It may be true, as Mansfield says, that what is available is "a set of tentative, partial findings," but it is certainly also true that interest in these findings is waxing. Mansfield and Terleckyj, for example, testified at hearings on the subject of federal R & D and economic growth this spring before a House Science and Technology subcommittee.* The issue of technological innovation was a central concern of the President's Advisory Group on Contribution on Science and Technology, which wound up its work in early August. And both the National Science Foundation and the National Bureau of Standards have programs bearing on the subject. The best known of these is the NSB's Experimental Technology Incentives Program. ETIP is a program of small-scale experiments principally designed to encourage government agencies to remove "roadblocks" to innovation created by procurement and regulatory policies (*Science*, 26 September 1975). NSF has funded a number of studies on R & D productivity and related subjects that have provided grist for the mills of discussion. Economists seem to agree that it is too early to evaluate the effect of these programs.

The concern about R & D and economic growth is hardly new. The first serious discussion of broad government action to promote innovation in private industry came in the middle 1960's at the initiative of Hollomon. His proposal for a network of state efforts resembling the agricultural extension program finally was enacted into law in microcosmic form.

An even more ambitious attempt seemed to be in the offing in 1972, when President Nixon called for shifts in federal R & D policy to make the government a more effective agent in promoting innovation in industry outside the defense and space sectors. A major aim was to improve the competitive position of the United States in foreign markets. A major effort to come up with a comprehensive list of options for possible programs was directed by William T. Magruder, then a White House aide. "The Magruder exercise," as it was familiarly known, sputtered out, a victim, it would seem, of interdepartmental differences and the distraction of the Administration by Watergate.

Some of the ideas bruited about then are likely to come under consideration again. Tax measures, modification of patent and antitrust laws, and programs of direct federal spending on R & D to bolster technological innovation have had proponents for years. And proposals for other sorts of federal incentives—for R & D cost sharing and various kinds of guarantees against financial risk, for example—have been put forward. These ideas and the initiatives taken by foreign governments to stimulate innovation in industry—including Britain, France, and Japan—have been under scrutiny in recent years, with the result that the pros for taking a particular sort of action in many cases are virtually balanced by a set of cons.

At this point, no one is claiming that there is a federal quick fix to the problem of technological innovation. No snake oil remedies are being sold. On the contrary the experts are stressing the complexity of the problem and counseling caution and a modest trial-and-error approach to federal R & D policies. A statement by Mansfield at the conclusion of a paper he wrote at the request of Senator William Proxmire (D–Wis.) for a forthcoming collection on priorities for federal R & D sums up this attitude:

"There sometimes is a tendency to slur over—or perhaps not to recognize—the fact that very little really is known concerning the effects of many of these policy alternatives, or concerning the desirability of their effects. (Indeed, in some areas, no one really knows how to study these questions effectively, let alone provide answers here and now.) Given the current uncertainties, it would seem wise to proceed with considerable caution, and to build into any program the capacity and necessity to resolve many of the key uncertainties before too big a commitment is made." These caveats notwithstanding, what the economists have provided now with their econometric evidence of the substantial social rate of return of R & D, however, is a new justification for federal initiatives.—JOHN WALSH

*Hearings titled *Federal Research and Development Expenditures and the National Economy* before the subcommittee on domestic and international planning and analysis will be published soon and will be available from the House Committee on Science and Technology.

Environmental Research: EPA Plan Termed Myopic

The 5-year research plan prepared by the Environmental Protection Agency is heavily criticized by a group of academic and industrial scientists in a review undertaken for the Office of Technology Assessment.

The chief criticism is that EPA's research is excessively focused on short-term regulatory issues at the expense of longer range research, such as the study of the health effects of low level exposure to pollutants.

EPA research director Wilson K. Talley says he regards the review as useful criticism but that OTA "has faulted me for not taking on all the problems of the environment." Talley declines to characterize the report as either fair or unfair. Phyllis Daly, head of the research planning office that compiled the EPA 5-year plan, describes the OTA review as a "forum for saying that there are many gaps in environmental research—I don't feel that it was really meant as a criticism on the 5-year plan."

Asked about the criticism concerning short-term research, Talley and Daly told *Science* that only $25 million of EPA's research is devoted to short-term projects, whereas $135 million goes to intermediate research and $80 million to long-term projects.

On the other hand Robert Daly (no relation), the OTA project director, responds that his panel members "felt that almost everything identified was short-term. The long-term things which are identified mostly address the development of techniques. We asked EPA for further breakdowns of research categories described in the 5-year plan but they declined to supply them." EPA's Daly denies the charge, saying that OTA was given all the information it requested.

The OTA group notes that environmental factors are now thought to be involved in cancer, heart disorders, and other degenerative diseases, yet present air pollution standards, for example, are almost totally based on the effects of acute exposure to pollutants. What is needed is information about the effects of low level, long-term exposure to pollu-

tants, particularly in relation to other diseases as well as cancer. "Because of the present commitment of EPA to respond to near-term exigencies, it has not been able to develop a strong long-term health research capability," the OTA reviewers allege.

