are frantically trying to halt developers who are gobbling up valuable marshland at an alarming rate.

Water-borne commerce presents another big challenge for the bay. Both the Baltimore Harbor and the Chesapeake and Delaware Canal undergo periodic deepening to accommodate ever-larger boats. Noxious dredge spoils from the harbor are dumped into a deeper part of the bay, smothering marine life and spreading industrial poisons. The widening of the canal, currently in progress, poses an additional threat: because the water level of the Chesapeake is slightly higher than that of the Delaware Bay, fresh water is diverted into the canal, thus allowing an increase in the salinity of the upper bay during times of minimum estuary flow.

But sewage is the major scourge of the bay. It emanates from numerous inadequate treatment systems, as well as from leaky septic tanks belonging to shore dwellers who are not hooked up to municipal systems. Maryland has embarked on an ambitious program to construct treatment plants and has devised a system to clamp down on septic tank violators. But the state has no control over the behavior of federal installations, or over the variety of undesirable products that float down the Potomac River from Washington, D.C.

While Maryland has finally come to grips with many of the problems that have been building up on the bay—15 environment laws were passed in the 1970 legislative session—it does not have a clear policy for dealing with some future developments that will require a sophisticated balancing of the conflicting needs of the population. For example, a heavy-industry complex has been proposed for the port of Crisfield on the Eastern Shore. Crisfield is in Somerset County, the most depressed county in the state and badly in need of a new economic base. But conservationists say the depth of the bay and its flushing action are insufficient to support a deepwater port. The project now seems to be at an impasse—an official of the state Department of Natural Resources (DNR) says something is badly needed in Crisfield, but no one dares study the matter for fear of being ambushed by packs of conservationists.

No strategy has yet been unveiled to handle the intense pressures for recreational development on the Eastern Shore that are expected to result from the construction of a second bay bridge. The new span, being built adjacent to the existing one, which crosses the bay just above Annapolis, is expected to be completed late next year.

No one is sure how serious the bay's problems are. The five-state Susquehanna River Basin Compact, ratified last year, gives Maryland a strong hand in decisions about planned diversions from the bay's main artery, but the machinery of the compact is yet to be activated. According to the Chesapeake Bay Foundation, which was set up 5 years ago to "save the bay," it is "on the ragged edge of becoming badly polluted." Ominous signs may be read in seasonal fish kills, oil spills, the closing of Baltimore area beaches, and the 28,000 acres of oyster beds and 39,000 acres of clam beds that have been closed due to pollution.

On the other hand, the Chesapeake is in far better shape than her dirty smaller sister, the Delaware Bay. A DNR official points with pride to the fact that the prized bay oyster is still eaten raw—despite the fact that the oyster's filter-feeding system tends to pick up whatever pollutants exist in the surrounding water. Boating, swimming, and sport fishing are on the increase, and no significant loss of species has occurred from pollution.

Is the bay dying and if so what can be done to save it? Decisive action will have to await more detailed understanding of the bay. But the Chesapeake can't wait forever—geomorphologists say that in 50,000 years or so shore erosion and silt from its estuaries will have turned it back into dry land.

—CONSTANCE HOLDEN

NSF Prods Scientists to Coordinate Bay Research, but Academic Rivalries Snag Badly Needed Studies

Why isn't more known about the Chesapeake Bay? Despite more than 1000 published studies of winds, tides, flora, fauna, and the effects of pollution in the bay, many questions about the impact of man's activities remain unanswered. One reason seems to be that too much of the research has been fragmented, specialized, or restricted to one small portion of the bay.

Actually, the jumble of reports and studies that confronts anyone seeking information about the bay only reflects the institutional complexity that characterizes the region. One step in the right direction was the formation 2 years ago of the Maryland Department of Natural Resources, which pulls the state's environment-related activities under one roof. Even so, two sets of state agencies, from Maryland and Virginia, and a variety of federal agencies, ranging from the Bureau of Commercial Fisheries to the Army Corps of Engineers, all have some claim to oversee activities within the bay. The resulting jurisdictional tangle leaves no single agency with either the authority or the incentive for bay-wide planning and management.

