have on coal production and the economy. In the event of a veto, however, he promised to try to write strict reclamation standards into any new federal coal leases.

(The White House announced on 19 May, as this issue of *Science* was going to press, that the President will indeed veto the strip mining bill, a measure similar to the one he vetoed last December. Administrator Frank Zarb of the Federal Energy Administration said that the bill's reclamation requirements and mining restrictions would reduce coal output by 40 to 126 million tons a year. Sponsors of the legislation, who reject such figures as unfounded, believe that the veto will be overridden.)

On land use planning, Hathaway said he would "work toward administration support" of legislation in this field. And, in his opinion, the measure pending in the Interior Committee was a "good bill." President Ford has, for budgetary reasons, decided against sending a land use bill to Congress this year, having chosen instead to sponsor only a measure narrowly concerned with energy facility siting.

Also, in the hotly controversial matter of whether to relax standards preventing "significant deterioration" of air quality in clean air regions, Hathaway said, "I would not want to see us develop energy in that way." Yet the White House wants Congress to amend existing law to allow such deterioration as may be compatible with human health.

**Evasiveness Charged**

Some senators on the Interior Committee, especially Richard Stone (D–Fla.) and James Abourezk (D–S.D.), believe that Hathaway responded to their questions evasively by qualifying his answers or pleading ignorance. For instance, Stone thinks, perhaps unfairly, that this nominee from landlocked Wyoming should have arranged to be better briefed about outer continental shelf oil development and the problems it will create for coastal states. Abourezk found Hathaway unconvincing on his priorities for the use of western water, although the nominee tried to assure the senator that he put industrial use behind municipal and agricultural use. Abourezk and Stone, together with Senator Haskell, are definitely committed to vote against this nominee at the 21 May meeting scheduled by the Interior Committee to act on his confirmation. But Hathaway seems assured of a favorable vote both in committee and on the Senate floor.

At the outset of the confirmation hearings, committee chairman Senator Jackson (D–Wash.) noted that the Senate has traditionally allowed presidents wide discretion in choosing Cabinet officers. (The only such nominee rejected in recent decades was Lewis Strauss, who in 1959 was denied confirmation as Secretary of Commerce.) And, however many the questions about Hathaway's performance as governor, no one has suggested that he is not of good faith and integrity.

In the latter regard, the committee staff actually turned up a testimonial in Hathaway's favor by pursuing a disquieting rumor about him. The rumor was that the American Bar Association (ABA) had uncovered damaging information earlier this year in investigating Hathaway's qualifications for a possible appointment to a judgeship. But the ABA had found nothing of the kind, and, as the committee was informed, it was prepared to recommend him as well qualified, or even exceptionally well qualified.

Even so, if Hathaway is confirmed, as now seems virtually certain, he will be a while in living down doubts about his capacity for prudent management of the public lands.—LUTHER J. CARTER

# OECD: Report on Research System Says the Honeymoon Is Over

There is value, as Robert Burns wrote, in seeing ourselves as others see us, and such perspective is provided by the final volume* of a three-part study of national research systems by the Organisation for Economic Cooperation and Development (OECD) which gives an informed Western European view of research organization and science policy in the United States and Canada.

The survey started out as a study of the organization and financing of fundamental research and ended up documenting the decline of faith in such research in Western industrial nations.

The authors have had to contend with a moving target. The idea for the study was generated in the era of the "technology gap" in the middle 1960's, when the value and virtue of basic research was little doubted and a lot of time was spent on such questions as what percentage of a country's gross national product should be devoted to support of R & D and what portion of that, in turn, to basic research.

Volume 1, published in 1972, concentrated on the three largest Western European countries—Britain, France, and Germany (*Science*, 14 April 1972), and volume 2 (*Science*, 27 July 1973), on five small, industrially successful nations—Belgium, the Netherlands, Norway, Sweden, and Switzerland. As the authors note, the first volume focused on fundamental research. The second volume broadened its scope to give more attention to the research system as a whole, and the latest volume, which includes some general conclusions, devotes much attention to the changes which have affected research systems. These shifts have been caused primarily by the rapidly developing demands on research systems to deal with new economic and social problems.

Headquartered in Paris, the OECD is an international organization devoted to fostering economic growth. *The Research System* is a product of the able staff of the OECD's directorate for science, technology, and industry (which, not insignificantly, used to be called the directorate for scientific affairs).