Observers not connected with EPA were the first to bring several pollution problems to public attention, such as those of vinyl chloride and nitrosamines in air and of chloroform in water. This suggests, says the OTA group, that EPA should improve its prediction record by developing a system for screening pollutants.

In the field of control and abatement technology, the OTA review says that the EPA's development efforts appear to favor demonstration over exploratory research. This raises a familiar problem: "To the extent that EPA is both regulator and developer, it could be put in the position of promoting its own technology." Talley says it hasn't happened yet.

In another major research area, that of the transport, fate, and monitoring of pollutants, the OTA reviewers feel that much of EPA's work is fragmented. "Research into the complex of processes that link emissions from a source and their effect on the biosphere has not been assigned a high enough priority to support the scientific basis of the regulatory process," says the OTA report.

Turning to socioeconomic research, the reviewers fault EPA for putting highest priority on technological fixes for environmental issues, even though in many cases the most important problems are institutional.

A criticism that occurs several times in the review is that the EPA should do more to coordinate and take the lead in federal research on environmental issues. At present, says the OTA report, "there appears to be no coherent integration" of federal environmental research and development programs except in the energy area, and the EPA's 5-year plan offers no method of achieving such coordination. Talley's response is that "EPA has no federal responsibility for coordinating federal environmental research." OTA project director Daly says that such responsibility is implicit in the agency's legislation, and that the 5-year plan in any case speaks of EPA's coordinating role. The plan, in an appendix, states that EPA "is clearly mandated to be the lead agency in environmental R & D," and that it "has the responsibility to make sure that environmental R & D capabilities in other agencies are not unnecessarily duplicated. . . ."

The OTA review is the first major public criticism of EPA's research since September 1974 when two separate reports, one by the National Academy of Sciences and one by the staff of the Senate Public Works Committee, said that the agency's research effort was in shambles.

Interest in Peaceful Nukes

Talley became EPA research director shortly thereafter, and the management structure of the program was reorganized in mid-1975. OTA's Daly says that the review should not be construed as a criticism of Talley, who submitted the 5-year research plan to Congress voluntarily (a bill exists requiring such a plan but it has not yet been passed).

Talley is a nuclear physicist with an interest in the peaceful use of nuclear explosions. Is a nuclear background embarrassing for a director of environmental research? Not at all, Talley says. He has been a member of the Sierra Club for 15 years, and it was the desire to help avoid greater penalties to the environment that led him into nuclear energy. Later he served on the Ash Council, the group that recommended the creation of EPA to President Nixon.

Though the OTA report is hard hitting, Talley is studious in avoiding any countercriticism. "If they had said the plan's the greatest thing since sliced bread, I don't think I would have been particularly pleased because I would not have learned anything."

—NICHOLAS WADE

Briefing

Junk Charge Dropped Against VIMS Director

Embezzlement charges against William J. Hargis, Jr., director of the Virginia Institute of Marine Sciences (VIMS), brought by a local grand jury last July, were dropped on 1 September by Gloucester County Circuit Court Judge James B. Wilkinson. As a result, Hargis, who had stepped aside as VIMS director until the matter was settled, has resumed his duties as director (*Science*, 10 September).

The case against Hargis was so flimsy as to call into question the motives of the state in bringing it. No satisfactory explanation has yet come to light, nor is there any evidence to corroborate speculation that Hargis' outspoken statements on the Kepone pollution scandal were the cause of the state's actions against him.

Hargis had been accused of improperly appropriating to himself 167 hours of back leave in connection with service since 1971 as vice chairman and chairman of the National Advisory Committee on Oceans and Atmosphere (NACOA), which advises the President and the Secretary of Commerce on ocean matters. Hargis had also been indicted for allegedly wrongly allowing a ship's carpenter to take some rusted diesel engine parts from the VIMS premises in October, 1975.

Judge Wilkinson dismissed the annual leave charge right away, for lack of evidence. Subsequently, he heard the county prosecutor's case on the junk engine parts charge, and then told the jury that he would not allow it to consider that charge either. Judge Wilkinson remarked that he didn't see on what grounds the grand jury had indicted Hargis in the first place—a remark which may have referred to the role of the state police investigator, J. K. Adams, who investigated Hargis and made the presentation to the grand jury last July.

Reacting to the news, Hargis told *Science*, "I feel much better about it [the case], of course. But I still don't know why I've been put through this. I don't know who's responsible or why. . . . My family is relieved, but we think somebody owes us an apology."

Friends of Hargis, some of whom have started a defense fund to pay his legal costs, have speculated that Hargis was investigated, indicted, and prosecuted for political reasons. VIMS has been a major source of data on the extent of Kepone contamination in area fish and shellfish. Moreover, earlier this year, VIMS issued some comments on a draft environmental impact statement for a proposed Portsmouth oil refinery, which were critical of the plan. The comments were widely interpreted as being critical of any more refinery construction in the Chesapeake Bay, although a VIMS spokesman notes that the refinery's builders have taken the VIMS criticisms into account.

It is a matter of record that state officials, who have fostered the growth of industry in the region, which has 80 per cent of Virginia's population, have been irritated at VIMS.—D.S.