- **Everyone knows what the greenhouse effect is. Well ... do they? Ask someone to explain how the greenhouse effect works. There is an extremely high probability that they have no idea.**
- **Beware of wheels within energy diagrams as these usually constitute the energy creation mechanism of perpetual motion machines. One such gem of clarity, used uncited by Plimer (2009, p. 370), was offered by Kiehl and Trenberth...**
- **the mechanism by which the addition of carbon dioxide warms the atmosphere has no empirical basis. Therefore the assertion that global warming is anthropogenic, may well be philosophical and perhaps political, but it is most certainly not scientific.**
- **increasing visible radiation, even by quite a large amount, results in no measurable rise in temperature because no appreciable amount of visible radiation is converted into infrared when absorbed and re-emitted - contrary to Arrhenius' hypothesis.**
- **Tyndall's confusion of absorption and opacity is a major error that was propagated into Arrhenius' Greenhouse hypothesis, and constitutes a fact not accounted for in Arrhenius' calculation of "Climate Sensitivity" to carbon dioxide.**
- **Although the greenhouse effect died with the Wood experiment, the diverse multitude of radiation "budgets" shows that the greenhouse effect is far from buried. This is a classic case of shifting the goalposts, because the greenhouse effect is not a scientific hypothesis that can be buried when it dies from experimental causes; it is a political symbol that cannot be allowed a proper burial, and so remains forever on display at the funeral parlor; an eternal viewing just like Lenin's.**

http://greenhouse.geologist-1011.net/

The Greenhouse Effect: Origins, Falsification, & Replacement

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Abstract

This article focuses on the lack of a clear thermodynamic definition of the greenhouse effect. The idea of a "greenhouse" effect was initially introduced in 1824, an age when only one mode of heat transfer was known and when the theory of "aether" was used to explain how light and heat were conducted through space. As the greenhouse effect was refuted by a simple experiment in 1909, this article finds that the mechanism of heat residence in materials subject to incident radiation, referred to in the modern misuse of the term "greenhouse effect", would be better referred to via Kirchhoff's Law. Furthermore, this modern reincarnation of the *Greenhouse Effect*, perhaps more aptly called the *Kirchhoff Effect*, is controlled by the material property of emissivity; a thermodynamic property that is poorly understood in translucent materials and as yet undocumented with respect to the temperature of a radiating translucent-body at

thermal equilibrium. This article, in clarifying emissivity in this context, critically analyses the role of "greenhouse gases" in a modern radiation budget and finds that the putative relationship between carbon dioxide concentration and air temperature, has no evidentiary underpinning whatsoever. In fact, simple experimentation has shown that not only is visible light not converted into heat on absorption, but that carbon dioxide concentration has little if any effect on air temperature in the urban environment. This would indicate an equivalence of carbon dioxide and air emissivities and ergo, that carbon dioxide concentration makes little if any difference to the *Kirchhoff Effect* as it applies to the temperature of the atmospheric gas mixture we call air. As such, the mechanism by which the addition of carbon dioxide warms the atmosphere has no empirical basis. Therefore the assertion that global warming is anthropogenic, may well be philosophical and perhaps political, but it is most certainly **not** scientific.

Introduction: Night in the Hothouse

The "Greenhouse Effect" is of crucial importance to modern climatology and is the putative cornerstone of the Anthropogenic Global Warming hypothesis. However, the greenhouse effect lacks clear thermodynamic definition and this forecasts the likelihood that the name is misapplied. Even general descriptions of this putative mechanism are confused. In the first year university geology text by Press & Siever (1982, p. 312) we read:

> The atmosphere is relatively transparent to the incoming visible rays of the Sun. Much of that radiation is absorbed at the surface and then reemitted as infrared, invisible long-wave rays that radiate back away from the surface (Fig. 12-14). The atmosphere, however, is relatively opaque and impermeable to infrared rays because of the combined effect of clouds and carbon dioxide, which strongly absorbs the radiation instead of allowing it to escape into space. This absorbed radiation heats the atmosphere, which radiates heat back to the Earth's surface. This is called the "greenhouse effect" by analogy of warming greenhouses, whose glass is the barrier to heat loss.

Whitaker (2007, p. 17-18) writes:

> The incoming solar radiation that the earth absorbs is re-emitted in the form of so-called infra-red radiation - this is where the vital 'greenhouse effect' begins. Because of the chemical structure of the greenhouse gases in the atmosphere, they absorb the infra-red radiation from the Earth, and then emit it, into space and back into the atmosphere. The atmospheric re-emission helps heat the surface of the Earth - as well as the lower atmosphere - and keeps us warm.

Wishart (2009, p.24) explains:

> The Moon is another excellent example of what happens with no greenhouse effect. During the lunar day, average surface temperatures reach 107°C, while the lunar night sees temperatures drop from boiling point to 153 degrees below zero. No greenhouse gases mean there's no way to smooth out temperatures on the moon. On Earth, greenhouse gases filter some of the sunlight hitting the surface and reflect some of the heat back out into space, meaning the days are cooler, but conversely the gases insulate the planet at night, preventing a lot of the heat from escaping.

Plimer (2009, p. 365) really describes this situation very well when he writes:

> Everyone knows what the greenhouse effect is. Well ... do they? Ask someone to explain how the greenhouse effect works. There is an extremely high probability that they have no idea. What really is the greenhouse effect? The use of the term "greenhouse effect" is a complete misnomer. Greenhouses or glasshouses are used for increasing plant growth, especially in colder climates. A greenhouse eliminates convective cooling, the major process of heat transfer in the atmosphere, and protects the plants from frost.

Plimer (2009, p. 366-375) goes on to explain the dynamics predicted by Kirchhoff's Law, stating, "*All the CO_2 does is slows down heat loss. Atmospheric CO_2 does not trap heat, as insulation does.*". Archer (2009, p. 15-29) uses the kitchen sink analogy to describe similar dynamics in that a partially blocked drain will not prevent a sink from emptying but slow drainage so that for a given inflow (e.g., the tap) a given water level is maintained - much the way a given temperature is maintained for a given thermal radiation level, depending on the emissivity of the material.

The greenhouse effect in modern literature, is often taken out of it's historical context (e.g., Press & Siever, 1982, p. 312; who completely neglect the falsification of their definition by the Wood Experiment in 1909), or is simply misused to describe other, distinctly separate, thermodynamic concepts such as Kirchhoff's Law and it's quantification via the Stefan-Boltzmann Equation (e.g., Archer, 2009, p. 15-29). To his credit, Plimer is the only recent author to acknowledge the role of convection. Plimer is also the only author to acknowledge the respective roles of both kinetic heat (e.g., convective transfer) and electromagnetic heat (e.g., "radiation balance").

