geophysicist David Deming:¹⁰

Willie Soon and Sallie Baliunas (2003)¹¹ reviewed more than 200 previous studies and concluded that the evidence for the existence and global extent of both the Medieval Warm Period and the Little Ice Age was well established. It was hardly a controversial result, yet the Soon and Baliunas (2003) paper was greeted by a firestorm of controversy. Three editors of the academic journal in which the study had been published resigned in protest (Regalado, 2003, p. A-3).

Writing in the June 24, 2003, internet version of Scientific American, reporter David Appell explained Soon and Baliunas' sin.

...the consensus view among paleoclimatologists is that the Medieval Warming Period was a regional phenomenon, that the worldwide nature of the Little Ice Age is open to question and that the late 20th century saw the most extreme global average temperatures.

Soon and Baliunas had committed the cardinal sin of violating the new consensus.

So far we have a situation where there are two hundred papers for and one paper (actually two MBH98 & MBH99) against the MWP and LIA. This is pretty overwhelming but it is not enough because it does not explain how Mann et al obtained such a contradictory result. Part of the answer was already indicated above by Daly when he suggested that "tree rings are inappropriate as temperature proxies".

Enter McIntyre and McKitrick

The main destroyers of the Hockey Stick were two Canadians, Steve McIntyre and Ross McKitrick. There are a lot of technical statistical issues which are beyond the scope of this talk. So instead I am mostly going to summarize the conclusions of McIntyre and McKitrick as they appear in the literature and have been independently verified by two US government reviews. We don't have enough time tonight to go into much detail but I can recommend the following paper presented by Ross McKitrick entitled *What is the 'Hockey Stick' Debate About?* Presented at the APEC Study Group, Australia on April 4, 2005.

The important point to understand from this is that MBH98 paper uses a statistical technique to massage the data in order to obtain a final result which displays a graph of temperature versus time. Therefore, given the significance of the results obtained, (as with Pons & Fleishman), it would be natural for others to wish to examine in some detail the statistical techniques used in the paper. To quote from the McKitrick

In the Spring of 2003, Stephen McIntyre requested the MBH98 data set from Mann. He is not a scientist or an economist, he was just curious how the graph was made and wanted to see if the raw data looked like hockey sticks too. After some delay Mann arranged provision of a file which was represented as the one used for MBH98... I joined the project in the late summer of 2003 and we published a paper in October 2003 explaining the errors we found in Mann's data. We showed that when these errors were corrected the famous hockey stick disappeared.

Mann responded to the McIntyre & McKitrick paper with a number of objections, all of which have been subsequently refuted. However one objection from Mann resulted in a request for computer algorithms used by Mann et al:

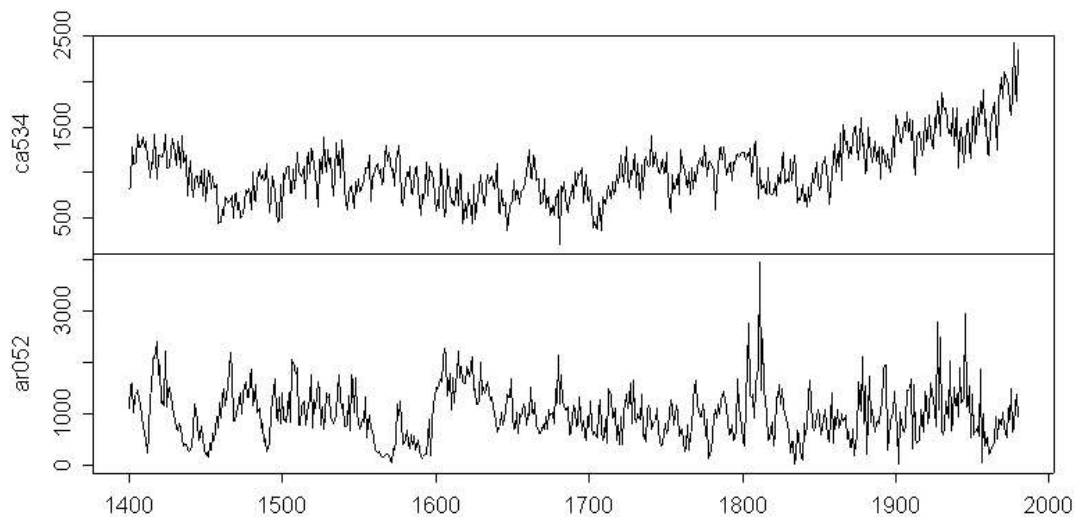
¹⁰ *Global Warming, the Politicization of Science, and Michael Crichton's "State of Fear"* (Preprint, to be published in the June, 2005, issue of the Journal of Scientific Exploration, v.19, no.2 <http://www.scientificexploration.org/jse.php>)

