Litt om CO_2 og drivhuseffekt, plukket fra Introduction to Physical Geology:

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RAYMOND SIEVER
HARVARD U.

CARBON DIOXIDE AND CLIMATE

The small amount of carbon dioxide in the atmosphere (a little over 320 parts per million) has a profound effect on our climate. The atmosphere is relatively transparent to the incoming visible rays of the Sun. Much of that radiation is changed by reflection at the Earth's surface to infrared, invisible long-wave rays that radiate back away from the surface. 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 then heats the atmosphere, which radiates heat back to the Earth's surface. This is called the "greenhouse effect," by analogy to the warming of greenhouses, whose glass is the barrier to heat loss. Any process that alters the amount of carbon dioxide in the atmosphere may conceivably affect the Earth's climate.

Since the start of the industrial revolution, about the beginning of the nineteenth century, we have been pumping carbon dioxide into the atmosphere at an accelerating rate by our burning of coal, oil, and gas. The carbon dioxide level of the atmosphere has been increasing, as shown by systematic measurements in various places in the world. In addition, calculations have been made of the amounts of carbon dioxide added to the atmosphere from the figures for fuel consumption. There is a pronounced discrepancy: the increased level in the atmosphere is not as high as would have been predicted by the additional supply. This suggests some loss or output from the atmosphere, something absorbing the extra carbon dioxide, moderating the effect of the increased input.

Much of the carbon dioxide that is "missing" from the atmosphere has been mixed with the oceans. Gas molecules of carbon dioxide in the air are in equilibrium with dissolved gas molecules in the water. As the concentration of gas in the air increases, there is a tendency toward re-establishing equilibrium: the water dissolves more gas, taking some of the excess from the air. In this way, the oceans are absorbing some of the carbon dioxide produced by the industrial revolution (about 50 percent) and keeping the atmosphere much closer to its natural levels. Nevertheless, in spite of the ocean's moderating effect, carbon dioxide levels are expected to reach about 375 parts per million by the year 2000, a significant increase over 320 parts per million in 1970 and 295 parts per million in the middle of the nineteenth century. Yet it is doubtful that this has seriously affected our climate and that it will so affect it in the next decades.

The possible increase in temperature is not great, partly because atmospheric carbon dioxide is already absorbing about as much radiation as it can and the rest will pass through unabsorbed, and partly because any rise in temperature will produce more cloudiness, which will tend to lower the radiation coming in from the Sun. The best guess now is that, in the next thirty years, the carbon dioxide effect alone will increase the global average temperature by about 0.5°C, but that the countering effect of cloud cover may moderate this almost entirely. (It is doubtful that the small increase in cloudiness would be noticed by the average person.)

A more pessimistic view is taken by Wallace Broecker, a geochemist at Columbia University, who thinks that the Earth is in one of its frequent cooling periods (we have been in one since about 1940) that will bottom out in a few years. That cooling up to now had more than compensated for any warming by the additional carbon dioxide we have been pumping into the atmosphere. As the Earth moves again into one of its natural warming cycles in the next decades, Broecker suggests, the increasing carbon dioxide effect will add to it and may drive the global temperature higher than it has been in the last 1000 years.

But these kinds of calculations are subject to many uncertainties. One of the factors that is most uncertain is the role of dust. These tiny particles high in the stratosphere may reflect much sunlight away from the Earth and so decrease the amount of available radiant energy that warms the surface. The amount of man-made dust has become measurable, but at present is small compared to that of volcanic dust from major eruptions (see Fig. 12-16). The Earth's atmosphere, at least in historic times, has quickly recovered from a few relatively large eruptions as rainfall precipitated out the dust. It is possible, however, that an exceptionally long string of big eruptions, such as those geologists know of in the past, could have an important long-term cooling effect. The injection of much additional dust by industrial and agricultural activities over the next decades could also have an effect.

The issue is important because an increase in the average temperature of only a few degrees could lead to the melting of glacial ice, a rise in sea level, and flooding of coastal regions. Too important to be left to calculations that depend upon current uncertainties, levels of carbon dioxide and dust continue to be monitored by research laboratories so that we may better predict what will happen in the future.

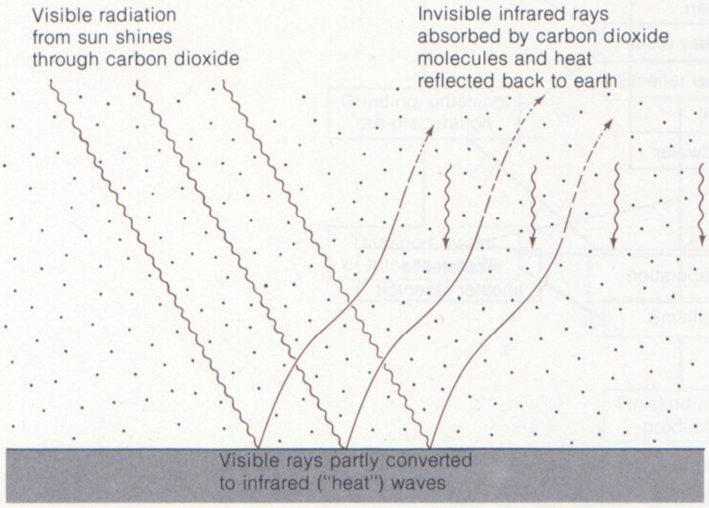

Figure 12-14
How the greenhouse effect works. Just as the glass of a greenhouse transmits light rays but holds in heat, the carbon dioxide of the atmosphere transmits visible radiation from the sun but absorbs and reflects back to Earth the infrared rays from the surface.

