

# Rachel's Environment & Health News

## #300 - Global Warming -- Part 1: How Global Warming Is Sneaking Up On Us

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A new study [1] makes it clear that global warming will be the greatest challenge that humans have ever faced.

Global warming is caused by the "greenhouse effect," which in turn is caused by a buildup of carbon dioxide (CO<sub>2</sub>) and other gases in the Earth's atmosphere. These gases act like the glass covering a greenhouse; they let sunlight in but they don't let it back out again. The result is a buildup of heat inside the greenhouse, which in the case of a real greenhouse is good. However in this instance the "greenhouse" is planet Earth, and warming up the planet will cause big trouble. "A continuous warming will cause extraordinary disruption of the human enterprise," says biologist George M. Woodwell, director of the Woods Hole Research Center in Massachusetts.[2]

The "greenhouse effect" itself is normal and natural. Carbon dioxide and water vapor ordinarily trap some of the heat from sunlight, keeping the Earth about 60 degrees Fahrenheit (F) warmer than it would otherwise be, thus making life possible. Before the industrial age began, in about 1750, the atmosphere contained 275 parts per million (ppm) of carbon dioxide (CO<sub>2</sub>).

In the Earth's distant past, the amount of CO<sub>2</sub> in the atmosphere has varied up and down; and the planet's temperature has varied up and down in lock step with the CO<sub>2</sub>. See Figure 1, which was produced by scientists who found the history of earth's climate and atmosphere revealed in the polar ice caps. There is little doubt that as CO<sub>2</sub> has gone up in the past, Earth's temperature has gone up. Thus the "greenhouse effect" is not doubted by physicists, who know that CO<sub>2</sub> really does trap heat from the sun. But there is a mystery in our present situation.

Humans have recently been loading up the atmosphere with CO<sub>2</sub> and other so-called "greenhouse gases," yet the planet's temperature has not risen as high as the theory predicts it should. When scientists look at the amount of greenhouse gases, and then check the planet's temperature, they don't find as much warming as the CO<sub>2</sub> would lead them to expect. This is why we hear, "Oh, global warming isn't really a problem, it isn't really happening."

The planet IS warming. Since 1880, when careful temperature records began to be kept in the U.S., the average temperature has risen about 1 degree Fahrenheit. But if greenhouse gases really had the effect that scientists say they do, the temperature should have risen by 2 degrees F or more by now. This discrepancy between what scientists SAY should be happening, and what IS happening, provides wiggle room for those who want to deny the existence of the problem entirely. IT WILL ALLOW THE DEBATE OVER GREENHOUSE WARMING TO CONTINUE FOR DECADES, WHILE THE BUILDUP OF GREENHOUSE GASES INEXORABLY CONTINUES.

Recent findings have now explained the mystery.[3] Although a buildup of greenhouse gases is occurring (and is in fact accelerating), three other forces are working simultaneously to cool the planet off. These cooling forces are "masking" or canceling out the warming effects of the greenhouse gases.

There are four kinds of greenhouse gases: CO<sub>2</sub>, methane, nitrous oxide, and CFCs or chlorofluorocarbons. The main culprit is CO<sub>2</sub>, and the greenhouse potential of the other gases is often expressed as "CO<sub>2</sub> equivalents." When the warming effect of all four gases is added together today and translated into CO<sub>2</sub> equivalents, we have 425 ppm of CO<sub>2</sub> equivalents in the atmosphere, a 55% increase since 1750. (Actual CO<sub>2</sub> is now 356 ppm and the remainder is other greenhouse gases.)

CO<sub>2</sub> itself comes chiefly from the combustion of coal and oil. Methane comes from agriculture (mainly the growing of rice and cattle). Sources of nitrous oxide are not well understood but production of Nylon is certainly one source, and catalytic converters on automobiles, and nitrogen fertilizers may be others.

CFCs are created exclusively by humans; they are refrigerants that are now famous because they are destroying the Earth's stratospheric ozone layer, allowing an increase in deadly ultraviolet light to reach the Earth's surface (see RHWN #285).

Ironically the heating effect of these four greenhouse gases is being nearly canceled out by other pollutants.

First, the effects of the CFCs are being countered by the CFCs themselves as they destroy the stratospheric ozone layer. Ozone itself is a greenhouse gas. The CFCs contribute to the greenhouse effect themselves, but they destroy the ozone, thus removing the ozone's greenhouse effect. Thus CFCs cancel out their own warming effect.

However, as CFCs are being phased out, DuPont and others are phasing in substitute gases which are, themselves, powerful greenhouse gases, but which will not destroy the ozone layer as effectively as the CFCs. The effect of the new CFC substitutes will be to promote global warming.

Secondly, the injection of sulfur into the atmosphere in the form of tiny particles emitted from the tall smoke stacks of coal-burning power plants (and from metal smelters, and to a lesser extent from automobiles), has created a haze over the whole planet, which is reflecting sunlight back out into space. As a result, less sunlight is striking the Earth's surface. This has nearly canceled out the warming effects of all the greenhouse gases.

