enrollment approved by the UGC, or start or stop any program they desire. The UGC, however, is free to recommend withholding payment if it disapproves of the changes. And, in maintaining the balance between autonomy and direction, the UGC extends to itself the right to restrain the universities from unilaterally setting up independently funded programs that might later be presented as a *fait accompli* that requires UGC support. As was noted in a UGC report several years ago, "it is customary for a university which is considering an offer of outside financial support for a development which may eventually become a charge on its general funds to consult the Committee; and universities are aware that unwise developments are liable to prejudice their claims in the next quinquennium."

In unsympathetic hands, this centralized source of finance could obviously be used to press the universities in directions against their will. But even though the UGC was brought closer to government than ever before when it was moved from the vicinity of the Treasury to the Department of Education and Science, its membership remains overwhelmingly drawn from universities. The present chairman, Kenneth Berrill, is an economist who was formerly at Cambridge, and 16 of its present 21 members hold full-time positions in universities.

Clearly, there are pressures for the universities to diverge from their traditional indifference to the outside world. A hint of possible pressure toward this goal came in 1967, when the government acquired the right to look into the universities' financial records and examine, if it chose, the manner in which public funds were being used. But there have been no complaints of undue intrusions. The main source of tension between the universities and the government arises from the booming public demand for higher education and the fact that the costs are becoming so great that the means are no longer available for each university to follow its interests without regard to the others. In this setting—and, again, with reference to the financial crisis that has enveloped American universities—the British system looks golden. It would be nice to emulate its attractive features, but it is probably no more transplantable to the American scene than is the unarmed status of British policemen.—D. S. GREENBERG

# The Global Environment: M.I.T. Study Looks for Danger Signs

For several years now there has been talk and speculation about disastrous upsets of natural systems possibly resulting from the impact of technological growth and change on the world environment. But no program for mounting a comprehensive investigation of global environmental problems has been developed, although proposals for a research effort on this scale are now germinating within the international scientific community—proposals that will be brought before the 1972 United Nations Conference on the Human Environment. An M.I.T.-sponsored "Study of Critical Environmental Problems" conducted on the Williams College campus last month by some of the nation's most eminent environmental scientists could provide important groundwork for such a research effort.

The study group, its 70 participants representing more than a dozen disciplines and drawn from numerous universities, laboratories, federal agencies, and corporations, sought to determine what can be said authoritatively about global problems and what further research is needed. Not surprisingly, the findings announced by the study group on 1 August generally were tentative and, for the most part, dealt with potential problems abstractly.

However, the finding that attracted the most attention from the press—and the one most certain to arouse interest in Congress—focused on environmental implications of a specific new product of advanced technology: the supersonic transport, a costly and controversial new aircraft which will again come under congressional debate later this summer (*Science*, 24 July).

The American SST, propelled by the most powerful aircraft engines ever built, would fly at about 1800 miles per hour at an altitude of 65,000 to 70,000 feet. According to Department of Transportation estimates, 500 of these aircraft would be in commercial service by the mid-1980's, not to mention the French-British Concordes and Soviet SST's that would also be flying. The M.I.T. study group, using data provided by General Electric (builder of the SST engines), developed estimates as to the amount of combustion products a fleet of 500 SST's would introduce into the stratosphere.

In the past, environmentalists have raised fears that the SST, by putting substantial amounts of water vapor into the stratosphere, might reduce the ozone balance and thus impair the earth's shielding from ultraviolet radiation, or that it might cause clouds to form and bring on climatic change in that way. In announcing its major conclusions, the study group made no mention of possible change in the ozone balance, having accepted as conclusive research findings indicating that changes in this balance caused by the SST would be much less than variations occurring naturally. But the group expressed "genuine concern" about the possibility that a large SST fleet might cause increased stratospheric cloudiness. It said that the SST's may cause water vapor in the atmosphere to increase by 10 percent globally, or by as much as 60 percent over the North Atlantic, where the SST traffic is expected to be heaviest.

Moreover, the group raised a possibility apparently never considered heretofore in the SST debate—that the SST fleet, by discharging combustion products such as soot, hydrocarbons, nitrogen oxides, and sulfate particles, would cause stratospheric smog, a condition that might also be especially pronounced over the North Atlantic. The group said that the amount of fine particles formed as the result of SST operations might be comparable to the amount put into the stratosphere by the volcanic eruption of Mount Agung in Bali in 1963.

Fine particles absorb radiation from the sun and the earth, although they

also reflect radiation. Following the Agung eruption, there was an increase of 6° to 7°C in the temperature of the stratosphere in an equatorial belt around the earth. The temperature of this part of the stratosphere remained at least 2° to 3°C above its pre-Agung level for several years.

According to the study group, the effect on the stratosphere of the SST fleet might equal the observed effects of the Agung eruption. The Agung eruption produced no apparent change in temperature below the stratosphere, but the study group by no means ruled out the possibility of stratospheric smogging causing temperature changes in the lower atmosphere and the earth's surface.

