NRC urges preparation for climate change

A committee of the National Research Council, an arm of the National Academy of Sciences, has called for a major national commitment to protect American agriculture from possible adverse climatic changes. The committee's report, *Climate and Food,* culminates a 15-month study initiated when evidence that the climate might be changing became generally accepted (SN: 3/1/75, p. 138).

The committee concluded that there is no reason to believe that the abnormally favorable climate conditions of the 1960s would continue, but that there are "a number of realistic, attainable strategies . . . that can be used to reduce the effects of adverse weather on crop production." These strategies include:

- Research on climate prediction. Careful study of U.S. temperature and precipitation records have still shown "no dependable prediction potential" for periods as short as three months in the future. However, such studies have shown that the recent past has been unusually favorable for agricultural production, and a return to "normal" would probably decrease yields.
- Weather modification. Intentional rain augmentation may be practical and reliable within three to five years. Suppression of hail may take five to eight years. Mitigation of hurricane damage is expected to take more than a decade. The report concludes: "Small modifications of weather can have important, positive impacts on food production on both a regional and national scale."
- Soil management. Long-term climate fluctuations can decrease vegetative cover of an area, increasing erosion. Water erosion is already "the most important conservation problem on half of the 180 million hectares of cropland in the United States," annually washing away nutrients that would cost $4 billion to replace, the report concludes.
- Plant breeding. Some of the crop strains developed in the Green Revolution are particularly sensitive to changes in rainfall or length of growing season. Breeding techniques can be used, however, to develop strains with great resistance to drought or temperature changes.
- Pest control. Climate changes that hurt crops may ironically improve the living conditions for pests that destroy the crops. During the great potato famine in Ireland, for example, torrential rains alone would have diminished the harvest, but potato blight was increased so much that a total crop failure resulted—killing a million and a half people. "Pestographs" showing the response of pests to weather conditions can now be used to pinpoint likely difficulties and prevent them.
- Adaptive husbandry. Crops or livestock to be raised in a particular area can be modified year to year depending on weather conditions. In the Midwest, for example, if excess spring rains delay corn planting, soybeans are now sometimes planted instead. Such general measures as stubble mulching and improved planting techniques should also be helpful.
- Reassess foreign policy. World food reserves are now inadequate to compensate for a year's bad harvest. Developing countries need to be encouraged to protect their own food production resources by preparing for adverse weather. The report concludes: "Experience of the past 15 years throws considerable doubt on the ability of the international distribution system to respond in time to major food needs during famine." □

X-ray waves find crystal impurities

Those who use crystals as components in optical and electrical systems as well as those who do pure research on the structure and physics of crystals often need to know where impurity atoms are located in the crystals. In the first place natural crystals are rarely 100 percent pure, and in the second place very often particular impurities must be introduced into manufactured crystals to produce desired optical or electronic effects. Impurities at or near the surface are especially important because surface physics is a peculiar field in itself, and in practical matters the surface is where the crystal contacts other components of the system such as electrodes.

In the Oct. 25 PHYSICAL REVIEW LETTERS three physicists from the University of Aarhus in Denmark, S. Kjaer Andersen, J.A. Golovchenko and G. Mair, report a method for finding the location of crystalline impurities by means of standing X-ray waves. They point out that the method should be of special interest to surface physicists because it can measure not only the location of impurities in the bulk of the crystal, but also the distance perpendicular to the surface of near-surface impurities, something surface physicists are eager to know.

Standing-wave phenomena are common in physics. A standing wave is reflected back and forth over a path equal to an integral number of wavelengths. This causes it to stand still and reinforce itself with its nodes and antinodes remaining in the same places. A standing wave can be excited in a child's jumping rope if one hits the proper rhythm. They are what make guitar strings and organ pipes resound.

In the electromagnetic spectrum standing waves are encountered just as frequently as in mechanics. Standing radio waves can be generated by waveguides of the proper shape; standing light waves, a necessity for making a laser, can be made by a pair of mirrors. The atoms in a crystal lattice can serve as reflectors of X-rays, and the planes that they form can act as effective mirrors in setting up standing X-ray waves. The geometry of the systems has to be something particular, because any reflection at all, let alone standing waves, depends very strongly on the geometry of the crystal and the angle of incidence of the X-rays.

