obscure but elite group called the Administrative Conference of the United States, an efficiency-promoting arm of the Executive Branch, predicts that the initial anger and resentment that mid-level bureaucrats have felt toward NEPA will give way to "an institutional viewpoint more sympathetic to environmental, as opposed to purely programmatic, values."

"Admittedly this is largely a prediction rather than an accomplished fact," Cramton adds; and he goes on to warn that it's entirely possible that NEPA may give rise to a new form of "bureaucratic gamesmanship," in which an agency's expertise is used to shape impact reports to fit preconceived decisions rather than the other way around. Representative John Dingell (D–Mich.) the other coauthor of NEPA, worries about this possibility too. The law's requirements, he said in a recent speech, are often complied with grudgingly, "behind a facade of false enthusiasm," and a risk exists that the law may do no more than spawn a race of adept memo artists "totally lacking in vision and concerned only with robotlike compliance. . . ."

Such fears are not without substance. In actuality, the main objective of most agencies appears to be one of writing defensible impact statements while minimizing changes and consequent delays in their work—most of which was under way when NEPA became law. There is some feeling at the CEQ that the machinery for producing NEPA reports, while becoming larger and more adept, has not begun to mesh satisfactorily with the machinery for making decisions. Added support for this view comes from an investigation by the Government Accounting Office of seven agencies' activities under NEPA. The study, made at Representative Dingell's request, has concentrated almost exclusively on procedural details for preparing statements, but some of the GAO investigators nevertheless came away with the personal impression that the law's identifiable effects on agency decisions have been less than monumental. "NEPA is more than just a papermill," one GAO man said, "but one concern is that impact studies are not being done soon enough to really affect the decision process. Agencies tend to wait until after it's decided that a power plant or a highway is needed, and after the site is selected, before thinking about the impact."

The CEQ has tried to compile a list of exemplary accomplishments under NEPA, but so far the list is conspicuously short. For one, the CEQ justifiably credits itself with convincing President Nixon to kill the Cross-Florida barge canal, and after all, NEPA created the council, which the President initially had thought unnecessary. As another example, the Interior Department says that NEPA studies have led it to tighten design requirements for the trans-Alaska pipeline, and that if the line is built it will be less detrimental to the Alaskan tundra than it might have been before.

Further inquiries reveal some evidence that NEPA has forced federal highway authorities to pay more attention to known prehistoric Indian sites rather than blithely paving them over because they were not officially listed in the Federal Register. The Interior Department's Bureau of Reclamation can also proudly claim that it will dig a borrow pit for gravel behind a small earthen dam in southeastern Idaho as a result of NEPA studies, rather than in front, where the pit would remain as a visible scar on the landscape for decades. (This has by no means become standard practice, however. Nor has the need for the dam itself been seriously questioned.) Further, in the Department of Agriculture, the annual acreage to be sprayed for gypsy moths this year has been sharply reduced, partly, but only partly, as a result of reappraisals forced by NEPA.

"This is a very hard thing to document," Train concludes. The problem, he explains, is that one never hears about the decisions that aren't made or about projects that were modified early in the game as a result of NEPA studies. Precisely why is unclear. It may be that government administrators are reluctant to admit where they had gone astray and that a nettlesome law has shown them the light. To some observers however, the notion of unsung environmental heroes in the depths of federal agencies seems implausible. At any event, modesty of this sort is an unfamiliar virtue.

Certainly NEPA has had some beneficial spinoff that weighs heavily against its drawbacks. The public exposure it provides to formerly closed administrative procedures represents an important new restraint on executive arrogance. In creating the CEQ, the law placed a vigorous, though not always successful, advocate for environmental interests within the sanctum of the White House.

But before the law goes much further toward lifting the scales from the eyes of the builders and diggers in the federal government, the courts will probably have to take a second bold step in reading NEPA's lofty language —and require that agency administrators make a reasonable showing that their decisions do in fact take account of all the new environmental information that it generates.

