What Really Causes Climate Change?

by Laurence Hecht

Dynamics of Earth-Sun orbital relationships, and not statistical trends in greenhouse gases, are the principal cause of climate change, as the past 2-million-year record of Ice Ages demonstrates. Although these facts are known to every competently trained climate scientist, they do not seem ever to have penetrated the cranium of Al Gore. Consider first these items:

- Early in February, storms dumped more than 12 feet of snow on upstate Redfield, N.Y., breaking the state record of 10 feet 7 inches made just five years earlier.
- Jan. 3, 2007, a record snowfall buried Anchorage, Alaska, accumulating 57.60 inches.
- Jan. 17, 2006 a record snowfall blanketed northwest Japan, dropping more than 3 meters of snow on some areas. More than 80 people died. The snow started coming down in December, which was the coldest December for many areas since 1946.
- March 2, 2005, temperatures fell to a 100-year low in Germany. The Swiss capital of Bern registered minus 15.6 degrees celsius, its coldest for the season since data began to be collected in 1901. France beat records set in 1971.
- Jan. 5, 2001, National Oceanic and Atmospheric Administration (NOAA) scientists announced that the U.S. national temperature during the November through December two-month period was the coldest such period on record. Forty-three states within the contiguous U.S. recorded below average temperatures during the November-December period.
- Aug. 25, 1999, Mt. Baker, Washington set a record for the most snowfall ever measured in the United States in a single season (1140 inches), NOAA reported.

Thanks to a $6-billion a year government-funded "climate industry," whose mission is to convince you that global warming is here, you've probably forgotten many of these events. Yet vivid images of lonely polar bears floating on ice, and Inuits telling of warmer than usual summers, haunt your imagination. Such is the power of advertising over an audience little schooled in climate science.

No doubt, a resourceful opponent might assemble anecdotal evidence of recent warm events to counter the cases we have just presented. He might also argue that the recent decades' warming trend—that is an upward trend of about one-half degree celsius in the global averaged temperature, most of it over the oceans at night—"proves" his case.

How does the informed citizen decide? Is he forced to choose between competing trend lines, as in a typical modern investment prospectus, hoping that what is going up now will continue to rise, or what is falling, fall?

Fortunately, there is a science of climate which can tell us some things about our past, and also some things, though not all we would wish to know, about our future prospects. By the word *science,* we mean here a rational and rigorously established conception of cause. This, as opposed to the current fad of extrapolation from statistical trend lines, a fad which has become as wildly popular in the global warming as in the hedge funds industry. (Indeed, present trends cannot predict which of these two sources of high-paid employment for the statistically inclined shall disappear first.)

