We and the World

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Thanks for invitation; I greatly appreciate it and am delighted to be here to talk about crucial problems we all face.

One of my first talks was to a Kiwanis group in England in 1949, and this is likely to be one of my last talks, thus closing the circle.

My talk is primarily about global warming and energy sources and uses, and, if time permits, I will include a bit about religion, free will, and other related topics.

As a physicist and electrical engineer I try to keep up with global warming and energy matters. Also, over the years I have served on the following relevant NAS-NAE study committees: 1971-1974 - Member and Chairman of the Committee on Motor Vehicle Emissions; 1979-1981 - Satellite Power Systems, and later, an assessment of the proposed Yucca Mountain nuclear-energy waste disposal facility.

The following Einstein quotation is always relevant because there is much that is absurd in the world:

Einstein said:

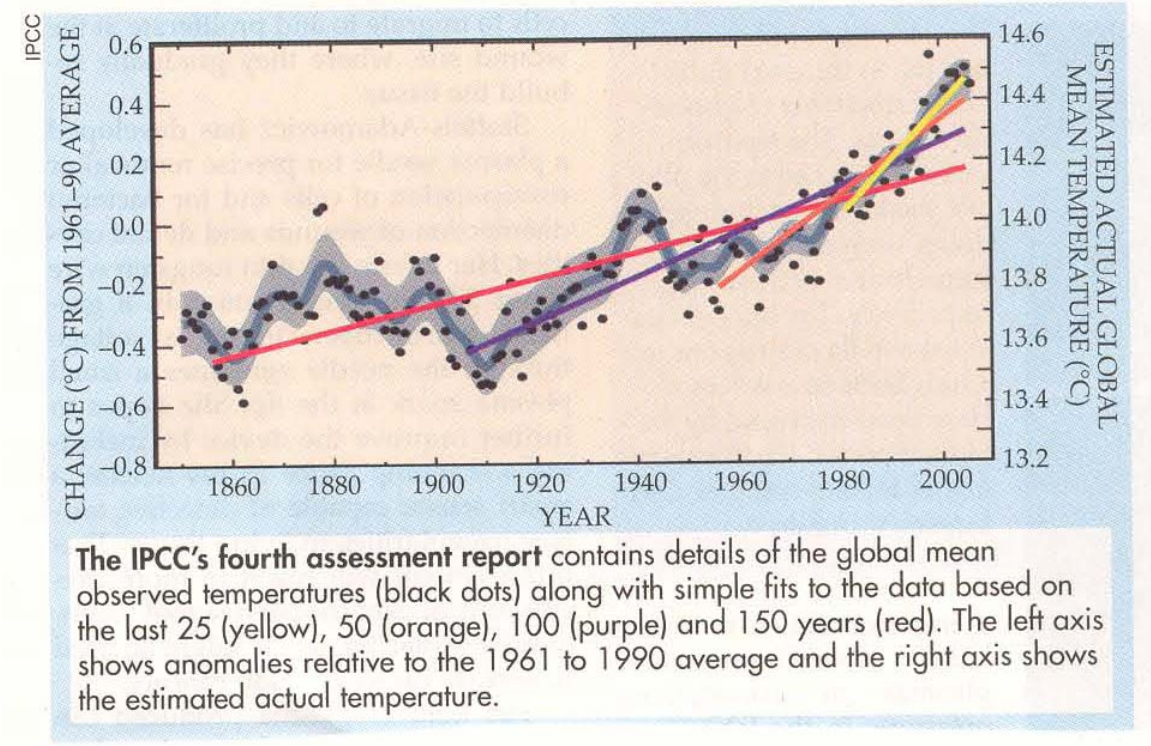
When I am judging a theory, I ask myself whether, if I were God, I would have arranged the world in such a way, and if at first the idea is not absurd, then there is no hope for it.