—ROBERT GILLETTE

OECD: Report Sees Closer Links between Research, Social Objectives

For its industrialized member countries, the Organization for Economic Cooperation and Development (OECD)* has proved to be the most useful of international forums for consultation and mutual criticism on economic matters. At the time of the flap over the technology gap, for example, the organization provided a meeting ground for OECD science ministers and much of the analysis that enabled them to put the issues into perspective. Since OECD was created as a spinoff of the Marshall Plan, it has treated education and scientific research as essential social and economic factors and, through a competent secretariat, has generated solid data and some enterprising studies in these areas. OECD's series of reviews of national science policy, including an extramural one on the Soviet Union, has contributed a good deal to defining the goals and describing the mechanisms of science policy. And this month, OECD is scheduled to take the science policy reviews a step further with publication of a comparative study of the or-

*OECD member countries are Austria, Belgium, Canada, Denmark, Finland, France, the Federal Republic of Germany, Australia, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

ganization and financing of fundamental research in France, Germany, and the United Kingdom.

The idea for the study was germinated during discussions on the technology gap, but the project was carried through at a time when concern in Europe and the United States had shifted to a quest for ways to link science and technology more directly to the accomplishment of social and economic objectives. And a major premise of the report is that support of fundamental research is increasingly based on evidence that such research will contribute to achieving these objectives. Or as one author of the report told *Science*, "You can no longer speak of research without taking into account social demand."

The survey is actually part 1 of a scheduled three-part effort. Part 2 is to deal with smaller European countries, and part 3 to compare the situation in Europe with that in Canada, Japan, and the United States.

The first report is really an examination of the web of relationships connecting industry, government, and the universities in scientific matters. As a comparative study, it bounces around, sometimes disconcertingly, from industry to university to government and from country to country. Its chief virtue is that its authors, members of a multidisciplinary team headed by J. J. Salomon of the OECD directorate for scientific affairs, give the impression of being in direct touch with their sources of information, of writing with less attention to diplomatic politesse than is often the case in the reports of international organizations, and of being willing to question the assumptions that govern science policy. If one thing marks the report as a product of the 1970's rather than of the 1960's it is that the authors have concluded that the major obstacles to fundamental research in the countries under study are structural rather than financial.

The report is up-to-date in the sense that it takes into account "dislocations" in the scientific community, which are making it increasingly difficult for able young scientists to find employment either in universities or in research jobs outside university walls. At the same time, the report finds that, despite new conditions, research institutions, particularly universities, have not changed significantly in character. European universities have not reached the "advanced stage of scientific col-

Keeping an Eye on SESPA

Boston. The American Chemical Society braced itself for protest demonstrations at its national meeting in Boston this week after an unexpected phone call from the Federal Bureau of Investigation. The FBI's Boston office warned the ACS to expect disruptions at a session last Sunday evening, then helpfully supplied the names of half a dozen persons who might be expected to lead them.

As it turned out, the trouble failed to materialize at the predicted hour, but ACS officials indicated that they were nonetheless grateful for the FBI's help. Along the way, it became evident that the FBI follows in some detail the activities of Scientists and Engineers for Social and Political Action (SESPA), a loosely knit group who publish a magazine of radical bent called *Science for the People*, and who are perhaps best known for demonstrations that they have staged at AAAS meetings. A SESPA spokesman interviewed by *Science* said he was surprised and dismayed that the FBI should be interested in the group, and he said the FBI's apparent surveillance amounted to a form of intimidation. Neither the Justice Department nor FBI offices in Boston and Washington would comment.

The chemical society's national meetings manager, A. T. Winstead, at first denied any knowledge of possible disruptions, then conceded that the FBI had indeed called. "We really wanted to keep this hushed up," he said, adding that the ACS had quickly arranged for a number of uniformed and plainclothes security guards to hover around the meeting at the Sheraton Boston Hotel. "We'd been expecting trouble for the past several years, and we were prepared," Winstead said. "But this year we hadn't bothered until the last minute."