¹¹ *Proxy Climatic and Environmental Changes of the Past 1000 Years* (Climate Research, v23, p89-110)

Mann also objected that we did not exactly replicate his computational steps or sequence of proxy rosters. No one had ever replicated his results, and we now know others had tried but were also unsuccessful. To date we are the closest anyone has been able to come in print. We were not bothered by Mann's response on this point, but it did seem pointless to differ over trivial issues. So we requested his computational code to eliminate these easily-resolved differences. To our surprise he refused to supply his computer code, a stance he maintains to today.

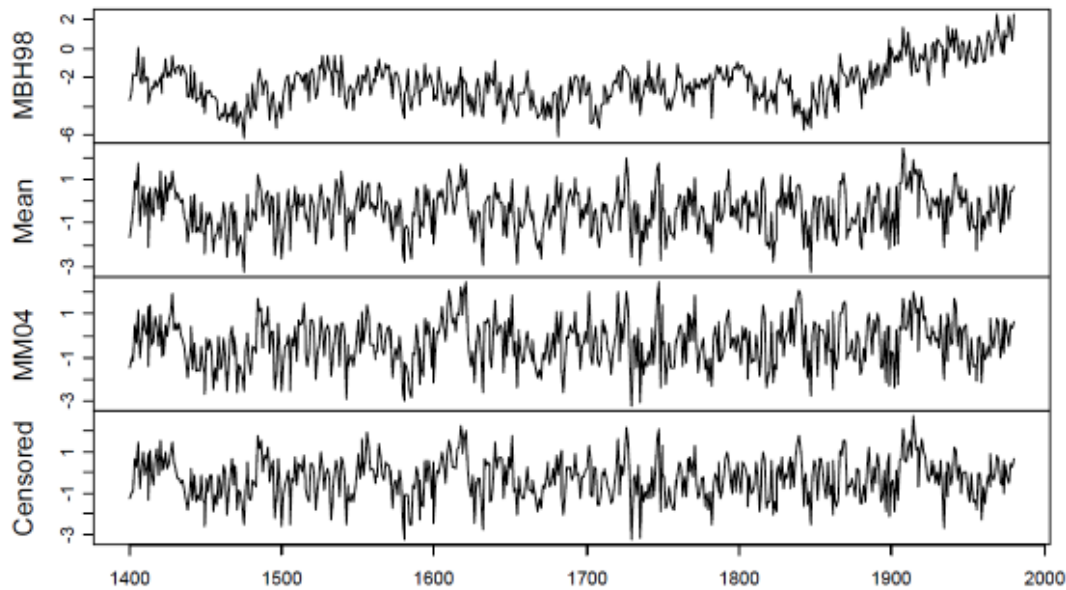
I smell a rat when scientists refuse to disclose all their data or procedures, especially if it is done to try to prevent others from reproducing or testing their results.

