

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-

location? Michaelson and Raftery now report that it is.

They have shown that the purified receptor macromolecule contains not just the specific acetylcholine binding site, but also the molecular elements necessary for ion translocation in order to depolarize the muscle cell membrane and lead to muscle contraction.

First they isolated the acetylcholine binding molecule, which is composed of several polypeptides. They combined the molecule with lipids from the muscle cell membrane. The combined molecule and lipids acted like a model membrane, with the acetylcholine receptor end of the molecule oriented outside the membrane. They put sodi-

um chloride and acetylcholine in the presence of the model membrane. The receptor molecule in the membrane recognized acetylcholine, and upon recognition, sodium ions passed through the membrane.

"This represents," the biologists declare, "the first clear demonstration that an acetylcholine-binding protein contains all of the molecular machinery necessary for membrane depolarization."

The investigators will now try to identify the molecular features of the acetylcholine receptor that induce sodium ions to pass through the membrane and to trigger membrane depolarization. □

A second steady weather satellite

The second step toward a unified, worldwide, day-and-night weather satellite network is now scheduled for Jan. 30, with the launching of SMS-B, the second Synchronous Meteorological Satellite. By the end of this decade, with luck and international cooperation, there should be a chain of five such weather-watchers, spaced approximately equidistant over the equator, each hovering over a fixed spot on the surface.

The key word is "hovering." Most weather satellites move in their orbits relative to the earth, so that if they spot a developing feature such as a hurricane, they must wait until they come around again to see how it is progressing. A synchronous satellite simply sits in its assigned position and stares as the weather evolves beneath it.

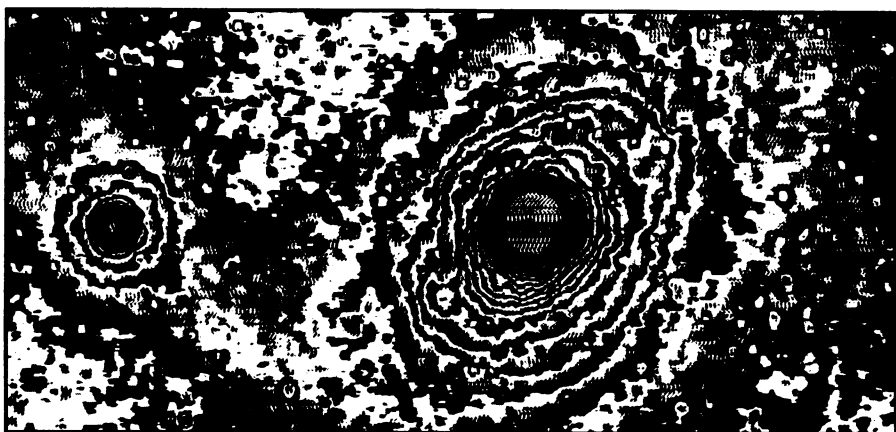
This is why so much attention has been paid to the synchronous Applications Technology Satellite, ATS-3, even though weather-watching is but one of its many roles. Even the daily satellite photo provided to television news programs comes not from the TOS, TIROS, Nimbus or other "official" weather satellites, but from ATS-3.

Recently, however, this was changed. The National Oceanic and Atmospheric Administration began providing these photos from a synchronous, full-time weather-watcher: SMS-1, the first step in a global weather network. Besides providing daytime images four times sharper than those from ATS-3, it has the additional advantage of infrared vision, so that it can keep up its vigil by night as well.

When the network is complete, it should include two satellites from the United States, followed beginning as early as 1977 by one from the Soviet Union, one from Japan and one from the continental collective known as the European Space Research Organization. The second U.S. link is scheduled for Jan. 30—but it may end up being only the first.

SMS-1, although its photography won resounding praise during the huge GATE experiment in the tropical Atlantic last summer, is having its problems. In the first place, it's not quite synchronous—it moves slightly in its orbit. Intended to hover at 75 degrees west longitude, or about the same meridian as New York City, it ended up due to launch vehicle problems at 72 degrees and in a slightly elliptical orbit that lets it wander a bit. Flight controllers are trying to get the orbit "tuned up," but now there is a more ominous difficulty: transmission difficulties, suggesting that the prodigal

Redshifts, galaxies and bridges



Isodensitometer image shows connection between NGC 7603 and its companion.

For cosmologists contemplating the expanding universe, the redshifts in the spectra of the light from distant objects remain the major data. The argument is that the redshifts are Doppler shifts, the result solely of difference in motion between our galaxy and the distant one. If they are not, a lot of cosmological calculating goes down the drain. There is an argument, and the latest contribution is an attack on an attack on the Doppler shift concept.

In an expanding universe every galaxy will appear to be receding from every other galaxy. The farther any galaxy is from any other, the redder will its light appear to observers in the other. So the redshifts are used to determine the distance of the objects and various things about the shape of the universe and the curvature of space.

Astronomers who suggest that other mechanisms may be contributing to the total redshift, and the redshifts should therefore not be so trustingly accepted as distance indicators, look for instances of links between galaxies of discordant redshifts. Some time ago Halton C. Arp of the Hale Observatories presented evidence for bridges between the galaxy NGC 7603 and a

smaller companion and between NGC 4319 and Markarian 205.

Now a second look has been taken at those two instances (with a third possibility added, the group called Seyfert's sextet) by Merle F. Walker of the Lick Observatory, C. D. Pike of the University of St. Andrews in Scotland and J. D. McGee of Imperial College, London. They used an electronographic image converter, in which the incoming light is converted to electrons which are then imaged on a cathode screen or emulsion by electromagnetic fields, because this method is more efficient at showing faint objects than direct photographs. Their report is in the *ASTROPHYSICAL JOURNAL* (Vol. 194, p. L125).

They find no evidence for bridges in the case of NGC 4319 or Seyfert's sextet. A bridge does appear between NGC 7603 and its companion, but Walker, Pike and McGee are not sure that this too is not a projection effect, a case of the smaller galaxy lying in front of a spiral arm of the larger one. There is no evidence for a physical interaction between the arm and the small galaxy. On the whole the three observers are skeptical of bridges between galaxies of discordant redshift. □