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As head of the Solar Lobby, Hayes, like Rappaport, was present at the ceremony on the White House roof when the President displayed his new solar water heater and announced his big commitment to solar. And, again like Rappaport, he thought the level of that commitment was inadequate, and said as much to reporters even before the ceremony was over. Hayes is aware that some people suspect that the Carter Administration has hired him as one way of neutralizing or silencing an effective critic. "I intend to maintain a ferocious integrity and independence," he said.

Hayes thinks SERI can become "the most intellectually exciting and effective energy institute in the world," and that its analyses of energy issues, instead of collecting dust and going unread by policy-makers (the fate of most past SERI analyses, he suspects), can become influential action papers. He intends to continue in his activist role, only now to play that role not with the modest resources of the Solar Lobby but with the far grander resources of SERI.

Rappaport thinks that Hayes will be disappointed by the results of some of the SERI analyses of the solar potential. The potential, he says, is there—Rappaport subscribes to the new national goal for solar—but "it's not nearly as possible as he [Hayes] thinks it is right now." Only with the rising prices of alternative energy sources will some solar technologies become attractive economically, Rappaport believes.

Hayes says that, while he has been a solar advocate, he has never been a "promoter in the sense of a hired gun." Instead, his role has been "first and foremost that of a synthesizer and analyst." He will, he says, decide technical issues on the basis of the best information he can get from SERI staff scientists and outside experts.

Many solar advocates would no doubt object if a prominent lobbyist for nuclear power were appointed head of the Oak Ridge laboratory or one of the other national labs with a major R & D role in nuclear energy. But to some degree the people put in charge of these various other laboratories have invariably, and perhaps necessarily, been proponents of the technologies with which their laboratories have been concerned, whether it be development of better reactors or better nuclear weapons.

"Solar energy is an okay thing," Jeremy Stone observes. "It's like being kind to animals. Hayes won't become a controversial figure by being appointed director of SERI. Congressmen know Hayes and like him. It will help SERI."

On this latter point, Rappaport agrees. "One of my problems has been an inability to sell SERI in the right fashion. Denis has an audience that will listen." He now expects to see some "goodies" for SERI, including quicker and more favorable action on its capital and operating budgets.—LUTHER J. CARTER

Pentagon Plans Boost for Basic Research

Secretary Brown's memo should help clear the confusion on criterion of relevance left by Mansfield Amendment

Defense Secretary Harold Brown has sent his top lieutenants a message which should encourage increased Department of Defense support of basic research and, therefore, further repair DOD relations with university science.

The military has been a major patron of R & D since World War II, but in the past decade has damped down spending on basic research. This deemphasis, combined with the effects of inflation, has resulted in a 50 percent decline in the purchasing power of DOD funding of basic research. Universities have done much basic research for DOD and the cuts had a heavy impact on academic science.

In recent years, efforts have been made by defense officials to reverse the trend, but money has not been readily available and, in an organization as big and complex as DOD, a policy once established is hard to change.

Brown's policy memorandum on support of research, dated 30 May, is low key enough. His main message is as follows:

> I would like each Service and Defense Agency to review its research programs to ensure that they are meeting the objectives of the Consolidated Guidance, have sufficient emphasis on the long-term aspect of the research program, and are applied to broad science and engineering areas with potential relationships to a military function or operation. The result of your review should be reflected in the FY 1981 budget submission and in subsequent management of the Research Program.

But the memo is addressed to the service secretaries, chairman of the Joint Chiefs of Staff, and others at the top of the chain of command, and is couched in the kind of Pentagonese calculated to overcome inertia.

The decline in funding of basic research in the universities in part reflects the strains of the Vietnam war era when university campuses were hotbeds of antiwar and, therefore, antimilitary sentiment.

Congress exerted perhaps the most restrictive influence through the so-called Mansfield Amendment, first enacted in 1969. In its original form the amendment limited DOD funding to research projects with a "direct and apparent relationship to a specific military function or operation."