In their analysis of Mann's FTP site McIntyre & McKittrick discovered that Mann et al had used a non-standard statistical technique to standardize all the proxy data. They showed that this had the effect of cherry picking hockey stick shapes from among all the series and giving them a weight hundreds of times greater than the others. An example is shown below:



Two tree ring chronologies from the MBH98 data set. Top: Sheep Mountain, CA, USA. Bottom: Mayberry Slough, AR, USA. Both series are the same length, but due to the 20th century trend in the top panel, Mann's algorithm gives it 390 times the weight of the bottom series in the PC1.

Another result of McIntyre & McKittrick's analysis of MBH98 is shown below. It shows in the top panel the post-1400 North American tree ring network PC1 as calculated by MBH98. The second panel shows the average (mean) of the proxies. There is no 'hockey stick'. The third panel shows the PC1 of the same series using standard statistical techniques (as opposed to MBH98's non-standard technique). There is no hockey stick. The fourth (bottom panel) shows the MBH98 calculated PC1 of same series but with one set of results (the Graybill-Idso high-altitude series) removed. Again there is no 'hockey stick'.



PCI of the post-1400 NOAMER tree ring network, calculated by MBH98 using short-segment standardization. Second panel: simple mean of proxies. Third panel: PCI using standard software without short-segment standardization. Bottom panel: Unreported PCI calculated by MBH after censoring Graybill-Idso high-altitude series. All normalized to 1902-1980.

As McKittrick states:

Of crucial importance here: the data for the bottom panel of the figure is from a folder called CENSORED on Mann's FTP site. He did this very experiment himself and discovered that the PCs lose their hockey stick shape when the Graybill-Idso series are removed. In so doing he discovered that the hockey stick is not a global pattern, it is driven by a flawed group of US proxies that experts do not consider valid as climate indicators. But he did not disclose this fatal weakness of his results, and it only came to light because of Stephen McIntyre's laborious efforts.

As an additional test of the MBH98 algorithm McIntyre & McKittrick generated 10,000 series of random numbers and ran them through the MBH98 algorithm. In 99% of cases the algorithm generated 'hockey sticks'.

This is where we will leave the Hockey Stick saga. The story is much longer and gets more political. Steve McIntyre relentlessly pursued all the authors of the original papers of the proxy data used by Mann et al in their 2 papers. In most cases, it is a story of obfuscation, prevarication or downright refusal to hand over the raw data. This is typified by the response of one major author in the field, Phil Jones, who wrote in an email:

We have 25 or so years invested in the work. Why should I make the data available to you, when your aim is to try and find something wrong with it.

But isn't the very core of the scientific method the attempt to find something wrong with a theory? This is the way our knowledge grows and we get closer to the truth.

8. Climate Models

There are two types of climate models:

- General Circulation Models (GCMs)
- Statistical Correlation Models

When climate scientists talk about predicting the future climate, they are almost always using GCMs and this is what the IPCC¹² has to say about GCMs:

