and 1973 Voyager projects. Representative Joe L. Evins (D–Tenn.), chairman of the Independent Offices Appropriations Subcommittee, which handles appropriations for NASA and nearly a score of other agencies, might be a particularly inviting target for missionary work. Certainly it is clear from the following incident that his information about the space program and its scientific overseers and cheerleaders is far from complete. During hearings last April, Evins noted that the NASA organization chart showed the Academy's Space Science Board, which is a few months older than NASA itself. "Is this new?" he inquired.

In promoting a change for the better in its fortunes on Capitol Hill, NASA should, Karth believes, show greater restraint in its enthusiasm for manned flight extravaganzas. Giving a speech last August, Karth expressed astonishment at having learned that only 2 weeks before, in the face of growing doubts among the citizenry about the space program's value, the Manned Spaceflight Center at Houston had asked 28 companies to submit proposals for a study of a manned Mars and Venus reconnaissance spacecraft under consideration for flights in 1975 and 1977. To Karth, these requests, since cancelled, were further evidence of the folly that can result from NASA's dichotomous management structure, in which the manned and unmanned programs are run by separate offices. Recent efforts by NASA to strengthen its management have neither eliminated the dichotomy nor silenced Karth and other critics.

However, the fate of a new round of proposals for planetary exploration may turn more on events in Vietnam than on anything the space agency and its friends in Congress and the scientific community can do to refurbish NASA's image and explain its goals. Yet such an effort may be needed if NASA is to make the best of a federal budgetary situation which holds little promise for agencies with large new plans.—LUTHER J. CARTER

Systems Analysis: No Panacea for Nation's Domestic Problems

The management technique known as "systems analysis" or the "systems approach" may have enabled Defense Secretary Robert S. McNamara to revolutionize administration of the Defense Department. But how would it fare if pitted against the domestic problems that confront federal, state, and local governments? Could systems analysis help end air and water pollution, educate the illiterate, heal the sick, eliminate crime, untangle transportation snarls, or boost recipients of public aid into self-sufficiency?

The answer, according to a report prepared for the U.S. Arms Control and Disarmament Agency by the Denver Research Institute (DRI), is a qualified "yes." Titled "Defense Systems Resources in the Civil Sector,"* the DRI report finds that systems analysis can become "a powerful tool" for dealing with *some* civil problems—but only if government agencies and private industry remove the numerous "obstacles" that currently inhibit use of the new techniques. And even then, the report makes clear, systems analysis is no panacea.

The report, based on interviews with 119 "knowledgeable people" in government and industry and on a review of the limited literature, was prepared by John S. Gilmore, John J. Ryan, and William S. Gould, industrial economists at DRI. The group sought primarily to analyze the systems capabilities of defense firms and evaluate the civil market for these resources in case there should be a cutback in defense spending. They concluded that civil systems work is "unlikely to absorb any great share of total defense resources." Instead, "its greatest promise is in improving the quality of government administration."

What are these promising new systems techniques, which have been called everything from "quantified common sense" to the "greatest advance in the art of government" in nearly a century? Definitions vary with the definer, but generally the "systems approach" involves identifying a problem, defining the objectives which must be achieved to solve it, considering alternative methods for meeting these objectives, and choosing the most attractive alternative "by rigid cost-effectiveness analysis, by intuition and judgment, or by something in between," the authors say. Systems techniques may also be applied to subsequent design and engineering work.

The defense systems approach evolved after World War II, largely in response to the technological revolution in weapons. Nuclear warheads, nuclear power sources, guided missiles, jet aircraft, electronic computers, and other developments created doctrinal problems, the DRI report says, "that would have seemed fantastic to earlier generations of men making national security policy and budgeting for its execution."

Much the same sort of complexity now seems to be building up in the civil sector too, the DRI study notes. Governments are finding it difficult to allocate limited resources among rapidly increasing demands, and swollen urban areas have brought a host of problems that demand solution with increasing urgency. These demands—coupled with an effort by defense firms to find civilian markets—have spurred efforts in the 1960's to develop a "civil systems" capability. The most widely publicized have been sponsored by the State of California, which contracted with four aerospace companies in 1965 for systems studies on information handling, crime, waste management, and transportation, and later followed these up with additional systems studies.

The DRI report gives the California effort mixed reviews. It found that knowledgeable professionals praised the initial studies for their "comprehensive scope" and "freshness of thinking," but criticized the studies for being "sometimes weak in their knowledge of the subject area," for making "political-

*Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402; $1.

ly naive recommendations," for failing to identify and analyze a sufficient number of alternative approaches, for trying to accomplish too much, and for putting "too much emphasis on engineering" and not enough on "social and institutional aspects."