What changed the minds of ACS officials was a telephone call last Friday noon from Bernard McCabe, a supervisor in the Boston FBI office, to Arnet L. Powell, a former chairman of the society's northeast section. Powell said agent McCabe told him the Boston police had been advised that SESPA might "march on" the ACS meeting, and would he pass the word along? Powell, a chemist at the Office of Naval Research, emphasized that his only previous contact with the FBI was in the course of routine security clearance checks.

Some weeks before the Boston meeting, SESPA members asked the ACS for permission to set up a table to distribute literature and for the use of a small meeting room. The ACS board of directors turned down the room request but allowed the table. Last Sunday afternoon, several neatly dressed young men and women attending the table in a bustling lobby said Winstead apparently had a list of names of SESPA people that went well beyond any mentioned in correspondence with the ACS. "I wondered how he knew so many names," one graduate student from M.I.T. said. Others in the group seemed both surprised and a little awed that the FBI should be interested in them.

Joe Richmond, who said he is a postdoctoral chemist at Harvard, and who was among those named on the FBI list, conceded that SESPA members had talked about plastering posters around the ACS meeting and staging a guerilla theater skit during one session, but that too few members had shown up on Sunday to make this possible. Richmond said SESPA's objective was not to disrupt the meeting but to draw attention to what it felt were urgent issues of ethics and unemployment facing chemists and which the ACS leadership was ignoring.

In general, the SESPA members who did show up at the ACS meeting Sunday seemed less bellicose than many who have appeared at AAAS meetings. It is worth noting that, since SESPA tries hard not to develop a strong central leadership, its character may be expected to change from one week to the next and from one place to another. In Boston this week, Joe Richmond said "We aren't trying to alienate. We are genuinely trying to reach out and communicate." Nevertheless, the ACS is on its guard, thanks to the FBI.—R.G.

laboration" achieved in the United States, the report says. Putting it another way, the report says European universities lack the "entrepreneurial spirit" of their American counterparts.

In all three countries under study, the major share of fundamental research is carried out through a dual system—the universities plus what the report terms a "peripheral" system. In Britain this peripheral system is made up primarily of government laboratories, in which scientists make careers as researchers outside the universities. In France, the Centre National de la Recherche Scientifique (CNRS) and other government agencies support separate laboratories and individuals on a scale that matches the university research apparatus. In Germany, the Max Planck Institutes and other peripheral research institutions provide the alternative to university research.

The report asserts that university expansion and reform, in the three countries, while substantial, has had little operational effect on research. In fact, the drive toward departmentalization in France and Germany may carry the danger of creating large, self-contained units, based on a single discipline, which get little stimulus to be outward looking and are resistant to interdisciplinary work.

The report's authors see little mitigation of the Old World lack of mobility among scientists. Only in Germany is there evidence of willingness to move from university to university and from university to industry.

There are, of course, other national patterns reflecting political and administrative habits and histories. The French system for science is the most highly centralized of the three, with budgeting and policy-making powers concentrated in a top-level interministerial body. The British operate the most pluralistic system, with research funds coming from a number of government agencies. The British system is influenced by the so-called Haldane doctrine, which calls for a separation of authority over fundamental and applied research, with applied research funded through the "technical" ministries and fundamental research support allocated through research councils dominated by nongovernment scientists. The report describes the German system as the British system "adjusted in the light of federalism," which means that the central government and the Land, or state, governments join to support research institutions in a variety of financing patterns.

Despite such national differences, the report identifies major problems common to all three countries. One of these is the "aging" process in laboratories operated by the government.