The difficulties of doing a comparative study over a period of several years under such conditions are obvious. Events have moved so rapidly that the data seem unusually dated (the cutoff point for most statistics in the latest volume is 1972). Changes in science policy—signaled by banishment of the science advisory apparatus from the White House and the advent of the energy crisis—are noted, but the effects of inflation and recession do not seem to be taken fully into account, particularly in the discussion of university research. And in this volume there seems to be somewhat less slash and dash in the authors' style, qualities that lent piquancy to the usually bland fare of international organization reports. The conclusions reached in volume 3 are modest and sensible, but American readers are likely to be most interested in the perspective offered

**The Research System.* vol. 3. Obtainable from OECD Publications Center, Suite 1207, 1750 Pennsylvania Avenue, NW, Washington, D.C. 20006. The price is $9.50.

in the report on changes in science in the last decade.

(Canada is not really given equal time in the report, but a conscientious effort is made to indicate where U.S. and Canadian paths have converged and diverged. A major point made is that Canada has been preoccupied with developing its own resources and industry and has sought to maintain scientific independence from the United States. The Canadians have followed policies similar to those of the five European countries which figure in volume 2 in encouraging industry through government research support and university cooperation.)

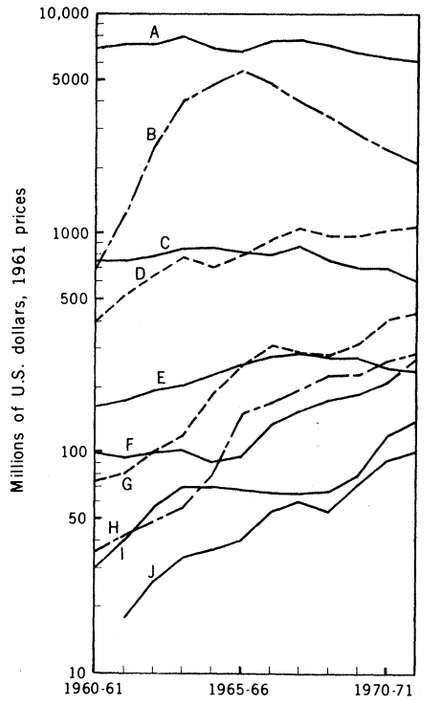
According to the OECD analysis, the pattern and premises of U.S. support of R & D have altered drastically in recent years. Until the middle 1960's the federal R & D budget was dominated by spending in support of what the report calls "strategic objectives"—defense, space, and nuclear energy. The rationale was supplied by the Cold War competition with the Soviet Union. The argument was that a strong scientific establishment was necessary for economic growth as well as for national security, and a major program of fundamental research was assumed to be a guarantee of the strength of the R & D system.

The shift away from concentration on strategic objectives is attributed to multiple causes. Social unrest in the 1960's produced a demand for R & D activity in new sectors, such as urban affairs, health care delivery, and education. The Vietnam war brought the military budget under hostile scrutiny; a measure of blame fell on scientists for developing military technology. And environmental issues contributed to the antiscience backlash. Balance-of-payments problems and later inflation and recession attracted attention to the economic payoff from R & D and to the question of whether basic research is really essential. The public and public officials began to apply new criteria to R & D initiatives, asking what specific benefits they promised for society and also what negative consequences they might bring. The corollary was that new means of assessment were necessary.

The effects on government, according to the authors of the report are as follows:

> ... the wide differences which exist between the major strategic objectives of the last twenty years and the "new" economic and social concerns of the 1970's have necessitated an evolution extending far beyond a simple reorganisation and often encountering conflict with accepted traditional forces. These differences do not eliminate such long-standing problems as co-ordination within the State sector; rather, they provide a new dimension; they imply a thorough overhaul of not only research management, but of the whole concept of the role of research in public bodies.

