remain at their present levels through 1973. Officials emphasize that long-range forecasts are notoriously fallible, but dour NIH officials are certainly taking care not to raise false hopes.

One bright spot is that NIH feels less like a bureaucratic orphan than it did last spring when the office of HEW assistant secretary for health and scientific affairs was untenanted because of a political contretemps (*Science*, 11 April 1969). The new incumbent, Roger O. Egeberg, is regarded as an effective advocate of biomedical research. And Egeberg's deputy, Jesse Steinfeld, is a former deputy director of the National Cancer Institute, so NIH feels it has a well-informed friend "downtown."

A decisively brighter budget picture for NIH soon, however, does seem unlikely. In recent weeks the comments of Administration officials, like Presidential urban-affairs adviser Daniel P. Moynihan, have built the impression that even an early settlement in Vietnam would not release a major flow of funds in the direction of biomedical research.

What this suggests is that NIH management will have to make increasingly difficult decisions under mounting pressures. And it is worth remembering that the Wooldridge committee put strong emphasis on the need for improving the decision-making machinery at NIH.

As a result of a Wooldridge-panel recommendation, NIH has created an advisory committee of distinguished nongovernment people. But no matter how helpful this committee proves in giving advice on general policy matters, it meets only four times a year and can't help with critical day-to-day management decisions.

NIH management machinery really hasn't altered since NIH's formative years. The judgment of scientific peer groups will probably continue to be decisive in the award of research grants, with study sections setting priorities and council approving grants. But decisions on large sectors of the NIH budget are much more directly influenced by management. The congressional appropriations process, which, in effect, provides separate budgets for each of the institutes, sharply limits management ability to shift funds, for example. But NIH administrators have considerable influence on such questions as the division of emphasis between extramural and intramural research, and also on negative decisions. In recent years NIH has backed away from expanding research in behavioral sciences and biomedical engineering, for example, not because these areas were unpromising but essentially because of financial limitations. Other hard decisions face NIH, on which management may have to take the bit in its teeth. Cries of distress are rising from the medical schools, many of which are heavily dependent on NIH financing, and pressures are growing for NIH to launch a major rescue operation that presumably would drain more funds from regular university research.

NIH management has been accounted generally successful, but the Wooldridge committee, in its friendly assessment, added a fairly common qualification when it said, "The sophisticated understanding, common motivation, and personal compatibility of this handful of capable men has permitted them to work around the handicaps of less than optimum organizational structure and operational procedures and achieve a quality of results considerably higher than would ordinarily have been possible."

NIH administrators, by and large, have enjoyed the confidence of their clients in the biomedical research community. The agency, however, has moved rapidly from relative affluence to retrenchment, and NIH beneficiaries are already asking for a greater voice in deciding how funds are to be distributed. In this more competitive day, attention may well be shifting from the question of the quality of NIH's research to the quality of its policy decisions.—JOHN WALSH

France: Profit Rather than Prestige Is New Policy for Research

Paris. All governments with sizable budgets for science and technology eventually begin to worry about whether they are getting a good return on their investment. In the United States, relations between science and government have been agitated by this factor for nearly a decade; in Britain, profitability is now openly proclaimed to be a major consideration in government support of research; and the Soviets, too, have been wondering whether they have been getting enough out of research and, as a consequence, have been working at arrangements for closer links between research and industry. Now, after a 10-year period in which science and technology were expanded and venerated mainly to enhance national prestige—and with little regard for economic payoff—France is following the same pattern. And, as has been the case elsewhere, basic researchers are among those who regard the future with most anxiety, though the beneficiaries of Gaullist affection for highly visible prestige projects, especially in atomic energy and space, are also fearful.