In Search of the Elusive Greenhouse: The Important Question of Historical Context

According to Spratt & Sutton (2008, p. 30), John Mercer is credited with the phrase, 'greenhouse effect' in the 1960s. However, according to Weart (2003), Flannery (2005), Archer (2009), and Plimer (2009), the idea of a "greenhouse" effect was first proposed by Jean Baptiste Joseph Fourier in 1824. What these popular authors (from both sides of the argument) leave out is the context of the discovery and publication of Fourier's Law in 1822. The historical context of a discovery or idea is crucially important because therein lie the influences, misperceptions, and errors of the time - and past misconceptions often play a large role in the shaping of contemporary hypotheses. In this case, Fourier's major proposition was that of Fourier's Law, which described the relationship between thermal conductivity, temperature variation, conducting surface area, and thickness of the body between heat source & sink. When extended by conservation of energy, this relationship also defines the conduction of heat between two bodies of different materials, with the additional consideration of thermal contact conductivity. Moreover, Fourier and his contemporaries operated under the assumption that light, as a wave, could only be propagated through a material medium and to explain the propagation of light and heat in a vacuum or across space, the medium of "aether" was postulated. Not to be confused with the organic chemical solvent, "ether", aether as the very substance of the void, received its first formal scientific hypothesis at the hands of Newton (1704), itself a modification of an earlier proposition made by Hooke (Whittaker, 1910, p. 17). The idea of aether, with it's roots in the Cartesian definition of matter and original proposition by Rene Descartes (Whittaker, 1910, p. 4), wasn't decisively debunked until the results of the Michelson & Morley (1887) experiment were published.

Arrhenius refers to the "sea of aether", which seems to allude to the dynamic aether proposition in which aether acts as a fluid with no mass. Subject to viscosity, a mass-less fluid moves in currents with the motion equal to that of masses in the vicinity, while proportionally closer to the location of the centre of mass, the motion of this mass-less fluid is proportionally closer to that of the centre of mass. This clever evasion of Michelson & Morley's results may seem to suggest that the speed of aether is always equal to the frame of reference wherever the frame of reference is fixed to a mass. However, this added complication without independent evidentiary underpinning, is no more than an *ad hoc* explanation at best. Although dynamic aether does predict that light will bend around large masses, unlike Einstein's prediction, this "sea of aether" also predicts that light bending around a star in the plane of the star's rotation will exhibit a different frequency shift either side of the star. Unless the fulfillment of Einstein's prediction in real world observations was accompanied by such unexpected phenomena, aether presents itself as one of the unsound assumptions of historical science. After 1887, the theory of aether rested on too many uncertainties to constitute a credible hypothesis, much less any foundation for a hypothesis. In fact, the flurry of *ad hoc* arguments that accompanied the fragmentation of the aether hypothesis after 1887 lead Trowbridge (1910) to exclaim that there was an aether for everything.

In the context of aether as the material medium of light and "ultrared" (or infrared radiation as it is known today), radiation and transmission of light and heat were not distinguished from thermal conduction. Furthermore, Svante Arrhenius continued to publish on the assumption of the aethereal wave propagation theory as late as 1906 (e.g., Arrhenius 1906, p. 154, 225). In the absence of an alternative mode of heat transfer, the greenhouse hypothesis was a logical choice of description for the kind of energy trap that would seem apparent between mediums of differing thermal conductivity. However, as thermal contact conductance was found to be equal in both directions, the greenhouse hypothesis needed an additional mechanism to survive.

What is the Greenhouse Effect?

In the Nineteenth Century, the mechanism of the greenhouse effect was widely known as the speculation that visible waves were converted to heat when transferring from one material to another. This idea may seem to make sense in terms of wave mechanics. However, when Michelson and Morley falsified the aether hypothesis by demonstrating the absolute (non-relative) nature of the speed of light, this refutation of aether raised the question of an additional mode of heat transfer other than *conduction* through the now non-existent aether; a method of heat transfer independent of conduction in any material. In doing so, they introduced an evidence-based complication that the greenhouse hypothesis did not account for. Nonetheless, Arrhenius did not consider the implications of the Michelson-Morley experiment, and according to Arrhenius (1896), "*Fourier maintained that the atmosphere acts like the glass of a hothouse, because it lets through the light rays of the sun but retains the dark rays from the ground.*". Ten years later little had changed for the greenhouse effect, and Arrhenius (1906, pp. 51-52) defined it accordingly:

> That the atmospheric envelopes limit the heat losses from the planets had been suggested about 1800 by the great French physicist Fourier. His ideas were further developed afterwards by Pouillet and Tyndall. Their theory has been styled the hot-house theory, because they thought that the atmosphere acted after the manner of the glass panes of hot-houses. Glass possesses the property of being transparent to heat rays of small wave lengths belonging to the visible spectrum; but it is not transparent to dark heat rays, such, for

> instance, as are sent out by a heated furnace or by a hot lump of earth. The heat rays of the sun now are to a large extent of the visible, bright kind. They penetrate through the glass of the hot-house and heat the earth under the glass. The radiation from the earth, on the other hand, is dark and cannot pass back through the glass, which thus stops any losses of heat, just as an overcoat protects the body against too strong a loss of heat by radiation. Langley made an experiment with a box, which he packed with cotton-wool to reduce loss by radiation, and which he provided, on the side turned towards the sun, with a double glass pane. He observed that the temperature rose to 113 (235 F.), while the thermometer only marked 14 or 15 (57 or 59 F.) in the shade. This experiment was conducted on Pike's Peak, in Colorado, at an altitude of 4200 m. (13,800 ft.), on September 9, 1881, at 1 hr. 4 min. p. M., and therefore at a particularly intense solar radiation. Fourier and Pouillet now thought that the atmosphere of our earth should be endowed with properties resembling those of glass, as regards permeability of heat. Tyndall later proved this assumption to be correct.

As you can see, the greenhouse hypothesis is clearly defined by it's proponents as the transformation of light into heat and subsequent entrapment by a medium pervious to light but impervious to heat (such as glass). In 1858 John Tyndall laid some important groundwork when he devised an experiment to measure infrared transmission through gases. Although Tyndall frequently uses the term, "absorption", he failed in all of his experiments to differentiate absorption and reflection, which is clearly indicated by the experimental diagrams used to depict Tyndall's application (e.g., Tyndall, 1864, p. 415). Both Arrhenius (1906) and Weart (2003, p. 3) neglect to mention this rather important fact when describing how Tyndall's work "underpins" the greenhouse effect. The fact that Tyndall failed to differentiate absorbed heat from otherwise reflected heat renders Tyndall's findings on the "greenhouse" effect, purely hypothetical. One thing Tyndall did discover is that the bulk of infrared obstruction occurs at low orders of concentration with subsequent increases in concentration having successively less and less effect. This laid the foundation for later authors in thermodynamics such as Stefan and Boltzmann.

Basic Thermodynamics Upgrade for the Twentieth Century

The refutation of Newton's aether hypothesis proved the distinction between thermal conduction (heat transfer through substances) and thermal radiation (aether independent propagation of heat as electromagnetic waves). It did so because the sun's heat crosses space where it cannot be conducted as it can in materials such as air and water. It is important to remember the distinction between the modes of heat transfer because in failing to do so, heat transferred via one mode is usually neglected. This error is common, even amongst modern authors. According to Burroughs, (2007b, p. 124):

> Most of the atmosphere is made up of nitrogen and oxygen (see p. 24), which absorb virtually no radiation and allow it to escape to space. There are, however, "greenhouse" gases that absorb and reradiate the infrared to earth.