**Evolution of U.S. R & D Expenditures**




A. Defense
B. Civil Space
C. Civil Nuclear
D. Health
E. Agriculture, Forestry
F. Economic Services
G. Mining and Manufacturing
H. Public Welfare
I. Other Community Services
J. Pollution

The atmosphere which the authors believe now prevails is indicated by the title they chose for the first part of the report—"The Honeymoon Is Over." They see the "privileged relations" between the scientific community and the government as ended. The scientific community divided uncharacteristically on such issues as the ABM, the SST, and nuclear power. At least partly in response, the government dismantled the central consultative machinery which involved scientists from outside government in the decision-making process and protected the interests of science. In the universities, the government moved to challenge the peer-review system under which scientists determined the choice of research projects. In the government research sector, the agencies which dominated the era of devotion to strategic objectives—the Department of Defense (DOD), the Atomic Energy Commission (AEC), and the National Aeronautics and Space Administration (NASA)—and whose R & D budgets were now diminished, were precisely those most dedicated to the belief that technological advance depended on progress in the most fundamental science across the disciplinary spectrum. In the health field, the National Institutes of Health, committed to basic research, controlled a dwindling portion of the health research budget.

The Mansfield Amendment of 1970, which required that basic research projects funded by DOD have a "direct and apparent" relationship to a specific military function, is taken as a symbol as well as a major symptom of a change in attitudes.

In dollar terms, the decline of R & D funding for the old Big Three agencies is not as dramatic as the report suggests. The DOD, AEC, and NASA R & D budgets amounted to about 85.7 percent of the total in 1967 and had dropped to 77.6 percent by 1971 (see chart); things have not changed greatly since 1971, although space funding continues to decline. These are hardly paltry proportions. However, the toll of inflation and the rise of energy R & D make it difficult to argue seriously against the OECD generalization. (National Science Foundation figures show that in terms of constant dollars the federal R & D budget fell about 13 percent between 1968 and 1972.)

The cold climate for R & D, which has chilled university science, has also affected industry. Since about 70 percent of R & D manpower in the United States is employed in industry, it is a vital area in any discussion of trends in science. The subject is not readily accessible, however, and students of science policy seem to give it less attention than other sectors. One difficulty is that scientists and engineers in industry function in a multiplicity of ways that defy the tidy categorizations which can be applied to scientists and engineers in universities and government. Not only are the boundaries between basic and applied research less clear, but industry scientists and engineers may operate in management, production, or even sales operations. In addition, many companies are highly secretive about research budgets and the use of R & D personnel and are shy about discussing research policy. The OECD team obviously made a strong effort on industry R & D, and although a lot of the information is anecdotal, the sections on industry are perhaps the most original and generally most rewarding in the report.

The recession in scientific manpower between 1969 and 1972 is attributed principally to cutbacks in defense and space projects. According to the report, company presidents were indulgent toward R & D as long as sales and profits were up. When serious reversals began, R & D came under close scrutiny.

Basic research suffered more heavily than more applied research, except in such high-technology enterprises as the Bell System, Eastman Kodak, and IBM—true believers in fundamental research.

In industry at large, bad times brought smaller cuts in product-oriented research than in basic research, and there was a discernible trend toward closing down or cut-

ting back centralized labs where basic research tended to be done. The OECD surveyors wonder whether some basic research labs might not have been closed before it could be determined whether their work would have led to useful innovation.

The OECD sees U.S. industry as confronted with serious new challenges. The relative competitive advantage of U.S. industry in international markets is seen as diminished by the growing sophistication of industry abroad. Environmental legislation in the United States has imposed restraints on industry operations, and the energy crisis has increased costs and created need for new energy sources.

Tensions between government and industry have been sharpened because new legislation and regulatory agency orders sometimes place conflicting demands on industry. Auto manufacturers, for example, may find it difficult to reconcile requirements to meet new air emissions and safety standards while simultaneously increasing mileage performance of autos to meet energy conservation demands. At the same time, car makers may be barred from collaborative research by antitrust laws.

A more subtle but nevertheless serious problem facing industry is what the OECD teams dub "the technology trap." The study describes it this way.