The group called for a program of monitoring and research aimed at clearing up the "uncertainties about SST contamination" of the atmosphere and said that no large-scale operation of SST's should begin until those uncertainties are resolved. The Nixon Administration is currently developing a research program to determine whether the SST is or is not a weather-modification machine. Prototypes of the American SST are not scheduled to fly before 1973, but the commercial model of the Concorde may be flying by then.

Among other findings and recommendations announced by the study group were the following:

• Although the burning of fossil fuels is producing a gradual increase in carbon dioxide in the atmosphere, the possibility of climatic changes resulting during this century from the buildup of $CO_2$ is believed to be small. However, the group did not discount the possibility of such consequences in the longer term, and it recommended continuous measurement of the carbon dioxide content of the atmosphere.

• The atmosphere's oxygen content remains practically constant at 20.946 percent. And if all of the world's recoverable fuels were burned, the oxygen level would be reduced to only 20.800 percent. Nevertheless, it was recommended that the oxygen content of the atmosphere be measured every 10 years as a precaution.

• DDT is not expected to have a significant effect on the ability of ocean phytoplankton to convert carbon dioxide into oxygen. However, no direct measurements or reliable estimates of the concentrations and effects of DDT in open oceans have been made. It is known that high levels of DDT residues

# First Environmental Quality Report

*President Nixon on 10 August sent to Congress the first annual report of the Council on Environmental Quality, a body established by the National Environmental Policy Act (NEPA) of 1969 and which is often compared to the Council of Economic Advisers established under the Employment Act of 1946. The President said the report is a "historic milestone" and represents the first time any nation has systematically taken stock of the quality of its surroundings. He said that even though adequate systems for monitoring and measuring environmental conditions are lacking, the council had produced a report which will be valuable to Congress and the Executive Branch and which will clarify environmental issues for a broad public. As this is written, at least two congressional committees are planning early hearings on the report.* The report and NEPA's influence on government decision-making will be discussed in News and Comment in a later issue of* Science. *Excerpts from the President's message accompanying the report follow.*

The basic causes of our environmental troubles are complex and deeply imbedded. They include: our past tendency to emphasize quantitative growth at the expense of qualitative growth; the failure of our economy to provide full accounting for the social costs of environmental pollution; the failure to take environmental factors into account as a normal and necessary part of our planning and decision-making; the inadequacy of our institutions for dealing with problems that cut across traditional political boundaries; our dependence on conveniences, without regard for their impact on the environment; and, more fundamentally, our failure to perceive the environment as a totality [of related parts]. . . .

### Land Use Policy

We have treated our land as if it were a limitless resource. Traditionally, Americans have felt that what they do with their own land is their own business. This attitude has been a natural outgrowth of the pioneer spirit. Today, we are coming to realize that our land is finite, while our population is growing. The uses to which our generation puts the land can either expand or severely limit the choices our children will have. The time has come when we must accept the idea that none of us has a right to abuse the land, and that, on the contrary, society as a whole has a legitimate interest in proper land use. . . . I believe we must work toward development of a National Land Use Policy to be carried out by an effective partnership of Federal, State, and local governments together, and, where appropriate, with new regional institutional arrangements.

### Recycling of Wastes

Essentially, waste is a human invention: Natural systems are generally "closed" systems. Energy is transformed into vegetation, vegetation into animal life, and the latter returns to the air and soil to be recycled once again. Man, on the other hand, has developed "open" systems—ending all too often in an open sewer or an open dump. We must move increasingly toward closed systems that recycle what now are considered wastes back into useful and productive purposes. . . .

### "Environmental Literacy"

We must train professional environmental managers to deal with pollution, land planning, and all the other technical requirements of a high quality environment. It is also vital that our entire society develop a new understanding and a new awareness of man's relation to his environment—what might be called "environmental literacy." This will require the development and teaching of environmental concepts at every point in the educational process.

* Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $1.75.

are found in certain marine organisms; for instance, DDT residues in mackerel caught off the California coast exceed permissible tolerance levels for human consumption. A "drastic reduction" in use of DDT was urged. A program of base-line measurements of the concentration and effects of DDT in the oceans also was recommended.

• Up to 1.5 million tons of oil are introduced into the oceans every year through ocean shipping, offshore drilling, and accidents. In addition, as much as another 3 to 4.5 million tons of oil disposed of on land may be finding its way into waterways and eventually into the oceans. Available evaluations of the effect of oil on marine life are conflicting, some showing severe damage, others showing relatively little. More extensive research is required.

The summer study's working group on environmental monitoring, headed by George Robinson of the Center for the Environment and Man at Hartford, estimated that an effective global system for monitoring critical parameters could be established for about $25 million. This estimate, admittedly rough and tentative, assumes that existing weather stations and environmental institutes would become a part of the system. In many cases, the scope and competence of existing institutions would be broadened simply by the addition of special equipment and a few more people. Airborne monitoring would usually be accomplished by mounting the monitoring equipment on commercial aircraft.

