SCIENCE

Stardust And Ice Ages

BY JIM WILSON, Science/Technology Editor

RON SANFORD/THE STOCK MARKET PHOTO

● Geology has never been a particularly mysterious science. While earthquakes, volcanoes and avalanches may be spectacular, the processes that drive them can be explained in terms of basic 19th-century mechanics. More recently, supercomputers have taken the drama out of prospecting for ore and energy. Their ability to crunch seismic-analysis data has reduced the risk of hitting pay dirt from a sporting to a business proposition. It now appears that geology's last mystery—ice ages—has been solved as well. The cause of these frosty cataclysms turns out to be dust—not just any dust, but stardust.

Planet Earth is currently enjoying a sort of cosmic summer vacation. Called "interglacials," these relatively warm periods have, over the past 2 million years, occurred almost exactly every 100,000 years. The last ice age began about 70,000 years ago as the Earth's average temperature dropped between 5° and 8° F. It ended around 10,000 years ago, leaving a variety of geologic calling cards behind withdrawing ice sheets, including house-size boulders in otherwise empty fields.

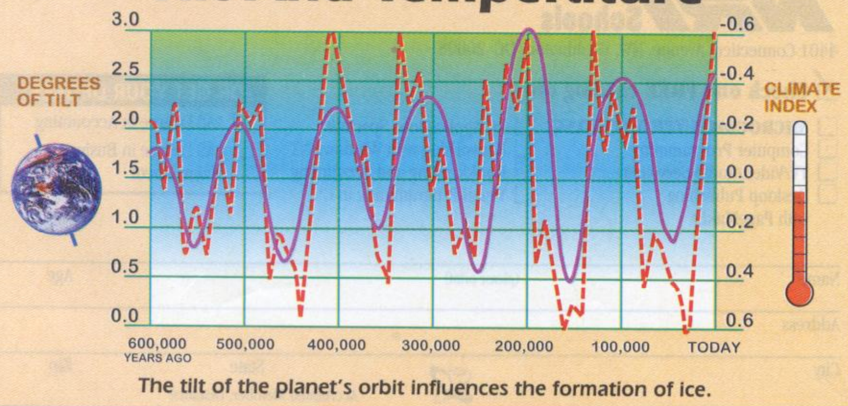
Because ice ages leave so much evidence, geologists were long ago able to reach two conclusions about the nature of these global events. The first is that they have occurred on and off for at least 70 million years, perhaps longer. Second, and most puzzling, within the past 2 million years—a mere tick on the clock in terms of geologic time—they began repeating every 100,000 years.

These sort of patterns spark the curiosity of geologists the way a newly discovered fingerprint swirl ignites the imagination of a detective examining an inconclusively closed case. In the case of ice ages, the generally accepted explanation for their origin was the Milankovitch cycles theory. It originated in the 1920s, when Milutin Milankovitch, a geologist from the country that had just become Yugoslavia, noticed an apparent overlap among minor variations in the Earth's orbit, the angle of the planet's poles in relation to the Sun and the geologic changes that signaled the beginnings and ends of ice ages. The match was not perfect, but at the time it was considered the best possible explanation for the geologic mystery.

Since then, planetary scientists have learned a good deal more about the actual influence of various factors on solar input. About three years ago, geologists, including Gordon MacDonald of the University of California at San Diego, had begun rethinking the Milankovitch cycles theory. Their loss of faith had been prompted by improved measurement techniques that showed that only the tilt of the Earth's orbit corresponded with ice ages. The trouble was that this modification produced an insufficient change in solar input to give ice sheets their marching orders.

MacDonald mentioned this puzzle to his friend Richard A. Muller, a physicist at the University of California's Berkeley National Laboratory. Muller took up the hunt by measuring the tilt of the plane of Earth's orbit in relation to the larger plane of Jupiter's orbit. A crude but useful way to visualize this is to imagine the Sun as the hub of a car wheel, the plane of Jupiter's orbit extending to the sidewall of the tire and the plane of Earth's orbit as the hubcap. Simply

Tilt And Temperature



The tilt of the planet's orbit influences the formation of ice.

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