state & society

Academy delays decision on fluorocarbon regulation

Two groups of the National Academy of Sciences, after a year and a half effort, have issued reports on chlorofluoromethane depletion of stratospheric ozone and other environmental effects of the CFM's. The Committee on Impacts of Stratospheric Change recommends that as soon as the reliability of the data is significantly improved, and in no case longer than two years, if it appears that ultimate ozone reductions of more than a few percent are a major possibility, then the government undertake selective regulations of the uses and releases of CFM's.

John W. Tukey (Princeton University and Bell Laboratories), chairman of the Committee, said when the report was released in mid-September "We think it would be worthwhile to get a few things straight, and that not more than two years should be allowed." He emphasized that if things are clarified earlier, less time should elapse before regulation should begin. This is in contrast, Tukey noted, to the CFM industry, which has been advocating a two-year delay on regulation in any case.

Regulation should in any case be selective, treating one use differently from another. Meanwhile all products containing the CFM's known as F-11 ($CFCl_3$) and F-12 (CF_2Cl_2) not intended to remain under seal (such as aerosol cans and refill containers for air conditioners and refrigerators) ought to be labeled as to their contents.

While the Committee on Impacts of Stratospheric Change studied the possible climatic effects of the CFM's and the consequences of depletion in stratospheric ozone, the Panel on Atmospheric Chemistry, headed by Herbert S. Gutowsky (University of Illinois) considered the question of how and to what extent the CFM's will affect stratospheric ozone. Membership of the two groups overlapped to some extent.

The Committee report is *Halocarbons: Environmental Effects of Chlorofluoromethane Release*, and the panel report is *Halocarbons: Effects on Stratospheric Ozone*. Both will be available from the Academy's Printing and Publishing Office.

The Academy studies are the latest in a series of evaluations of the impact of halocarbons on the stratosphere. One such report, "Fluorocarbons and the environment," was issued in mid-1975 (PHYSICS TODAY, October 1975, page 34) by the Federal Interagency Task Force on Inadvertent Modification of the Stratosphere (IMOS). If the Academy study

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confirmed the IMOS assessment, the task force recommended that rulemaking to restrict fluorocarbon use begin and suggested January 1978 as a time frame.

On 21 September 1976 the IMOS group

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Daddario evaluates progress at technology-assessment office

The Congressional Office of Technology Assessment, though it has completed 24 projects of the 49 undertaken since OTA began operations two years ago, continues in the process of institutional development, according to director Emilio Q. Daddario. The assessment office has recently evaluated the plans and programs of the Energy Research and Development Administration and the Environmental Protection Agency; now the OTA itself has been critically analyzed by another Congressional evaluative group. The director discussed these criticisms with us and defended his office's record.

Daddario graduated from the University of Connecticut's law school with an LLB degree in 1942. He served in the US House from 1959 to 1971 and was the Democratic nominee for governor of Connecticut in 1970. Daddario held the position of senior vice president of Gulf and Western Industries Inc's precision engineering group from 1971 to 1973, when he was named director of OTA. This year he became President-elect of the American Association for the Advancement of Science.

Still taking shape. The OTA consists of the Director and his staff of about 90 researchers and administrators, plus a bipartisan Technology Assessment Board made up of six Senators and six Representatives. (The director is also a member of the TAB, but he has no vote.) The Technology Assessment Advisory Council, some dozen outside experts, assists the Board. The OTA staff is organized as program groups of about ten persons each, in the areas of energy, oceans, materials, national R&D policies and priorities, health, food and transportation; each group is headed by a program manager responsible directly to Daddario.

Daddario acknowledges that the OTA is still in the formative process. "I'm not sure even now," he said, "how long the institutional development will take." The need to create a strong institutional base for technology assessment within an environment as flexible and changing as the Congress remains, for him, a very important consideration. At the time when Daddario was one of the Congressmen studying the problem of how to create an instrument for such assessments within the Legislative Branch, he told us, "I wasn't concerned with the details of how the office would carry on its daily work—the important thing then was to build the institution, and it still is."

The director explained his own view of the need for technology assessment, which

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he sees as one of the vital tools for the development of a sound science policy, not only in Congress or the Executive Branch but throughout society. "A technological application can appear to be good in the first instance," he said, "can in fact be very beneficial, but it may also have some side effects that could be avoided if it were looked into more deeply. But as it gets ingrained into the fabric of society, as it reaches the point where the economic interests become profound and intense, the problem of secondary effects becomes more difficult to deal with."

Recent assessments. Some of the OTA reports requested by Congressional sources and already completed are the following:

- An analysis of the effects of limited nuclear warfare. The findings of the Ad Hoc Panel on Nuclear Effects, headed by Jerome Wiesner (President, MIT), proved useful—especially the conclusion that the casualty estimates of the Department of Defense were unrealistically low—in the Senate Foreign Relations Committee's deliberations on US strategic policy.
- A look at mass transit in terms of energy consumption and the economy.
- A study on the need to assess potential social impacts of emerging medical technologies, such as cortical implants to provide "vision," or totally implantable artificial hearts.
- An assessment of the coastal effects of offshore energy facilities, including oil and gas drilling sites and floating nuclear plants.

