CLIMATE SCIENCE AND THE PHLOGISTON THEORY

Weighing the Evidence

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On 2 February 2007 the Intergovernmental Governmental Panel for Climate Change (IPCC) released a "Summary for Policymakers" which is a precis – written by its representatives, not all of whom were scientists – of its longer report, due for release in May.

Drafts of the as-yet unpublished main report have been widely circulated and prompted much comment but views which differ from that of the IPCC and the main authors have been largely neglected.

In response to the SPM ten scientists presented an alternative report based on the IPCC's draft document and this Independent Summary for Policymakers (ISPM) was released in London on February 5. The ISPM notes the limited level of knowledge of climate sciences and comments on hypotheses neglected by the IPCC SPM, and not surprisingly its conclusions contradict those of the IPCC.

The rather alarmist IPCC SPM claims that it is between 90% and 95% probable that the observed climate change since 1950 has mainly been caused by mankind and in particular by the emission of CO_2 produced by the burning of fossil fuel. In contrast the ISPM states that the extent to which humans are contributing to climate change is uncertain and will remain uncertain for some time. The ISPM also points out that that the observed climate changes are still within the limits of natural variability and can be explained by natural events, and suggests that some warming might be beneficial.

This paper considers this controversy from the perspective of the history of science and shows precendents for questioning science orthodoxy.

1. THE SUBSTANCE WITH A NEGATIVE WEIGHT

In the 17th century the theory of phlogiston was developed to explain the processes of oxidation and reduction. Becher (1635–1682) and Stahl (1160–1734) postulated that the visible flame during most forms of combustion was due to the emission of a substance they named phlogiston. They argued that a substance the flammability of a substance was related to its phlogiston content and that this was released into the air during the combustion process, leaving behind an inflammable product. Upon reduction, a substance would take up phlogiston which then made it flammable. To them, combustion within a confined environment saturated the air with phlogiston and this prevented further combustion and caused the death of living creatures.

This was the accepted theory throughout the whole of the 18th century but it is the world upside down. The primary process during combustion is the uptake of oxygen and it follows that the weight of the burning substance will increase. The phlogistonists were aware of the increase, but some explained it by attributing a negative weight to phlogiston and others like Guyton de Morveau (1737–1816) claimed that the specific weight of phlogiston was lower than that of air and that the lower weight of material prior to combustion was analgous to a heavy object being raised by a hydrogen balloon.

This belief in phlogiston persisted until the first part of the 19th century even despite the 1777 proof of the uptake of oxygen by Lavoisier (1743–1794).

With respect to what follows one may wonder, if Stahl could have made use of a supercomputer at that time to model and predict the reactions he studied, would he have abandoned his theory. Probably not because the theory of phlogiston was so widely accepted that its incorporation into the models would be inevitable and only with extreme persistence would its inclusion be overturned.

2. THE DECIPHERING OF THE MAYA SCRIPT – THE THOMPSON AFFAIR

Another example of the persistence of incorrect theory is found in the history of the transcription of Mayan scripts. As with phlogiston that persistence owed much to a consensus among researchers but unlike phlogiston it was sustained by personal attacks upon those who challenged it.

The deciphering of ancient and unused languages was an established area of research by the 19th century. Egyptian hieroglyphs were decoded by J.F. Champollion (1790–1832) and he translation of the linear B form of Mycean Greek by M. Ventris (1922–1956).

Mayan scripts were proving difficult and for many years only the Mayan calendar was identified, first by E.Förstermann (1822–1906) using principals of astronomy, and geographic positioning tentatively identified by L. de Rosny (1837–1914) on the basis of the sequence of glyphs, but for many years this was the limit to the deciphering.

By the middle of the 20th century the widely held view among Mayan scholars was that glyphs were neither representations of spoken words nor syntactical constructs. The leader in this thinking, by virtue of his strong personality, was Eric Thompson (1898–1975), an Englishman attached to the Carnegie Institute in Washington.

Thompson managed to impose his view on other Mayan scholars and was scathing of those who dared challenge his authority, in particular of Russian, Y.V. Knorosov (born 1922) who worked on the Maya script behind the Iron Curtain. Knorosov's first article, published in a Russian journal in 1952, is now generally accepted as the correct deciphering but when Knorosov's ideas first reached the West, Thompson was furious "Has Knorosov any scientific honour? Certainly not. This is a Marxist hoax".

It was not until after Thompson's death in 1975 that the theories of Knorosov received wide attention and acceptance, which led of course to a rapid acceleration in the deciphering of the glyphs. According to M.C. Coe[1], Thompson had, through his

[1]M.D. Coe. 'Breaking the Maya Code" Thames and Hudson, 1992.

authority and disdain of others, retarded developments in this field for some 50 years. His excessive self-esteem and stubborn belief had meant that most Mayan scholars had blindly accepted what was nothing more than pseudo-science.