Ironically, modern authors neglect the older idea of thermal conductivity in spite of the fact that it is still a working theory that has not been called into question by evidence. In point of fact, the temperature we measure at a thermometer bulb exposed to the atmosphere is not a product of radiation from the atmospheric gases, but of the

conduction of the heat accumulated in those gases to bodies, like the thermometer bulb, with which they have direct contact. This process is called thermal contact conductance and is quite distinct from thermal radiation.

This modern neglect of thermal conduction leads to an assumption under which *all* atmospheric heat transfer occurs by radiation. As a result of such assumptions, the greenhouse hypothesis has been also depicted as a stratified radiation trap by modern authors such as Burroughs (2007b, p. 125) and Whitaker (2007 p. 18). However, such authors forget that the greenhouse theory was coined to explain conductive heat retention, not the electromagnetic propagation of heat, which wasn't discovered until much later. It is important to remember that heat comes in two forms:

1. Kinetic Heat: heightened molecular motion
2. Radiant Heat: electromagnetic radiation in the infrared bandwidth of frequencies

The sudden increase in heat that you feel when stepping from the shade out into direct sunlight is radiant heat, which is propagated electromagnetically at the speed of light. The gentler heat that you feel in the shade is kinetic heat conducted from the air to you only as a consequence of direct contact. This crucial difference in the manifestations and transfer of heat is why air temperatures are measured in the shade (Burroughs, 2007a, p. 97), and solar radiation at the ground is measured in direct sunlight (Burroughs, 2007a, p. 98). This is an important distinction that is entirely absent from the greenhouse hypothesis and omitted from most energy budget diagrams used to demonstrate global warming.

Spectroscopic Saturation

Ångström (1900) describes a variation of Tyndall's experiment with a minor refinement. In this experiment, infrared radiation is passed through a tube of containing significantly less CO_2 than that of an equivalent column extending from top to bottom of the atmosphere. Like Tyndall, Ångström (1900) did not measure reflection and so could not venture a plausible figure for absorption or emissivity. Initially, 90% of the infrared radiation was transmitted by the CO_2, and when the amount of CO_2 was reduced by a third (via pressure variation), the amount of radiation transmitted by the gas mixture increased by less than 0.5% to 90.4%. The results of Ångström's experiment are twofold:

1. CO_2 is transparent to 90% of infrared radiation applicable to temperature variation.
2. Those infrared bands that CO_2 readily obstructs are already almost totally blocked by atmospheric CO_2.

Adding CO_2 to the atmosphere could not cause a measurable variation in the amount of heat transmitted by the atmosphere, because in the specific infrared bands obstructed by CO_2, the obstruction is already almost total. We may conclude from these results that adding CO_2 to the atmosphere will have no measurable effect on infrared radiation levels at the ground.

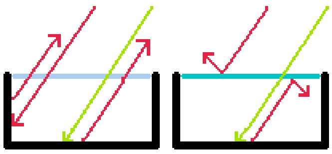
A Simple Experiment with Not-So-Simple Implications

Ångström's experiment failed to account for conduction of heat via fluid convection. As the contrast between conductive and radiative heat transfer can trap heat without

resorting to refractive frequency shifts, Ångström's results were not sufficient to overturn Arrhenius' greenhouse hypothesis. In 1909, Robert W. Wood conducted an experiment to test the core proposition of the greenhouse hypothesis: that light rays are converted to heat on absorption and emitted as infrared that is subsequently trapped. Wood (1909) in a paper titled, "*Note on the Theory of the Greenhouse*", writes:

> There appears to be a widespread belief that the comparatively high temperature produced within a closed space covered with glass, and exposed to solar radiation, results from a transformation of wave-length, that is, that the heat waves from the sun, which are able to penetrate the glass, fall upon the walls of the enclosure and raise its temperature: the heat energy is re-emitted by the walls in the form of much longer waves, which are unable to penetrate the glass, the greenhouse acting as a radiation trap.

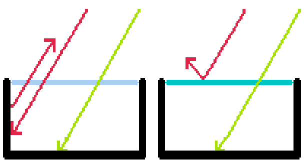
Sceptical of this explanation, Wood (1909) conducted an experiment comparing air temperatures in a glass greenhouse and a diathermic greenhouse.



This diagram shows the first stage of the Wood Experiment and the predicted behaviour of wavelengths filtered by glass, side by side with the those entering the diathermic control unfiltered. Although more energy passes through the diathermic control (on the left), shorter wave energy (in green) entering the glass enclosure on the right is predicted to be absorbed and transformed into a longer wavelength (in red) subsequently trapped by the glass - resulting in a potentially higher temperature in the glass enclosure on the right.

Wood's method is described as follows:

> To test the matter I constructed two enclosures of dead black cardboard, one covered with a glass plate, the other with a plate of rock-salt of equal thickness. The bulb of a thermometer was inserted in each enclosure and the whole packed in cotton, with the exception of the transparent plates which were exposed. When exposed to sunlight the temperature rose gradually to 65°C., the enclosure covered with the salt plate keeping a little ahead of the other, owing to the fact that it transmitted the longer waves from the sun, which were stopped by the glass.



This diagram shows the first stage of the Wood Experiment and the behaviour of wavelengths filtered and unfiltered by glass, side by side with the diathermic control. Although more energy passes through the diathermic control (on the left), shorter wave energy (in green) entering the glass enclosure on the right is not transformed into a longer wavelength (in red) and subsequently trapped by the glass. The only difference remaining is the difference of energy entering and exiting either enclosure, which results in the significantly higher temperature of the diathermic halite covered enclosure on the left, due to the greater access and egress of solar energy to and from the air inside the enclosure.

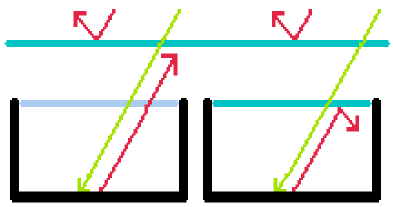
The fact that the diathermic greenhouse outperformed the glass greenhouse in the first stage of the experiment shows how important radiative heat is, and that not all of the sun's radiation is absorbed by the atmosphere before reaching the ground. Moreover, Wood's greenhouses in the first stage of his experiment present a spectacular analogy of what happens to lower atmosphere temperature if upper atmosphere absorptivity is increased. The halite pane in Wood's first stage can be compared to the present stratosphere. If adding CO_2 to the atmosphere raises

absorptivity, then the glass pane in the first stage of Wood's experiment can be compared with a CO_2 enriched stratosphere. What makes the comparison so good is that neither stratosphere nor panes convect so the focus is on radiative heat transfer rather than conductive transfer from this level outwards. Both the troposphere and the air inside the respective greenhouses do convect, so here conductive heat transfer is the larger issue. As Wood so eloquently points out, the pane that absorbs less transmits more heat and that produces a higher temperature in the convecting air below.

Why is it so? Heat relayed (absorbed and re-emitted) is scattered, so only half of it makes it inside while the other half is sent outside; back to space. The more heat is absorbed, the less is transmitted directly inside where it is absorbed and the more is divided between being relayed into space and relayed inside the system. Suppose the halite transmits 80% of the radiation, reflects 50% of the remainder and relays what is left. 5% is relayed into space and the total percentage making it inside is 85%. If the glass on the other hand, transmits 20% of the heat, reflects 50% of the remainder and relays what is left; 20% is relayed into space, while 20% is relayed inside making the total percentage of radiation entering the box only 40%. That is a lot less than the 80% entering via the less absorptive material. This is why raising CO_2 concentration will have a cooling effect if raising CO_2 levels raises absorption at the expense of transmission. As we shall see, whether this is really true is yet to be answered.