The French situation, though part of what emerges as an international pattern in relations between science and government, is, however, affected by a number of peculiar national characteristics. First of all, it is doubtful that any other scientific community has to contend with the sort of administrative rigidities and centralization of management that have been bred into French science since Napoleonic days. As the Nobel laureate Jacques Monod remarked in an interview, "Our local institutions have been preconditioned to nonresponsibility on many important administrative matters. It is difficult for them to play the independent role that they should play in a modern scientific community." Also affecting the potential for revamping French science and technology is the Frenchman's stubborn, personal aversion to changing jobs and locale. In recent years, this has begun to erode, and job changes are not the rarity that they once were. But the preference to stay put is still strong, and it is backed up by a highly unionized scientific and technical community which in the past has demonstrated its readiness to go out on strike in behalf of job security. As a result, "mobility" is today one of the terms most often heard in discussions of French scientific and technical planning. Among govern-

ment planners and some scientists, it is cited as a remedy for much of what ails French research; union officials tend to look upon it as a polite term for squeezing people out of jobs. However defined, mobility is shaping up as one of the key issues in the management of French research, and it is generally agreed that a great deal hinges on the government's ability to deal with this problem. In turn, the promotion of mobility is related to problems that extend far beyond the scientific community. It is not romantic affection for a particular patch of soil that makes people reluctant to move. Rather, there is still a desperate housing shortage in France, and being forced to move to a new location can turn out to be an extremely difficult experience. Also, since scientific salaries in France are relatively low, it is not uncommon for wives to work, and, as the head of one research group put it, "You know that if you tell a man that he has to leave, you're probably, in effect, telling him that his wife has to find a new job and that they have to find a new place to live. It's much easier to let him stay, even if you don't like his work."

While the closing years of the De Gaulle regime rang with concern over the "American challenge," it is the new government, free to come down from the concept of science and technology as instruments of national prestige, that is taking important steps to enlarge the economic payoff from the approximately $2.5 billion that government and industry currently spend on research and development. Thus, one of the first steps of the Pompidou government was to amalgamate the previously separate Ministry of Science and Ministry of Industry into a new Ministry for Industrial and Scientific Development. At the head of this was placed a member of that professional breed not particularly loved by scientists—an economist, François-Xavier Ortoli, who, at age 45, is an outstanding example of the apolitical, upward-moving technocrats who are becoming increasingly important in the governments of all industrialized nations. Despite his relative youth, Ortoli has served, during various administrations, as Minister of Finance, Minister of Public Works, Minister of Education, and Secretary to the Cabinet, and also, for 2 years, as head of the highly influential *Plan*, which prepares 5-year voluntary designs for national economic development. He is known to be efficient, industrious, and capa-

Task Force Presents Space Options

A presidential task force, headed by Vice President Spiro Agnew, last week said it "rejected a crash program" for a manned landing on Mars "for obvious budget reasons," but budget estimates indicate that two of the three possible timetables recommended by the task force do resemble an all-out Apollo-style effort. The task force, which set as a goal a manned Mars mission during this century, offered three options: accelerated programs with a manned Mars landing in 1983, or in 1986, or a more leisurely program with a manned Mars landing scheduled for some time after 1990. The task force also recommended a greater emphasis on NASA's science applications programs and recommended that unmanned planetary exploration be undertaken. The task force's report was presented to President Nixon, who is expected to make his recommendations soon to Congress on the future goals of the space program. Nixon has indicated that he is pleased with the task force's recommendations, and that he does not favor a crash program to put men on Mars.

At a White House press conference, Agnew indicated that selection of one of the three options would probably be highly dependent on budgetary and national priority considerations. The report stresses flexibility in the manned space program and states that "exploration of the planets should not assume overriding priority and cause sacrifice of other important activities in times of severe budget constraints." In presenting these options the task force indicated that many precursor activities (including detailed biomedical and physiological flights, unmanned reconnaissance of the planets, creation of reliable life-support systems, and a nuclear propulsion capability) would be required before any manned Mars mission could be attempted.