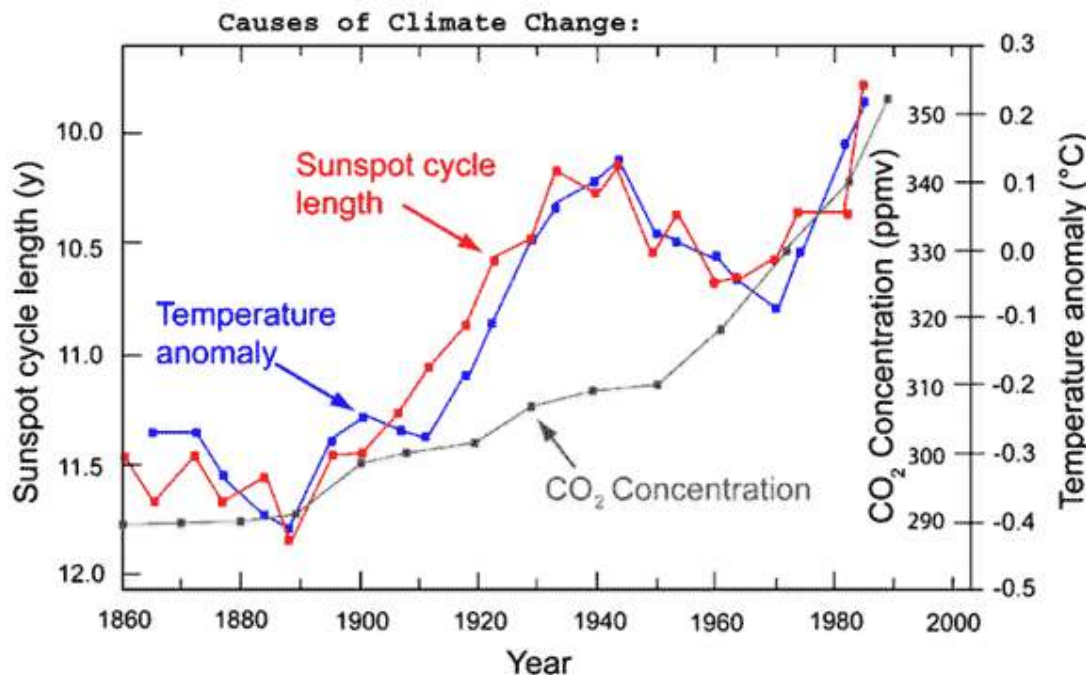
In climate research and modelling, we should recognize that we are dealing with a coupled non-linear chaotic system, and therefore that the long-term prediction of future climate states is not possible.

This is enough to establish that GCMs are of no value in trying to estimate future increases in global temperatures. But as we shall see later, that does not mean they are of no scientific value at all. An important point to appreciate is that GCMs are just an attempt to try to quantify the original AGW hypothesis in some way - that is, to try to put some numbers around the hypothesized increase in global temperature with increase in CO₂. The fact that a model comes up with a number of degrees Celsius increase in global temperature by the Year 2100 does not prove the original hypothesis. It is not even verification.

You can find a description of GCMs and some of their limitations in Tim Ball's short article *Computer Climate Models* (12/2008, at <http://friendsofscience.org/index.php?id=418>).

The statistical correlation model has a venerable history. For instance, the Royal Astronomer William Herschel in 1801 reported to the Royal Society¹³ on a correlation he discovered between the time variation in the price of grain and the time variation in the number of sun spots. When considering climate, the statistical correlation model is more of an attempt to find correlations between certain climate parameters, such as global temperature, and other natural phenomena, such as solar magnetic field strength or sunspot number. Then if one can predict the future behaviour of the natural phenomena it might be possible to predict the future climate parameters.

An example of such a correlation is shown below:¹⁴



Sunspot cycle length versus smoothed global mean temperatures from 1850 to 1970 and compared with CO₂ concentration

¹² From the IPCC Third Assessment Report (page 774).

¹³ Herschel W, 1801 Phil. Trans. Roy. Soc. v91 p265–318.

¹⁴ *Solar Changes and the Climate* (<http://friendsofscience.org/index.php?id=352>)

Clearly the correlation between temperature and sunspot cycle length is much better than between temperature and CO₂ concentration. On the basis of these correlations there are some scientists predicting that global temperature is expected to drop back down significantly by 2030.

As stated earlier, correlation does not prove causation. A major reason AGW proponents reject the suggested causal relationship between the sunspots and global temperatures is that there is no understood physical mechanism that can link sunspots with global temperature. I find it amusing, if somewhat ironic, that such a laudable skeptical position is taken by climate scientists towards all alternate possible explanations of global warming, save their own AGW theory. As it happens, a suggested mechanism for solar influence on climate was published in 1997¹⁵ and 1998¹⁶ and is known as the Svensmark Effect. Experimental verification of this proposed mechanism was published in 2006¹⁷.