Wood, dissatisfied with the verity of his initial result continues by applying an additional experimental control. He takes a measure to eliminate from both enclosures, the incidence of all wavelengths that could be blocked or otherwise filtered by the glass. Wood continues:

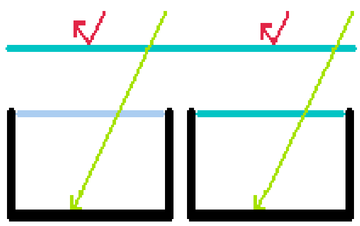
> In order to eliminate this action the sunlight was first passed through a glass plate.



This diagram shows the second stage of the Wood Experiment and Arrhenius' hypothetical heat conversion. Longer wavelengths (in red) that are normally blocked by glass are no longer incident on either enclosure, and according to Arrhenius' hypothesis the shorter wavelengths (in green) penetrating both glass and halite alike are to some degree converted to longer wavelengths (in red) when relayed (absorbed and re-emitted). However, although these newly converted longer wavelengths (in red) may escape through the diathermic halite pane, they are expected to be blocked by the glass pane - thereby raising the air in the enclosure beneath the glass to a much higher temperature to that beneath the diathermic halite pane - according to the mechanism proposed in the Greenhouse hypothesis of Arrhenius.

Wood (1909) goes on to record his results as follows:

> There was now scarcely a difference of one degree between the temperatures of the two enclosures. The maximum temperature reached was about 55°C. From what we know about the distribution of energy in the spectrum of the radiation emitted by a body at 55°, it is clear that the rock-salt plate is capable of transmitting practically all of it, while the glass plate stops it entirely.



This diagram shows what actually happened during the second stage of the Wood Experiment. Longer wavelengths (in red) that are normally blocked by glass are no longer incident

on either enclosure, and accordingly only the shorter wavelengths (in green) penetrate both glass and halite. However, the equality of temperature between the two enclosures indicates that the shorter wavelength (in green) absorbed is not subsequently converted into a longer wavelength that can be trapped by the glass pane but not by the halite pane. This demonstrates that Arrhenius' hypothetical conversion of short waves into long waves during relay does not happen to any extent sufficient to noticeably impact air temperature.

...and so, if the magical conversion of light rays into dark rays was really happening, the interior of Wood's diathermic greenhouse would have been significantly colder than that of Wood's glass greenhouse. The fact that both performed equally proves that visible light is not converted into heat on absorption. Wood (1909) provides experimental (and thus scientific) facts that soundly disprove the greenhouse effect by disproving the mechanism. Moreover, the Wood Experiment soundly falsifies the later Greenhouse warming mechanism based on increasing the role of an upper atmosphere heat relay by increasing upper atmosphere absorptivity. If anything, the first stage of Wood's experiment showed that increasing upper atmosphere infrared absorption would have a cooling effect on the lower atmosphere. This is explained by the division of relayed infrared radiation between that relayed towards the ground and the equal amount relayed straight back out into space.

Thermal Conversion Laser Test: A Modern Variation on the Wood Experiment

The hypothesis proposed by Arrhenius (1896, 1906) that visible light is converted to heat on absorption and thence re-emitted as infrared can be tested using lasers in the visible spectrum and rapid response black fluid distillation thermometers.

Modern equipment, such as a laser pen (532nm at 5mW over a 3mm diameter), a clothes peg, and 2x Stevenson-Reeves calibrated distillation thermometers (black fluid), and a hand lens (10x), is more than sufficient to testing Arrhenius' hypothetical core mechanism of the Greenhouse Effect (IE that visible radiation is converted into infrared radiation when absorbed and re-emitted). The beam of the laser pen has a total radiation of:
$(0.005) / (0.0015 \times 0.0015 \times 3.1416) = 0.005 / (7.07 \times 10^{-6}) = 707\ Wm^{-2}$.

Shining a laser like this into the eye could cause serious injury and I've observed that even reflection scatter from the beam is intense enough to cause severe headaches if exposure is sufficient. When playing with lasers, please take care. That said, 700 Wm^{-2} is much more intense than sunlight (at sea level), and eminently suitable for testing Arrhenius' wavelength shifting Greenhouse mechanism.

The method is to place the thermometers side by side, parallel but separated by one centimetre (about half an inch), with the graduations lined up. Affix the laser at least thirty centimeters (about one foot) away from the thermometers, so that when switched on, the beam strikes and is centred on the base of one thermometer. Prior to switching on the laser, use the hand lens to verify that both thermometers are indicating an equal temperature (to the nearest 10th of a degree Celsius). Once the thermometers are thus equilibrated, use the clothes peg to fasten down the laser pen switch and keep the laser shining on the test thermometer. Having ensured that the laser is still centred on the base of the test thermometer, use the hand lens to occasionally compare temperatures of test and control thermometers. You will have observed that nearly all of the visible light is absorbed by the liquid of the test

thermometer, but do you observe any variation in temperature between the thermometers?

The results I observed when I conducted this experiment over a period of about 30 minutes, offered no confirmation of Arrhenius' wavelength shift. I observed no difference between the test thermometer with an additional 700 Wm^{-2} of visible light shining on the bulb and the control thermometer with no additional light shining on the bulb (other than ambient laboratory conditions equal for both thermometers). Even switching to a 630-670nm red laser affected no difference in temperatures indicated by test and control thermometers.

My conclusion is that increasing visible radiation, even by quite a large amount, results in no measurable rise in temperature because no appreciable amount of visible radiation is converted into infrared when absorbed and re-emitted - contrary to Arrhenius' hypothesis. I further propose that infrared radiation, hypothetically emitted by the fluid of the thermometer would at least in part be either reflected or absorbed by the glass, thereby raising the temperature of the thermometer fluid and causing the fluid to expand. This is not observed and so we may conclude that light is not transmuted into heat on absorption.

Kirchhoff's Law: The Forgotten Alternative to the Shattered Greenhouse

Although Wood (1909) explains his greenhouse shattering results as being a product of convection, this only explains how heat is redistributed within an enclosed fluid. Returning our attention to 1858, we may recall Tyndall's failure to distinguish reflected from absorbed heat when considering the decline of transmission in response to certain gases. Balfour Stewart determined that absorption by an opaque body is the complement of its reflection. In other words, what is not absorbed by an opaque body is reflected by it (Stewart, 1858). Absorptivity was therefore defined as the proportion of incident radiation absorbed by an opaque body.

Gustav Kirchhoff went on to determine that the emissivity (the proportion of theoretical black-body radiation represented by actual radiation) of a body is equal to its absorptivity, and that emission (as opposed to emissivity) is equal to absorption (as opposed to absorptivity) at thermal equilibrium (Kirchhoff, 1859; Kirchhoff, 1860). Also known as Kirchhoff's Law, these are important features of the thermodynamic property known as emissivity. Initially, the proportion of absorbed energy that isn't re-emitted as radiation represents an amount of stored energy which raises the internal temperature (as thermally conducted rather than radiated in and out of objects inside the body such as a glass thermometer and the liquid inside the glass thermometer) - over and above what one would expect. The temperature continues to rise until the radiation emitted by the body is equal to the radiation absorbed by the body in spite of the bottleneck presented by the lack of emissivity. This state of balanced heat flow at elevated temperature is called thermal equilibrium, and is driven by Kirchhoff's Law - which applies to all bodies.