Things are hardly better as far as research on the bay goes, with only minimal overall coordination among almost a dozen different institutions. The "Big Three"—the Chesapeake Bay Institute (CBI) of the Johns Hopkins University, the Chesapeake Biological Laboratories (CBL) of the University of Maryland, and the Virginia Institute of Marine Sciences (VIMS)—dominate bay research to the point where some of the other institutions that deal with the bay or its surrounding lands have felt excluded.* Despite some evidence that cooperative research programs and an awareness of the need for a comprehensive approach are on the upswing, the Chesapeake Bay Research Council, the most recent bay-wide attempt at coordination by the Big Three, is by all accounts so inactive as to be practically defunct.

It is against this discouraging background that a new report to the National Science Foundation (NSF), *The Chesapeake Bay*, grapples with the problem of coordinating research on the bay. The report, which was written by a 13-member committee of scientists for the Johns Hopkins University, the University of Maryland, and VIMS, proposes an ambitious information system, a bay-wide research program, and a new organization to coordinate the

* Other institutions active in research on or around the bay include a laboratory of the Bureau of Commercial Fisheries at Oxford, Maryland; a water quality laboratory of the Environmental Protection Agency; the Chesapeake Bay Center of the Smithsonian Institution; a research station of the Corps of Engineers, where a large hydraulic model of the bay is being constructed; the U.S. Geological Survey; Old Dominion University; Virginia Polytechnic Institute; and the University of Virginia.

research. Grants totaling $200,000 from NSF's program of Interdisciplinary Research Relevant to Problems of Our Society (IRRPOS), supported the 8-month study, which began last July. The NSF is under considerable pressure from the Nixon Administration's budget directors in the Office of Management and Budget to come up with research programs that contribute demonstrably to the solution of national problems. The initial NSF response, IRRPOS, has been upgraded, expanded to an $81-million program, and renamed Research Applied to National Needs (RANN). At this point, however, it seems doubtful that Congress will approve all of the expansion.

The RANN effort represents a radical departure for the Foundation, which has historically championed basic research and the cause of science for science's sake. The new program, from which the Chesapeake Bay report is one of the first returns, emphasizes applied research that is likely to produce tangible, short-term payoffs. The NSF

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Thinking Big

The Nixon Administration is hunting for a new "initiative" to maintain national leadership in world technology and, at the same time, use some of the engineering and scientific talent going to waste because of aerospace and defense cutbacks.

Energy and transportation seem to be front-runners among the possible choices, but the environment and urban programs are also under consideration. A spokesman in Washington recently said that the search is being headed by Edward E. David, Jr., presidential science adviser and the director of the Office of Science and Technology (OST).

The first announcement of the search was made by David on 1 April 1971, at the San Clemente White House, after he attended a meeting with President Nixon, Labor Secretary James D. Hodgson, and representatives of universities, professional societies, and industry. Afterward, Secretary Hodgson announced the Administration's $42-million program of short-term aid for unemployed scientists and engineers, and David announced his search for a long-term goal.

"So what we will be doing," he said at that time, "is putting together a program of new technological initiatives . . . with the objective of keeping the country in the forefront, and great."

The Washington spokesman said that the Administration has no intention of boosting the space program to its former levels; nor of raising defense budgets to reabsorb the unemployed. The Administration, he said, hopes that the jobless professionals will "bite the bullet" and realize that winding down in aerospace will continue.

On the other hand, he said, the Administration wants to identify a specific, achievable, technological goal that could use some part of these highly skilled, unemployed persons. It is looking in areas "where you can see the country is going anyhow," and, in that sense, will be different from the post-Sputnik launching of the space program by President Kennedy in 1961. It has also ruled out a New Deal, WPA-like public works project for the jobless engineers and scientists.

However, the Administration completed a simpler, but briefer, review of domestic "conversion" possibilities last January when a study group drawn from the Office of Management and Budget, the OST, the Civil Service Commission, and the Labor and Defense Departments, looked at the aerospace manpower impasse. The group produced many of the suggestions which later became the Administration's $42-million short-term program, but it ruled out a major domestic high-technology program as impractical.