Projects now in the works or soon to be completed by the OTA include assessments of nuclear proliferation and safeguards; the recovery, recycling and re-use of resources; solar-electric energy, ocean-energy technologies and coal utilization.

Criticism for the agencies. The OTA's analyses of the ERDA Plan and Program documents were conducted in two three-month stages in 1975 and 1976, at the request of the Senate Committee on Interior Affairs, the House Committee on Science and Technology, and the Joint Committee on Atomic Energy. Panels corresponding to major ERDA program categories, outside reviewing organizations and consultants, and three university contractors took part in the OTA's examination of the energy agency's first statement of objectives and approaches; the assessment pointed out a lack of long-range planning by ERDA and excessive concentration on technological solutions to short-term energy problems. A comparative analysis of the agency's 1976 Plan and Program was much more positive, reflecting ERDA's general compliance with the OTA's recommendations.

This year Daddario's office also reviewed the EPA's five-year R&D outlook, the first one published by the environmental agency. The OTA again indicated that long-range research, to develop overall environmental-management strategies rather than stressing means of regulatory enforcement, should have received heavier emphasis.

Daddario sees such analyses as part of the OTA's mandate to provide an early warning to the Congress of probable impacts of technological programs. In his words, a dialogue is established that allows agency plans and aims to be better understood on all sides. "Many of the things we brought out," he told us in connection with the ERDA analysis, "even though we appeared to be in conflict with [ERDA], were points the agency people were trying to make themselves—unsuccessfully—within the Executive Branch." Comments on OTA's work from officials within the agencies involved tend to confirm Daddario's view: Wilson K. Talley, Assistant Administrator for R&D at EPA, has referred to the assessment office's evaluation as a "helpful commentary on what needs to be done," and ERDA Administrator Robert C. Seamans Jr called OTA's analysis of his organization's plan and program a "most thorough review."

Watching the watchers. A staff report on the OTA's organizational effectiveness prepared for the House Commission on Information and Facilities asserts that the technology-assessment apparatus has been short on performance, wasting valuable time on feasibility studies rather than actual assessment, and that it does more of its work in-house than was originally planned. We asked Daddario about the contention that the OTA's designers meant it to be largely a contract organization. "It was never envisioned," explained the director, "that we would contract everything out." Congressman Olin Teague (D-Tex.), chairman of the Technology Assessment Board, responded to the critical report by asking the OTA to prepare a status report justifying its operations; on the basis of that document Teague has since declared himself satisfied with the assessment office's management of its responsibilities.

—FCB

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met to review the NAS report, noted that the Academy's scientific findings substantiate the preliminary findings made last year by IMOS, and unanimously recommended that Federal regulatory agencies now commence proposed rule-making procedures so that any necessary future restrictions are based on "thorough and thoughtful considerations."

After CFM's are released at Earth's surface, they rise slowly into the stratosphere, where they are decomposed by the Sun's uv radiation. Chlorine atoms and chlorine oxide (ClO) produced by this decomposition then catalytically remove the ozone. This results in more biologically active ultraviolet reaching the Earth's surface.

At present, the Gutowsky report notes, ozone reduction is highly uncertain. If releases continued at the 1973 level, the ultimate ozone reduction would be about 7%; this figure is relatively certain to be between 2–20%. However, the report continues, this range does not allow for

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Washington Bulletins

★ **Copyright legislation is passed.** Both houses of Congress have approved a House Senate conference report on S. 22, the long-awaited bill that constitutes the first comprehensive revision of US copyright law since 1909. The measure extends the lifetime of copyrights and sets guidelines for the reasonable use of copyright-protected materials in education. President Gerald Ford has signed the bill.

★ **ERDA still has no FY 1977 funding authorization,** with Congress adjourned for the year. Budget appropriations could not be used without the measure, but Congress suspended the authorization requirement until 31 March 1977. Until funding is authorized by the new Congress in 1977, ERDA will initiate no programs not already authorized in previous budgets, according to a spokesman. No physics projects are affected.

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possible inadequacies in the bases of the calculation, such as essential chemical reactions not yet recognized to be essential and the possibility of as yet unidentified tropospheric sinks.

If we continue to use halocarbons at a constant rate, ozone reduction would gradually flatten out, approaching a steady state, the report says. To reach half of this value would take roughly 50 years.

The major impacts of increase in biologically active ultraviolet reaching the Earth are: increased incidence of both melanoma and less serious kinds of skin cancer and effects on plants and animals of unknown magnitude.