3. IS CO_2 TODAY'S PHLOGISTON?

According to basic laws of physics the radiative equilibrium between absorption and emission will create a temperature gradient in the Earth's atmosphere. Carbon dioxide in the atmosphere will absorb infrared radiation being emitted from the Earth and re-radiate it in all directions, an action which widely believed to contribute to the greenhouse effect.

The temperature gradient is however not only determined by the radiative equilibrium state but also by the flow of water which evaporates from the surface, moves upwards (evapo-convection) and takes latent heat into the atmosphere where the water vapour condenses into clouds. Water vapour is present at much higher concentrations than CO_2 and because of its re-radiation properties water vapour dominates the greenhouse effect.

As a gas CO_2 will rise higher than the condensed water vapour of clouds and this stratification has two important consequences, namely that the CO_2 will especially contribute radiated energy into space and that the greenhouse effect will be dominated by water vapour in the lower altitudes. Essenhigh claims that the principal greenhouse effect is caused predominantly, if not exclusively, by the long wave infrared absorption and emission by water vapour.

More daring is the view that the increase in CO_2 concentration is a reaction to an increase in heat from the sun and that the increase in the upper atmosphere will contribute to establish a new energy equilibrium for the earth-atmosphere system.

4. WHERE IS THE ANALOGY TO WEIGHING?

One might expect that the enhanced greenhouse effect can be measured but in practice this is not so easy. Published figures show that over the past century the average global temperature is believed to have increased by 0.8 C and simultaneously the CO_2 concentration has risen by about 30 per cent. This might be a mere coincidence because temperature and climate as a whole are strongly influenced by many factors (e.g. the fluctuation in solar radiation).

Can we measure the temperature gradient in the atmosphere that was mentioned above? Here we strike the problem that for any location around the world it changes throughout by day, month and season. One can of course average values over years but even then the annual fluctuations remain considerable.

One might expect that with the relatively rapid spreading of CO_2 within the earth's atmosphere its concentration would be consistent and this have a consistent impact on local temperatures. This is not the case because despite CO_2 increases in the atmosphere above Christchurch (New Zealand) and Scott-Amundsen station (Antarctica) being consistent with other locations no material temperature increase has been observed. (See Figure 1).

Could this be the definitive "weighing" of the enhanced greenhouse effect which refutes the theory? It's not that simple. The atmospheric system is so complex that

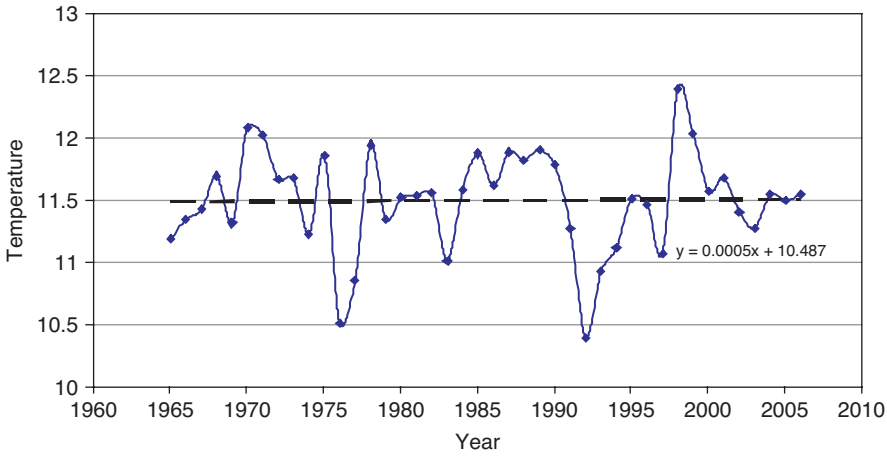

Figure 1: Temperature record Christchurch (NZ). (Courtesy John McLean Australia)

specific locations might not be representative for the system as a whole and, as noted above, factors such as evapo-convection are a strong influence that varies with location.

It is often said that the combination of all observations – and here one refers in particularly to exceptional weather conditions – prove that increases in the concentration of CO_2 must cause an enhanced greenhouse effect but opponents of this view liken it to Guyton de Morveau clinging to the theory of phlogiston.

The idea that CO_2 could have a significant effect on the global climate, originates from Arrhenius (1859–1927) and is based on observations during glacials and intergalcials. Low temperature, low CO_2 concentration; high temperature, high CO_2 concentration. Arrhenius assumed that the high CO_2 concentration during interglacials caused a greenhouse effect which increased the temperatures.

