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Global Weather

Man is changing the earth's atmosphere. Most obvious is the increasing concentration of carbon dioxide. If present trends of release continue until the year 2000, global atmospheric temperatures could be increased, through a greenhouse effect, by as much as 4°C. Potentially more serious are effects we cannot now foresee or evaluate. The atmosphere has intrinsic tendencies toward instability. Thus, in tropical latitudes a gentle breeze can develop into a destructive hurricane in a few days. Other weather patterns persist for months but suddenly give way to new patterns. On a still longer time scale, weather was mild in the period around A.D. 1100 and severe around A.D. 1600.

New developments in science and technology promise a better understanding of the weather and the effects man may have in his efforts to alter it. These developments were the subject of a major presentation by Thomas F. Malone and of a symposium* at the recent annual meeting of the AAAS. Some major developments were cited. (i) Understanding of the physical processes occurring in the atmosphere has progressed to the point where the behavior can be approximated by mathematical models. (ii) Computers now under development will have sufficient speed and memory to permit realistic simulation of world-wide weather and to determine consequences, to the atmosphere, of human intervention. (iii) Capabilities exist for observing and measuring atmospheric conditions on a global scale in unprecedented detail.

Development of earth-orbiting satellites for useful purposes is being effectively pursued. As weather-observing platforms, satellites have many desirable features. They are able to view the atmosphere as a global phenomenon. A satellite in polar orbit can examine every point on the earth periodically, and at intervals of as little as 12 hours.

For the most part, satellites measure phenomena occurring far beneath them. The greatest success to date has been in photography of cloud cover. Temperature observations have also been made of surfaces, cloud tops, tops of moist layers, and the stratosphere. Additional means of measuring important aspects of the weather will become available as various portions of the electromagnetic spectrum are linked to atmospheric processes.

Satellites may be used in another important way: as data collectors. In principle, a satellite in polar orbit can interrogate each of thousands of remote sensors at intervals of 12 hours.These sensors can be of various forms—for example, buoys in the oceans. Information from different altitudes in the atmosphere is particularly desired. Global coverage on a spacing of, for example, 500 kilometers is also wanted. The most practical way of achieving such distribution is by use of free-floating balloons. These have been built and are being tested. They are equipped with an electronics package and a solar-cell power supply that, in total, weighs only 100 grams. Reliable reception from them has been obtained at distances up to 8000 kilometers.

Technology is furnishing powerful tools for measurement, analysis, and forecasting of global weather. From this, it is hoped, will come understanding of what we are doing to our planet and either reassurance or a convincing warning. In view of our uncertainties concerning the atmosphere, we have no alternative but to work urgently toward such an understanding—PHILIP H. ABELSON

*"The World Weather Watch," chairman, Louis J. Battan; arranged by John E. Masterson; participants, Robert M. White, Walter Orr Roberts, Joseph Smagorinsky, and Morris Tepper.