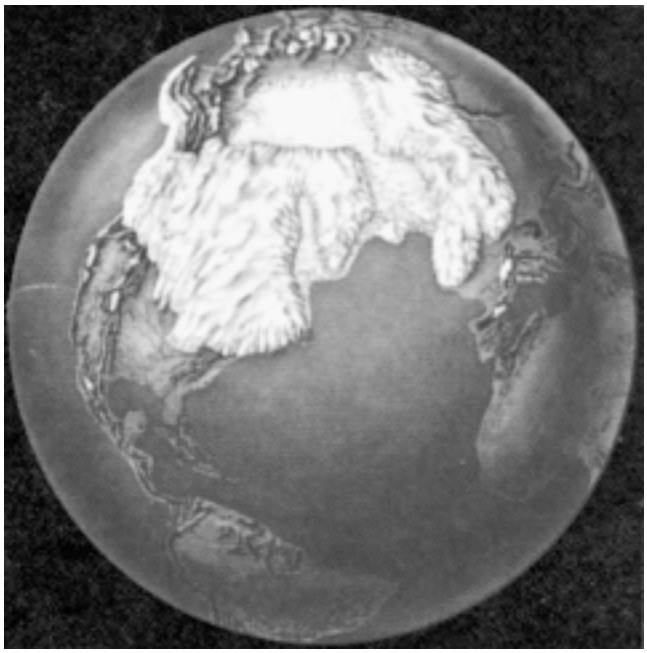
We Are in an Ice Age

Just 12,000 years ago, the North American continent was covered by a sheet of ice, from 1 to 2 miles thick, reaching down to New York City, and spreading across Pennsylvania, through Ohio, Indiana, Illinois, and into the prairie states. Tongues of the glacier reached down from the Rocky Mountains and Appalachian heights at much more southerly locations. As the glacier retreated in the period from approximately 10,000 to 8,000 B.C. the landscape we now know was formed—the Great Lakes, the upper Ohio and Missouri Rivers, the lakes dotting the northern tier, all of which had been buried under ice for 100,000 years. A similar situation prevailed over northern Europe and Russia, with the difference that the ice had retreated about 1,000 years earlier than the North American Laurentide ice sheet.[1]

The huge volume of water tied up in these ice sheets had come mostly from the oceans. Sea levels during the period of extended glaciation were 200 to 400 feet lower than today's, as the recent evidence of ancient cities found underwater off the Indian coastline has again confirmed.

We know these things from the work of geologists and

1. Laurence Hecht, "The Coming (or Present) Ice Age," *21st Century Science & Technology,* Winter 1993-1994, pp. 22-35. www.21stcenturysciencetech.com/Articles%202005/ComingPresentIceAge.pdf



Anastasia Sotiropoulos, based on CLIMAP

The Northern Hemisphere at the time of the last glacial climax, about 18,000 years ago.

other specialists over the past two centuries. Most of what we report here was known by the early decades of the 20th Century. Correlation and cross-checking of evidence from North America and Eurasia first showed the simultaneous existence of these huge ice sheets. But soon, new evidence established that there had been not one, but several periods of Northern Hemisphere glaciation.

Today we know that in the last 800,000 years, eight successive periods of glaciation, each lasting approximately 100,000 years, have occurred. Between many of these glaciations there occurred a warming period, known as an *interglacial* and lasting approximately 10,000 to 12,000 years, during which the ice retreated back to its resting place in Greenland and the polar regions. All the while, the continent of Antarctica remained covered in ice, as it still does today, holding now about 90% of the world's ice at an average thickness of one and-a-quarter miles.

The Astronomical Determination

What was causing the periodic advance and retreat of the glaciers? In 1910, Vladimir Köppen (1846-1940), a Russian-German meteorologist trained in planetary astronomy and very much acquainted with the work of Kepler, had been musing over the work of two Alpine glaciologists. In their extensive field studies, Albrecht Penck and Eduard Brückner had identified four separate cycles of glacial advance and retreat in the Alps. To try to make sense of their work, Köppen took up a hyothesis that had been first proposed in 1830 by Sir John Herschel, that long-term cyclical variations in the Earth's orbital relationship to the Sun would produce changes in the amount of solar radiation reaching the Earth.

At almost the same time, a skilled mathematician from the University of Belgrade, Milutin Milankovitch (1879-1958), had independently begun his own investigation of the astronomical theory of climate. In 1920, after nine years of work, Milankovitch published a book in the French language, *The Mathematical Theory of Heat Phenomena Produced by Solar Radiation.* Therein he identified the three major cyclical variables which, some 50 years later, became indisputably recognized as the principal cause of climate change. When Köppen read the book, he sent a postcard to Milankovitch, and a collaboration developed among the two, and Köppen's son-in-law, the astronomer-geologist and daring polar explorer, Alfred Wegener.

The essential point of their work was this: The amount of solar radiation (insolation) reaching the Earth, depends upon the distance of the Earth from the Sun and on the angle of incidence of the Sun's rays upon the Earth's surface. These angles and distances vary over long cycles of tens of thousands of years.

