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