at most, 0.3 percentage points a year to growth, and probably less.

Denison wrote that the "change in R & D spending from the 1966 rate to the 1970 rate might reduce its contribution by 0.1 percentage points with the effect perhaps delayed until the mid 1970's. The range of 0.0–0.1 percentage points cover the probable change in contribution." Denison acknowledges that some other economists put the contribution higher and attributes this to differing estimates of various factors.

Denison and others note that there are special difficulties in calculating the impact of R & D. What is being measured are changes in output per unit of input, and only some kinds of advances in knowledge are measurable in this way.

Improvements in production processes are most readily measurable. New products, on the other hand, don't show up as reducing unit costs. According to Denison, "Nearly all federally financed R & D is in this category and so is the larger part of industry-financed R & D. Only R & D that is directed either toward new process, which may be roughly identified with research to reduce a firm's own costs, or toward new *intermediate* products and capital goods, has an objective that, if achieved, raises measured output per unit of input."

> "What happened is, to be blunt, a mystery."

In a recent article, "R & D and the productivity slowdown,"* Griliches suggests some explanations for the apparent collapse of R & D's contribution to productivity growth. One possibility is that "much of the effect of past R & D is embodied in new equipment, and a slowdown in capital growth may also induce a decline (a postponement) in the effect of R & D on productivity."

For a general answer to the puzzle of the collapse, Griliches says, "The most likely explanation is one of confusion: the large energy price shocks, the resulting fluctuations in capacity utilization, the substantial increase in uncertainty about future absolute and relative prices may have forced many firms away from their long-run production frontier."

Griliches writes that "The other point to remember is that even though the measured effects of R & D on measured productivity may be small, its true effects may be quite a bit larger. First, we have yet to learn how to measure the spillover effects of R & D within and across industries. Second, much of past and current R & D is spent on socially valuable activities such as our health and the health of our environment, items that are not valued positively in the national accounts as currently constituted. Finally, R & D is a chancy and fickle process. Even if it has run into a dry spell, this does not imply that the current expenditures may not have future returns or that there are no major productivity returns on the drawing boards."

If the case for R & D is somewhat better than the input-output analyses show, what are the implications for economic policy? Asked what he thinks could be done to improve economic growth, Denison lives up to his reputation as a careful analyst who takes the long view.

He cautions that "growth rates are almost glacial." The nearly 3 percent a year average increase in productivity in the quarter century after World War II was historically unusually high, says Denison. He says that the strong postwar growth rates owe most to a rising level of education and high capital investment.

Does he have advice on what to do about productivity in the short run? Denison says that considering the sharp change in the growth rate, "I would not know how to put together a package to get you back to the growth rate we had."

What about more government support of R & D? Although Denison says that R & D is probably not responsible for much of the productivity retardation, he is on record as thinking that R & D is "a promising way of promoting future productivity." He notes that in the context of growth rates, a yield of even a tenth of a percent a year in growth in productivity from a particular source over 10 years is "not bad."

Denison says he is impressed by the studies of Edwin Mansfield of the University of Pennsylvania and others indicating a high social return from investment in R & D. Denison thinks that the inability of individual firms to recapture more than a fraction of the return on their R & D investment provides a justification for increased government support of R & D. "If the government is going to subsidize anything," he says, "I'd put R & D high on the list."

—JOHN WALSH

*American Economic Review, May 1980.

Governor Brown Boosts Microelectronics

A novel plan to pump up to $10 million a year into microelectronics research at the University of California, Berkeley, has been cooked up by Governor Edmund G. Brown, Jr., university officials, and local industrialists. The plan, outlined last month in Brown's state budget message, seeks to involve the California semiconductor industry in both the planning and the funding of microelectronics research at Berkeley.

The idea is to set up a microelectronics research center in the university's electrical engineering department, with an injection of $2.6 million of state funds for facilities and equipment. Research at the center would be financed jointly by the university and industry, with each side providing up to $5 million a year.

The proposal, which is now before the state legislature, is part of an overall state budget that, for the first time since World War II, will not keep pace with inflation. The University of California system, for example, is due for an increase of less than 4 percent under Brown's austere budget recommendations. The microelectronics proposal is one of the few new spending initiatives in the entire budget, and if approved, the center would be the largest joint industry/university research unit of its type in the country.

According to plans worked out between Brown's office, the university, and representatives from semiconductor companies, research would be funded at the proposed center on a project-by-project basis. Projects approved for state funding would be able to go ahead only if an industrial sponsor could be found to come up with matching funds. Overall policy for the center would be set by a board, appointed by the president of the University of California from nominees submitted from the university, the governor, and industry.