By using a more precise geological time scale it has been shown that the rise and fall of CO_2 in the atmosphere follows the corresponding change in temperature, not the reverse. Where Arrhenius's theory requires a separate explanation for the autonomous rise and fall in CO_2, this alternative is easily accounted for - fluctuations in the influence of the sun cause variations in temperature and as temperature varies so too does the amount of CO_2 liberated from the oceans, which with 40 times the storage of the atmosphere is the largest short-term CO_2 reservoir on earth, albeit somewhere behind geological storage in the long-term.

This simple and plausible sequence of a variation in temperature being followed by a variation in CO_2 largely refutes the theory of a CO_2 enhanced greenhouse effect, but what happened on a geological time scale is not necessary representative of what is observed today. It cannot be denied that the large scale burning of fossil fuel is an CO_2 source which might have a quite different effect on the climate system to natural emissions but in recent years it is clear that more CO_2 accumulates in the atmosphere in relative warm years and less in cold. Moreover, there is poor correlation between the annual increase in atmospheric CO_2 concentration and the estimated annual anthropogenic emissions.

The hypothesis that temperature drives CO_2 accumulation is plausible but no proof that the anthropogenic emissions have no effect on the global warming. Based on the physical principle that CO_2 absorbs infrared radiation and reflects part of it towards the earth's surface some impact is to be expected.

5. THE ROLE OF THE SUN

There is no doubt that the sun is the major driving force behind climatic variation.[2] It sets the complex weather system into motion and thermal variation drives high and low pressure cells. We experience the change in weather through temperature, precipitation, wind force and direction, cloudiness and sunshine. All these parameters are now confidently measured with high precision but uncertainty remains in the interpretation of these figures and the true meaning of their observed values and long-term averages.

On a global basis the average temperature appears to have stabilized or even decreased slightly since 1998. This might be transitory or perhaps be the first signal that we are approaching the next little glacial as predicted by astrophysicists from models of solar fluctuations.

The mainstream view holds that anthropogenic CO_2 emissions must be the cause of average global warming, and argues that solar fluctuations cannot supply the sufficient direct heat to account for the temperature increase. Astrophysicists challenge this with their contention that solar influences are not only direct solar irradiance but also in the modulation of cosmic rays which themselves influence cloud formation. Recent experimental research on this subject[3] may prove to be a major turning point in theories about climate change, much as Lavoisier's weighing was vital to the refutation of the theory of phlogiston.

6. THE PERSPECTIVE FROM THE VIEW OF SCIENCE PHILOSOPHY AND GOOD SCIENTIFIC PRACTICE

The recently released IPCC SPM quite remarkably declares that it is 90% to 95% probable that increases in average global temperature are attributable to human activities but in the absence of empirical proof (see ISPM) bases this claim on computer models. It is often said that 2500 scientists contributed to the IPCC's 'Scientific basis' report into the assumed human influence on the climate as if such a number of scientists should automatically confer 'scientific truth'.

Science history is replete with examples, apart from phlogiston and the deciphering of Mayan scripts, where mistakes and misbeliefs were perpetuated by the professional standing of certain individuals[4]. Even Sir Isaac Newton misdirected researchers for 50 years with his theory on the transmission of sound.

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[2]C. de Jager Solar Forcing of Climate, 1. Solar Variability . Space Science Reviews (2005) 120: 197–241 DOI: 10.1007/s11214-005-7046-5 C _ Springer 2005.

[3]H. Svensmark, J.O.P. Pederson, N.D. Marsh, M.B. Enghoff, and U.I. Uggergoj.. "Experimental evidence for the role of ions in particle nucleation under atmospheric conditions". Proc. R. Soc. A.doi, 1098/rspa October 2006, 1773.

[4]H. Hellman. 'Great Feuds in Science'. John Wiley, 1998.

