Meetings

Weather Modification

Efforts to modify the weather, under way on a modest scale for several years, are gaining momentum. Emphasis in the United States is on cloud seeding to increase precipitation. Modification of hail to reduce crop damage is also receiving attention, particularly abroad. Experiments on suppressing lightning are actively under way. Engineers have the operational ability to disperse cold fogs at airports. Meteorologists, using the increased capacity of computers, are developing models of large-scale experiments and climate modification, some on a hemispheric scale. Of far-reaching significance are the possibilities of man's inadvertent modification of the weather and the climate through air pollution from automobiles and industrial sources.

These are some of the facets of weather modification reported at the First National Conference on Weather Modification held at the State University of New York at Albany, 28 April–1 May 1968, under the auspices of the American Meteorological Society and with support of the National Science Foundation. The meeting was keyed mainly to applied science and technology. Meteorologists, engineers, and others were asked to present analyses of their experimental and theoretical work dealing specifically with current programs in weather and climate modification.

Social scientists taking part in the Albany conference poignantly noted that the fears, suspicions, and doubts of the general public must be allayed before progress toward weather control can achieve the recognition and the pace of a major program. Such a venture, which may equal or perhaps surpass the importance and imagination of the conquest of space, requires a broadly based approval and support of the public and the polity. Also, since the behavior of people is determined by their perception of events rather than by the objective events themselves, social and political consequences of weather modification must be expected to vary widely from place to place, time to time, and person to person.

The international side of weather modification was highlighted through reports by overseas experts and by a special message from Secretary of State Dean Rusk to the conference, read at the opening session. It stated in part that "The extent of the knowledge of the world's weather processes which you have so painstakingly collected over the years in preparation for this moment is impressive. . . . The presence at this meeting of several of your colleagues from other countries confirms the fact that we share our knowledge and discoveries with other nations and they with us. . . . Though the information and discoveries which you will produce will be useful to all, we are especially concerned with practical applications in the developing countries."

Perhaps the discussion on inadvertent weather modification produced the biggest surprise of the conference. Revealed was increasing evidence that the weather over many thousands of square miles of the United States and Europe is being modified to varying degrees by the presence of polluted air. Over the past several years a number of unusual snow and rain storms have been observed in the east central part of New York State. These storms consist of extremely small precipitation particles. When in the form of snow, the particles are like snow dust having cross sections ranging from 0.02 centimeter (200 microns) to 0.05 (500 microns). When in the form of droplets, they often are even smaller in diameter, at times being so tiny that they drift rather than fall toward the earth. When collected on clean plastic sheets, the precipitation is found to consist of badly polluted water. Another case in point seems to exist around La Porte, Indiana, about 30 miles downwind from the smoky mills of Gary and South Chicago. From 1951 to 1965 (14 years) La Porte had 31 percent more precipitation, 38 percent more thunderstorms and 246 percent more days with hail than nearby communities. Year-to-year correlation was found between the rainfall in La Porte and variations in steel production and hazy days in the Chicago area.

Several papers examined effects downwind of an area seeded with silver iodide particles and brought before the conference some rather exciting results. Experiments in western United States and in Australia indicated that more precipitation was found approximately 100 to 150 miles downwind of a seeded target area. This fact reinforces similar findings reported earlier in the United States and U.S.S.R. It was speculated that such effects were not likely to be the result of the transport of ice nuclei; instead, they were ascribed to some type of dynamic interactions about which little is known.

The conference advanced a growing awareness of the need for the use of legal machinery to aid, shape, and accommodate weather modification. Since weather is transient and cannot be bounded by political borders, and since experiments over broad areas are, or may become necessary, the utility of uniform legal rules with respect to licenses, operations, ownership, and use and control of the elements seems beyond question. One clear point made was that it may be well for the federal government, which already has a large investment in current weather modification activity, to move farther and more rapidly in the area of the law and weather modification.

Other highlights of the conference were:

1) *Precipitation increase.* Precipitation increases following silver iodide seeding were reported by several speakers: Australia, 15 percent; United States, 10 percent; Switzerland, 100 percent. These results were determined by statistical analysis of field projects extending over periods of seven seasons or more. Research in India reported a 20-percent increase in monsoonal rainfall by the technique of seeding warm clouds with salt crystals or brine solution released into the clouds from aircraft or ground blowers.

2) *Precipitation decrease.* A 5-year field project in Missouri with aircraft silver iodide cloud seeding, reported an overall indication of a negative treatment effect somewhere near a 40-percent decrease of rainfall. This finding

added to a growing conviction that in some instances silver iodide seeding may increase precipitation and sometimes decrease it, depending on various factors, particularly the cloud-top temperature.

3) *Hail modification.* An operational hail-suppression project in Kenya, Africa, shows apparent positive results of about 70-percent reduction in hail damage to the tea crop as the result of one season's seeding by aircraft. Data on hail suppression gathered in North Dakota during a 2-year period indicates a statistically significant reduction between the hail energy received on the target area compared with the control area.

4) *Rainmaking.* The practical application of cloud-seeding techniques in several regions in Australia, where clouds suitable for seeding are known to occur, is being carried out by State Agricultural and Public Works departments. The departments have responsibility for water resources including water distribution and use.

