variations in nutrient concentrations over long periods of time. But, in response, Spooner says that "we need as much data as we can get right now to calibrate the models. Our scientists working on the models say, 'Don't cut back in monitoring stations.' We too are as anxious to collect data for as little expense as we can."

In addition to the unresolved scientific questions, there are some sticky political problems involving land use around the Bay. It is clear that nutrient pollution from agricultural use must be cut back, particularly in Pennsylvania. But as Paul Swartz, director of Pennsylvania's Bureau of Soil and Water Conservation, puts it, controlling pollution on farms "is a difficult political problem."

Part of Swartz's job is to convince farmers to control runoff, a big challenge because little of Pennsylvania actually borders on the Bay. Yet the state is the primary contributor of nonpoint nutrient pollution. Half the land in the state drains into the Susquehanna River, Swartz says. In the area around the lower part of the river alone, there are more than 12,000 farmers. This area accounts for 41% of the state's total nutrient pollution in the Bay. "Our selling point to the farmer can't be 'save the Bay,' " he says. "The Bay is not the same to Pennsylvania as it is to Maryland or Virginia." The state's sales pitch is that farmers will save money by preventing fertilizer erosion and will prevent more ground water contamination.

Under a new state program, Pennsylvania provides money to entice farmers to use soil and nutrient conservation techniques. But so far the state has allocated only $2 million for the program and is funding farmers in just 6 out of 39 counties. Swartz only has four people in his office to coordinate the program with the help of local workers. He predicts that the state may eventually need $300 million to control the nutrient problem.

Maryland and Virginia have similar programs to encourage farmers to practice conservation. Last year, for example, the Maryland legislature established a commission consisting of 25 members of local communities and gave it the final authority to judge local development plans involving land within 1000 feet of the shoreline. The program goes into effect next year. Virginia "takes a more traditional approach" in land-use planning, says Buttleman, who is administrator of the Council on the Environment, an advisory group to the state. Although he acknowledges that Maryland's program to control local development "would make it a lot easier to plan centrally, politically we're a long way off in Virginia from doing that."

Few of the key players in the Bay program say there is a shortage of funds for Bay research. The states' combined spending on Bay research and monitoring totals about $47 million annually, with Maryland the biggest contributor. EPA's annual budget for the Bay has been $10 million and most of this is devoted to monitoring, research, and cost-sharing grants to states. Congress is currently considering the program's reauthorization as part of the Clean Water Act and will likely renew the funding at the same amount through 1988.

But the need for more money to improve sewage treatment will clearly increase as specific goals are set for nutrient loadings, a circumstance complicated by a federally proposed phaseout of federal grants to construct sewage treatment plants. Since 1965, the federal government has provided $2.44 billion for sewage treatment plants, but the Administration now wants to phase out these grants and shift the cost to state and local governments.

Somewhat surprisingly, Fox of the Environmental Policy Institute says that in his opinion the phaseout might not be a bad idea. (The Institute has not taken an official position on the matter.) Under the EPA grant program, he contends, sewage treatment plants were built in areas where development should not have been encouraged. State and local governments may plan for development more wisely if they have to shoulder the cost, he believes. Virginia and Maryland have already picked up some of the slack and have increased the amount of money available for construction loans.

The Bay program has entered what state and federal officials call the implementation phase, and there is much discussion about what broad action should be taken next. The Chesapeake Bay Foundation has urged the states and EPA to revise or set new water quality standards for known toxic chemicals, to fit sewage treatment plants located in the most highly enriched tributaries with nitrogen controls, to support a ban on phosphate detergents in Pennsylvania and Virginia, and to increase funds to encourage farmers to practice conservation measures. Baker of the Foundation lauds the cooperation among the various committees, but remarks that progress in cleaning up Bay "is like rowing 3 knots against a 4-knot current."