I. GLOBAL WARMING

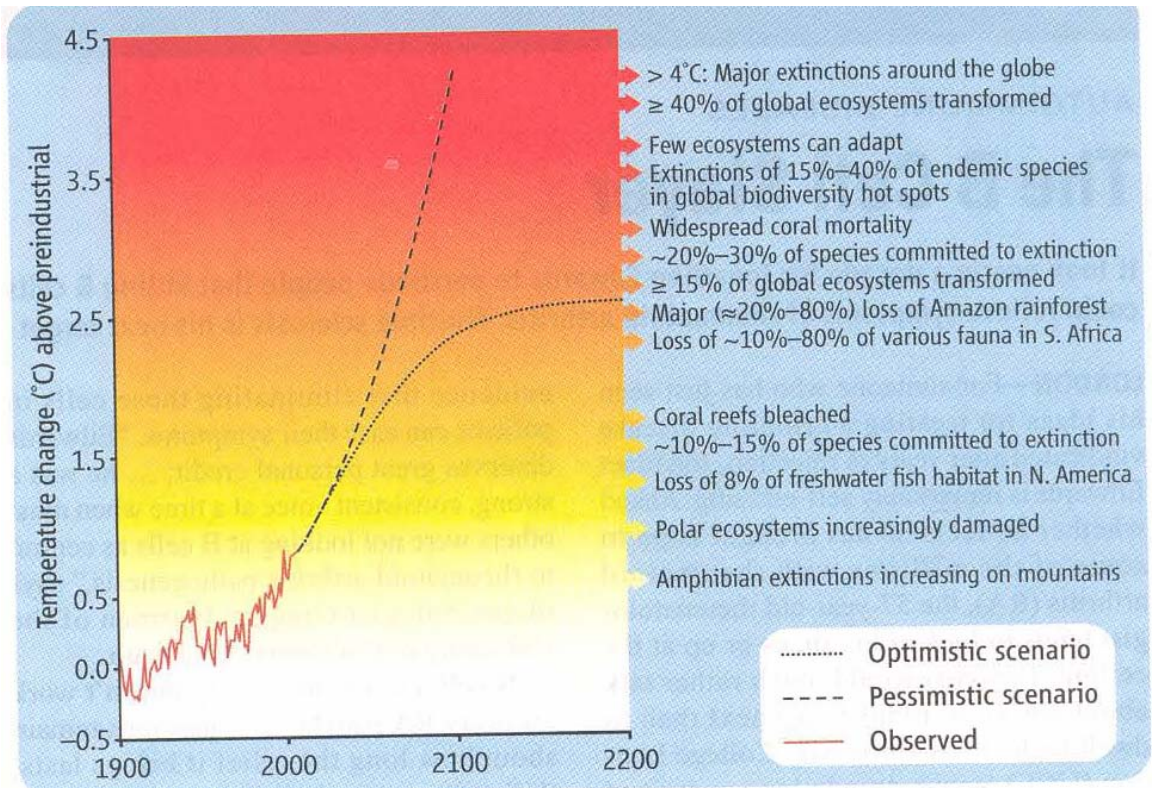
The current consensus is that most, if not nearly all, of global warming arises from greenhouse gases associated with human activities. Population is growing rapidly in many parts of the world so the problem is likely to continue to get worse. A recent UN report states that Climate Change is so severe and sweeping that only urgent, global action can head it off. Unfortunately, it is optimistic and unrealistic to expect quick action. Al Gore, in his Nobel acceptance speech, said that climate change is a real, rising, imminent, and universal threat to the future of the earth!

Climate change is already responsible for an estimated 150,000 deaths per year, but this is negligible compared to that which would come from appreciable sea-level rises.

The graphs below summarize the past and possible futures of GW.



The IPCC's fourth assessment report contains details of the global mean observed temperatures (black dots) along with simple fits to the data based on the last 25 (yellow), 50 (orange), 100 (purple) and 150 years (red). The left axis shows anomalies relative to the 1961 to 1990 average and the right axis shows the estimated actual temperature.



Global temperatures are estimated to rise in the next 100 years 1.8 to 4 degrees Celsius (3 to 7 degrees F) and 3.5 degrees F in the next 50 years, depending on future emissions of greenhouse gases. Melting of total ice-sheet frozen water would raise sea levels about 80 meters (over 260 feet). Chapel Hill is 560 feet above sea level, only a minor reason for rejoicing! There are some reasonably plausible estimates of a sea-level rise of more than a foot by the end of this century.

In Greenland the rate of glaciers slipping seaward in 2005 is 2 to 3 times as fast as in 1996.

In Australia, more than 3000 flying foxes recently dropped dead from heat. More than 25% of US birds (59 species) are already in urgent need of help.

Carbon dioxide, along with methane, is one of the most important greenhouse gases. Greenhouse gas emissions grew 70% from 1970 to 2004! The atmospheric concentration of C02 rose from 280 ppm in 1800 to 370 in 2000 and is projected to reach 580 ppm, a threshold value thought to trigger severe climate change, in 50 years.

To meet increasing global energy needs while ameliorating their negative consequences, it is widely believed that current carbon emissions must be reduced by at least a factor of three. It has been stated that up to an 85% cut in CO2 emissions is needed to head off potential catastrophic changes that could lead to floods, famine, and species extinctions. It has been estimated that a temperature

increase of only 2.7 degrees F would lead to between 20 to 30 percent of all plant and animal species facing the risk of extinction, and for a 6.3 degree F increase, between 40 and 70% of species could disappear!