The effect of the Mansfield Amendment continues to be a subject of debate. The issue is whether application of the criterion of relevance or the heavy budgetary squeeze of the past decade has been the principal cause of the decline in basic research support. Not in dispute, however, is that the basic research budget slumped.

The low point in the last decade in DOD support for basic research came in fiscal years 1974 and 1975 when expenditures were $303 million and $305 million, respectively, in current or what inflation-conscious DOD officials call "then" dollars. In terms of 1980 dollars, that comes to the equivalent of less than $430 million in each of the two low years compared with a figure of $728 million in 1969 ($353 million in then dollars) and an estimated $573 million for the prospective 1980 fiscal year.

Basic research funding made a partial recovery under the Ford and Carter administrations, edging up to $328 million in 1976 and rising to $477 million for the 1979 fiscal year (all in current dollars). The Carter Administration has also worked at increasing the percentage of

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the total basic research funding going to universities; this too had dropped during the decade of drought. According to plan the percentage should rise from about 40 percent now to 47 percent next year.

In his May memo Brown put his initiative loyally in the context of the Carter Administration's special treatment of basic research. To this end he invoked the President's March message to Congress on science and technology and noted that Carter "emphasized basic research as an important element of national security."

The Administration and Congress by and large accept the view that the 1970's has been a period of underinvestment in R & D by both government and industry, and that the result has been an erosion of U.S. technological superiority.

For DOD, the decline in basic research support has a special twist. It is seen in terms of the loss of a generation of researchers and advisers. DOD has relied on links with academic scientists established during World War II and the Cold War era. Such service was then regarded as a public duty and not an onerous one. Many of these scientists were luminaries who not only served as researchers and advisers for the defense establishment but also routinely introduced young and promising colleagues to the fraternity. These were in turn initiated into the activities—grants and contracts, summer studies, advisory committees, consulting arrangements—which define the DOD-university relationship.

In the middle 1960's the easy relationship that had prevailed came under pressure. Activists sought to turn university policy against research for the military, and pressure was exerted in various ways on faculty involved in any way with the Pentagon. Some senior scientists dropped out, but the major effect was that fewer up-and-coming researchers ever opted in. On the Pentagon side, for a time, at least, the protesting academy created irritation and mistrust of younger scientists and a coolness toward the university connection. And in the 1970's, fewer scientists were beginning research careers, in part because of the drop in DOD funding of basic research.

Nothing approaching a complete break ever occurred. Among engineers the working relationship with defense agencies seems to have remained substantially intact. And scientists in some institutions and some disciplines appear to have carried on much as before. But the broad pattern of relations with academic scientists unquestionably changed, with gaps opened notably by the absence of young researchers in the physical sciences, and especially representatives from prestigious research universities.

This worried the Pentagon because, in the past, many of the best ideas came from the brightest members of that particular group. It is now seen necessary, therefore, to establish contact with the oncoming generation of researchers, make them familiar with DOD problems, and enlist their aid in the effort to stay ahead technologically in the 1980's and 1990's.

It is hardly surprising that the Pentagon management subscribes to this view, since Defense Secretary Harold Brown is a Ph.D. in physics who launched his career at the Livermore nuclear weapons lab. Brown came to Washington, rose rapidly in the defense research hierarchy, and in the 1960's became successively Director of Defense Research and Engineering (DDR & E) and Secretary of the Air Force. He then spent an out-of-government interim as president of Caltech.

In fact, however, a retreat by Congress and the Pentagon from a rigid interpretation of the Mansfield Amendment began soon after the amendment passed, and the relevance test of a "direct and apparent relationship" was replaced with the more general requirement that there exist ". . . in the opinion of the Secretary of Defense, a potential relationship to a military function or operation."

Groundwork for the reemphasis of basic research was laid during the Ford Administration when Malcolm R. Currie held the DDR & E post. A Defense Science Board 1976 summer study, *Fundamental Research in the Universities*, made a comprehensive case for strengthening DOD-university relations. A member of that study group was Frank Press, now President Carter's science adviser.