For a glacier to grow, it is only necessary that the amount of snow and ice accumulated over the Winter season not be melted back by the Sun's rays during the warmer months. In the short, cool summers of the high polar latitudes, there may or may not be enough solar radiation to melt back the winter's accumulation. The small changes in insolation, produced by the changing orbital relationships, it was thought, might be just enough to change the delicate balance of glacial stability to one of advance. Once the advance starts, the increased reflectivity of the ice surface, as compared to sea or land cover, cools the local atmosphere further and causes a self-feeding process of glacial growth and spread. This might explain the cycles of the Ice Ages.

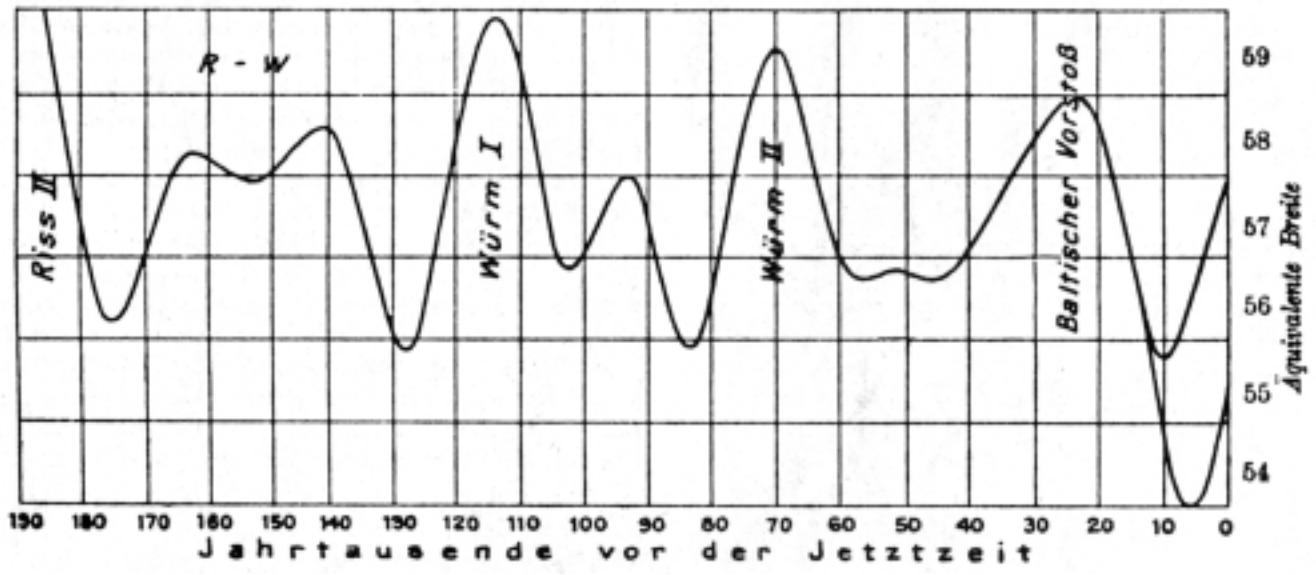
To give an example: As every schoolchild learns, the yearly variation of the seasons is not caused by the change in the Earth's distance from the Sun, but by the inclination of the Earth's axis, which causes the Sun's rays to strike the Earth at an oblique angle, in a manner that varies as the Earth makes its annual path of revolution about the Sun. Were there no axial inclination, there would be no difference of seasons and a much slighter variation in temperature from the Equator to the high latitudes. But the Earth's axial tilt, known technically as the obliquity of the ecliptic, changes on a 40,000-year cycle from 22 to 24.5 degrees. The more inclined the Earth is, the more extreme are the variations between Summer and Winter, particularly in the high northern latitudes where the cycle of glaciation is to be triggered.