If nothing is done, greenhouse gases are projected to increase by 25 to 90 percent by 2030! Stabilization of the greenhouse gas emission rate is not enough since the earth would continue to warm and the sea level to rise. Stabilizing emissions by 2050 would slow average annual global growth by less than 0.12%, and the longer action is delayed the more it will cost. The UN Intergovernmental Panel on Climate Change says human activity is largely responsible for GW and emissions of carbon, mainly from fossil fuels, must stabilize by 2015 and decrease thereafter. The time for maximum action is now. Not very likely!!

II. ENERGY: PROBLEMS and POSSIBILITIES

There is no shortage of energy, only of useful energy and power. The sun deposits 120,000 terawatts (1.2×10^{17} watts!) of radiation power on the surface of the earth each day, and the world currently consumes only an average of 13 terawatts of power, 1/100 of a percent! To provide a frame of reference, for November my electricity bill showed an average of 27 KWH per day, or a continuous use of about 1 kilowatt, which works out to be about 10^{-8} of the average world power usage, and thus about 70 times average world per capita use.

The Hubbert peak, where the global peak of oil supply occurs, has been estimated to be reached soon, perhaps in less than ten years. American oil production reached a peak in 1970, however, and now, even with much increased drilling, it has decreased to about half of its peak value.

As oil imports inevitably decrease and oil prices correspondingly increase, we will need to meet more and more of our power needs from coal, shale, biomaterials, and other alternate energy sources. For portable energy, increasingly costly gasoline will begin to be displaced by batteries, fuel cells, and possibly stored hydrogen. But there are major energy costs in producing such materials, so the net energy gain may be less than expected, and it may be even negative for hydrogen until and if much cheaper ways of generating and storing it are found.

America is over 60% dependent on foreign oil. 67% of our oil use is in transportation and 22% of all electricity is used in lighting.

If the auto fuel efficiency standard were raised to 35 mpg by 2020, it would save 2 to 2.5 million barrels of oil per day.

A two-degree setback in the thermostat in winter is said to cut energy use by 1%.

In 2006 US payments abroad for oil were more than $250 billion.

Oil was about $25 per barrel in 2003.

13% of the crude oil consumed in the US is used for nonfuel chemical production. Work on using biomass is feasible and attractive, but liquid biofuels as substitutes for petroleum are said to reduce carbon dioxide emissions less effectively than does saving and restoring forests.

Some worthwhile goals: Produce petroleum-derived clean fuels, carbon sequestration, and hybrid systems.

Support and emphasize alternative sources –solar, wind, hydro, clean coal, biodiesel, and biomass.

Build green buildings, use CFL and/or LED lighting, reflective roofs if solar cells are not used, and use higher efficiency furnaces and other household equipment.

Genetically engineered self-organizing viruses may be used in the future to help make battery electrodes, transistors, and solar cells.

The energy obtained from all existing silicon photovoltaic solar cells in one year would be insufficient to produce the next year's panels! It would take about three years to produce the energy from cells needed to manufacture them. Work in progress on dye-sensitized titanium dioxide cells is, however, now going into large-scale production in Wales with a payback time of only about half a year. Cells are placed on half-mile-long rolls of flexible metal foil.

In the absence of all energy subsidies, solar is the most economical energy source.

Energy independence from foreign oil would greatly reduce the income of middle-east countries and aid in the war on terror and increase the security of the US.

Compact fluorescent lights (CFLs) use a quarter of the power of an incandescent bulb producing the same amount of light, run much cooler, and last about 13 times as long. Although they currently cost more, their cost may be recovered by reduction in one's electric bill in as short a time as a month or two. I have had about 20 in my house for the last year or so. It has been estimated that replacement of an incandescent by a CFL will save the equivalent of 100 pounds of CO2 per year, about the equivalent of a 100-mile car trip!

Although light-emitting diodes (LEDs) are currently appreciably more expensive than CFLs, they run cold and their efficiencies are as high as 60% in the lab, are projected to reach 90% in a few years, and 25-52% in actual use, much superior to the 5% of incandescents and the 15-25% of fluorescent lighting. A 5.8 watt LED is equivalent to a 60-watt incandescent. Philadelphia recently replaced 14,000 traffic light signals with LEDs for a projected cost savings of $4.8 million. In a few years it may be possible to reduce the 22% of the US energy used for lighting to 10% or less, leading to a tremendous reduction in the amount of oil needed and the global warming produced.