The report also reviews other civil systems efforts: the introduction of planning-programming-budgeting systems into most major federal agencies; a high school construction project, carried out by Stanford University's Education Planning Laboratory and architects from Berkeley, for 13 California school districts (it is described as "probably one of the most successful civil systems efforts ever undertaken"); and various fledgling efforts by federal, state, and local governments. What does experience thus far prove? Mainly that a civil systems approach seems desirable and "possible" but that there are "large institutional obstacles to expanding demand—obstacles at all levels of government, and in the firms supplying systems service."

Government, for example, often lacks the data needed for systems approaches to civil problems. It is easy to determine how many mothers in a community are on welfare and how much they are paid in benefits, but not so easy to identify the pertinent stresses leading to family breakup, much less measure these stresses and conduct a cost-effectiveness study of alternative methods of rehabilitation.

Government also tends to be fragmented, with multiple agencies and political levels having jurisdiction over a particular civil problem, whereas systems work generally assumes that governmental authority matches the boundaries of the problem, as in the Defense Department or in the space agency.

Other problems arise from the fact that few people in civil government understand the systems approach; civil governments have little experience with the "contracting out" procedures used in defense systems work; state and local governments have little "thinking money" for long-range planning and redesign of existing systems; and they lack the "continuity" of the federal defense establishment—the type of people making decisions may change radically while civil systems are being developed. Civil governments are also subject to bureaucratic inertia that renders them "better prepared to resist change than to adopt it," says Gilmore.

NEWS IN BRIEF

• **ABM EXCHANGE**: The Atoms for Peace Award presentation on 14 November was marked by a sharp exchange over the validity of an antiballistic missile system (ABM) between a current and former recipient of the award. Alvin M. Weinberg, director of the Oak Ridge National Laboratory and a 1960 recipient of the award, and Isidor I. Rabi, Nobel laureate in physics and long-time government science adviser who was one of three men who received the 1967 award, substantially disagreed over the role of an ABM system in the nuclear arms race. Weinberg, in delivering the principal address at the ceremony, said that a strong defense system could limit the missile's effectiveness and end the spiraling arms race. He stated, "If defensive systems continue to improve, the capacity of the world to destroy its people and its lands will gradually deteriorate . . . so that nuclear war, even in a defensively oriented world, could never be regarded as a rational instrument of policy." During a news conference following the speech, Rabi took sharp exception to Weinberg's suggestion that a strong defense system promotes peace, the New York *Times* reported. Rabi was quoted as saying the idea was "political madness and technically unsound." He added that "there is no defense that can't be broken."

• **NSF LEGISLATION:** A special three-member subcommittee of the Senate Labor and Public Welfare Committee conducted hearings 15 and 16 November on two similar bills that would modify the structure of the National Science Foundation. The hearings, the first in the Senate on the NSF Act since its passage in 1950, were chaired by Senator Edward Kennedy (D–Mass.). Kennedy sponsored one of the measures, S. 2598. The second bill, H.R. 5404, was originally introduced by Representative Emilio Q. Daddario (D–Conn.), and passed by the House in April. Both the Kennedy bill and the Daddario bill would authorize NSF to support scientific activities related to international cooperation and foreign policy as well as to support applied research. Both also specifically direct NSF to support the social sciences in addition to the physical sciences, and both would augment the responsibilities of the National Science Board. The Daddario bill states the board "shall establish and be responsible for the policies of the Foundation," while the Kennedy bill says the board "shall establish policies to guide the foundation." Neither bill encountered significant opposition during the hearings although several witnesses favored the Daddario bill's position on powers of the National Science Board. Senator Fred Harris (D–Okla.), sponsor of a measure that calls for the creation of a National Foundation for the Social Sciences, appeared as a witness supporting the Kennedy measure. He praised Kennedy's bill as "a basically good bill" but added that its passage would not affect the need for a social sciences foundation.

• **MARINE SCIENCES CURRICULA**: A 157-page compilation of marine sciences programs and faculties at universities throughout the nation has been published by the National Council on Marine Resources and Engineering Development. Copies may be obtained without charge by writing to the council at Room 476, Building 159E, Washington Navy Yard, Washington, D.C. 20390.

• **MENTAL RETARDATION CENTER**: The University of Miami has received $500,000 for its proposed Mental Retardation Center from the Joseph P. Kennedy Jr. Foundation. The research and training facility, the first of its kind in the Southeast, will open by 1970. The bulk of the cost of the $5-million center has been provided by a $3-million construction grant from the U.S. Public Health Service.