Apart from obliquity, two other astronomical cycles which affect insolation were known:

- the 26,000-year period of the precession of the equinox, which, when combined with the advance of the perihelion (the point at which the Earth is closest in its orbit to the Sun) produces a 21,000-year cycle;
- the 90,000 to 100,000-year cycle of variation of the

FIGURE 1

Milankovitch's Radiation Curve for the Last 190,000 Years



This curve of the fluctuation in intensity of solar radiation over time, depending on the orbital parameters, was reproduced by Köppen and Wegener in their pioneering work, Die Klimate der geologischen Vorzeit (The Climates of the Geological Past), published in 1924.

eccentricity of the Earth's elliptical orbit.

At the encouragement of Köppen, Milankovitch calculated the effect of the three astronomical cycles on Northern Hemisphere glaciation for 650,000 years into the past and 160,000 years into the future. This came to be known as the Milankovitch-cycle theory of climatic history. Although Milankovitch was still fighting an uphill battle at the time of his death in 1958, within two decades his general theory had become widely accepted.

Pacemaker of the Ice Ages

Much of the corroborating evidence came from the field of paleobiology. An innovative technique of estimating the sea level temperature came from the field of nuclear isotope science. Since the 19th Century, biologists had observed small sea creatures known as foraminifera, which thrive near the ocean surface, form calcareous shells, and die, depositing their fossil shells on the ocean bed in layers known as the *Globigerina ooze.* The ratio of two stable isotopes of oxygen, oxygen-16 and oxygen-18, is very sensitive to the temperature of the sea water in which it is dissolved. The temperature of sea water at a given time could thus be inferred from the relative proportion of these two oxygen isotopes found in the carbonate shells of these fossilized sea creatures. Analysis, by these and other means, of deep-sea core samples taken in the 1970s showed the Milankovitch periodicities of 20,000, 40,000, and 100,000 years, going back for 1.7 million years.

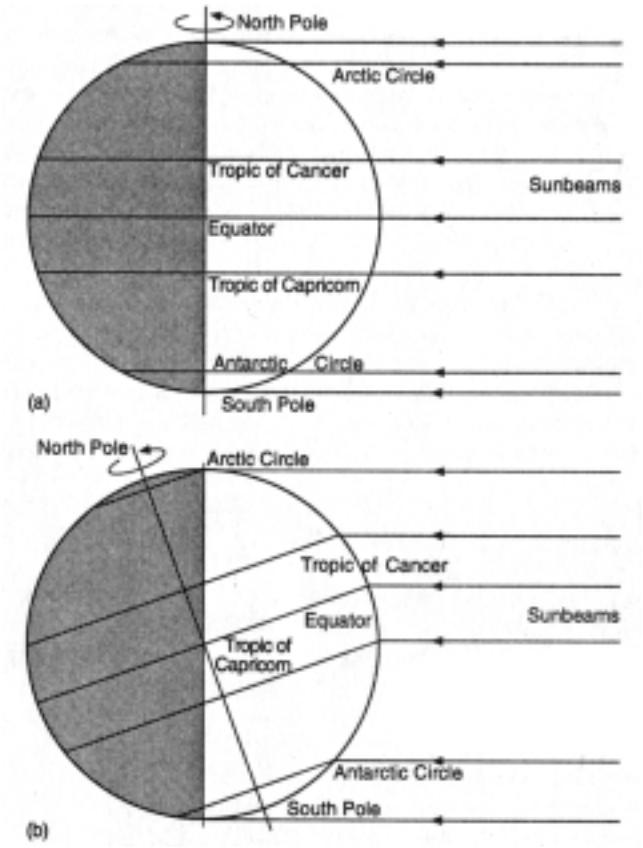
The results were written up in a famous paper by three young researchers at Columbia University's Lamont-Doherty Geological Laboratory.[2] There, Hays, Imbrie, and Shackleton described the orbital variations as "pacemakers of the Ice Ages." The 100,000-year cycle was found to be the strongest, a fact which correlated with other evidence suggesting that the Northern Hemisphere ice sheets had advanced and retreated on a 100,000-year cycle. Within that long cycle, the evidence showed a 20,000-year cycle of temperature change, which was not sufficient to cause full glacial retreat. However when the two cycles compounded, sometimes amplified by low points in the 40,000-year cycle of obliquity, an interglacial would occur. The ice sheet would melt back and retreat up to Greenland and far northerly locations. It would be reversed when the 20,000-year cycle of precession of the equinox reached its maximum, and a new glaciation would initiate.