As sulfur pollution becomes better-controlled (for example, by provisions of the Clean Air Act of 1990), the sulfur haze will clear up and will "unmask" the effects of the greenhouse gases which are relentlessly building up. At this point--in a decade or two--global warming will become apparent with a vengeance.

The third (temporary) masking effect is the eruption of Mount Pinatubo in June, 1990. Airborne debris from Pinatubo has reduced the sunlight reaching Earth's surface about one percent and produced the relatively cool summer that we all experienced in 1992.

Pinatubo's cooling effects will disappear after a year or two. But the masking effects of CFCs and sulfur will linger for a decade or longer. While this masking is occurring, those who are inclined to pooh-pooh the problem, such as most political leaders in recent memory, will be able to pretend the problem isn't real and will prevent the action we need: a rapid transition away from our coal-and-oil-based economy and a switch to renewable fuels. Meanwhile greenhouse gases are inexorably building. CO<sub>2</sub> alone grows at 1.5 ppm each year.

When the effects of greenhouse gases become fully apparent, what will happen? Ultimately, major shifts in ecosystems will occur. Cold regions will become warmer; warm regions will become hotter. Rainfall patterns will change. The interiors of continents, such as the corn-and-wheat-growing regions of the U.S. may become drier and less productive.

In the meantime we can probably expect unstable weather conditions, such as more unusual events like big hurricanes, tornadoes, droughts, floods, and extremes of temperature (hot AND cold). As Douglas Cogan says,

A SIMPLE ANALOGY TO THE PRESENT SITUATION IS TRYING TO PREDICT WHEN WATER WILL DRIP FROM A FAUCET. WHEN THE FLOW OF WATER THROUGH THE SPOUT IS SLOW AND REGULAR, ONE CAN OBSERVE THE PATTERN OF DROPS AND EASILY PREDICT WHEN THE NEXT DROP WILL FALL IF THE FLOW IS THEN INCREASED SUFFICIENTLY AND MAINTAINED AT THAT RATE, ONE CAN SIMILARLY FORECAST THAT THE DRIPS WILL BEAD TOGETHER AND FORM A CONTINUOUS STREAM. THE

SYSTEM HAS SHIFTED FROM ONE STEADY STATE TO ANOTHER. BUT IF THE FLOW OF WATER IS INCREASED GRADUALLY, THERE WILL BE A PERIOD WHEN THE DRIPS COME TWO OR THREE IN A ROW, THAT PAUSE FOR AN INSTANT, FOLLOWED BY FIVE DRIPS IN RAPID SUCCESSION, AND SO ON; THE PATTERN BECOMES ERRATIC AND HIGH UNPREDICTABLE. THIS UNSTEADY PHASE IS THE PART OF GLOBAL WARMING THAT THE PLANET MAY NOW BE EXPERIENCING, AS THE FLOW OF GREENHOUSE GASES ENTERING THE ATMOSPHERE SLOWLY INCREASES. [pgs. 42-43]

Outstanding among all the available facts is the global temperature record dating back more than a century, in which the 1980s stand out as the warmest decade by far, and in which the '90s are now setting new records.

The ten warmest years since 1880 have been (in temperature order): 1990; 1991; 1988 and 1981 (tied); 1987; 1983 and 1980 (tied); 1989; 1973; 1986 and 1977 (tied). Is it a coincidence that the past six years are among the 10 hottest years ever recorded? Not likely.

[Diagram has been removed. Fig. 1 Long-term Variations in Global Temperature and Atmospheric Carbon Dioxide. Notice how one tracks the other. It seems highly unlikely that future patterns will be different. Source: J.M. Barnola, et al. "Wostok Ice Core Provides 160,000-year Record of Atmospheric CO<sub>2</sub>," NATURE, Vol. 329, No. 6138 (1-7 October 1987), p. 410.]

--Peter Montague

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[1] Douglas Cogan, THE GREENHOUSE GAMBIT: BUSINESS AND INVESTMENT RESPONSES TO CLIMATE CHANGE (Washington, DC: Investor Responsibility Research Center [IRRC], 1992). Available for \$45 from IRRC, 1755 Massachusetts Avenue, N.W., Washington, DC 20036; phone (202) 234-7500.

[2] THE EARTH IN TRANSITION; PATTERNS AND PROCESSES OF BIOTIC IMPOVERISHMENT (NY: Cambridge University Press, 1990), pg. 5.

[3] Intergovernmental Panel on Climate Change [IPCC], 1992 IPCC SUPPLEMENT (Geneva, Switzerland: World Meteorological Organization and the United Nations Environment Programme, February, 1992).

Descriptor terms: global warming; greenhouse effect; ozone; pinatubo; greenhouse gases; global environmental problems; carbon dioxide; ozone depletion; cfc;