As the authors put it, "The question obviously does not arise in recently established and still expanding agencies for which the difficulty is still rather

Patents: To Combine or Not to Combine

In New York on 29 March the antitrust division of the U.S. Department of Justice filed a suit against 20 of the nation's biggest aircraft manufacturers, alleging that for 44 years they illegally agreed to cross-license each other's patents on airplane parts, to the exclusion of other companies. The effects have been "restricting and suppressing competition . . . in the research, manufacture, and sale of airplanes" and "hindering and delaying the research and development of patentable inventions for airplanes." Government economists say the agreement has effectively discouraged innovation within the industry.

The list of 20 defendants includes the granddaddies of the U.S. aircraft industry, many of whom are the country's largest defense and space contractors: Boeing Co., Curtiss-Wright Corp., Fairchild Hiller Corp., General Dynamics Corp., Grumman Aircraft Engineering Corp., Ling-Temco-Vought, Inc., Lockheed Aircraft Corp., Martin Marietta Corp., McDonnell Douglas Corp., North American Rockwell Corp., and United Aircraft Corp. Named also is the organization formed in 1928 to administer the agreement, Manufacturers Aircraft Association, Inc. (MAA). The suit calls for the termination of the agreement and for MAA's dissolution.

Ironically, the suit was filed one week after the President's technology message was issued, which in one section stressed the desirability of having firms combine on R & D efforts which are too costly or risky to attempt singly. "Especially in highly fragmented industries," the message said, "formal or informal combinations of firms provide one means for hurdling these barriers. . . . In general, combinations which lead to an improved allocation of the resources of the nation are normally permissible, but actions which lead to excessive market power for any single group are not." In an "on the other hand" passage, the technology message rules undesirable "joint efforts among leading firms in highly concentrated industries." This view is a page borrowed from the book of the January *Economic Report of the President*, which says, in its R & D section, that consortia among private firms are desirable in highly fragmented industries. But "joint efforts" among leading firms in "highly concentrated industries" are undesirable. Evidently the Justice Department has now decided that the airplane manufacturers' agreement falls in the latter category.

The problem is one of relativity. What agreements are considered "desirable" is liable to shift from time to time. For example, the aircraft companies' agreement on patents, says one MAA spokesman, was first drawn up in 1917, as a direct result of U.S. preparations to enter World War I. Then, there was a need to create a fleet of 25,000 airplanes from an aircraft industry that was, at the most, nascent. Not only did the government, including the then Assistant Secretary of the Navy, Franklin D. Roosevelt, encourage the companies to get together and utilize each other's patents at that time, but the agreement has been reviewed by Justice since then and found legal. Now, the Justice Department has decided the agreement violates the 1890 Sherman antitrust act. Hence, while the suit may have little immediate impact on aerospace R & D, it does indicate which way the winds are now blowing in Washington on combinations of firms in "highly concentrated" industries.

—DEBORAH SHAPLEY

to find [than] to recruit a sufficient number of competent scientists. On the other hand, the problem is becoming critical for agencies which are obliged to curb their growth, and in some cases even reduce their staff. Even if this can be done relatively painlessly through the mechanism of retirement, this method is inadequate and the recruitment of young scientists is usually blocked. This blockage is reflected in a very substantial rise in the average age (sometimes more than one year per year), and there is clearly no more certain way of devitalizing these bodies and transforming them into deadweights."

The report puts the problem in a broader context by describing what amounts to a life cycle for the government laboratories. They are established in the first place to achieve specific results rapidly, often in new fields of research such as nuclear energy or space. As these objectives are achieved—or not achieved—there is a tendency for research aims to blur and for the research program to become diversified. Meanwhile, industry and universities have often moved into the laboratory's original field of research. In most cases, fundamental research has been an integral part of the laboratory's activities from the start, but, as time passes, the proportion of fundamental research tends to increase. And, according to the authors, " 'fundamentalization' is often a symptom of the aging of research institutions."

In part, this phenomenon is related to low mobility among European scientists. The authors suggest that the "movement toward job security—systematically sought, moreover, by scientists' unions—may very well transform the agencies in the government sectors into havens for second-rate scientists who can be assured of making a career there, which they might well find difficult to do in more competitive sectors."