Once appropriate legislation is in effect, the report recommends that a new review of our current knowledge on the climatic-effect problem be undertaken every three to five years. The Tukey report finds that accumulation of CFM's in the atmosphere increases the absorption and emission of infrared radiation, retarding heat losses from the Earth, thus affecting Earth's temperature and climate. This effect "is inevitably combined with the effect due to increased carbon dioxide and acts in the same direction."

During the past year two relevant scientific discoveries were made, the Tukey report notes. V. Ramanathan (NASA Langley Research Center, Hampton, Virginia) found[1] that F-11 and F-12 are sufficiently effective absorbers of infrared light (near 10 microns) that they might have a significant effect on the Earth's heat balance. F. Sherwood Rowland and Mario J. Molina (who sounded the ozone alarm in June 1974) and J. E. Spencer (University of California, Irvine) found[2] an unexpected relative insensitivity of chlorine nitrate ($ClONO_2$) to decomposition by ultraviolet light. The Gutowsky report notes that chlorine nitrate not only temporarily removes ClO from the ClO_x cycle but also NO_2 from the NO_x cycle. When the Panel included chlorine-nitrate reactions in its calculations, it found that the predicted ozone reductions were reduced by a factor of about 1.85, and that the distribution of ozone with altitude was modified. However, Gutowsky notes, the presence of $ClONO_2$ in the atmosphere has not yet been established.

Uncertainties. The Gutowsky report says the major sources of uncertainty in the ozone-removal predictions (for which numerical estimates can be made) are: in the measurements of seven of the reaction-rate constants (a fivefold range); approximations of the one-dimensional calculations used in the calculations (a threefold range); treatment of photochemical processes and measurements of concentrations of natural stratospheric species (a twofold range for each).

In two years, the report maintains, "if we pressed forward vigorously," we could: reduce the possibility of an unidentified factor being found and reduce the overall identified uncertainty of the predictions from a tenfold range to a fourfold or fivefold range; have begun to use more sophisticated models of stratospheric transport and chemistry.

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By the same token, in five to ten years, the report believes we might clarify, "at least in significant part": detailed climatic consequences of ir absorption by the CFM's and consequent effects on agricultural productivity and possible changes in sea level; consequences of changes in the altitude distribution of ozone. —GBL

References

1. V. Ramanathan, Science **190**, 50 (1975).
2. F. S. Rowland, J. E. Spencer, M. J. Molina, "Stratospheric formation and photolysis of chlorine nitrate, $ClONO_2$" J. Phys. Chem., in press.

Seven new members join National Science Board

President Gerald Ford's nomination of seven persons to serve six-year terms on the National Science Board, the policy-making body of the National Science Foundation, won Senate confirmation.

They are Raymond L. Bisplinghoff, chancellor, University of Missouri at Rolla; Lloyd M. Cooke, corporate director–community affairs, Union Carbide Corp, N.Y.C.; Herbert D. Doan, partner, Doan Associates, Midland, Mich.; John R. Hogness, president, University of Washington, Seattle; William F. Hueg Jr, professor of agronomy and dean, Institute of Agriculture, University of Minnesota, St Paul; Marian E. Koshland, professor of bacteriology and immunology, University of California–Berkeley and Alexander Rich, professor of biophysics, Massachusetts Institute of Technology, Cambridge.

Averch takes up NSF education post

The Senate has confirmed recently the nomination by President Gerald Ford of Harvey A. Averch as Assistant Director for Science Education of the National Science Foundation. Averch has been acting Assistant Director for Science Education at NSF since Lowell J. Paige resigned the position in August 1975.

Averch holds a doctorate from the University of North Carolina and worked for the Rand Corp as senior staff economist before he joined NSF in 1971. From 1971 to 1974, he was director of NSF's Division of Social Systems and Human Resources. Averch became deputy assistant director in the Research Applications Directorate of NSF in 1974.

in brief

The deadline for receipt of nominations for the National Science Foundation's second annual Alan T. Waterman Award is 31 December. The award, which is presented to a young scientist, mathematician or engineer, carries with it a medal and up to $50 000 a year for three years of research or advanced study. Further information may be obtained from Lois Hamaty, Office of Planning and Resources Management, NSF, Washington, D.C. 20550.

Recent appointments at the International Atomic Energy Agency are Terence Garrett (United Kingdom) as secretary of the General Conference, Charles H. Millar (Canada) as head of the division of nuclear safety and environmental protection, and Svasti Srisukh (Thailand) as director of the division of technical assistance.

The National Research Council in 1976: Current Issues and Studies is available from the NRC Office of Information, 2101 Constitution Avenue N.W., Washington, D.C. 20418.

The International Nuclear Information System's *Atomindex* has converted from a bibliography to the world's only nuclear-science abstracting service. Now incorporating into its data base the service provided by ERDA's discontinued *Nuclear Science Abstracts*, the semi-monthly INIS *Atomindex* is available from UNIPUB, Box 433, Murray Hill Station, New York, N.Y. 10016. The subscription rate is $110.00 for 24 issues.