Nevertheless past studies have shown that one of the simplest X-ray-reflecting geometries, the Bragg geometry, showed promise of being able to locate crystalline impurities with standing X-ray waves. Basically the standing wave excites X-ray fluorescence by the impurities, and the fluorescence reveals their location.

Previous work along these lines suffered from poor resolution and other difficulties, but the present authors report that they have built an apparatus that reveals bulk impurity locations with a resolution of about 0.02 angstrom, a small fraction of the interatomic distance in most crystals. It should do about as well for surface impurities, the experimenters feel. An important factor in the study of surface impurities is their perpendicular depth below the surface, and this has been difficult to determine by other methods. Because the planes of reflection that make the standing waves lie perpendicular to the surface in this geometry, the perpendicular distance should be fairly easy to get by this means, the experimenters say. □

Living electrode measures compounds

Millions of live bacteria are the crucial element in a new biochemical tool. The bacteria electrode, developed by Robert K. Kobos and Garry A. Rechnitz of State University of New York at Buffalo, measures the concentration of the amino acid arginine over a thousand-fold range.

Traditional electrodes can sense only about two dozen simple inorganic ions or gases, but the technique is fast and simple. When the appropriate electrode is dipped into a solution, interaction between ions in the sample and on the electrode produces a change in electrical potential.

Rechnitz uses a building block approach to attempt extending this rapid technique to analysis of hundreds of biological chemicals found in body fluids and living tissues. The idea is to use biological materials to convert specific biochemicals into ions that can be sensed by standard electrodes.

Rechnitz and workers in several other laboratories first used isolated enzymes as the biological material in the electrodes. Different enzyme electrodes can now measure about 25 organic chemicals. To analyze urea concentration, for example, a glass electrode that senses ammonium ions was coated with urease. That enzyme converts urea to bicarbonate and ammonium ions. The change in electrical potential measured by the ammonium electrode reflects the urea concentration in the sample.

The number of substances that can be sensed this way is limited because it is difficult to identify, isolate and store the appropriate enzymes. Researchers must also identify all required cofactors and attach them, along with the enzymes, to the electrode tip.

Now Kobos and Rechnitz are using intact bacteria to sense biological chemicals. The living cells, they explain, have evolved to contain enzymes and cofactors at optimum conditions for carrying out specific reactions.

The tip of the new electrode contains a thick slurry of bacteria, trapped between a cellophane membrane in contact with the test solution and a gas-permeable membrane in contact with a standard ammonia-sensitive electrode. Kobos and Rechnitz have selected bacteria that convert amino acid arginine to ammonia, and the standard electrode senses that product. All other chemicals tested gave a response less than a hundredth as large as the response to arginine.

"We knew we wanted bacteria that produce ammonia, and this type effectively converts arginine to ammonia," Rechnitz says. "But we are particularly interested in arginine, because we have no enzyme electrode for that amino acid."

By choosing different bacteria, Rechnitz plans to build electrode probes that can measure more and more molecules not detectable with standard electrochemical or enzyme electrodes. □

Advances in stroke: Encouraging progress

Encouraging results in the diagnosis, treatment and prevention of stroke, the third leading cause of death among Americans and a major crippler, were discussed last week at the 50th Anniversary Congress of the Pan American Medical Association in Hollywood, Fla.

In the past decade, physicians have come to realize that a stroke is not due to a spasm or hardening of arteries of the brain. Rather a stroke is due to a clot in those arteries (a thrombus), a clot in the carotid artery in the neck or in an artery in the brainstem (an embolus), or to hemorrhage of arteries in the brain. A clot blocks the transmission of oxygen and nutrients to neurons, killing them within seconds. Neuronal death then leads to brain damage and possibly paralysis. A clot can make the brain swell so much that it no longer fits the skull and leads to death. Hemorrhage can also cause brain damage, paralysis and death.

