NAS Warning on Climate Changes

A new report by the National Academy of Sciences warns that this century's warm climate is "highly abnormal," viewed from a historical perspective and that a transition to colder conditions may already have begun. Since any such change would have a deleterious effect on agriculture, the report urges a sweeping new research program to assess possible effects.

Much is already known about the past history of climate changes, but regular patterns are hard to discern and possible causes of the variations remain a mystery. Judging from the data available, however, the current period seems particularly benign: We live in the warmest century of the last millenium, during the warmest 10,000-year period out of the last million years. The annual mean temperature of the Northern Hemisphere apparently reached a peak in 1940 and has been dropping rapidly ever since—by about half a degree Celsius overall, with yearly fluctuations of about 0.1 degree C.

What this means depends on how one interprets the cyclic nature of past climate changes. Some patterns are well established: Major ice ages, during which temperatures may drop as much as 8 degrees C., come every 100,000 years, and the present "Holocene" interglacial (warm) period began only about 10,000 years ago, so that such a large change does not yet seem likely. Besides, these great glacial epochs develop rather slowly.

Within these great epochs are two other fairly well-established cycles of 20,000 years and 2,500 years duration, involving temperature changes of 3 and 2 degrees, respectively. The shorter of these cycles appears to have reached its most recent nadir in the "little ice age" from 1430 to 1850, and paintings of the time show glaciers in the French Alps extending down whole mountainsides that today are covered with trees. While we are thus in an upward swing of the shorter cycle, we may just now be approaching the end of a warm period in the longer one, and with considerable understatement the NAS report notes that "the question naturally arises as to whether we are indeed on the brink of a [10,000-year] period of colder climate."

For a while, anyway, still shorter—but far less predictable—variations will dominate. These fluctuations of temperature amount only to a degree or so, but they can strike in a matter of decades. Though continents would not be covered with ice during these changes, agriculture could be seriously disrupted. During the general warming trend in the first part of this century, the growing season in England increased by two to three weeks; already, in the cooling since 1940, a comparable shortening has occurred. In the "little ice age," traditional grains died out in Iceland.

The potential for catastrophe arises because of the population increase and concentration of agriculture that has occurred during the recent warm period. Temperature changes determine not only growing seasons but rain patterns and the need for fuel, as well. And with food shortages already occurring, the prospect of climate-induced crop deterioration raises the possibility of widespread disaster. Concludes the report: "As we approach the full utilization of the water, land and air, which supply our food and receive our wastes, we are becoming increasingly dependent on the stability of the present . . . [unusually warm] climate."

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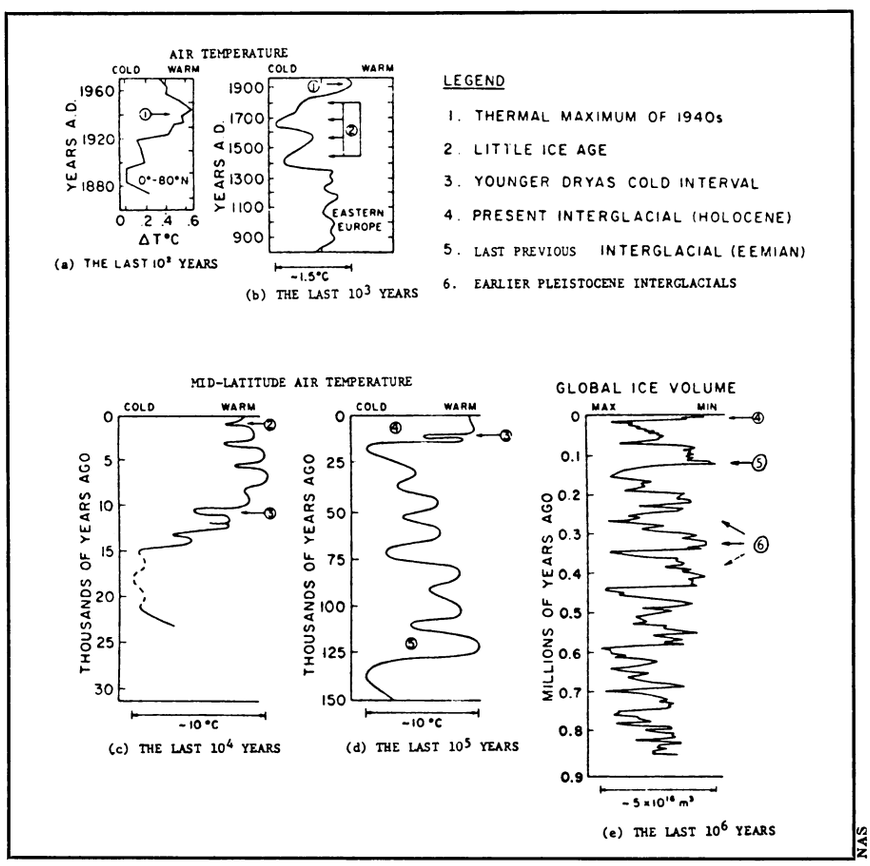
In addition to natural forces, a new effect may threaten climatic stability—pollution. Carbon dioxide tends to increase temperatures because it helps the earth retain solar heat; particles of dust or aerosols tend to cool the earth by scattering the sun's light. If both continue to grow at about four percent



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Trends in global climate from recent times to a million years ago. Regular cycles of 100,000 years, 20,000 years and 2,500 years duration are evident.

a year, the report estimates, carbon dioxide loading could raise the earth's temperature by as much as half a degree by the end of the century, but particulates would become increasingly important because they stay in the atmosphere longer. Two other competing man-made influences must also be considered: The report cites studies which indicate that direct heating of the atmosphere by human industry will approach one percent of the effective solar heating by the middle of the next century, but that artificially created clouds and increased reflection from man-made lakes could cause a competing cooling influence.