> Several R & D directors underline independently that the choice of technologies to be pursued has become a graver and more difficult problem than it has ever been before in the United States. It is easier to present concrete examples of this difficulty than statistical data or final explanations. Two interpretations of this problem can be found; they are probably more complementary than contradictory. According to the first one, the growing pool of scientific and technological knowledge multiplies the number of possible technical solutions to the same problem, whereas 10 or 20 years ago the number of choices was still smaller and industrial decisions therefore simpler. Aircraft builders support this interpretation: "Technology advances are now being made in so many directions that a new problem has arisen: the technology trap. Just because something is technologically possible does not mean that it should be developed into hardware."
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> According to the other, complementary interpretation, presented among others by the research director of IBM, the development costs of new technologies are increasing quicker than for example other production and marketing costs; in other words, the R & D part in the total costs of certain advanced technologies is increasing.
>
> Hence, choosing the right technology at the very beginning is more and more vital, and choosing the wrong one can be more and more fatal. While the number of possible solutions apparently increases, each single solution is said to become more expensive in relation to other costs, at least in some high technology sectors. This explains why individual companies are apparently less able than before to test alone all possible technologies in one sector, and less willing to choose, because the penalty for choosing wrongly can be fatal for a single company. . . .

The days when defense and aerospace industries and other government contractors enjoyed relatively simple relations with Washington have passed. Using the ordeal of Lockheed and other contractors as examples, the report questions whether the old "pluralistic, competitive" system can survive. In Japan, some European countries, and Canada, cooperation between government and industry is much more highly developed. And although they concede that tradition in the United States strongly opposes government intervention in industry, the authors see a trend toward government action.

A main finding of the OECD group is that the United States badly needs a strong technology policy. By this is meant that "responsible national authorities [should] influence the selection of industries and technologies through direct and indirect support, according to economic, social and political criteria which will indicate the most important technologies for the future of the country."

While a major remaking of habits and attitudes will be required, OECD sees some signs of a more interventionist attitude in Washington spurred on by balance-of-payments problems. The report cites the New Technological Opportunities (NTO) program headed by William N. Magruder, which caused a flurry in 1971. The idea was to provide some direct aid to industry in developing designs for new technology meant to bolster trade, security, or social enrichment. Also cited is the technology incentives program, sponsored jointly by the National Science Foundation (NSF) and the National Bureau of Standards, which is meant to encourage industrial R & D in innovative areas. However, NTO and Magruder have disappeared from the government scene, and the incentives program is just now climbing out of the incubator. Given the old and new tensions between government and industry and industry's concern over proprietary rights, the practical prospects for a workable technology policy seem highly uncertain. The OECD case for a technology policy is indeed persuasive, but so, after all, is the case for a coherent science policy, and that has never been enough to overcome the obstacles.

The report is probably right, however, in predicting that the government will increasingly give priority to oriented research designed to attain economic and social goals. In a related effort, government is seen as pressing for better measures of the value of research.

The global inference drawn in the report is that, while the scientific potential in the countries studied has increased greatly, no effective strategy for managing it has emerged, and in such countries as the United States, science policy machinery is in considerable disarray.

In the United States and most of the other countries studied, however, the authors see a tendency toward conducting discussions of scientific and technological issues more openly than in the past. They also note a trend "in favor of ministerial bodies vested with fairly broad responsibilities to influence the whole scientific and technical activity."

What they have in mind is apparently a cabinet-level body without operating responsibilities, but performing primarily coordinating functions. They see this approach being taken in the United States with the effort to enhance the role and influence of NSF.

A main conclusion of the report is that the decision-making process for science and technology should recognize the demand for broader consultation than in the past. Not only should scientists and engineers outside government be more widely involved, but "representatives of the potential users, . . . should be associated with the definition of problems, the determination of objectives and the orientation of research programs."

Achieving such participation is easier said than done. But in saying it, the OECD has expressed a revised concept of what science policy is ultimately about. And this, in fact, is a major service performed cumulatively by the three volumes of *The Research System*, which might be subtitled "From technology gap to technology trap."—JOHN WALSH

## RECENT DEATHS

**Rena L. Foy**, 45; professor of education, Bowling Green State University; 7 February.

**Samuel Gelfan**, 72; professor emeritus of neurophysiology, New York Medical College; 16 March.

**Morris A. Goldberger**, 82; professor emeritus of gynecology, Mt. Sinai School of Medicine, City University of New York; 1 March.

**Miriam C. Gould**, 85; former professor of psychology, Vassar and Smith colleges; 29 January.

**Ellwood S. Harrer**, 70; professor emeritus of wood science, Duke University; 5 February.

**Henry L. Heyl**, 68; former associate dean, Medical School, Dartmouth College; 1 March.

**Israel Light**, 59; dean, School of Related Health Sciences, University of Health Sci-