The findings and recommendations of the summer study will be set forth in detail in a report to be published by the M.I.T. Press in October. Next spring, a series of edited volumes containing many of the background and working papers used in the summer study will be published. The study was financed by 11 federal agencies, five foundations, and M.I.T. director of the study was Carroll L. Wilson of M.I.T.'s Sloan School of Management and the Program for Social Application of Technology.—LUTHER J. CARTER

## APPOINTMENTS

**Eric A. Walker**, retired president, Pennsylvania State University, to vice president for science and technology, Aluminum Company of America. . . . **Edward C. Wood**, director of applied programs, physical sciences division, Stanford Research Institute, to executive director, new SRI–Irvine Laboratory. . . . **Walter K. Kahn**, professor of engineering and applied science, George Washington University School of Engineering and Applied Science, to chairman of the department. . . . **Cedric M. Smith**, chairman, pharmacology department, State University of New York, Buffalo, has been named the first director of the new Research Institute on Alcoholism at the university. . . . **John H. Morrison**, professor of biology, Kent State University, to chairman, biology department, Cleveland State University. . . . **Norman S. Cohn**, chairman, botany department, Ohio University, to dean, Graduate College and director, Research Institute at the university. . . . **C. Sharp Cook**, head, radiation physics division, Naval Radiological Defense Laboratory, to chairman, physics department, University of Texas, El Paso. . . . **W. H. Matchett**, research fellow, Battelle Memorial Institute's Seattle Research Center, to chairman, botany department, Washington State University.

## RECENT DEATHS

**Robert L. Airth**, 48; professor of botany, University of Texas; 7 July.

**Avery A. Ashdown**, 78; retired professor of organic chemistry, M.I.T.; 15 July.

**Eric L. Berne**, 60; psychiatrist and developer of transactional analysis; 15 July.

**Leo W. Boulanger**, 46; professor of entomology and director of research, University of Maine; 2 July.

**Henry L. Cain**, 76; founder and president emeritus, University of the Americas, Mexico City; 1 July.

**Sydney Chapman**, 82; former professor of geophysics, University of Alaska; 16 June.

**Walter F. Colby**, 89; former professor of physics, University of Michigan; 2 July.

**Ellsworth Collings**, 83; dean emeritus, College of Education, University of Oklahoma; 18 June.

**David A. Cooper**, 72; professor emeritus of medicine, University of Pennsylvania; 6 July.

**Clarence B. Farrar**, 96; retired chairman, psychiatry department, University of Toronto; 3 June.

**Angus M. Griffin**, 60; associate dean, George Washington University Medical Center; 24 June.

**Leslie R. Groves**, 73; director of the World War II Manhattan Project which developed the atomic bomb; 13 July.

**Henry Guze**, 51; psychoanalyst and adjunct professor of anthropology, Drew University; 2 July.

**Robert W. Hull**, 46; chairman, biological sciences department, Florida State University; 13 July.

**George N. Jones**, 66; professor of botany, University of Illinois, Urbana-Champaign; 25 June.

**Carl F. Kayan**, 70; professor emeritus of mechanical engineering, Columbia University; 5 July.

**Paul L. Kirk**, 68; retired professor of biochemistry, University of California, Berkeley; 5 June.

**Albert B. Lauderbaugh**, 66; retired assistant vice president in charge of research and development, Columbia Gas System, Pittsburgh; 4 July.

**C. N. Hugh Long**, 69; former dean, Yale University School of Medicine; 6 July.

**Andrew A. Marchetti**, 69; professor of obstetrics and gynecology, Georgetown University; 24 June.

**Abraham Maslow**, 62; professor of psychology; Brandeis University; 8 June.

**Carl A. Moyer**, 61; former director of research, Michigan Technological University; 29 May.

**Carey G. Mumford**, 67; professor emeritus of mathematics, North Carolina State University, Raleigh; 24 June.

**Hortense Powdermaker**, 69; retired professor of anthropology, City University of New York; 16 June.

**Carl F. Prutton**, 71; retired head, chemistry and chemical engineering department, Case Institute of Technology; 15 July.

**Eva J. Ross**, 67; retired chairman, sociology department, Trinity College, Washington, D.C.; 3 July.

**Zevi N. Salsburg**, 41; professor of chemistry and mathematical science, Rice University; 20 June.

**Mikhail Shemyakin**, 62; founder of the School of Biochemistry, Soviet Academy of Sciences.

**Herbert A. Siegel**, 47; professor of psychology, Towson State College, 20 June.

**Richard Spear**, 49; professor of education, East Carolina University; 4 June.

**Thomas B. Symons**, 89; retired dean of agriculture, University of Maryland; 4 July.

**Charles K. Weichert**, 67; former dean, College of Arts and Sciences, University of Cincinnati; 20 June.