

Environment '72: Small progress

The 1972 report of the President's Council on Environmental Quality, issued last week, verifies what everyone suspects subjectively: In spite of a decade of growing public awareness, political verbiage, and a few years of frenetic activity, the environmental quality is not much better, and in some cases, worse.

But there is hope. The report outlines numerous activities under way at the state, Federal and international levels, stresses the importance of the increasing level of public awareness and activism, and raises some reason for optimism. "We are becoming more sophisticated about the nature of the problems," says council member Gordon J. MacDonald. "They are not problems that can be dealt with with outbursts of emotion." The report analyzes environmental indices, forecasting, economic impacts of environmental improvements and the status of the national parks. Three chapters—on energy, recycling and a case study of the

Delaware River Basin—were not published, inciting a brief flurry of partisan accusations. According to some reports the White House felt the chapters were politically sensitive and wanted them released after the elections. But council members said the chapters were withheld (although later released in "draft" form to the press) because more research was needed.

The general tone is that although little is yet known about the environment and the effects of pollution on the ecosystem, man is beginning to learn. The major handicap to evaluation is the lack of environmental indices. An index is a quantitative measure that aggregates and summarizes the available data on a particular problem. Progress in developing indices for air pollution is the most advanced, but the indices are still "tentative . . . and unsatisfactory in some respects."

Based on these incomplete indices "air quality . . . improved between

1969 and 1970." (The data are not available for 1970 to 1972.) Of the five major pollutants, carbon monoxide and particulates decreased; sulfur oxides and hydrocarbons remained the same and nitrogen oxides increased.

Indices are even more difficult to develop for water pollution because the number of water pollutants is larger and there are no uniform national standards for water quality. The 1970 figures show that 27 percent of the U.S. stream and shoreline miles were polluted. A year later, 29 percent were. "The problem of nutrients (phosphorus and nitrogen) is worsening dramatically in all types of basins." The report cites as a serious problem pollution caused by runoff of agricultural chemicals.

The problem of toxic substances (cadmium for example) and pesticides remains serious. No formula has yet been verified that can adequately gauge the rate of deterioration of the environment due to these elements. The report states flatly: "The data are sparse or nonexistent" for toxic substances.

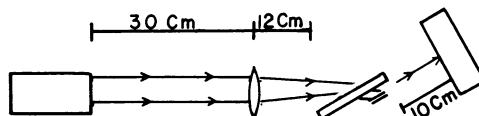
The unpublished chapter on energy is an attempt to evaluate the over-all effects of energy sources, focusing on electrical power. It states that coal has the greatest potential harm, natural gas, the least. Nuclear energy plants would do less harm to the environment, but

A step toward an X-ray laser

Lasers began in the infrared, and a lot of hard work has gradually extended them across the visible range of the spectrum and into the ultraviolet. In the process the science of optics has been revolutionized as devices (holograms, for example) that used to be only theoretical examples became practical possibilities. The existence of X-ray lasers would extend the revolution. X-ray holograms would give three-dimensional pictures of the insides of things that are now X-rayed in two dimensions. Crystallographers could get three-dimensional pictures of crystals, including biological macromolecules. An X-ray laser could do a much better job at inducing thermonuclear fusion in fuel pellets than lasers now used in such experiments.

In the July PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES a group from the University of Utah, John G. Kepros, Edward M. Eyring and William Cagle Jr., report an experiment that may prove to be a significant step on the way to X-ray lasers. It appears to be the first demonstration of the stimulated emission of coherent X-rays, the effect that must be achieved if an X-ray laser is at all to be possible.

In the experiment, the substance that emits the X-rays is a copper sulfate gel sandwiched between glass plates. Stimulus for the emission is light from a neodymium-glass laser which is focused into a line on the sandwich by a cylindrical lens. When the stimulus is applied (though not every time) the copper sulfate sandwich gives off X-rays. These are hard X-rays since they pass easily through the air, and the beam is collimated—it does not spread as it proceeds but maintains a constant width. Collimation is one of the characteristics of a coherent beam, and it leads



the Utah group to believe they are seeing a lasing effect in the X-ray range around one angstrom (the shortest-wavelength working lasers are now around 1,000 angstroms plus). But Eyring cautions that since collimation is the only evidence of lasing that they have, the case is not completely proven.

Nevertheless Raymond C. Elton of the Naval Research Laboratory says he is "excited and encouraged" by the Utah result. He says he can think of no other explanation for the present evidence, but in his opinion the most convincing evidence would be the determination of the wavelength of the X-rays and thereby the identification of the particular substance in the sandwich that is emitting them. Elton suspects that the Utah experiment may be exploiting a plasma effect, that is, the actual emission comes after the light pulse has vaporized and ionized the material in the sandwich. Elton further suggests that the reason other people using plasmas have not seen a similar effect is that focusing the light in a line produces a cylindrical plasma, whereas others have been working with spherical plasmas. Elton wants to repeat the experiment at NRL.

Both Eyring and Elton caution that this is still a long way from a workable X-ray laser. The effect is difficult to reproduce: It does not occur every time the stimulus is fired, but every firing destroys the sandwich. The road ahead toward a continuous laser or even a reliable pulsed one based on this idea is long.

problems such as storage, disposal and prevention of accidents must be solved first.