Clearly more research is needed into the causes of natural climatic change and the effects of human pollution. The academy's Committee on Climatic Variation, which drew up the current report, concludes that the present annual expenditure of $18 million on this research should be increased to some $67 million over the next five years. The funds would be used to increase monitoring of present atmospheric changes, analysis of the various records that tell climatic history, more use of computers to stimulate climatic conditions, empirical and theoretical studies into the mechanisms of change, and an attempt to predict future changes and the impact these would have on humanity.

Fortunately, two new tools have been developed that should allow research to progress much faster than would have been possible even a few years ago. Meteorological satellites, says the report, represent an "observational breakthrough" that will allow direct, continuous measurement of ice-pack changes, the amount of particulate pollution, vertical distribution of temperature and moisture, and estimate the overall "radiation budget"—the amount of solar energy absorbed or reflected. A second, "computational breakthrough" results from development of "gang" computers, like Illiac IV (SN: 10/13/73, p. 236), which will accept greatly increased amounts of data for integration in increasingly sophisticated numerical models of climatic change. Over the next five years, the need for computing time for use in climatic modeling is expected to increase elevenfold.

But the challenge will be immense. With present skills, the experimental "long-range" forecasts of temperature anomalies—covering a period of just 30 days—run only 11 percent better than chance. For precipitation, they run only two percent better. Yet large new expenditures to find ways of predicting variations over periods of years must be found, for in the words of the report: "We simply cannot afford to be unprepared for either a natural or man-made climatic catastrophe." □

Saccharin study: No substitute for data

After a two-and-one-half-year study on the possible carcinogenicity of the non-nutritive sweetener saccharin, a National Academy of Sciences *ad hoc* subcommittee has come to an agreement and issued a report. The conclusion: Back to the lab bench for more data. The lessons of the "cyclamate fiasco," in the words of one academy scientist, have apparently sunken in and no one is making hasty decisions.

Researchers at the Wisconsin Alumni Research Foundation Institute (WARF) reported in 1971 that some rats developed bladder tumors after a two-year diet containing five percent saccharin. The Food and Drug Administration at that time removed saccharin from the list of food additives "generally recognized as safe," and placed restrictions on its use. These included limiting it to its then-current uses and recommending a maximum adult consumption of one gram per day. Americans were consuming about 4.2 million pounds of saccharin at that time, 70 percent of it in soft drinks.

Under a contract from the FDA, the NAS subcommittee in 1972 began its evaluation of the existing data on saccharin safety. They reviewed the WARF data, FDA studies which also reported bladder tumor formation in rats fed high saccharin levels, and other studies on the metabolism of saccharin and its effects on reproduction, birth defects and tissue changes. They concluded that although the WARF and FDA studies do show tumor formation at high saccharin levels, the sweetener itself cannot be blamed on the basis of existing data.

NAS subcommittee chairman Julius M. Coon of Thomas Jefferson University in Philadelphia told SCIENCE NEWS the critical issue is whether saccharin as a pure chemical induces the tumors. Test animals have been fed commercially produced saccharin that often contains contaminants, including 200 to 5,000 parts per million of orthotoluenesulfonamide (OTS), a volatile chemical sometimes used in making plastics. "OTS has not been proven to be a bladder tumorigen," Coon says, but it is under study now and there is some evidence of its role in bladder tumor formation.

Other major questions left unanswered by existing studies, the subcommittee states, are: The role of saccharin and its impurities in transplacental carcinogenesis; the role of bladder stones and parasites (found in some of the test animals) in tumor induction; the possibility of changes in urine at high saccharin levels that might cause the induction of tumors, and the effects of saccharin on humans consuming low levels over long periods of time.

The subcommittee delayed reporting its evaluations for several months waiting for the results of a long-term epidemiological study being conducted at Oxford University. The Oxford group is studying the incidence of cancer in diabetics, and unlike other studies, their investigation includes information on the exact amount of saccharin the patients consume. The report, however, has not yet been released.

The FDA currently is studying the NAS report and will decide whether or not to remove saccharin from its interim regulation status. It seems unlikely, however, that this action will be taken until some of the subcommittee's questions are answered.

Comparing the current evaluation of saccharin to the Government's action on cyclamate, Coon says, "The cyclamate action was very hasty and people didn't sit back and take a cool look at the whole problem." The evidence against saccharin "is actually a lot better than that against cyclamates," he says, but this time, more conclusive evidence will be gathered before anyone takes quick action. □

Acetylcholine and muscle contraction

In 1936, a chemical was discovered that appeared to play a major role in muscle contraction. It was produced at the ends of nerves and depolarized the membranes of innervated muscle cells so that the cells contracted. The chemical was acetylcholine. Since then, there has been increasing evidence that acetylcholine is the nerve chemical that triggers muscle contraction. The strongest evidence to date comes from Daniel M. Michaelson and Michael A. Raftery, chemical biologists with the California Institute of Technology. They report their findings in the December PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

In 1972, Raftery and Jacob Schmidt, also with Caltech, purified a macromolecule from the membrane of the muscle cell that serves as a receptor for acetylcholine. Last year, Gerald L. Hazelbauer and Jean-Pierre Changeux, molecular biologists with Pasteur Institute in Paris, showed that membrane fragments from the muscle cell contain all the molecular apparatus necessary for acetylcholine recognition and ion translocation. But still this question remained: Since the membrane fragments contained protein components other than the acetylcholine receptor, was the receptor alone responsible for acetylcholine recognition and ion trans-