This phenomenon, of course, has been observed in the United States, and the report quotes Oak Ridge's Alvin M. Weinberg, who, so to speak, wrote the book on the subject, in describing the tendency to "transfer from mission to discipline."

What to do about this the report leaves rather open, but it leans toward what it identifies as the Weinberg position. That is, government laboratories should be assigned new tasks contributing to the solution of national problems in the way already begun at Oak Ridge and, for that matter, at Britain's Atomic Energy Authority establishment at Harwell.

The report's final section on fundamental research and technological applications is sketchier than the other sections on the organization and financing of research in universities and government agencies. This is no doubt partially attributable to the shortcomings noted by the authors in the available "global data." They quite reasonably question the value of using quantitative data in addressing what is essentially a qualitative problem. The authors, therefore, have concentrated in this section mainly on the links between the university and industry.

Despite the incompleteness of data and the fact that the definition of fundamental research is even more elusive in industry than elsewhere, the report does make some generalizations. The proportion of R & D funds devoted to basic research in particular industries seems to be roughly similar in the three countries studied. It also appears clear that chemical and allied industries—petrochemicals and pharmaceuticals—spend a much higher proportion of R & D funds on basic research than does any other industry, with the electrical-electronics industry not too far behind.

Some of the more interesting observations in the study were based on visits to science-based firms in the three countries. Again, national patterns emerge. The most satisfactory interaction between industry and research institutions in other sectors seems to be maintained in Germany. It is worth noting that the most important contacts seem to be with the peripheral system, primarily the Max Planck Institutes, rather than with the universities. The Germans encourage industry-university links in a variety of formal and informal ways—for example, through scientific societies and seminars organized by industry. German scientists in industry are more likely to teach part-time in universities than their French or British colleagues are, and German professors are more likely to do industrial consulting. German industry also does considerably more than French or British industry in the way of supporting graduate students and funding contract research in universities.

Attitudes that permeate the universities and secondary schools and the social structures of the three countries obviously help to explain the differences. And the report's authors suggest that an important external factor promoting industry-university links in Germany was the relatively unfavorable competitive position of Germany during the 19th-century period of industrialization. Like Switzerland and the Netherlands, Germany was faced with finding markets abroad, without having the colonial outlets Britain and France commanded. This external pressure helped bring German science and industry together, and it gives Germany an advantage in the present situation.

The situation today, as the report describes it, is one in which "a period of unprecedented growth in the resources allocated to research and development has been succeeded by a period of questioning and uncertainty."

The survey team's analysis, and the basic argument of the report, is set forth in this excerpt from the introduction:

> Neither the rate of growth in the resources allocated to research activities, nor the obejctives on which these resources have been concentrated for more than twenty-five years past, can be regarded as a permanent feature. On the contrary, the period which is now opening seems likely to be characterized by great uncertainties as to the ways and means of progress—or possibly of regression—of resources and the whole nature of new research programmes. Now that government concern is tending to shift away from vast technological programmes linked with defence and prestige, fundamental research programmes, too, are the subject of reappraisal. This change of priorities does not mean that less fundamental research will be needed to satisfy the demands of society, but rather that research will be required to respond more closely to the imperatives of selectivity dictated by the social, political, and industrial context. In particular, the question will arise of determining the proportion of fundamental research which should be "oriented" towards the sectors of society which call for a stronger component of technical innovation (health services, urban public transport, housing, protection of the environment, and so forth).

Perhaps the chief significance of the survey is that it marks the end of a distinct phase for fundamental research and for science policy. The OECD view has become an influential, almost official view that generally reflects, or will be reflected in, the science policy of member nations. This latest comparative study is, in a way, an extended epitaph for what the report at one point calls the "golden" era of fundamental research.—JOHN WALSH