The fact that the work of Stewart and Kirchhoff concerned only opaque bodies puts Tyndall's work with translucent materials like carbon dioxide in context. Tyndall determined "absorption" from the proportion of radiation transmitted by the gases he was testing. In fact, what Tyndall was measuring was not absorption but opacity (Tyndall, 1864, p. 415). Tyndall's confusion of absorption and opacity is a major error that was propagated into Arrhenius' Greenhouse hypothesis, and constitutes a fact

not accounted for in Arrhenius' calculation of "Climate Sensitivity" to carbon dioxide. I would point out that the translucency of a body (e.g., carbon dioxide) does not eliminate emissivity as a useful physical property by which a translucent body's temperature may be related to radiation incident on the body, if we can understand that transmitted radiation is neither incident on the body as such, nor does radiation transmitted by a body in any way affect its temperature. The only impact transmitted radiation has is to complicate measuring reflection and absorption occurring in translucent bodies. Thus, both Stewart's definition of absorptivity and Kirchhoff's definition of emissivity apply to the opaque component of a translucent body, but to the exclusion of that body's transparent component. As Tyndall first published before Kirchhoff, it comes as no surprise that Tyndall does not account adequately for these factors.

Nevertheless, Tyndall's experiment wasn't a complete loss. Due to his consistent method, Tyndall's results were sufficient for Jozef Stefan to deduce, in 1879, that radiation from a mass is proportional to the fourth power of its absolute temperature. The constant of proportionality, the Stefan constant, defines this relationship for a perfect black-body. In 1884 Stefan's student, Ludwig Boltzmann, went on to generalise this law to apply to normal masses, called "grey bodies" in Physics, by introducing the concept of emissivity to this application. Boltzmann not only quantified the effect of radiation on grey-body temperature, but the effect of compositional changes at constant radiation, on the temperature of a body. Plimer (2009, pp. 365-375) and Archer (2009, pp. 15-29), from opposite sides of the argument, both admit that the "greenhouse effect" is a terrible misnomer, but like nearly all other authors in climatology, neither attribute the modern mechanism of heat residence to the fundamental law that dictates this mechanism, nor to the person who discovered it. The "greenhouse effect" is not just a misnomer, it is an Nineteenth Century supposition, formally hypothesised by Arrhenius in 1896, and falsified by the Wood experiment barely 13 years later in 1909.

The emissivity of Stewart, Kirchhoff, and Boltzmann is independent of path length as it concerns the radiation or heat flux at the point of emission, and in a homogeneous translucent body, it is the heat flux that varies with depth, not the emissivity (which is a property of the material at the point at which the temperature is taken). As can be seen from the use of path lengths to identify different "emissivity" curves for materials such as water and carbon dioxide, authors using the term in this context (e.g., Rubens & Ladenburg, 1905; Hottel, 1954; Leckner, 1972; Farag, 1976, Farag & Allam, 1981; Lallemant et al., 1996) are not referring to emissivity *per se*, but a function of transmittivity or opacity that relates temperature to depth via the Beer-Lambert Law without the need to calculate and substitute the depth-derived value for internal radiation in a translucent material. This is based on a definition of total impacting radiation as the sum of reflection, absorption, and transmission. The resulting tables are useful in the context of thermodynamics within a flame. However, transmitted radiation does not affect internal energy stores and has no effect on the body's internal temperature. Thus when considering emissivity for the purpose of determining emission temperature, only those elements that affect the obstruction of radiation have any affect: reflection and absorption or internal reflection and emission. Ergo, the definition of emissivity in opaque materials remains the same for translucent materials:

1. Absorptivity is equal to Emissivity
2. Emissivity is the complement of Reflectivity insofar as transmission and transmissivity are excluded from the sum (i.e., Emissivity is equal to the difference between Unity and Reflectivity to the exclusion of transmissivity)
3. At thermal equilibrium, emissivity is equal to absorption (or emission) divided by

the sum of reflection and absorption (or emission)

The most significant fact underscored by this analysis is that we have no Boltzmann emissivity measurements for any gases. As the Boltzmann emissivity is crucial to determining the temperature of a radiating body, this lack of gas emissivity measurements means that no physical evidence exists to underpin any hypothesis using compositional changes to predict atmospheric temperature. Knowing that the measurements discussed by the likes of Rubens & Ladenburg (1905), Hottel (1954), or Leckner (1972) have no bearing on the Boltzmann emissivity suggests that the emissivity of mixing may not be quite so complicated as is presented by Farag (1976), Faraq & Allam (1981) or Lallemont et al (1996).

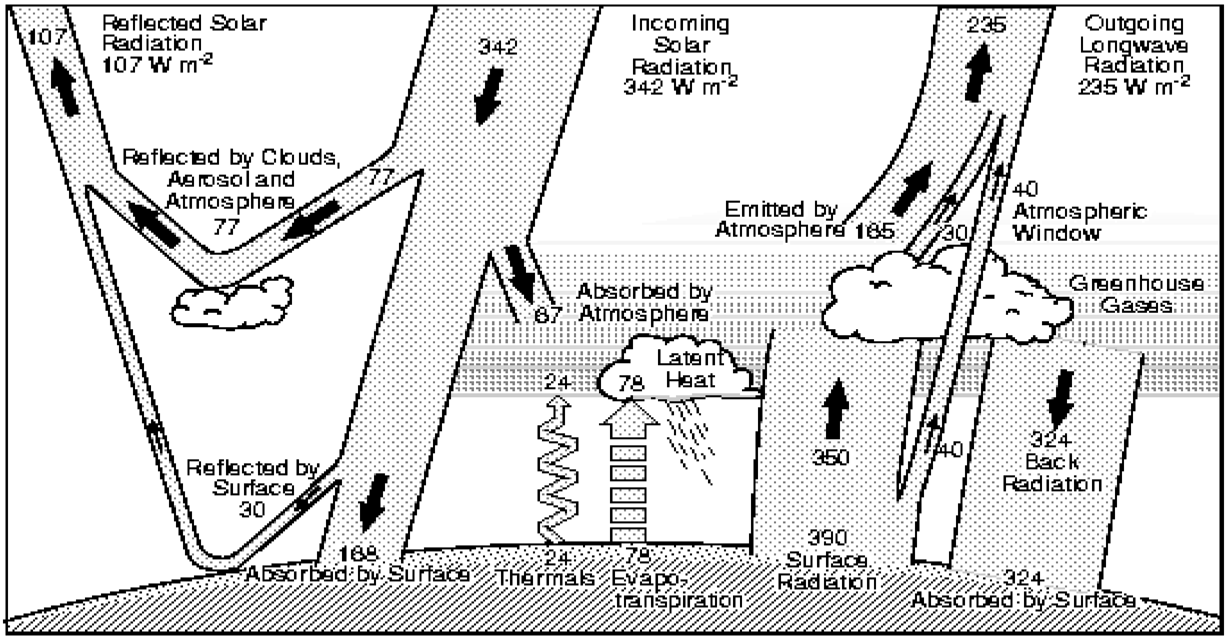
A practical example demonstrating the simplicity of emissivity as it applies to mixing is that of colour blending. Colour as we see it, is defined by the applicable combination of frequencies observed in the spectrum and as such, colour is defined by the distribution of spectral emissivity (i.e., emissivity specific to key spectra). Differences in the response of materials to radiation in very narrow and specific spectra is how devices such as Carbon Dioxide detectors function. Interestingly, the colour of a mixture (e.g., paint) is dependent on the proportion and colour of component materials making up the mixture. The relationship between colour intensity and concentration of pigment is linear. In fact, you can test this for yourself in simple colour mixing experiments. Therefore we may induce that the relationship between emissivity of mixing and component emissivities is likewise linear, as follows:

> Emissivity of Mixing is equal to the sum of products of component concentration and component emissivity.