To summarize what we have discussed about verification of the AGW theory; although verification is not proof, in the absence of refutation, verification can lead to increased confidence in the veracity of a theory. Unfortunately for the AGW theory, all the verifications of the theory discussed above turn out to be invalid.

9. Refutation

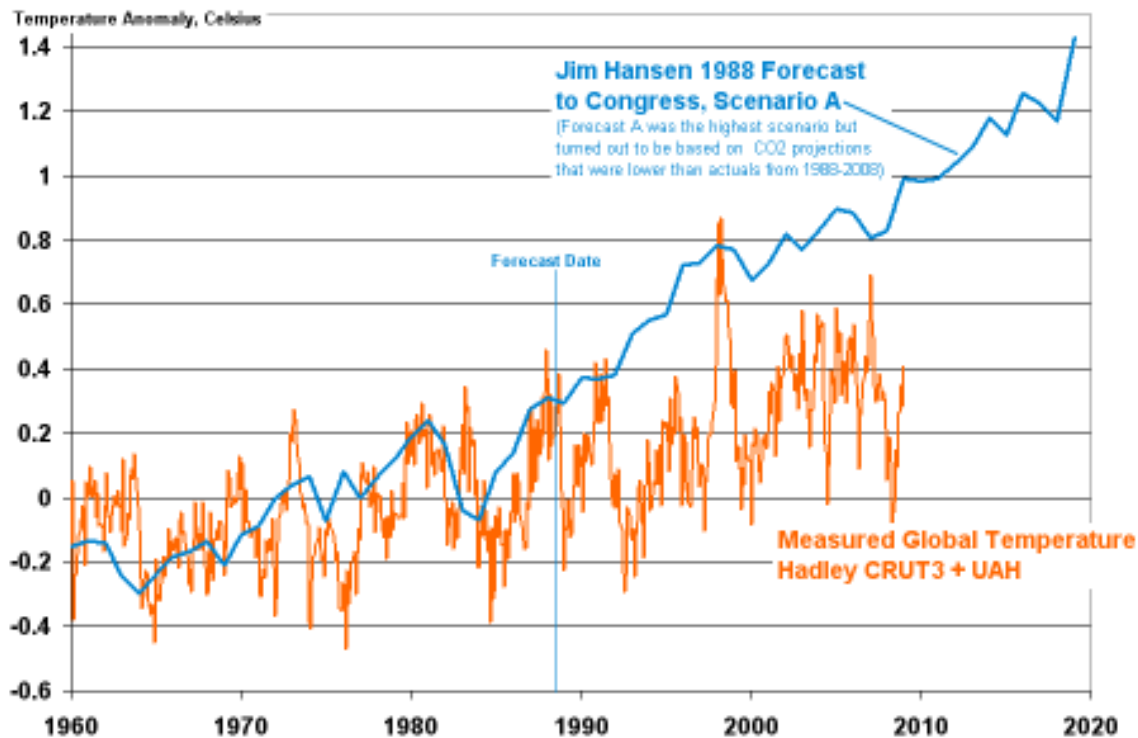
Returning to Popper, we are reminded that the growth of knowledge occurs through the refutation of theories. But what if a theory is so constructed that it is not possible to devise an experiment to test it? That is, it is “unfalsifiable”. Popper asserted that such theories are unscientific and that “falsifiability” becomes the criterion to distinguish between science and pseudo-science.

Here is an example of what I mean. In 1988 James Hansen presented the forecast below to the U.S. Congress. The blue line was his forecast based on a specific scenario for the increase in CO₂ till 2020. It should be pointed out that the actual increase in CO₂ has been greater than this scenario and therefore the slope of the blue line should be higher.

¹⁵ H. Svensmark and E. Friis-Christensen, *J. Atmos. Sol. Terr. Phys.* **59**, 1225 (1997).