As for the diagnosis of stroke, one of the major new advances is the CAT (computerized axial tomography) scanner. X-ray images shot from many angles are combined mathematically into a cross-sectional picture of the brain (SN: 3/13/76, p. 170). For instance, if hemorrhage in the cerebellum of the brain is not diagnosed and corrected within three hours, a patient can die, Irving S. Wright, professor of medicine at Cornell University Medical Center, points out. Arteriography (the injection of a radiopaque material into the arteries of the brain so that X-rays can visualize them) used to be the only technique available for detecting a hemorrhage, and it was not particularly effective. Now the CAT scanner, he says, can reveal hemorrhaging within an hour. The CAT scanner is also noninvasive and perfectly safe, which is not the case with arteriography. The CAT scanner can likewise provide quick and safe diagnoses of hemorrhaging in the cerebrum of the brain, reports Robert Schwartzman of the University of Miami School of Medicine.

Surgery and even microsurgery represent several recent advances in the treatment of stroke. For example, if a person wakes up in the morning with a paralyzed arm, or cannot talk or see, he may well have an embolus in the carotid artery. The surgeon may operate and remove the clot. Or, if the carotid artery is really blocked, the surgeon might use microsurgery, hooking up the carotid to another artery in the brain. That way blood coming from the heart can bypass the clot and still reach the brain. Carotid surgery should be performed only by skilled surgical teams, however, Noble Davis of the University of Miami School of Medicine stresses, and only on select patients. Microsurgery, he says, is an even more heroic type of treatment and has even more limited application.

There is still no surgery available for clots in the posterior circulation of the brain—in the brainstem. However, a number of neurologists use anticoagulants to treat this kind of stroke and report success with them. Two studies, one in Canada and another sponsored by the Veterans Administration, also tentatively suggest that aspirin can help dissolve clots in the posterior circulation.

Paralysis due to stroke can also be reversed if rehabilitation is started immediately, Wright reports.

But probably the greatest advance that has come in countering strokes in the past decade is the realization that several small strokes, or transient ischemic attacks, may constitute early warning signals before a massive stroke. This means that if the physician is able to detect one of these strokes, he may be able to remove a clot or stop hemorrhaging before major brain damage, paralysis or death ensue. □

Ford announces new nuclear policy

President Ford has released details of the long-awaited policy shift designed to reduce the danger of international nuclear technology proliferation. The new policy is based on the findings of a task force headed by Robert W. Fri, deputy administrator of the Energy Research and Development Administration. The basic conclusions of the study, previously leaked to the press, have already become the subject of much controversy and election-year politics (SN: 10/16/76, p. 244).

As expected, the President called for a three-year international moratorium on the transfer of sensitive nuclear technology, such as the sale of fuel reprocessing or enrichment plants, that might enable more countries to develop atomic weapons. He also said that the United States would "no longer regard reprocessing of used nuclear fuel to produce plutonium as a necessary and inevitable step in the nuclear fuel cycle." Such a statement calls into question the future of two huge government-sponsored projects—the development of a prototype breeder reactor and construction of a demonstration plant for reprocessing nuclear fuel.

At a White House press conference, Fri repeatedly hedged questions on whether a reprocessing plant under construction at Barnwell, S.C., would be completed. He no longer called the project a "demonstration program," but rather insisted on the term "evaluation program." Then, to further obscure the issue, he concluded: "And we are going to consult with other countries and undertake an analysis in ERDA to determine exactly what that means."

Regarding the future of the breeder reactor, Fri said no decision would be made until 1986 on whether these should be commercialized, and that by then "there will be adequate information available on the reprocessing and nonproliferation effects." Breeder reactors would require reprocessing plants in order that the "bred" plutonium could be separated out for use as fuel.

To implement the policy changes, President Ford announced several new administrative and diplomatic initiatives. He pledged to offer official letters of intent to foreign customers of American nuclear fuel, promising continued adequate supplies if the countries involved would cooperate in the nonproliferation efforts. He said he would propose legislation to the next Congress to expand enriched uranium facilities in this country, so that such fuel guarantees could be made. And he directed ERDA to demonstrate the feasibility of all components of nuclear waste management technology by 1978, so that an adequate repository for such wastes could be completed by 1985. □