The U.S. is at present spending about $3.8 billion a year on civilian space programs and about $2 billion on military space programs. The first option, providing for a manned Mars landing in 1983, is the most expensive and accelerated of the proposals; the civilian space budget would rise next year to $4.2 billion, increase to $6.8 billion in fiscal 1974, and reach $9.4 billion in fiscal 1980. Administration officials estimate the total cost of the program through 1986 to be about $134 billion in current dollars. The decision on a Mars landing would be made in 1974. The second option, leading to a manned Mars landing in 1986, would allow space budgets to be contained below $7 billion annually until early 1980's, when they would reach peak expenditures of $8 billion annually. The decision on the Mars landing would be made in 1978. Administration officials estimate the total cost of this program through 1986 to be about $97 billion. The third option would defer a decision on Mars until after 1990 and cost significantly less in the first 11 years.

The report endorsed an integrated program that would provide an all-around capability for all types of space missions (*Science*, 5 September 1968). It said that orbiting space station modules and a space transportation system would be the "cornerstones" for any of the space program options. The space station modules, to be occupied by 50 to 100 men, would be available in the mid-1970's and would be a basic element of future manned activities in earth orbit and in expeditions to the moon and to the planets. A reusable space shuttle, a nuclear-powered rocket engine, and a space tug would also be needed. The report also calls for a balanced program of unmanned space missions with broad scientific applications. It recommends "progressively more sophisticated missions" to the near planets as well as multiple flyby missions to the outer planets, which would take advantage of a line-up of the outer planets in the late 1970's. It also recommends the application of space technology to human and environmental problems on earth, including air and ocean traffic control, worldwide navigation systems, environmental monitoring, weather and pollution prediction, surveys of earth resources, and communications.—MARTI MUELLER

ble, but little has been heard of his views on the social and political issues that have racked France in recent years.

The new ministerial arrangement absorbs the major responsibilities of the now defunct Ministry of Science, including space, atomic energy, and oceanography. But these fields now occupy a higher status in the government hierarchy, for the old Ministry of Science held authority by delegation from the Prime Minister, whereas the newly created Ministry for Industrial and Scientific Development exists on its own at Cabinet level. The Centre National de la Recherche Scientifique (CNRS), roughly the counterpart of the National Science Foundation, remains associated with the Ministry of Education, but though university support is considered to be the area most immune to the austerity that has been invoked by the new government, the work supported by CNRS is said to be an object of skeptical curiosity by the utilitarian men who head the new government.

Focus on Atomic Energy

The treatment that the government intends to apply to science and technology is still to be spelled out in detail, but no one doubts that the atomic energy establishment—pride of De Gaulle and despair of scientific and industrial planners—will get major attention. Created to give France both a nuclear arsenal and independence in nuclear generating power, the Commissariat à l'Energie Atomique (CEA) has 31,000 people on its payroll, and, though it has accomplished its military assignment, the French power-reactor program has little to show for the vast sums it has absorbed. The main reason is that, to stay clear of U.S. domination of enriched uranium production, France chose to develop a line of natural uranium reactors—a policy that surely kept it free of dependence on the United States but also one that led down a technical route that has turned out to be a loser in nuclear economics. To turn to the United States for a supply of enriched uranium for commercial-scale operations was, of course, unthinkable in the Gaullist era. But now it is quite thinkable, and, as a consequence, it appears certain that France will buy an American design, for use with American-made fuel, though the actual construction will be carried out by French firms. CEA employment, which has been stable for the past few years, is slated to decline, perhaps by 1000 a year for 5 years. Like any well-established organization threatened by outside economizers, CEA maintains that it is misunderstood and unjustly criticized. Thus, a spokesman for the agency explained that nearly a quarter of the 31,000 employees are engaged in military work (and, so far, there is no indication that the new government is backing off from De Gaulle's nuclear weapons ambitions); 11,000 are in production activities, and only 2000 are in reactor work, with a similar number engaged in what is described as "basic research." "Nevertheless," the CEA man said, "everyone insists that the CEA must be cut down because the reactor program has not been a success."