¹⁶ *Influence of Cosmic Rays on Earth's Climate* (Physical Review Letters, v81, n22, p5027-5030)

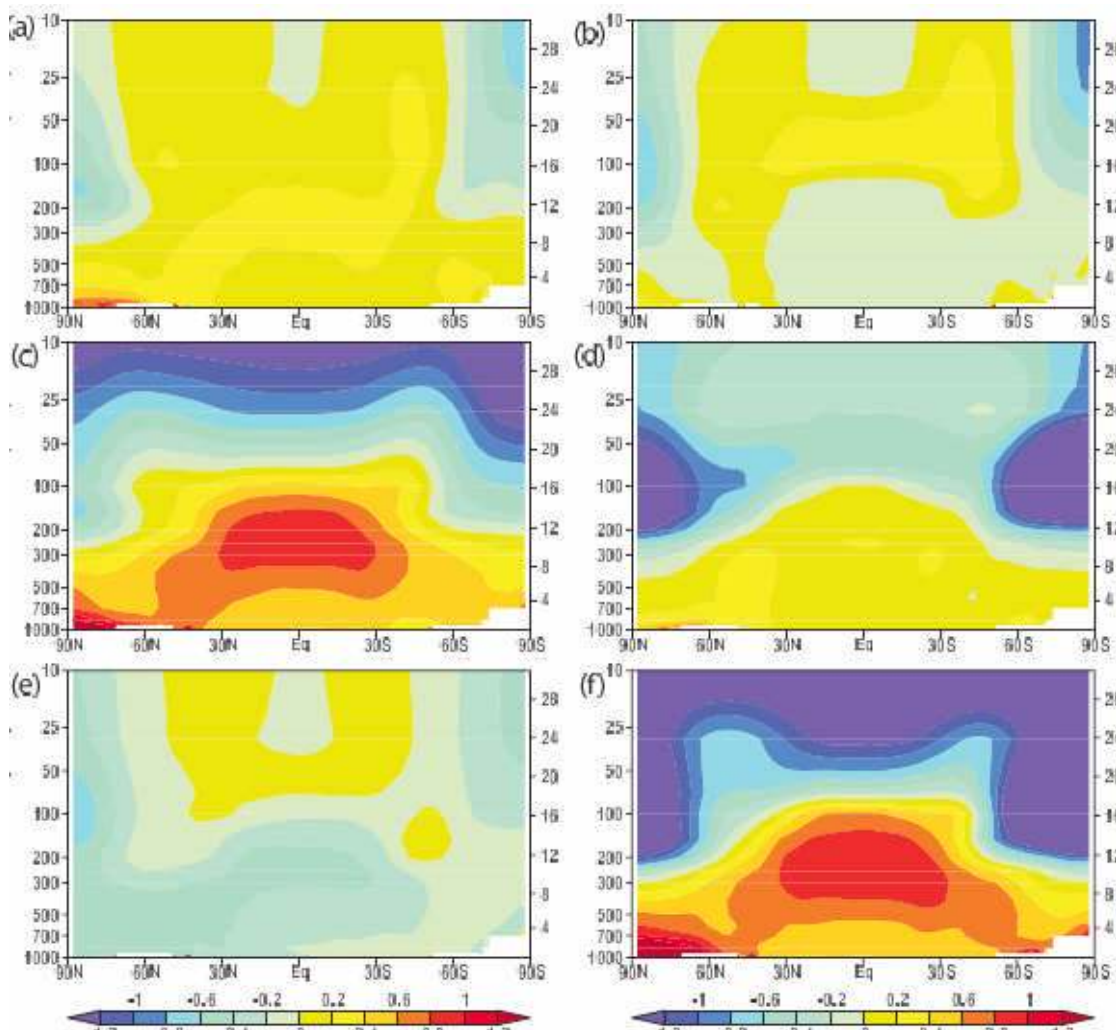
¹⁷ *Experimental Evidence for the role of Ions in Particle Nucleation under Atmospheric Conditions* (Proceedings of the Royal Society A, October 3, 2006)



Would anyone looking at this graph conclude that Hansen's forecast has been vindicated or refuted by the facts? Of course, without confidence levels being shown on the forecast, it is not possible to tell. There is a whole other story to be told about confidence levels and the IPCC's misuse of them in their reports but it is beyond the scope of this talk. Suffice it to say that I think a reasonable person would conclude from this graph that the evidence severely questions the magnitude of the projected global warming if not the AGW theory in its entirety.