The unpublished chapter on recycling stresses the need for incentives for reusing many items that become trash. The unpublished case study of the Delaware River Basin is critical of industry and land development plans along the shore, but praises the Delaware law that bars new substantial industry along the state's coastline.

The report estimates that it will cost about \$287 billion in the decade of the 1970's to clean up the environment—an estimated 2.2 percent of the gross national product. This includes expenditures by business as well as government. The report concludes: "Neither this year nor next will we be able to provide a general statement about whether environmental quality has improved or deteriorated. The environment encompasses too many factors to be so easily characterized." □

Australia yields possible oldest vertebrate print

Footprints of an extinct genus of animal thought to be the oldest trace of a vertebrate yet found on the planet have been discovered in southeastern Australia by scientists at Monash University, Melbourne. Geologic and plant-fossil evidence puts their age in Devonian times—possibly more than 350 million years—says James Warren, professor of zoology at Monash.

Warren and his colleagues are linking the prints, made in igneous rocks, with the wedge-shaped prints of the *ichthyostega*, fossilized remains of which were found in Greenland before World War II. Spaces between the footprints and the rolling method of motion suggested the Australian creature fitted the pattern of the *ichthyostega*—a fresh-water animal about three feet long, with gills, a blunt head, long thin tail and up to four or five toes on each of the four feet.

The footprints were discovered by Norman Wakefield of Monash during a botanical survey in the upper reaches of the remote Genoa River area of East Gippsland in Victoria. The fossil evidence there indicates the creature was living in a now-vanished swampland area and made the prints when it was forced to cross new soft rock during geologic upheaval to search for fresh water and food. Announcement of the find was delayed until the print-bearing rocks were removed to safety.

Warren says the evidence associating the prints to the Greenland *ichthyostega* is fairly strong and so has implication in linking Australia to the Northern Hemisphere land mass in the Devonian Age—or previously. □

U.S. crops: Genetically vulnerable to disease

Agricultural research and modern methods of farming have greatly increased the yield of crops in the United States. Corn yield per acre has risen threefold in the past four decades. But we pay a price for the greater efficiency. The price is uniformity and with uniformity comes the constant threat of blights or epidemics that may wipe out an entire year's crop.

The severity of the corn blight of 1970, which wiped out 15 percent of the nation's corn crop for that year, can be directly traced to the genetic uniformity of the corn, says the National Academy of Sciences' Committee on Genetic Vulnerability of Major Crops, in a report issued this week. The committee, headed by James G. Horsfall of Connecticut Agricultural Experiment Station, reviewed the causes of recent crop epidemics and assessed the vulnerability of the major crops in the United States.

The corn plants of America had been inbred and crossbred until they were "as alike as identical twins." When a pathogen evolved that could attack that strain of corn, virtually all corn in the nation was susceptible.

A review of 14 major U.S. crops showed that most are "impressively uniform genetically, and impressively vulnerable." For example, 96 percent of the pea crop is devoted to only two varieties of peas.

The uniformity of crops is the result of pressures from all sectors. Consumers want uniform, inexpensive produce. To squeeze the most out of each acre, the farmer resorts to the highest-yield varieties and uses machines to

Crop	Value (millions of \$)	Major Varieties	Acreage (percent)
Bean, dry	143	2	60
Bean, snap	99	3	76
Cotton	1,200	3	53
Corn	5,200	6	71
Millet	-	3	100
Peanut	312	9	95
Peas	80	2	96
Potato	616	4	72
Rice	449	4	65
Sorghum	795	-	-
Soybean	2,500	6	56
Sugar beat	367	2	42
Sweet potato	63	1	69
Wheat	1,800	9	50

NASA

A few strains dominate some crops.



NASA

Uniformly bred, uniformly blighted.

plant and harvest. To plant by machine he needs seeds that are uniform in size. Such crops as tomatoes must ripen at the same time, since the machine used to pick them cannot distinguish between ripe and green tomatoes. "And so it goes," says the report, uniformity—always uniformity."

Breeders try to develop strains resistant to disease and have succeeded to a certain extent. But there is always the danger that a parasite will evolve or be imported for which the plants have no defense.

Most of the great epidemics of the past century have been caused by exotic pests that originated far from the crop they ultimately destroyed. French grapes were attacked by parasites from North America; chestnut blight and Dutch elm disease came from the Orient. It must be assumed that a pest anywhere in the world is a potential threat to a large and uniform crop.

The committee recommends a "watchdog system" to guard against future epidemics. Overseas laboratories could be used to test plants such as cotton and sorghum against insects and parasites at breeding stations in the tropics where these plants originated. Offshore laboratories could study the susceptibility of American crops to exotic pests. The last defense would be a quarantine at the borders.

The United States should not depend entirely on these measures, however. "If uniformity be the crux of genetic vulnerability, then diversity is the best insurance against it." The report calls on scientists to maintain a backup system in the form of gene pools, collections of plants and seeds with a wide variety of genetic characteristics. Breeders should be constantly on the lookout for new sources of genes in mutations and wild varieties.

National efforts to maintain a gene