Plug-in hybrid cars. New battery developments promise quick charging capability. Generating the electricity to power plug-in cars causes a third or more less greenhouse gas pollution than does burning gasoline. No significant new infrastructure is needed, as would be the case for hydrogen fuel-cell cars. In summary, plug-ins are the most practical and best alternative to the internal-combustion engine and can provide the equivalent of more than 150 miles per gallon effective efficiency. But a sign of the times is that the Federal tax credit for buying hybrids expires on 31 December 2007.

Building new coal and gas fired electricity generating plants is counterproductive unless ways to sequester the greenhouse gases thereby produced are made an integral part of such plants. Thus, to begin to address the global warming problem in the US, prohibit the building of new coal-fired generation plants until technology is available for use to capture and sequester their CO2 emissions.

Coal-fired plants currently generate 40% of US CO2 emissions. The Cliffside plant of Duke Energy will release over 6 million tons of CO2 per year as well as produce other air pollution and mercury in rivers. In a time of water shortage, plants like this one use over 120 million gallons of clean water per day. A frightening fact is that the emissions from coal-fired generating plants is about 100 times more radioactive than that from nuclear waste, and it gets spread around much more!

We need tougher fuel economy standards and a cap-and-trade program for greenhouse gases. Currently, to avoid a Bush veto, a minority of republican senators managed to eliminate the provision of a pending energy bill that involved imposing $13 billion in new taxes over ten years on the biggest oil companies, as well as eliminating tax breaks on alternative energy industries. It is significant that studies showed that the eliminated taxes would have amounted to only 1.1% of the net profits of the five largest oil companies, based on current oil prices.

What more can we do? Develop more alternative-energy sources. More research into improving the efficiency and reducing the cost of solar cells; install wind farms on land and at sea; more hydro and geothermal generators; generate power from ocean-wave motion; improve the energy/weight ratio for batteries and supercapacitors; and support more research on discovering a way to make room-temperature superconductors for transmission of energy.

Some alternate-energy sources have been downplayed because it might be hard to store and transmit the energy generated. But energy can be stored in batteries, supercapacitors, large rotating flywheels, and even in just pumping water into elevated tanks. Another well-known technique is compressed-air energy storage, involving injecting compressed air, for later use with turbine generators, into underground storage fields.

Nuclear energy plants have grave problems with disposal of radioactive nuclear waste and are currently only supported

by industrial builders with large subsidies from the Government, especially subsidies for disaster insurance, and, in any event, they cost too much money and take too long to build and to be put into production to help reduce global warming for many years.

Instead of pushing plans for moon colonies, manned trips to Mars, and seemingly endless foreign wars, our government should be greatly increasing its support of energy research and development. The time has come for the environment to be a central theme of policy-making rather than just a fringe issue. The point of no return is fast approaching, and maintaining the profits and vested interests of powerful industries must not govern future actions of the Government.

Business as usual, if it continues for even only another decade, will be disastrous. Warming, floods, forest fires and droughts will all increase and worse will come.

The current Administration has systematically manipulated science information for years to attempt to cast doubt on the reality and dangers of global warming. The White House has edited climate change reports to exaggerate scientific uncertainties and diminish the significance of climate change. One of the most recent of such reprehensible actions is the 22 October removal of statements of the Director of the US Centers for Disease Control, to be presented the next day to the Senate Environment and Public Works Committee, on how climate change could worsen allergic diseases, exacerbate deadly

heat waves, and broaden the geographic range of infectious diseases.

Finally, the US representative at the current Bali UN Climate Conference is refusing to support the proposed view that a non-binding reduction of 25 to 40 percent in richer nations' emissions would be required by 2020 and deeper cuts later, even though the European Union has already committed to a 20 to 30 percent reduction below 1990 levels by 2020.

III. RELIGION and SCIENCE

Much of religion is based on faith in the existence of a personal god: theism, while science depends on experimental verification of observations of the material world. Since faith is personal, everyone may have their own faith, not necessarily the same as that of others. In my opinion, this accounts at least in part for the existence of the many different religions present in the world. Because scientific facts, laws, and theories are subject to independent verification, there is only one science, the same in all countries.

I recommend two valuable but quite different books:

"God: The Failed Hypothesis – How Science Shows That God Does Not Exist," by V. J. Stenger, Prometheus Books, 2007, and

"Jesus for the Non-religious," by John S. Spong (a retired Episcopal bishop), Harper, 2007.

I mention them and a lot more in an essay I wrote some years ago and keep updated. It is entitled “Science, Religion, and Science Fiction,” and is available for reading and downloading from my website:
http://jrossmacdonald.com.

In the essay I also talk much more than I have time for here about free will and theodicy, the problem of why God allows evil: in simple terms, why do bad things happen to good people?

Thank you for listening; I hope my talk will stimulate you to think about its important subjects, particularly the “bad thing” global warming. Time for action is running out.