Those who worked on the study say that the ground rules that were given to the group eliminated any chance of a large federal infusion of funds.

David had said at San Clemente that "we have in the country a state of technological underambition." Clearly, the Nixon Administration, like its predecessors, hopes to identify itself with some suitably ambitious national goal. It is trying to do this with its program for curing cancer, and it would like to do likewise for high technology.—D.S.

NSF Makes Headway

The National Science Foundation (NSF) budget appears to be on schedule and on course through Congress this year and so far has not encountered the heavy weather to which it grew accustomed in years gone by. In the first phase of the authorization and appropriations process, the House Science and Astronautics Committee made some shifts of funds among programs but reported out a bill (H.R. 7960) which retains the general shape and the same total budget of $622 million proposed by the Administration.

The House committee decided to restore Administration cuts amounting to about $40 million mainly in science-education and institutional-support programs. The committee compensated for the action principally by reducing by $30 million funds requested by the President for NSF's program of Research Applied to National Needs (RANN) and by making sizable cuts in support of grants for research.

RANN is NSF's showcase effort to encourage applied research on issues relevant to society. The committee seems to have decided that the Administration's request to increase funding from $34 million in the current fiscal year to $81 million next year was overdoing it. The committee cut the figure to $51 million, which still represents a 40 percent increase.

The decision to restore funds for science education and institutional support reflects committee differences over priorities with the Administration which has taken the general view that programs to expand the supply of scientific and technical manpower should be restrained in view of current unemployment in the field. In the case of science-education funds, a high-intensity lobbying campaign also seems to have had an effect. Two programs in particular profited from the salvage effort. These are the Student Science Talent Program, which provides funds to finance summer programs in universities and research institutions for high school students talented in science, and the Undergraduate Research Participation Program, which does what the name implies for college

intends to prevent backsliding into the natural academic inclination toward narrow research pursuits by taking an active role in monitoring and directing the course of the research, in contrast to the "hands off" policy that prevails in the Foundation's basic research funding. The meetings of the study group that produced the Chesapeake Bay report were attended, for example, by the NSF project officer.

Since NSF lacks the staff to coordinate bay-wide research directly, it looked to the research institutions themselves to create a coordinating mechanism. The alternative would apparently be for NSF to contract with a Rand-type, nonprofit firm to manage future research on the bay, a prospect that threatens local university researchers who do not like the idea of an outside group setting research priorities. With this incentive, it might be expected that the Chesapeake Bay report would be the model of a well-integrated research program. Unfortunately, the report appears to fall so far

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students. Planned Administration cuts in both programs precipitated a shower of protests to congressmen emanating from directors of the 125 programs for high school students and satisfied parents. One source in the committee said, "I don't know whether it was organized or not. If it was, it was damn well done." The high school program gets $2 million and the college program $4 million for the year.

The House authorization bill came out of the subcommittee headed until the last election by former Representative Emilio Q. Daddario of Connecticut and now chaired by Representative John W. Davis (D–Ga.).

Besides shifting funds, the House committee narrowed the discretionary powers of the NSF director in "reprogramming" money. The committee "line-itemed" the bill, that is, it specified amounts to be spent in particular categories. In addition, for the first time the committee required the NSF to inform Congress and receive word of approval from the responsible committees within 30 days before transferring funds from one category to another. Observers say that the action was meant by the committee as a rap on the knuckles for NSF director William D. McElroy for not telling it about cutbacks in institutional support programs.

NSF budgets have historically suffered their greatest traumas at the hands of the House Appropriations Committee. The committee has not completed action on the bill, but the word from those who have attended the closed hearings before the Appropriations subcommittee headed by Representative Edward P. Boland (D–Mass.) is that the atmosphere has been friendly and there has been no talk of major surgery as in other years.