So, on the basis of gas mixture emissivity, we can model atmospheric temperature via a radiation budget. There is but one slight problem; we still lack the atmosphere's component gas emissivities as they apply to the Stefan-Boltzmann Equation. The alternative route to radiative budgeting is to measure reflection off the atmosphere in the context of the difference in radiation incident on the surface and on the top of the atmospheric layer in question.

Counterfeiting the Currency of the Universe

Kirchhoff's Law is unavoidable, as it is based on the conservation of energy in that a body cannot not emit more energy than it receives or absorbs. Emissivity describes the proportion of absorbed energy that is initially emitted. As this proportion remains relatively constant, energy accumulates raising the temperature until the emitted radiation is equal to the absorbed radiation courtesy of stored energy congested within the body by lack of emissivity. Beware of wheels within energy diagrams as these usually constitute the energy creation mechanism of perpetual motion machines. One such gem of clarity, used uncited by Plimer (2009, p. 370), was offered by Kiehl and Trenberth (1997, Fig. 7):



If we assume thermal equilibrium, the regular features, excluding the greenhouse cycle tally up. 342 Wm^{-2} incoming solar energy is balanced by 107 Wm^{-2} (reflection) + 235 Wm^{-2} (emission) = 342 Wm^{-2} outgoing radiation. Non-gaseous temperatures just below the surface are raised so that 198 Wm^{-2} reaching the surface is balanced by 30 Wm^{-2} (reflection) + 168 Wm^{-2} (surface absorption). However, this is where things get ugly as the total surface absorption of 168 Wm^{-2} can only be balanced by 24 Wm^{-2} (thermals) + 78 Wm^{-2} (evapo-transpiration) + 66 Wm^{-2} = 168 Wm^{-2} emitted by the surface.

However, Kiehl and Trenberth (1997) go on to supply the surface with an additional 324 Wm^{-2} of special radiation from "greenhouse gases". I say special because in this case the surface absorbs all of this radiation instead of reflecting 30 / 198 x 324 = 49 Wm^{-2} (but this would mean that the earth radiates more energy than it receives). The question remains, however, where do the "greenhouse gases" get the energy to emit 324 Wm^{-2} in the first place? It can't be from the surface, because the surface can only emit 168 Wm^{-2} into the atmosphere given that, that is all it absorbs before the greenhouse gases are introduced. Furthermore, by what mechanism do these "greenhouse gases" preferentially radiate towards the surface and not towards space? In the overall picture, for the "greenhouse gases" to radiate 324 Wm^{-2} towards the ground, they must equally radiate 324 Wm^{-2} into space which turns the earth into a heat creation machine emitting 666 Wm^{-2} for a total absorption of 342 Wm^{-2}.

Accounting for atmospheric temperature, Kiehl and Trenberth (1997) portray an atmosphere absorbing 87 Wm^{-2} (solar radiation) + 24 Wm^{-2} (thermals) + 78 Wm^{-2} (evapo-transpiration) + 66 Wm^{-2} (surface radiation liberated from the "Greenhouse" perpetual motion machine) = 225 Wm^{-2}. This is not quite right because just as only 67 Wm^{-2} out of 342 Wm^{-2} is absorbed by the atmosphere from incoming solar radiation, so too only 87 / 342 x 66 = 17 Wm^{-2} of outgoing surface radiation is absorbed by the atmosphere. Furthermore, Kiehl and Trenberth (1997) portray all radiation reflected from the surface as escaping where 87 / 342 x 30 = 8 Wm^{-2} of reflected surface radiation is absorbed by the atmosphere. Total radiative absorption is thus 87 Wm^{-2} +

24 Wm^{-2} + 78 Wm^{-2} + 17 Wm^{-2} + 8 Wm^{-2} = 214 Wm^{-2}. Given that this is the amount of radiation emitted by this model of the atmosphere (the 324 Wm^{-2} bouncing back and forth in the greenhouse cycle violates the First Law of Thermodynamics - so the prudent thing to do is assume that the entire mechanism is science fiction and exclude it from our calculations), it only remains to determine emissivity and execute the Stefan-Boltzmann Equation.

Emissivity was originally developed in the study of opaque materials, and the *Smithsonian Physical Tables* still only list emissivities for opaque materials. Translucent materials introduce a new complication known as transmissivity. If absorbed radiation in a translucent body is counted against total incoming radiation to get absorptivity, temperatures calculated from this value will be grossly exaggerated because transmitted radiation does not contribute to heat congestion nor to the temperature of the material through which it is transmitted - and yet this is part of the sum that totals to the amount of incoming radiation. Therefore absorptivity is equal to absorption divided by the sum of absorption and reflection. In the example by Kiehl and Trenberth (1997) above, this amounts to an atmospheric absorptivity (emissivity) of 87 / (77 + 87) = 0.5305. From this emissivity determination and the 214 Wm^{-2} that must be radiated from atmosphere, the Stefan-Boltzmann Equation yields 290°K or 17°C as a mean global surface temperature. If we throw away the energy recycling mechanism, this is not a bad audit - especially considering the actual mean global surface temperature is on the order of 16.0°C to 16.5°C. However, we need to throw away the energy recycling mechanism, as you cannot spend and store the same energy at the same time, or you wind up with a mechanism that violates the First Law of Thermodynamics by creating energy. This said, the corrected "Back Radiation" for Kiehl & Trenberth (1997) is 214/2 = 107 Wm^{-2} (the half of the atmospheric radiation that is not directed towards space) - a far cry from Kiehl and Trenberth's 324 Wm^{-2}.

Greenhouse Effect Version 2.0: Shifting the goalposts to resurrect a dead hypothesis.

Although the greenhouse effect died with the Wood experiment, the diverse multitude of radiation "budgets" shows that the greenhouse effect is far from buried. This is a classic case of shifting the goalposts, because the greenhouse effect is not a scientific hypothesis that can be buried when it dies from experimental causes; it is a political symbol that cannot be allowed a proper burial, and so remains forever on display at the funeral parlor; an eternal viewing just like Lenin's. Version 2.0 of the greenhouse effect relies on heat congestion by limited emissivity on the supposition that the addition of CO_2 to the atmosphere will alter overall atmospheric emissivity in such a way as to increase heat congestion and force temperatures to rise. This is evident in the portrayal of congested heat flow by the kitchen sink analogy in (Archer, 2009).