The astounding thing about this confirmation of the Koppen-Wegener-Milankovitch hypothesis, is that it indicates that we are set for a new advance of the ice sheet. We are now about 11,000 to 12,000 years into the recent interglacial. Obliquity is relatively high at 23.5 degrees, and the Northern Hemisphere Summer is occurring near the point of aphelion, precisely the conditions of reduction in insolation which would tend to produce the onset of a glacial event. The only moderating factor among the astronomical determinants is the eccentricity, which is relatively low. Were the orbital per-

2. J.D. Hays, J. Imbrie, and N.J. Shackelton, 1976. "Variations in the Earth's Orbit: Pacemaker of the Ice Ages," *Science,* Vol. 194, pp. 1121-32.

FIGURE 2

Obliquity and Intensity of the Sun's Rays



Even without a tilt of the axis, the variation in angle of incidence of the Sun's rays (a) would cause the poles to be cooler. Increasing the angle of obliquity amplifies the effect (b).

FIGURE 3

Precession and Location of the Solstice

The precession cycle changes the location on the ellipse where the Winter and Summer solstices occur. The Summer solstice now occurs near aphelion, the point at which the Earth is most distant from the Sun.

turbations the *sole cause* of the glacial cycle, we should be seeing an ice sheet begin to creep across our high northern latitudes even now. Perhaps we shall.

However, as Milankovitch himself had already recognized, the variations in insolation produced by the orbital changes are not enough, *in themselves,* to drive the enormous shift in climate which a glacial onset represents. The orbital variations must rather be a pacemaker, a pre-amplifier perhaps, which drives, or signals, other events still not known. Many climatologists have attempted to find those other factors, and a large and interesting literature on the subject exists, much of it compiled by the late Columbia University Professor Rhodes Fairbridge when he edited the *Encyclopedia of Earth Sciences.*

Attempts include such far-reaching, yet plausible causes as changes in the Saturn-Jupiter alignment affecting tectonic shifts in the Earth's mantle, the effect of variations in the solar wind on weather systems by mediation of changes in cosmic radiation, volcanic activity, and shifts in Earth's magnetic cycles. A large literature also exists on the effect of shorter-term, cyclical variations in the Sun's output, which may act as an amplifier of other cycles.[3] The most popular theory today proposes that shifts in the thermohaline circulation, the global ocean current which circulates cold water from the north Atlantic around the cape of Africa to the northeastern Pacific, may be the trigger for the sudden changes which bring on the Ice Ages.

Of all the hypotheses, that of human-produced carbon dioxide as the forcing mechanism for warming is the most deeply and extensively studied, and by far the most discredited. No other hypothesis rests on such flagrant and lying disrespect for data as that illustrated in our accompanying piece on the falsification of the historical CO_2 record. Dollar for dollar, the American taxpayer has never gotten so little and spent so much as on the government's promotion of the hoax known as global warming. NASA Administrator Mike Griffin had the courage to say it. In an interview with the German daily *Frankfurter Allgemeine Zeitung* Jan. 26, Griffin said that despite an annual investment of $5.5 billion in research on planet Earth, "we have yet to find out whether the present climate change is man-made, or just a short-term vacillation."

The finely tailored suit of global warming has been woven with an invisible silk thread. It is time that Congress and the American people face up to it, lest they find themselves both naked and freezing.

3. For example, the work of Theodore Landscheidt.