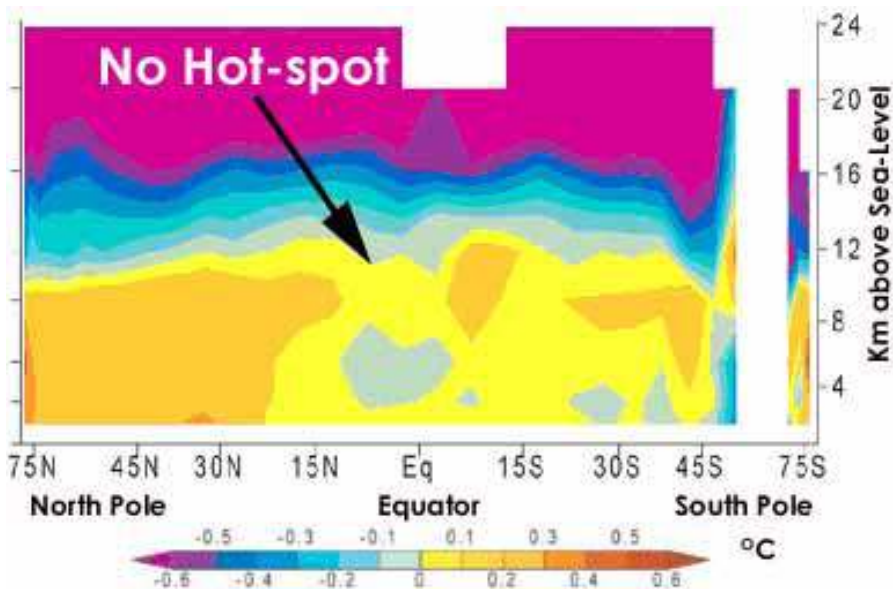
This raises the question, what test can we devise that could be used to refute the theory? If there is none, then we should conclude that the AGW theory is at best pseudoscience and give it the same status as, say, astrology or phrenology.

It turns out that there is a pretty good test of the AGW theory and it can be seen in the following illustrations from the IPCC:



Zonal mean simulated atmospheric temperature change ($^{\circ}\text{C}$ per century, 1890-1999), from two natural causes, three anthropogenic causes and one combined cause, simulated by the UN's GCM model. (a) Solar. (b) volcanic. (c) CO_2 . (d) ozone. (e) sulphate. (f) combined. The "hot-spot" signature of greenhouse warming is visible in (c) and (f). (IPCC, 2007, p. 675, based on Santer et al, 2003. See also IPCC, 2007, Appendix 9C).

What this illustrates is the unique signature that should be seen in the atmosphere from the various climate forcings. The bottom right graph illustrates the combined effect of all the forcings and clearly illustrates that the fingerprint from CO_2 is dominant. So if the signal is missing from actual measurements we can conclude that the AGW theory has been refuted. There has been over 30 years of measurements of temperatures in the atmosphere from both radiosondes and satellites and the results of such measurements are shown below:

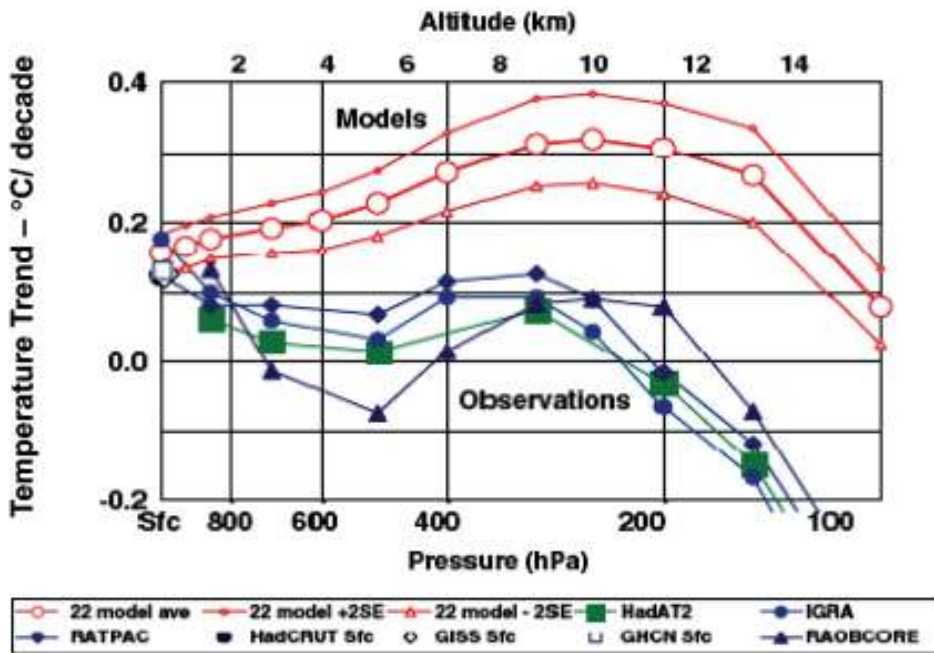


Source: HadAT2 radiosonde observations from CCSP (2006) p116,fig 5.7E.

This is a clear refutation of the AGW theory.

Another way of looking at this is shown in a paper by Douglass et al¹⁸ published in 2007:

A more detailed view of the disparity



A more detailed view of the disparity of temperature trends is given in this plot of trends (in degrees C/decade) versus altitude in the tropics [Douglass et al. 2007]. Models show an increase in the trend with altitude, but observations from balloons and satellites do not.

This result is pretty hard to argue with. Again it is a clear refutation of the AGW theory.

¹⁸ Douglass, D.H., J.R. Christy, B.D. Pearson, and S.F. Singer 2007. *A comparison of tropical temperature trends with model predictions*. Intl J Climatology (Royal Meteorol Soc). DOI:10.1002/joc.1651.

10. Conclusion

We started out with a brief description of scientific method. We considered some of the evidence for the AGW theory and then we looked at the evidence against the theory. To paraphrase Einstein, “All we needed was one fact” and we found it. To my mind and to the growing number of skeptics, the AGW theory will be consigned to pages of history; perhaps it would make a good modern addition to Charles Mackay’s 19th Century book, *Extraordinary Popular Delusions and the Madness of Crowds*.

I earlier alluded to something that is of deep concern to me and that is lack of any formal tertiary training of science students in scientific method and the philosophy of science. I believe it allows our scientists to be too easily swayed and taken in by political and irrational arguments.

I personally believe that in the end, “the truth will out”. Therefore by 2030 at the latest, when the Earth is possibly in the grip of another Little Ice Age, all the damage wrought by politicians with their various Carbon Abatement Schemes will have caused untold suffering and economic disruption. But when the people, in their anger, seek whom to blame, the politicians, being what they are, will have already worked out their exit strategy. They will say, “Don’t blame us. We were only following the advice of the scientists.” The inevitable end result of this will be that science will suffer. In the eyes of the public the status of science and scientists will hit rock bottom – on the same level as the used car salesmen.

The Climategate emails and program code have started the process earlier than I anticipated. If a company director had done what these scientists appear to have done, they would end up in gaol for many years. Yet these scientists were apparently part of a fraud that was at least a couple of orders of magnitude greater in cost to the public than anything dreamt of by Enron. Will they be investigated and, if found guilty, appropriately punished? I certainly hope so.