In view of all these concerns, which will take time and money to solve, Baker says that "the big job is to see if the public's interest, which has driven this [effort to save the Bay], will be maintained." Eichbaum concurs. "Whether society will sustain its enthusiasm is a very serious question." Bay cleanup is a complex problem, he says, but for now, "The pot is boiling. The program is evolving nicely." ■ MARJORIE SUN

Briefing:

Air Force to Mothball Vandenberg, Reduce Reliance on Shuttle

The Air Force has announced a detailed plan to cut its reliance on the space shuttle for launching military satellites. The plan, which will cost $2.6 billion over the next 5 years, will require about a dozen unmanned rocket launches a year by the early 1990's; until recently, the shuttle was expected eventually to ferry all military satellites to orbit.

The new plan, announced by Air Force Secretary Edward C. Aldridge, Jr., also involves a 6-year delay in opening the military's brand-new shuttle complex at Vandenberg Air Force Base north of Lompoc, California. The facility, which has so far cost $2.8 billion, was originally scheduled to begin operations with a shuttle flight last month. But all shuttle flights were suspended in January following the explosion of the Challenger and are not scheduled to begin again at least until February 1988.

The Vandenberg facility will be placed in "operational caretaker status" until 1992. This is less drastic than several other options under study, including virtually closing the facility until the mid-1990's (*Science*, 4 July, p. 15). It will require a cut of about 40% in staff and save almost $1 billion over the next 5 years.

The day before the Air Force announced the plans to reduce its reliance on the shuttle, the Economic Policy Council, a Cabinet-level body, sent a recommendation to President Reagan that would achieve the same result for civilian launches. The council, reportedly over the objections of the National Aeronautics and Space Administration, argued that the shuttle should be barred from launching commercial satellites and instead should fly only military and scientific missions that could not be launched by other means.

This recommendation is designed not only to cut down the huge backlog of satellites that has built up since the shuttle was grounded but also to stimulate the development of a private launch industry in the United States. It would, however, result in substantial lost income for NASA and further exacerbate the already disastrous economics of shuttle operations.

The council's recommendation is part of a broad White House assessment of space policy, which will also tackle the vexed issue of whether to build a replacement for the Challenger. NASA has been arguing strongly for a replacement orbiter, which would cost some $2 billion, but the Office of

Management and Budget and Reagan's chief of staff, Donald Regan, are said to be opposed.

Even though it is going to rely more heavily on expendable rockets, the Air Force is supporting NASA in its bid for a new orbiter. Indeed, the plan to open the Vandenberg facility in 1992 is based in part on the expectation that a fourth orbiter would be available by then.

The Air Force plan involves the following steps:

■ A total of 23 modified Titan rockets will be procured over the next 5 years to launch heavy payloads. Two years ago, after a long struggle with NASA, the Air Force gained approval to buy 10 of these rockets; it is now buying an additional 13.

■ At least 12 new rockets, called medium launch vehicles, will be purchased to launch navigation satellites, beginning in 1989. These rockets will be similar in capacity to the European Ariane rocket, and the Air Force order is expected to stimulate additional production of the vehicle for private commercial launches. In fact, the Air Force is requiring companies that bid for the contract to build the rocket to draw up plans to produce a variant capable of launching commercial satellites.

■ The capacity of both the Kennedy Space Center in Florida and the Vandenberg base to launch the new Titan rockets will be upgraded. A total of four flights a year from Kennedy and two from Vandenberg are planned by the late 1980's.

■ In future all critical payloads will be capable of being launched either on the shuttle or on unmanned rockets. Aldridge, who describes decisions in the late 1970's to rely exclusively on the shuttle as "a major mistake," says the Air Force will no longer "be dependent on a single launch vehicle."

Aldridge predicts that the Air Force will not recover completely from the shuttle disaster and the recent failures of Titan and delta rockets until the early to mid-1990's. He says that by the time the shuttle starts flying again, the Defense Department will have 21 payloads "sitting on the ground waiting to fly."

