

Man's impact on climate: What is ahead?

The SMIC international study avoids predictions of doom, but nevertheless foresees a potential for drastic effects of man's activities

For thousands of years, man's activities have had a profound influence on large parts of the earth's surface, and changes he has wrought have very likely resulted in changes of climate. Grazing of domestic animals, for example, has reduced parts of Africa and Asia to semi-deserts. It is only recently, however, that man's effect on climate has become apparent enough to arouse real concern. The subject is one in which misinformation, lack of information, and considerable speculation often combine to confuse rather than clarify.

To help place things in perspective, 30 prominent meteorologists from 14 nations met in Stockholm for three weeks, from June 28 to July 16. This Study of Man's Impact on Climate (SMIC), sponsored by the Massachusetts Institute of Technology, has resulted in specific recommendations for further study to prevent climatic catastrophe. Drs. Carroll L. Wilson and William H. Matthews of Massachusetts Institute of Technology directed the study. Drs. William W. Kellogg of the National Center for Atmospheric Research and G. D. Robinson of the Center for the Environment and Man in Hartford, Conn., were scientific coordinators.

At the outset, the SMIC participants point out that, apart from man's influence, the world climate is far from static; there have been dramatic natural fluctuations and, in fact, we are now living in an anomalously cold period. "Manmade effects will be obscured by the natural changes that we know must be occurring."

Pollution of the atmosphere is one of the most obvious effects of man on his environment. Industrial activity and the burning of waste crops and vegetation practiced in many tropical areas have added to the particle load, either directly or by injection of gases such as sulfur dioxide that react in the atmosphere to form particles. These particles scatter and absorb solar radiation, affecting the heat balance over wide areas and modifying precipitation. The SMIC scientists found that current estimates of the total particle population, the proportions existing in various locations, and the contributions from various sources vary greatly. Unable to resolve these differences, they recommend, among other things, better figures on global production rates

of particles and trace gases that may form particles, studies of the transformation of gases to particles, and monitoring global distribution and time trends of particles.

Carbon dioxide, a by-product of combustion of fossil fuels, is accumulating in the atmosphere at a rate of about 0.2 percent a year. It is estimated that the carbon dioxide content of the atmosphere will rise by 20 percent by the year 2000 A.D. One recent study had predicted that even large increases of carbon dioxide in the atmosphere would not produce dangerous temperature increases (SN: 7/17/71, p. 39). The SMIC recommends monitoring carbon dioxide at about 10 stations.

Until recently it has been assumed that man could not compete with nature in the release of heat on a large scale, but human production of energy



of all sorts, the study concludes, is rising at a rate of from five to six percent per year. "There may eventually be industrialized areas of 1,000 to 100,000 square kilometers where the additional input of energy by man will be equivalent to the net radiation from the sun."

Changes in surface features can also affect climate. The most sensitive feature, according to the SMIC scientists, appears to be ice and snow, particularly Arctic sea ice, because of the large changes in earth's reflectivity that would accompany a change in size of the ice cover and because of the relative ease of modification. Over the next century, the scientists believe, there is a real possibility that a global temperature increase produced by man's injection of heat and carbon dioxide into his envi-

ronment may lead to dramatic reduction or even elimination of Arctic sea ice. The melting of the ice would not affect ocean levels, but the changes in climate that would occur might include major changes in precipitation, seasonal temperatures, wind systems and ocean currents.

A major study aimed at understanding the behavior of Arctic sea ice is now under way (see p. 80), and the SMIC recommends an international agreement to prevent large-scale experiments in persistent or long-term climate modification until the scientific community agrees on the consequences of the modification. The scientists also recommend a census of such sensitive indicators of the state of the climate as Arctic sea ice, glacier mass and sea level, as well as the intensity of human activities likely to influence climate, such as fuel consumption.

Accurate assessment of the effects of man's activities, however, will have to await development of accurate models of world climate. "We now know enough of the theory of climate and the construction of climatic models to recognize the possibility of manmade climatic changes and to have some confidence in our ability ultimately to compute their magnitude." The meteorologists recommend development of improved atmosphere-ocean models that incorporate effects of cloudiness, sea ice, snow cover, particles in the atmosphere, and exchange of heat, moisture and momentum at the sea-air interface (SN: 5/30/70, p. 533). To fill in the blanks in these models, there should be: monitoring of the temporal and geographical variation of albedo and outgoing heat flux with an accuracy of at least one percent; monitoring of the global distribution of cloudiness, polar ice and snow cover; and studies of the distribution and properties of particles.

In the final analysis, the group recognizes that, in speaking about the future of man and his climate, we are faced with two classes of consideration—meteorological and social. Predictions of future climate will depend on predictions of man's future behavior—a knotty problem. "Therefore we can in the end only forecast what could happen if mankind proceeds to act in a certain way, more or less as he is acting now." □