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.

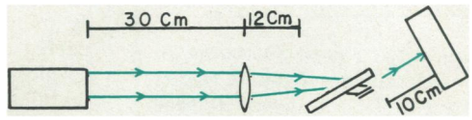
The unpublished chapter on energy is an attempt to evaluate the over-all effects of energy sources, focusing on electrical power. It states that coal has the greatest potential harm, natural gas, the least. Nuclear energy plants would do less harm to the environment, but

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.

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