The decline in funding of basic research in the universities in part reflects the strains of the Vietnam war era . . .

After the Carter Administration took office, efforts were made to increase basic research support in the budget. And, with the agreement of Brown, Press set up a working group on basic research in the Department of Defense, headed by J. K. Galt of Sandia Laboratories. The group reported a year ago and DOD seems to have accepted both its general recommendations and the rationale of DOD patronage of basic research as indicated in the following excerpt:

". . . the Department of Defense needs, particularly at the most senior levels, knowledge and understanding of this rapidly changing and ever more complex technological potential. This knowledge and understanding in turn requires a basic research program funded and fully supported by DOD to insure that fields of direct importance are not neglected in research, education, or training. Also the DOD basic research program encourages direct and natural access by DOD technical personnel to research institutions and scientists and provides a means of bringing into DOD a set of highly-qualified technical personnel who further the process of communication. It provides a means to acquaint research personnel with pressing technical problems of defense and suggests new research directions and possible applications. These practices help create a pool of research scientists in relevant fields, acquainted with DOD needs and potentially available to help on problems where technical contributions are part of the solution. In the other direction, this communication provides members of the research community with access to potential users and with an opportunity for relaxed and understanding debate about radical new concepts of military application.

The report also urged a buildup of basic research activity in some industry labs, which do some forms of fundamental research, in DOD in-house laboratories, and in nonprofit labs, but the main emphasis is on DOD links with the universities.

DOD's reordering of priorities are reflected in its organization and activities. Under Secretary William J. Perry has created a research office headed by George Gamota, a former Bell Labs physicist, to work on integration of basic research programs. This recreates a division of university affairs dissolved at the start of the 1970's during the downswing. Perry is also naming university scientists to a new committee on research to advise him on research problems. This group will be similar to one started by Brown when he headed DDR & E but which later lapsed into inactivity. DOD has also launched a series of meetings to review topical research. By involving university scientists DOD hopes to encourage research proposals and glean new ideas. The first of the meetings, held in mid-July at the National Academy of Sciences in Washington, focused on mathematics and information science.

DOD's efforts to redirect funds into basic research has resulted in increases averaging 20 percent for 2 years. However, the level of effort in basic research remains substantially below that of a decade ago. To push the recovery further, DOD must continue to convince

Congress of the necessity to do so; thus far, Congress has been generally sympathetic while remaining skeptical of ambitious new programs in the area.

In the universities, it is difficult to gauge the extent to which antimilitary feeling has dissipated in the post-Vietnam climate. So far, DOD's gradualist approach and the kinds of research supported have not precipitated any serious backlash.

As for the legacy of the Mansfield Amendment, the Galt report noted that confusion still surrounds the relevance criterion. This is doubtless one reason for the Brown memo. DOD officials emphasize that they are interested only in sponsoring basic research which has genuine promise for solving defense problems. At the same time, there has been concern that the definition of relevance has been construed too narrowly. Relevance is always to some extent in the eye of the beholder, and in this case the law says the eye that counts is that of the Secretary of Defense.

