

## Conflicting reports on climate change

Climatologists have for some time been saying that the Northern Hemisphere is cooling down and that this might cause a new ice age (SN: 3/1/75, p. 138). Three new studies offer conflicting views on the controversy.

National Oceanic and Atmospheric Administration scientists Donald R. Wiesnet and Michael Matson report that after studying satellite records of the Northern Hemisphere snow cover, they find a "lack of systematic increase" that would presumably accompany a cooling trend. Photographs and radiometer readings from NOAA satellites begun in 1966 show no significant change in the North American snow cover and only a small fluctuation in the Eurasian snow cover, which peaked in the winters of 1971-72.

Wiesnet and Matson say their findings tend to "contradict the evidence presented by some proponents of climatic change that the current climate is changing adversely with attendant cool hemisphere temperatures and harsh winters." The lack of a deteriorating trend "should perhaps be encouraging to energy conservationists," they conclude.

The exact opposite conclusion—that a cooling trend is indeed present—is supported by a research group at the Lawrence Livermore Laboratory that has developed a computer model of the climate that not only predicts the cooling effect, but offers an explanation. In the Dec. 23 NATURE, the group reports that their model predicts a 0.2 degree C. drop in temperature largely due to removal of tropical rain forests.

These forests cover 34 percent of the land area lying within five degrees of the equator, and extensive deforestation has taken place recently because of the need for firewood (SN: 9/27/75, p. 198). The mechanism involved is apparently a reduction of the latent heat normally released when rain is formed from vapor—the process that helps drive global air circulation, transferring heat and moisture from the tropics to the temperate zones. The reduction stems from an increased reflectivity of the tropical ground. (Barren land absorbs less sunlight than forest.) As the air currents become cooler and dryer, rainfall should decrease at the equator, and global temperatures fall. The authors say their study confirms a climate modeling experiment done by NASA.

Finally, from Rice University comes an interim report on research being conducted by geologist John A.S. Adams, who says the widespread burning of wood may be releasing much more carbon dioxide into the atmosphere than previously estimated and that the ability of remaining trees to reabsorb the gas is concurrently decreasing. Carbon dioxide content of the atmosphere has increased 15 percent over the last century, he says.



Computer-enhanced satellite picture of North America shows winter snow cover.

This may affect the climate in unknown ways, and how much of this increase comes from wood burning, as opposed to other fossil fuels, is hard to say. Adams is now beginning quantitative studies to find out. □

## Ozone drop supports depletion theory

The largest solar proton event in recorded history has provided the first natural confirmation that photochemical events can cause an abrupt and significant decrease in stratospheric ozone. This confirmation adds considerable weight to the evidence mounting in the controversy over ozone depletion by fluorocarbons. The researcher who presented this data calls it "the experiment that nature did for us."

Paul J. Crutzen of the National Oceanic and Atmospheric Administration at Boulder, Colo., described this "natural experiment" to the 12th International Symposium on Free Radicals meeting in Laguna Beach, Calif., last week. He was assisted in the analysis of the solar proton event by Donald Heath and Arlin Krueger of the NASA Goddard Space Flight Center.

In August 1972, an enormous solar flare caused the production of a large quantity of energetic protons—the largest quantity yet recorded. These entered the earth's atmosphere through the polar regions, since the planet's magnetic field would deflect them at lower latitudes. These energetic protons produce fluxes of secondary electrons, Crutzen says, that dissociate nitrogen gas ( $N_2$ ) and cause nitric oxide (NO) to form. This NO, in turn, attacks and depletes ozone in the upper stratosphere.

Crutzen predicted last summer that an ozone decrease should have occurred immediately after the August 1972 solar proton event. But the confirmation itself

was provided by data from a Nimbus 4 weather satellite which was measuring and recording ozone concentrations at the time. Heath and Krueger retrieved and analyzed the satellite data from a NASA computer. Crutzen had predicted that the increased production of NO would cause an ozone depletion of 15 to 20 percent over the North Pole. The Nimbus satellite measured 16 percent.

"The important thing about this particular event," Crutzen says, "besides it being a natural confirmation of the NO photochemical models, is that we predicted a large depletion in ozone and saw it." Symposium co-chairman F. Sherwood Rowland, a physical chemist at the University of California at Irvine and the first to propose the fluorocarbon-ozone depletion theory (SN: 9/21/74, p. 180), was equally enthusiastic.

"People keep telling us 'If there are really effects on the ozone layer by chemicals from aerosol cans or SST's, show us where a chemical injection into the stratosphere has caused a problem.' Crutzen predicted a measurable effect from NO and it was there." Besides this, Rowland says, the effect was discontinuous.

This means, Crutzen says, that after the ozone level dropped, it remained at this new lower level for a while. "This is exactly what one would expect." The drop in ozone would stay constant until the source of depletion, the NO, was removed from the polar region by air currents. This discontinuous effect shows, among other things, that there is no immediate "atmospheric sink" for the reactive chemicals. This point has been disputed during the SST debates, which focus on reactive nitrogen species, and during the fluorocarbon debates, which focus on reactive chlorine species (SN: 5/17/75, p. 322). Following NO dispersal, the overall effect of the NO on the earth's ozone layer should be about a one percent decrease, Crutzen says, and those data are now being analyzed. □

## Graduate science enrollments up

For the second year in a row, graduate science enrollments are up, according to a study from the National Science Foundation. A national sample of graduate science departments indicates that full-time graduate enrollments in Ph.D.-granting institutions increased about 4 percent between fall 1974 and fall 1975, after increasing nearly 5 percent the previous year. The turnaround in enrollment that began in 1973 came after a five-year decline.

The life sciences alone have shown continued growth in full-time graduate enrollment since 1971, with the greatest increases occurring in 1974 (10 percent) and 1975 (8 percent). The decline in social