The cost will be enormous. In addition to the $2.6 billion required for the Air Force program, NASA will require at least $500 million to fix the problems with the shuttle—whether or not it gets approval for a replacement orbiter.

And these costs will not end once the recovery period is finished. Aldridge says that the Defense Department will require some five or six launches of the heavy-lift Titans, four of the medium launch vehicles, and two of the smaller Titan II's every year in the early 1990's. ■ COLIN NORMAN

Research Fares Well in New French Budget

Paris

France's conservative government has announced that it plans to boost spending for civilian research by 5.8% in 1987. Allowing for inflation, this is currently predicted to allow a real growth in research spending of almost 3%. The increase contrasts sharply with the 8% cut in the 1986 budget, which was imposed by the Ministry of Finances soon after the government took over from its socialist predecessor in March.

The largest increases will go to basic research funding agencies, such as the National Center for Scientific Research and the National Institute for Health and Medical Research. The operating budget for these organizations, which had been cut by 10% for 1986, will now grow by 9% next year. The result in real terms will be to bring research spending back to approximately the same level as in 1985.

The Minister for Research and Higher Education, Alain Devaquet, has also announced that he intends to create 200 new scientific posts next year in government laboratories. At the same time, however, the number of technical and administrative staff will be cut by over 500.

Smaller increases will go to the more applied research oriented agencies, such as the Atomic Energy Commission and the National Center for Space Studies. This reflects both the fact that these agencies were given smaller cuts in March, and that a major debate is taking place about the new government's attitude to its large government-sponsored technology programs in fields such as space and nuclear energy.

The biggest cuts will be experienced by two agencies that had spearheaded the socialist government's efforts to merge its social and technological policies, namely the National Agency for the Exploitation of Research, which is responsible for developing the uses of government-sponsored research, and the French Agency for Energy Conservation. The budget of each will be reduced by about one-third.

The announcement of the 1987 budget reveals that, in contrast to many other areas of public spending which are being cut back significantly—and despite complaints about a lack of coherent science policy that accompanied the earlier cuts—research has fared relatively well.

The biggest budget increases, however, have been allocated to the Ministry of Defense. In line with preelection commitments, this is planned to increase by 7%, to a total of $24.6 billion.

Although no detailed figures are given on the proportion to be allocated to research and development, this is expected to increase considerably faster than the civilian R&D budget, in line with the government's decision that, where possible, the additional funding should go toward the modernization of defense equipment.

Furthermore, the Minister for Defense, Andre Giraud, who was director of the Atomic Energy Commission in the 1970's and subsequently Minister for Industry under President Giscard d'Estaing, is said to have defended his demands for significant increases by using the argument that support for new military technologies will eventually spin over into the civilian sector.

Even though the French government continues to refuse an official invitation to participate in the research phase of the U.S. Strategic Defense Initiative, among the areas which Giraud has said he would like to develop are technologies that could be used to protect Western Europe against short- and medium-range Soviet missiles—one of the principal areas in which Europe is expected to contribute to the SDI program. ■

DAVID DICKSON

Saving the Whales Faces New Hazard—Research Whaling

Efforts to uphold an international moratorium on commercial whaling recently received a setback in the U.S. courts and appear to face a new challenge—whaling conducted under the aegis of research.

After the International Whaling Commission (IWC) in 1984 voted the moratorium on commercial whaling that is now in effect, three IWC member nations, Japan, Norway, and the Soviet Union, filed objections, leaving them free to continue whaling. The commission is a voluntary organization with no enforcement powers. Besides world opinion, the major stimuli to adherence to IWC decisions are the provisions in U.S. fisheries law designed to punish violators of IWC mandates.

Under one provision, the Japanese decision to continue whaling could have triggered a loss of half their fishing quota in U.S. waters in the North Pacific, worth an estimated $500 million a year. However, a U.S.–Japan bilateral agreement was negotiated under which the Japanese could continue the hunt until 1988. Taking of both sperm whales and the smaller and more numerous minke whales was covered.

A group of conservation organizations