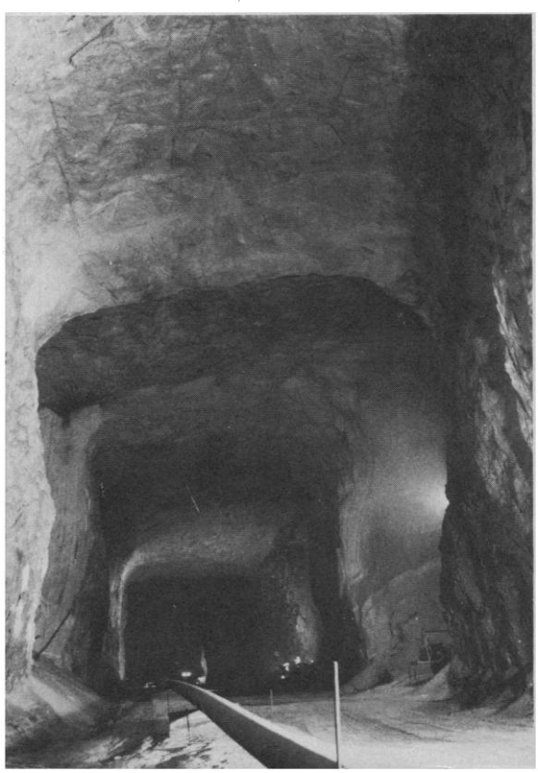
—JOHN WALSH

An Oil Insurance Policy That May Lapse

Strategic Petroleum Reserve plagued by early mismanagement, now beset by oil supply shortage, presidential commitments

As the Carter Administration and Congress push their search for a solution to the national energy problem, the long-troubled program to establish the Strategic Petroleum Reserve is receiving little high-level attention and continues to languish. Yet this reserve, which, if filled, will consist of at least 750 million barrels of crude oil stored in Gulf Coast salt domes (see box), would be the only buffer between the United States and an economic disaster in the event a large part of U.S. oil imports were cut off.

As insurance against such a calamity, Congress, acting at the urging of President Carter and President Ford, has appropriated nearly $7 billion for the reserve since early 1975. Some $1.4 billion of that amount will cover most of the development cost for the first 528 million barrels of storage capacity and the associated oil handling facilities; the remaining $5.6 billion will be a modest down-payment on the total cost of the oil needed to fill the reserve, now estimated by the Office of Management and Budget at $19 billion.



A tunnel in the Weeks Island salt mine. The mine will soon be sealed and declared ready to receive oil for the strategic reserve.

This is high-cost insurance, but the judgment at the White House and in Congress has been that it is worth the price. With a full reserve, the immediate response to a severe shortage would be to start moving crude from the salt dome storage facilities—at an initial rate, if need be, of as much as 4 to 5 million barrels a day—into the pipelines and fleets of coastal tankers that regularly deliver oil to most of the nation's refineries. The vital infusion of oil could be maintained for a half year or longer, thus giving the President a better chance to bring about a resumption of the flow of imports by careful diplomacy or other means.

But, while nearly everyone has agreed that the reserve is a great idea, there is less than 90 million barrels of oil in storage today and the flow of oil into the reserve has been drying up. Because of U.S. foreign policy commitments and the possible, if not probable, difficulty of filling the reserve without reducing supplies of petroleum products demanded by consumers, the reserve may go begging.

No oil has been purchased for the reserve since late last year when, with the mounting political crisis in Iran, the world market began to tighten. For the reserve to be filled to its planned capacity by the end of 1986, which is as early as anybody is now hoping for, officials at the Department of Energy (DOE) say that 250,000 barrels of oil a day must begin flowing into it by November, with this rate to be maintained day in and day out for the next 7 years.

President Carter's recent promise not to allow imports to exceed 8½ million barrels a day may mean that there can be no such steady flow of oil into the reserve, barring a prolonged recession. The import ceiling is 500,000 barrels a day above the current rate of imports, but 400,000 barrels below last fall's. To put 250,000 barrels a day into salt dome storage could put the reserve program in competition with consumers who want gasoline, home heating oil, and other petroleum products to remain in easy supply. With an election coming up, the President is unlikely to ask consumers to sacrifice for the sake of a reserve intended as a safeguard against severe supply disruptions that some people will perhaps regard as speculative and remote.

Buying oil for the reserve may be further constrained by commitments made in June at the Tokyo summit. President Carter and the leaders of other noncommunist industrial nations agreed not to buy oil for strategic storage when this would place "undue pressure" on prices. The tightening of the world oil market caused by the stoppage and subsequent curtailment of Iranian production already had led Secretary James R. Schlesinger, back in the early spring, to order DOE to suspend its efforts to buy oil for the strategic reserve, pending a softening of the market.

There has not, however, been a decision for the reserve program to be quietly dropped. Jay R. Brill, the retired Air Force general now directing the program, says there is no reason even to think that either the Carter Administra-

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