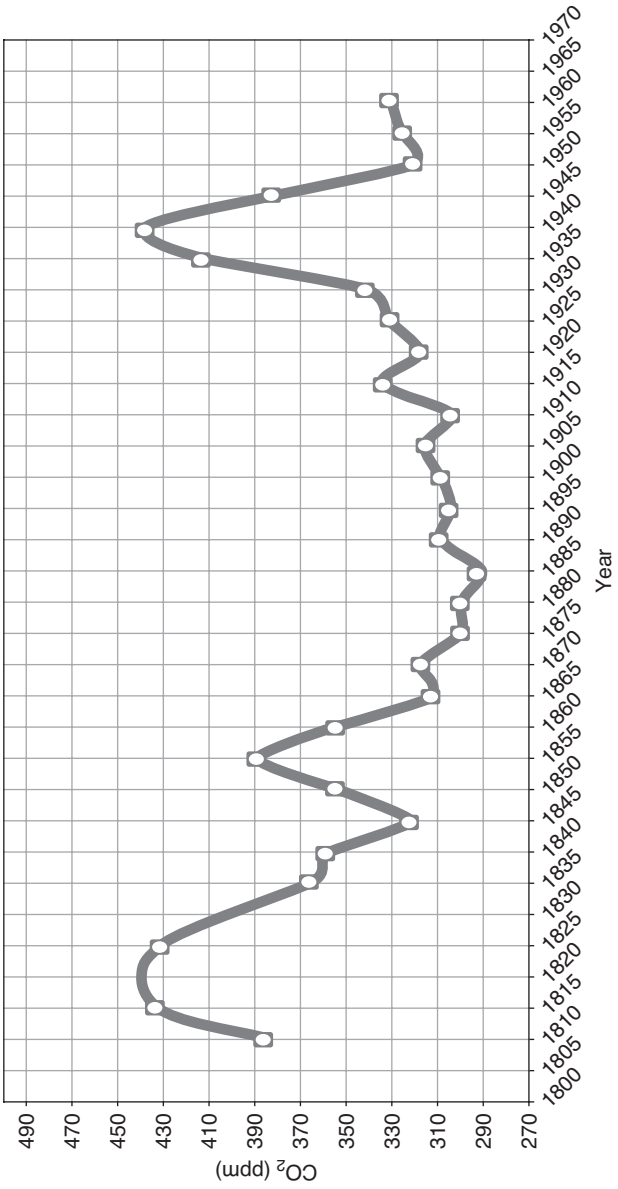

Figure 2: CO_2 concentration in the atmosphere on the Northern Hemisphere according to E. Beck.

Climate scientists were probably also put on the wrong foot by the early propagandists for the phlogiston-like theory of CO_2 driving temperature, not so much by the theory of Arrhenius which was worth consideration but by the selective literature search for measurements of CO_2 concentrations in the 19th and 20th century by Callender and Keeling. They concluded that increase in concentration over recent decades was without precedent but recently, after a more thorough review of the old literature, E.G. Beck[5] concluded that there were indications that current CO_2 concentrations were considerably exceeded in the 1820s and again in the 1940s (See Figure 2).

Callender and Keeling selected their data on a set of criteria which Beck disputes and they specifically excluded all data that deviated by more than 10% from the century's average. In these circumstances it is no wonder that they concluded that the current rise is without precedent (See Figure 2).

In a similar fashion the famous "hockey stick" temperature graph from Mann et al, widely publicised first by the IPCC and since by others, claimed that the recent temperature increase is without precedent over the last 1000 years. Mann et al. selectively omitted data including that for the Medieval Warm Period despite it being mentioned widely in literature and even in earlier IPCC reports. The omission of this key data simply makes it impossible to reproduce and hence verify their results[6].

In the recent IPCC SPM figure 4 is a graph of decadal average temperature from 1900 to 2005. By using a decadal average the graph is forced to end prior to year 2000 and masks the stabilization of the temperature over the last 8 years at a level below the 1998 value.

This kind of data selectivity, deceptive presentation and selective use of literature references (e.g. on the retraction of glacier and sea level rise – see the ISPM)[7] makes one doubt whether the inner circle of the IPCC has proper respect for the maintenance of good scientific practice. Another aspect of good practice is the proper consideration of all alternatives and all uncertainties, especially those about the extent and consequences of any influences but these too are ignored by the IPCC.

At the time of writing the direction of climate change is far from clear because the last 8 years average global temperature has been relatively stable despite the increase in CO_2. The dogmatism of the IPCC may prove to be misplaced because the theory of an CO_2 enhanced greenhouse effect could well be a new "phlogiston theory", one where mistaken notions about causes and effects drive the science along false paths to the detriment of us all[8].

ACKNOWLEDGEMENT

Thanks to John McLean (Australia) for his correction of the English text and other useful comments.

[5]E.G. Beck "180 years accurate CO_2 analysis in air by chemical methods" In press Energy&Environment.

[6]Here the reference to the research of Mann et al. is not given, because in my opinion the papers have to be retracted as violations of good scientific practice with respect to selective data use and refusal to cooperate with others to have the computer programmes reinvestigated.

[7]www.independentSPMfinal.pdf.

[8]"*...But you will agree with me, that no man ought to surrender his own judgment to any mere authority, however respectable. Otherwise, our own system would never have been advanced...*"
Joseph Priestley, from a 1796 introductory letter to his defence of phlogiston against the "antiphlogistic theory", online at http://web.lemoyne.edu/~GIUNTA/phlogiston.html