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Hemoproteins

A Hemoprotein Workshop was held at the National Institutes of Health, Bethesda, Maryland, 29–30 April 1968. The object of the workshop was to bring together about a dozen leaders in the field to discuss current concepts of hemoprotein structure and function and perhaps speculate about promising directions for future work. The meeting was chaired by J. T. Edsall, who also gave a short introductory history of hemoglobin chemistry.

G. Braunizer (Max-Planck Institut für Biochemie, Munich) summarized his recent findings on polymorphism of insect hemoglobins of *Chironomus thummi thummi, tentans, pallidivitans*, and *anthracinus*. Generally speaking the polypeptide chains are shorter than those of mammalian hemoglobins; amino terminal residues are different from mammalian residues (glycine rather than valine). The greatest difference occurs in the region near the C-terminal residues because of deletions. Braunitzer concluded his lecture by summarizing a recent investigation by Tichy, who has identified the loci of hemoglobin synthesis in the giant chromosomes of the salivary gland. *Chironomus*, like *Drosophila*, has but four chromosomes. Tichy is said to have found the locus of hemoglobin genes in chromosome No. III.

Max F. Perutz discussed the structure of the molecule of horse hemoglobin at a resolution (2.8 Å) higher than heretofore reported. He showed, with the aid of stereoprojection, indicated contacts between the globin and the heme group, between the alpha-1 and beta-1 chains, between alpha-1 and beta-2, and finally between beta-1 and beta-2. He called our attention to the fact that we do know many details of the structure of the molecule, but its functions, such as in the Bohr effect and the heme-heme interactions, are still not explained, nor do we understand the mechanism of alkaline denaturation.

Jeffries Wyman (Istituto Regina Elena, Rome) discussed hemoglobin as a complex feedback and control mechanism in the blood stream. He formulated linked functions and applied them to the hemoglobin molecule. He showed how binding of proton, oxygen, carbon monoxide, and aggregation effects are linked in the hemoglobin molecule.

Q. H. Gibson (Cornell University, Ithaca) discussed kinetics of hemoglobin reactivity. He summarized the photolysis of HbCO, which he investigated with F. J. W. Roughton a number of years ago. He also presented his more recent work on the mechanism of ligand formation. His findings suggested that in -SH hybrids there is mutual influence and that hemes of the beta chain modify the behavior of the alpha chains, showing that the CO bonding cannot depend on the bonding of Fe to histidine in the beta chains.

E. Margoliash (Abbott Laboratories, North Chicago) presented his recent formulation on evolutionary variability of cystochrome c. The concept has been developed in collaboration with W. M. Fitch (University of Wisconsin, Madison). He stressed the definitions of the terms homologous (structures derived from common ancestral form) and analogous (structures which are similar even though different in origin). The subject is much too complex to be summarized in a few sentences; however it is interesting to note that the evolutionary "tree" formulated by these investigators appears to be acceptable to biologists.

Short but witty concluding remarks were made by R. D. Owen (California Institute of Technology, Pasadena) who sees parallels between biology and hemoproteins, anatomy corresponding to structure, and physiology to functions. Genetics and even behavior (conformational changes) were paralleled.

The workshop was sponsored by the National Institute of Arthritis and Metabolic Diseases.

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Calendar of Events

Courses

Coastal Engineering Environment, Los Angeles, Calif., 4–15 Nov. Intended to acquaint participants with the latest methods in coastal engineering. For engineers interested in coastal, oceanographic, and offshore petroleum engineering. The course will cover fundamental background in hydrodynamics, physical oceanography, and coastal morphology as well as the design of coastal installations and structures, including practical methods of calculation, methods of funding, and economical justifications. *Fee*: $375. (P.O. Box 24902, Engineering and Physical Sciences Extension, University of California Extension, Los Angeles 90024)

Remote Sensing for Geology and Hydrology, Washington, D.C., 7–9 Nov. It will cover the use of electromagnetic radiation including ultraviolet, visible, near infrared, thermal infrared, and microwave (passive and active radar) in solving geologic and hydrologic problems. (Dr. J. L. Snyder, American Geological Institute, 1444 N St., NW, Washington, D.C. 20005)

Interpretation of Complex Arrhythmias, Chicago, Ill., 9–14 Dec. Intended for experienced electrocardiographers. (Miss Beverley Petzold, Executive Secretary, Cardiovascular Institute, Michael Reese Hospital and Medical Center, Chicago 60616)

Marine Soil Mechanics and Foundation Engineering, Los Angeles, Calif. 18–22 Nov. For scientists and engineers who are engaged in or anticipate working on engineering projects in deep waters of the sea, where some understanding of the physical behavior of bottom sediments is of importance. The course will cover an introduction to aspects of soil mechanics and marine geology currently considered of importance to the design and construction of foundations at sea, and discussions of unique problems arising from operational activities on the bottom. *Fee*: $275. (P.O. Box 24902, Engineering and Physical Sciences Extension, University of California Extension, Los Angeles 90024)

Identification of Organisms Important in Pollution, Atlanta, Ga., 4–21 Dec. Sponsored by the Federal Water Pollution Control Administration. Stipends are available to help defray expenses; there will be no charge for the course. The taxons to be covered include the algae, fungi, crustacea, mayflies, stoneflies, caddisflies, oligochaetes, fish, chironomids, and mollusks. (Dr. Fred K. Parrish, Program Director, Department of Biology, Georgia State College, 33 Gilmer St., SE., Atlanta 30303)