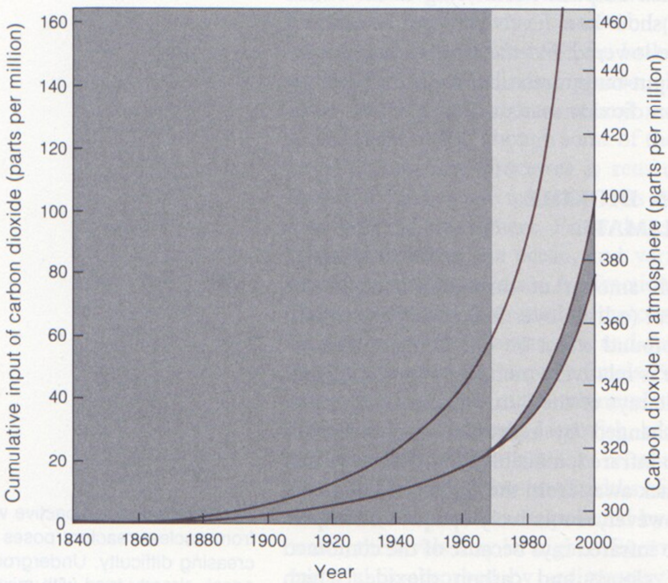

Figure 12-15
The lower curve shows the increase in atmospheric carbon dioxide since 1860, with a projection to the year 2000. The upper curve shows the cumulative input of carbon dioxide. The difference between the two curves represents the amount of carbon dioxide removed by the ocean or by additions to the total biomass of vegetation on land. [From "The Carbon Cycle" by B. Bolin. Copyright © 1970 by Scientific American, Inc. All rights reserved.]

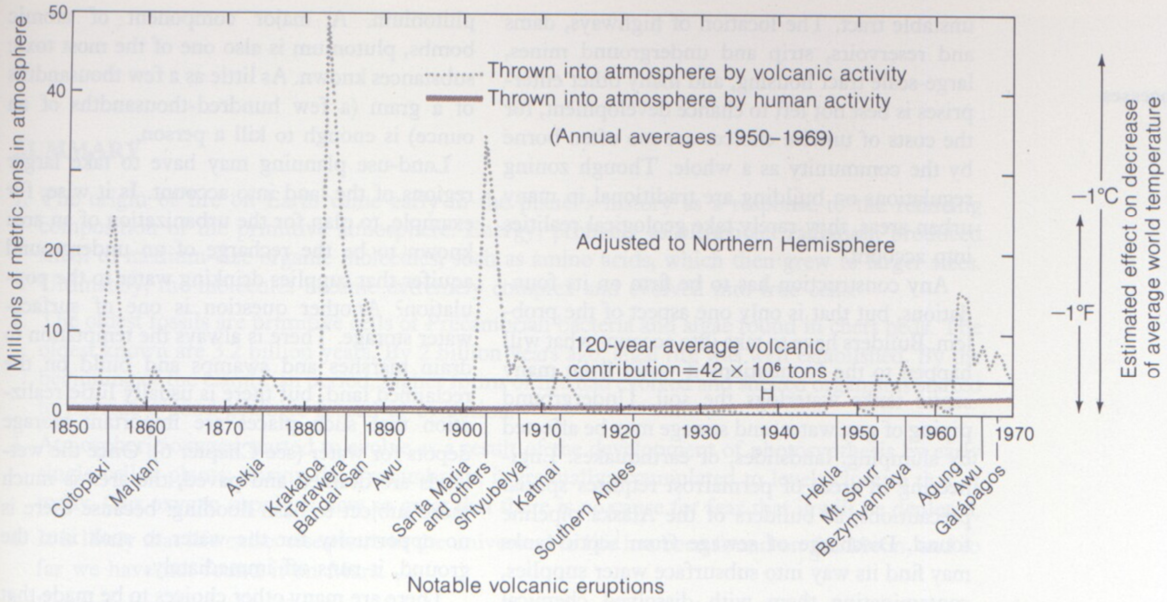

Figure 12-16
World-wide load of atmospheric dust thrown into the stratosphere by volcanic eruption since 1850 in comparison to that contributed by human activity. Peaks of volcanic activity may have an effect on world average temperature, as shown in the estimates on right side of graph. [After J. M. Mitchell, "Pollution as a Cause of the Global Temperature Fluctuation," in *Global Aspects of Pollution.* Copyright 1970 by Springer-Verlag New York, Inc.]