Labor leaders are finely tuned to sense unjust designs by management, so alarm comes quickly whenever management talks of plans for change. Inevitably, then, the present situation, with its emphasis on "mobility," has aroused the worst fears of the scientific unions. Francis Bailly, a solid-state physicist who is head of the biggest union of basic researchers, made an extremely dreary prophecy for French science under the new government. In an interview, he said that the creation of the new Ministry reflects a desire to squeeze science as an institutionally independent activity and force scientists into positions in industry or the universities. CNRS, from which his 3500-member union draws most of its members, operates many of its own laboratories, and, referring to this, he said, "We believe it is necessary to have a sector of science between the universities and industry. But the government is putting great pressure on fundamental research in its efforts to promote profitability from research. We're not against the mobility idea that the government is seeking to promote, but security is important, too."

Will There Be Strikes?

Bailly complained that, while the number of science graduates from the universities is increasing, the growth of funds to provide research positions for them in basic research is not keeping pace. "We don't seek special treatment for ourselves," he said, "but we think that scientists, like other workers, should have a voice in determining social goals. And we feel that profitability is a too narrow goal in determining science policy." In recent months, researchers at several laboratories have gone out on strike to protest cutbacks in funds. "Will there be more strikes?" Bailly was asked. "I don't know," he replied. "We expect that there will be many industrial strikes and we want to form alliances with the workers. I don't know," he said with obvious uncertainty. "Job security is a major issue. We'll have to see what the new government does, but we are not optimistic."

At the management end of things, Pierre Aigrain, head of the Délégation Générale à la Recherche Scientifique, which is similar to the White House Office of Science and Technology, readily acknowledged that major changes are in the works, but took the view that they are both desirable and, in fact, a continuation of past trends. "The emphasis on industrial development has been with us for several years, and the creation of the new Ministry is a natural outgrowth of that," Aigrain said. "The forthcoming budget will be a tight one," he said, but he doubted that the emphasis on applied science and industrial development would be at the expense of basic research. "Basic research will get its share of whatever increases are considered desirable, but there may be transfers within the sum made available for basic research." The example that he cited first is the same one that has come up for attention in other countries when the relative allocation of research funds has come under scrutiny: high-energy physics. "We spend 18 percent of our basic research funds on high-energy physics," Aigrain said. "It is an expensive field, and it is necessary to spend at a high level if you want to have significant participation. But it remains to be seen whether 18 percent is the necessary figure." Aigrain conceded that, when funds are tight, government budget-makers look for items that can be considered "elastic," and that scientific research often seems to fall into this category. The budget, he concluded, will not produce much cheer within the French scientific community, but neither will it "mistreat fundamental research."

While the financial situation commands attention, many French scientists feel that their country's notorious administrative rigidities constitute a burden that is as harmful as inadequate financial support. Reform stemming from the upheavals of May 1968 are supposed to have loosened things up a great deal, but scientists at the working level can still offer many examples of enduring bureaucratic mazes. Thus, one scientist tells of efforts to obtain travel funds that were included in a grant awarded him. In fact, the funds were given neither to him nor to his labora-

tory, but were held by the granting agency to be doled out upon request. When he sought the funds for travel, payment was held up for months because an examiner at the agency noted a discrepancy in the planned dates of travel. The discrepancy, as it turned out, was due to a typing error at the agency. To make the trip, tickets had to be purchased with other funds. Eventually, the agency paid up, but only after an extensive exchange of documents.