Brown has explained the proposal as a measure designed to help a key California industry to fend off competition from outside the state. In the past decade, the electronics industry has become a powerful economic force in California. It accounts for one-fourth of all the new jobs generated in the

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state, and about $3 billion worth of integrated circuits are manufactured in California each year. But, Brown pointed out in his State of the State address last month, "Other states are trying to persuade many of our high-technology companies to expand outside of California, and the industries themselves face aggressive competition from imports."

So far, the proposal has been welcomed by university spokesmen and representatives from the microelectronics industry in California.

Geological Survey Chief Lost in Transition

When the Carter Administration fired Vincent McKelvey as director of the U.S. Geological Survey (USGS) in 1977, the move prompted a hue and cry that one of the country's oldest federal science agencies was being "politicized" (*Science*, 23 September, 1977). The Reagan Administration has now terminated the appointment of McKelvey's successor, H. William Menard, and the same concerns have arisen again.

Menard, who was told on 26 January that he would not be kept on by the Reagan Administration, has said that his removal "shows that all my efforts to convince the transition team that this was an apolitical job were unsuccessful."

There is nothing inherently unusual about the ouster of two USGS directors in 4 years. The post is filled by presidential appointment and, like thousands of other federal officials, the Survey chief submits his resignation at the end of each presidential term. But when McKelvey was removed in the first few months of the Carter Administration, it was the first time in almost a century that a new President had decided that a change was needed at the head of the USGS.

McKelvey's departure sparked speculation that he was fired because his views on domestic oil and gas reserves did not mesh with those of the Administration. An alternative explanation was simply that his personal style was incompatible with that of his boss, former Secretary of the Interior Cecil D. Andrus. Whatever the reason, the episode raised concern among geologists that the USGS was losing its traditional political independence. In particular, it was feared that the Survey's estimates of domestic oil and gas reserves would become less credible if there was any suspicion that they are shaped to fit Administration energy policy.

The appointment of Menard allayed some of those fears. A respected marine geologist from the Scripps Institution of Oceanography, Menard came to the USGS with the blessing of the National Academy of Sciences, which had assisted in his selection. He reorganized some of the Survey's internal divisions, instituted new budgetary and auditing procedures, and encouraged long-term planning. Some of these moves tended to "rile up the old guard" in the Survey, according to one of Menard's colleagues, but there was little evidence that the USGS had bent to the political will of the Carter Administration during Menard's stewardship. Menard himself says that as far as resource estimates are concerned, "We knew that some of the things we turned up with would not go down well, but there was never any suggestion that we change the numbers."

So why was Menard removed by the incoming Administration? The most likely explanation is that he was simply a victim of wholesale housecleaning in the Department of Interior. During the election campaign, Ronald Reagan heaped criticism on the department for being more concerned with conserving resources than with exploiting them. The new secretary of Interior, James G. Watt has pledged to reorder Interior's policies, and within a week of taking office he removed the heads of all the principal agencies in the department with the exception of the director of the National Park Service. Menard was among the casualties.

Menard said he was notified at noon on 26 January that his resignation had been accepted, and he was told to clean off his desk by the end of the day. A senior research position has been created for him within the Survey, and he says that he will take that until he decides what to do. He is technically still on leave from the University of California, and could return there by 1 July.

Having demonstrated that the head of the USGS is indeed a political job, Watt has taken steps to allay some of the concerns in the geological research community. Three days after removing Menard, Watt announced that he has asked the National Academy of Sciences to draw up a list of candidates for the job. Noting that the USGS has "an outstanding record for scientific excellence and professional integrity," Watt said that he is looking for "a highly qualified earth scientist" to carry on the good work. The Academy has traditionally helped select the USGS director.

Whether a highly qualified earth scientist can be lured to Washington for a job of uncertain duration remains to be seen.

Youth and Loyalty at OMB

David Stockman, the former Michigan Congressman who now serves as President Reagan's budget director, has appointed two of his congressional assistants to positions with influence over federal research and development spending.

Frederick Khedouri, a 30-year-old lawyer who was Stockman's chief legislative aide, has been named associate director of the Office of Management and Budget with jurisdiction over energy, natural resources, and science programs. Under his purview are the budgets for the Departments of Energy and Interior, the National Aeronautics and Space Administration, and the National Science Foundation. The job was held in the Carter Administration by Katherine Schirmer.

The other major scientific post in OMB, associate director for health and human resources, has gone to Donald W. Moran, 29, who also served as a legislative assistant to Stockman when he was in Congress. Moran's responsibilities include the budget of the National Institutes of Health. He replaces Gilbert Omenn.

Neither Khedouri nor Moran have had much experience in science policy matters, although Khedouri worked on a study of uranium enrichment policy for the Natural Resources Defense Council in 1976. Moran ran employment and training programs in Michigan before joining Stockman's congressional staff.

Colin Norman