Nevertheless, the modernisation of Arrhenius' greenhouse effect neglects some rather important thermodynamic properties. In fact, version 2.0 of the Greenhouse effect neglects any quantitative science at all. There is no measurable thermodynamic property used to compare the relative strengths of greenhouse gases, and there is no equation of measurable thermodynamic properties that likewise can give us an indication of how much one gas is more a greenhouse gas than another. The measured "emissivities" of gases we have to date are not applicable because they are intended for use in systems where the point radiation is unknown. In fact, no gas emissivities applicable to calculating temperature from radiative emission have been

measured. We may well be able to determine air emissivity from remote imaging systems at the present time, but we have nothing on the component gases. It is impossible to do more than guess at how CO_2 from combustion and additionally from other sources such as respiration, deflation (soil erosion) and volcanic activity; affect the bulk thermal emissivity of the atmosphere as a consequence of compositional change, and temperature. The science isn't settled at all. In fact as it turns out, nobody even bothered to collect the evidence.

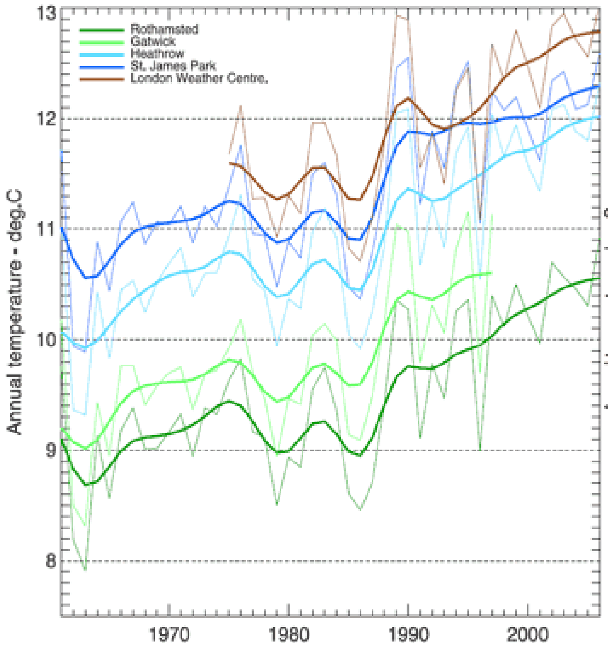
Urban Heat Islands & CO_2 Domes: The Experimental death knell for the Greenhouse Hypothesis

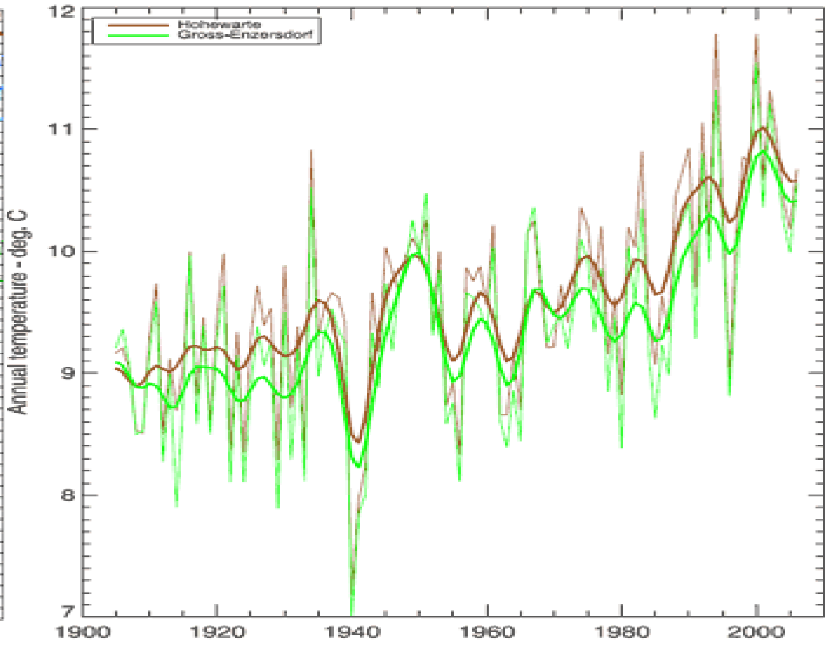
The Urban Heat Island Effect was first proposed by Fourier (1827, p. 584), and has been used on numerous occasions to cast doubt on the validity of the instrumental temperature record. Given that each recorded temperature in the time series for each location is measured only once, I would suggest that statistical confidence cannot be validly used to deny the ±0.5°C error inherent in the reading of graduations that are separated by less than 2mm, without a hand lens. This is of particular relevance to the instrumental temperature record, never mind the impact of the urban heat island effect, and the fact that urban temperatures are geographically over-represented. Yet all this only applies to the magnitude of climate change - and as any geologist can tell you, there would have to be something seriously wrong for there to be no climate change at all. The resulting furor has only served to obscure the most potent implication of the Urban Heat Island Effect.

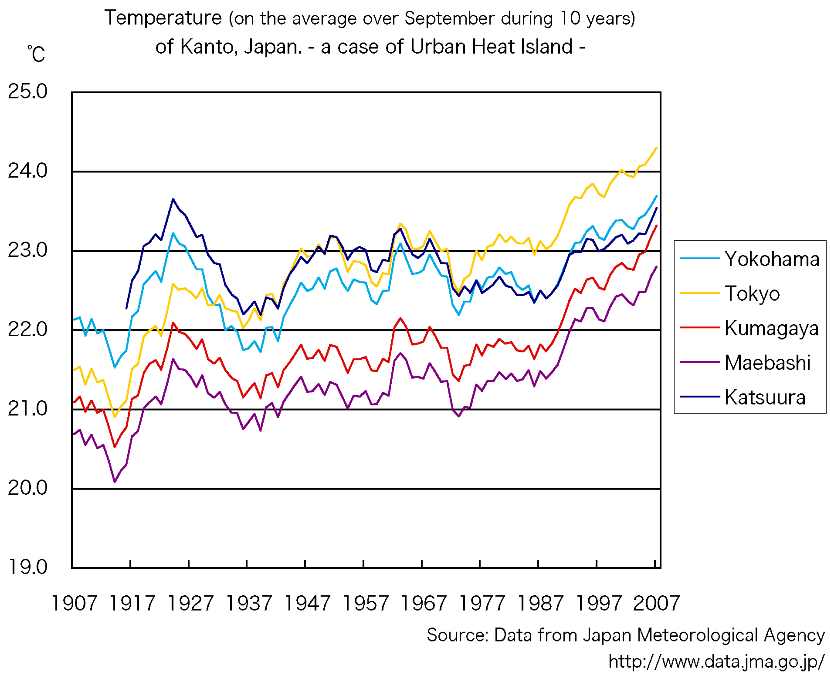
Urban centres are also known for their increased carbon dioxide levels, often near 1.5x that in the surrounding countryside (e.g., Idso et al., 1998a, 1998b). If increased carbon dioxide in any way raises temperature, this could at least partly explain the Urban Heat Island effect. The key question is by how much? This is partly a question of warming by urban processes resulting in entropic and material heat accumulation. The other part of the question concerns the hypothetical climate sensitivity to carbon dioxide. There are, at present, a wide range of guesses concerning climate sensitivity to carbon dioxide. Values include:

- 2.3°K per doubling of CO2 at MSR after Manabe & Wetherald (1967)
- 1.9°K per doubling of CO2 at MSR after Manabe (1971)
- 1.5°K per doubling of CO2 at MSR after Ramanathan (1976)
- 1.6°K per doubling of CO2 at MSR after Wang et al. (1976)
- 2.0°K per doubling of CO2 at MSR after Augustsson & Ramanathan (1977)
- 0.473°K per doubling of CO2 at MSR after Plimer (2001)
- 5.5 ±4.5°K per doubling of CO2 at MSR after Andreae (2005)
- 3 ±1.5°K per doubling of CO2 at MSR after IPCC (2007)
- 0.333°K per doubling of CO2 at MSR after Archibald (2007)
- 4.55 ±3.15°K per doubling of CO2 at MSR after Spratt & Sutton (2008)
- 0.415 ±0.085°K per doubling of CO2 at MSR after Plimer (2009, p. 266 cw p. 375)

In fact, what is truly outstanding, is that none of the documents detailing these "results" even credit any attempt at direct measurement, and this lack of evidentiary underpinning is underscored by the extraordinary disagreement of these figures, ranging from 0.33°K to 10.0°K. This translates to a carbon dioxide component of the Urban Heat Island Effect of between 0.14°K and 4.29°K given an urban carbon dioxide enrichment of 50%.







Turning our attention to observed Urban Heat Island Effects, Jones et al. (2008) finds that urban and rural trends are almost constantly separated by 2°K in London. An identical separation of trends is also shown in the Japan Meteorological Agency's trends for Tokyo. It would seem that urban temperatures are generally 2°K higher than rural temperatures. The question remains as to how much of this difference is produced by carbon dioxide, and how much is produced by urban material and entropic heat accumulation. As Idso et al. (1998a) found, there is a significant difference between urban carbon dioxide levels and surrounding rural carbon dioxide levels, so a test of Urban Heat Island effect in micro-settings within the same urban environment would prove useful. In smaller cities such as Vienna, the difference between urban and rural temperatures can be as little as 0.2°K on a strictly modal basis (Jones et al., 2008). This would allow very little room indeed for the impact of the urban CO_2 dome on urban temperature and casts serious doubt on the supposition that CO_2 is a "Greenhouse" gas.

On ISO:2010-April-16 I placed an *Oregon Scientific* station (with temperature display)

in the shade on a concrete apron in Clayton, Victoria, Australia. I placed the *Oregon* substation in the shade near the small garden on the other side of the building. The weather was mild, sunny, with a gentle breeze, so circulation was good enough to ensure no appreciable difference in carbon dioxide levels on either side of the building. It would therefore not be unreasonable to expect that the temperature difference between the *Oregon Scientific* station and the corresponding substation would indicate the complement of carbon dioxide's contribution to the Urban Heat Island Effect. At noon the temperature in the shade was 25.3°C while the temperature in the shade in the nearby garden was 23.3°C. The difference of 2°K left no room for any significant contribution by the increased carbon dioxide levels of the urban environment. Later in the afternoon, the temperature difference reached 2.5°K and as this temperature difference exceeds typical urban-rural temperature differences, it leaves no room at all for any impact on temperature by carbon dioxide, whatsoever. A simple experiment that anyone can perform, with consideration for typical urban-rural temperature differences proves that Manabe & Wetherald (1967), Manabe (1971), Ramanathan (1976), Wang et al. (1976), Augustsson & Ramanathan (1977), Plimer (2001), Andreae (2005), IPCC (2007), Archibald (2007), Spratt & Sutton (2008), & Plimer (2009, p. 266 cw p. 375) are all wrong about the greenhouse effect of carbon dioxide. While it is plausible that carbon dioxide may indeed have a cooling effect as suggested by Ellsaesser (1989) & Chillingar et al. (2008), it is a matter of simple experimentation to verify that carbon dioxide does not have a warming effect on air temperature. This rather than more statistical questions, is why the Urban Heat Island Effect is so devastating to the Anthropogenic Global Warming hypothesis.

If there are Faeries at the Bottom of the Garden, Why is there no Enchantment?

Technological advancement is the most valid measurement of a science that I can think of. We have clean water, electricity, refrigeration, transport, communications, computers, a conspicuous lack of world wars, and most importantly, espresso, thanks to science. Science is solely about evidence, and this makes scientific discovery closely connected with practical applications that would not have been possible without the discovery. In 100 years, what did the greenhouse hypothesis give us? It is an amazing theory and the tendency of materials, particularly gases, to warm is a property with amazing possibilities. For example, filling the space between double-glazed panes of glass with a "greenhouse" gas would produce a window that heats itself in the presence of incident light and could conceivably be used to minimise frost and ice buildups on windows in colder regions. Double glazing typically uses air, but argon filled double glazing is preferred. Why not carbon dioxide? In the real world, carbon dioxide conducts five times more heat than argon, and has twice the heat capacity. This makes carbon dioxide a vastly inferior insulator, and its lack of insulating properties are not nearly made up for by any amount of heat absorption and radiative warming.

Conclusion: Those who live in greenhouses should not throw stones.

Having had its foundations vanish and having been subject to demolition by indubitable experimental results, the greenhouse effect lives on as a label that only serves to misattribute Kirchhoff's discovery of the mechanism of incident heat residence in gray-bodies to Arrhenius. Arrhenius may well be the first to speculate on the possibility of significant climate change by humans. Then again, Fourier (1827, p. 584) could be said to anticipate urban heat island effect; another way we have changed the climate of the places where we live. Either way, this bears no relevance to the fact that the mechanism popularly used to explain global warming has nothing to do with the disproven greenhouse effect, and is defined at it's core by Kirchhoff's Law. Will the real discoverer of this principle remain forgotten, or is it possible to replace the misnomer, "Greenhouse Effect", with the more appropriate, "Kirchhoff Effect"? Even so, the Kirchhoff Effect is yet to be underpinned by emissivity measurements that are applicable to the Stefan-Boltzmann Equation and therefore to the temperature of a radiating atmosphere and in engineering circles this effect is simply not strong enough to allow practical applications such as self-heating double-glazed windows. As demonstrated by the literature, scientists can't agree on whether raising atmospheric CO_2 concentrations will have a warming or cooling effect because the evidence has not even been collected, and scientists without evidence are only capable of ignorant guesswork and idle supposition, just like anyone-else. Yet although the question of gas emissivity remains unanswered, it is a matter of simple experimentation to demonstrate the lack of effect that carbon dioxide content has on air temperature, just as it is a matter of simple experimentation to demonstrate that visible light does not turn into heat on absorption. The "Greenhouse Effect" as presented by proponents of Anthropogenic Global Warming, is found to be little more than a failed attempt to remodel a shattered hypothesis whose original proposal by Arrhenius was based on Tyndall's confusion of absorption and opacity. Without the "Greenhouse Effect", *Anthropogenic Global Warming* is no longer *Anthropogenic.*

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