There is also the tale of efforts to start a new research group at a university. First, approval had to be obtained from the faculty. Then, the Ministry of Education, which provides funds for facilities, had to be persuaded to depart from its normal practice of starting out a new activity with just one appointment. After much effort, the Ministry was persuaded that a lone researcher in this field made no sense. Then it was necessary to restate the case before another agency in order to receive operating funds. A scientist involved in these laborious negotiations stated simply, "In France, there are no package deals."—D. S. GREENBERG

Campus Computers: Federal Budget Cuts Hit University Centers

Federal budget cuts have apparently slowed the previously sharp growth in computer operations on the nation's campuses. Computer centers have been hurt directly by cuts in federal assistance for computer facilities and indirectly by reductions in federal grants for research. What's more, according to some computer center directors, these budgetary stringencies have been compounded because government accounting procedures discourage maximum use of campus computers by driving fees beyond the reach of some faculty members and students.

National figures on how computer expenses in federally sponsored research have recently fluctuated are hard to come by chiefly because individual grassroots researchers rather than central agencies decide on the specific items to be cut from a project. However, some computer center directors feel that computer use is one of the first items to be cut in a research budget.

One indication of such a trend is found in a survey of 37 major universities conducted last January by the National Association of College and University Business Officers. The survey reported that the increase in computer operating expenses at these institutions will drop from 29 percent a year during the period 1965 to 1968 to 13 percent a year between 1969 and 1971. In part, these figures represent an anticipated leveling off in the growth of computer facilities after a decade of rapid expansion, but many of these universities also expected computer use by federally sponsored projects to rise less rapidly under tight budgets. The Nixon Administration's economy drive has convinced some observers that the 13-percent growth figure estimated 9 months ago may be too optimistic.

Surprisingly, federal funds supply only a small share of computer operating expenses at colleges and universities. In 1965, direct federal grants for computer facilities and indirect support through the computer expenses of federal research grants contributed 36 percent of the total operating budgets at university computer centers. The Rosser Report, a federal study of campus computers (see *Science*, 25 February 1966), recommended that this figure increase to 60 percent, but NSF estimates that the proportion of federal support has actually fallen to 23 percent of fiscal 1969's $260 million outlay for computer operations. Despite this low level of federal aid, the budget cuts in some areas of federal support have been large enough to cause some dislocations, especially at private universities. At the University of Pennsylvania, computer use financed by federally sponsored research projects has recently risen 35 percent each year, but university officials predict a 10 percent decrease instead during the next fiscal year. In order to make up the lost revenue the university has sold substantial machine time to the Philadelphia public school system, the Drexel Institute of Technology, and Villanova University.

Harvard and Yale, two of the richest schools in the nation, have also suffered. Revenue from federally sponsored research at Yale has dropped off by 30 to 40 percent in the last year, instead of rising by 10 percent as had been expected. The university had to supply the lost income from its own funds, and, in a minor economy move, the computer center reduced its disk storage. At Harvard, Norman Zachary, director of the computing center, said that roughly 80 percent of Harvard's computing operations in late 1965 were devoted to federally sponsored projects, and that this figure has steadily fallen, to less than 66 percent now. Increased administrative and student use of computing facilities, supported by the university's own funds, account for part of the percentage decline, but since the federal budget cuts, the anticipated rise in government research use of computers has failed to materialize and may well have been reversed, Zachary said.

This second-order effect of research cutbacks varies widely and was not evident in some universities. New facilities at both Princeton and Caltech have cushioned the effect, at least for this year. Atomic Energy Commission and Environmental Science Services Administration laboratories near Princeton have guaranteed that they will use and pay for a certain percentage of the new computer's time. The new Caltech facilities supported by an NSF grant have spurred enough activity to obscure any drop in demand related to the federal spending ceiling.

Uncertainty over future demand on computers for research has curtailed some computer centers' plans for expansion. "We would have expanded much more rapidly if we had been able to count on this revenue stream," Richard G. Mills, director of information processing at M.I.T., told *Science*. Without these funds to support long-term improvement of computing facilities, Mills said, the research plant could enter a "spiral downward." Without updated computing facilities, researchers could not perform the sophisticated experiments that attract the research funds needed to support computer center expansion.