• **LETHAL AIR POLLUTION**: Warnings of an impending crisis because of carbon monoxide levels in New York City have been issued by two pollution experts. On 26 October New York City's Air Pollution Commissioner, Austin N. Heller, stated that growing carbon monoxide levels may force the banning of cars and trucks during certain hours in some areas of Manhattan such as Times Square. Myron Tribus, the dean of Dartmouth's School of Engineering, recently issued a stronger warning: "We're on our way to a public catastrophe. . . . Carbon monoxide levels in New York City are approaching the lethal level."

Moreover, civil governments can't just throw out old subway systems and antiquated school buildings the way the Defense Department junks an obsolete weapons system. They generally have to incorporate existing systems into any new system, and this lessens the opportunity for radically new approaches. Further constraints arise because civil governments can't order their constituents to use a new system (say, a mass transit system) the way the Defense Department can—thus the system must have market acceptability.

The resources for systems analysis and design are primarily found in government agencies concerned with defense and space, in the defense industry, and in the not-for-profit "think tanks." Focusing primarily on the defense industry, the DRI report concludes that defense firms lack many of the skills needed to succeed in the civilian market. Specifically, the defense firms lack "substantive knowledge of and experience with" most civil problems; they lack the "innovative marketing skills" needed to sell their services to a variety of customers; they rely on heavy support from their customers; and they are high-cost producers who may find it difficult to produce much of the hardware needed for civil systems at competitive prices. "Defense industry is not broadly experienced at operating in a market system, nor is its management," the DRI report concludes.

To reduce these obstacles, the report suggests action by both government and industry. It also proposes criteria for identifying the civil problems most amenable to systems analysis. In the short run, civil problems which approximate defense problems, or which deal with technological equipment and well-understood operations, offer the best possibilities, the authors feel. Thus a national oceanographic program patterned after the space program holds great potential for systems analysis, as do the operations of the Post Office and the collection and processing of weather data. However, in areas such as social welfare or education, "the systems approach should be applied—but cautiously, and without expectations of quick and easy results."

The authors lament that widespread civil use of systems approaches may take "years or even decades, unless there is either strong leadership to push it, or near-breakdown in existing government mechanisms." But they note that "with strong leadership" systems analysis improved the administration of national defense, and they predict that "the same would probably be true with the problem of generating innovation and efficiency in the civil sector of government."

Is there another Robert S. McNamara in the house?—PHILIP M. BOFFEY

British Science Policy: The Case for Growth

London. The second report of Britain's Science Policy Council reflects the rigors of making science policy in a cold economic climate. As in the United States, an era has apparently ended during which the science budget was boosted annually almost as an act of faith. What Vietnam has meant to science in the United States, a limping economy means to British science. A major theme of the new report* is an economic justification for a continued adequate growth rate in expenditures on science.

The Council on Science Policy was created by Britain's Science and Technology Act of 1965, which was intended to usher in a sort of technocratic New Deal in Britain. Members of the Science Policy Council are distinguished nongovernment scientists and science administrators. The chairman is Sir Harry Massey, professor of physics at University College, London, and P. M. S. Blackett, president of the Royal Society, is a member. The council advises the Secretary of State for Education and Science, who presides over the Department of Education and Science. DES holds the reins of the Science Research Council, Medical Research Council, Agricultural Research Council and Natural Environment Research Council, whose programs represent a major sector of civil science.

There is no comparable advisory group in the United States. Any such group would operate across bureaucratic boundaries to advise on the activities of NSF and on the research programs of HEW-NIH and the Department of Agriculture. Considering the breadth of its purview and the prestige of its members the council would appear to qualify as a major force in making science policy and science budgets. But who makes science policy and how in Britain remains a matter of speculation for outsiders. The report throws little light on the process. It does, however, give an ample idea of the questions that concern British policymakers these days.

Significantly, the council devoted a major section of the report to making a case for investment in science. (Expenditures on civil science rose from £6.5 million in 1945–46 to £295 million for 1967–68 and the council notes that this "has attracted inevitable questioning.") Instances such as the first production of ethylene polymers in Britain, made possible by the development of transition state theory by Polanyi in the early 1930's, and the genesis of microwave radar are cited as benefits to society gained from applied research.

The council also espouses the cause of basic research, not only because of the great, if long-term, economic dividends to be gained from new discoveries, but also because of the importance of such research in producing new generations of scientists and technologists and because "The stimulus to improved understanding and control of the external world has distinguished all progressive societies and is one of the main driving forces of civilization."

If an emotional note is struck anywhere in the report it is in rejecting suggestion that a wholesale deployment

**Second Report on Science Policy* (Her Majesty's Stationery Office, Cmnd. 3420, London), 4s. 3d.