The NSF fiscal 1972 budget still has a considerable distance to go. There has been no action on authorization or appropriations measures in the Senate. The authorizing subcommittee headed by Senator Edward M. Kennedy (D–Mass.) is expected, however, to hold early hearings. In the scenarios of past years the Senate has been the scene of rescue attempts on behalf of the NSF budget, but, unless there are some unexpected twists in the plot, this could be the year the NSF avoids a cliff-hanger.—J.W.

It Could Be Verse

The campaign to restore education funds to the National Science Foundation (NSF) budget produced an unusual footnote in verse and qualified Office of Management and Budget (OMB) director George P. Shultz as poet laureate of the Executive Office. At the House NSF authorization hearings National Academy of Sciences president Philip Handler read and submitted for the record a letter he said was a copy of a five-stanza rhyming remonstrance. The letter was addressed to Shultz by a New York woman, Mrs. Marilyn Harbater, who protested cuts in NSF science education programs, particularly the Student Science Talent Program. Her middle stanza read:

But how can America function
  in this technological age
If our scientific community
  is stifled and put in a cage?
Should our youngsters stop taking
    courses
  in bio and math and in chem
Because they are told in the future
  they'll have no need of them?

A check with OMB revealed that Shultz replied in kind with a letter in verse which not only states the Administration position on manpower but also rhymes and scans creditably. The hitherto unpublished work follows.

Dear Mrs. Harbater:

We thank you for your poem
  about the NSF
and the cut in training
  to which you think we're deaf

Alas, this type of program
  has had a small effect
on changing students' choices
  and the courses they select

And further we don't see now
  the need for a reliance
on special Federal efforts
  to add more men in science

While research is important,
  our problems to surmount,
it's the quality of people
  and not numbers that will count

With more demands arising
  to draw on our tax take
priority decisions
  are something we must make

But funding is increasing
  in fiscal seventy-two
in many fields of science
  where there is work to do

For many men in research
  this will increase the chance
to utilize their talents
  —our nation to advance

We praise your son's high purpose
  in using his bright mind
and think that still in science
  a future he can find.

Sincerely,
George P. Shultz
Director

Office of Management and
  the Budget,
Washington, D.C.

short of its goals as to raise some questions about the ability of academic institutions to think in terms of large-scale programs of interdisciplinary research.

About half of the 211-page report is devoted to a discussion of a physical and social inventory of the bay region and a proposed data bank. The inventory—an ambitious attempt to look at the bay region as a single system—will catalogue many thousands of "entities," from algae and airports to schools, power plants, and wetlands, as well as lists of their characteristics and the processes by which they interact. The enormous amount of data to be generated by this cataloguing procedure will be stored in a computerized data bank as part of an information system that, the authors of the report hope, could be useful both to researchers and to officials of regulatory and management agencies concerned with the bay. When complete, the inventory can, in theory, be used as a checklist to indicate the possible interactions among entities on the bay, thereby determining, for example, the environmental, economic, and social impact of a new power plant.

The first aim of the planning group was to design a program that would enable universities and other institutions within the bay region "to contribute more effectively to better management and control" of the bay. But the real utility of the proposed information system to regulatory officials is questionable. One administrator in the Maryland Department of Natural Resources told *Science* that the type of information contained in the inventory would be of minimal value in making management decisions; in his view, only the federal government has the resources to undertake a data bank of the magnitude required for adequate environmental information.

Many scientists are convinced that some form of data bank would be useful to researchers, but that the hierarchical structure of the inventory is more suitable to taxonomic data than to acquiring information on the dynamics of a biological or physical system. A research administrator at Virginia Polytechnic Institute told *Science* he was not convinced that a "monolithic data bank" would be useful, while other critics simply dismiss the inventory as a waste of time and money. It must be admitted, however, that the inventory represents a novel attempt to extend systems analysis techniques—familiar in hardware programs—to social and environmental systems.

The second half of the report presents a bay-wide research program and proposes a consortium of the three institutions to coordinate and carry out some of the research. The program includes biological research on the major food webs and energy budgets of the bay, research on the fluid dynamics and basic chemistry of estuarine waters, studies of the economic impact of air and water quality standards, and research on regulatory institutions and decision-making processes that influence the course of events on the bay. But it is noteworthy that the report devotes five times as much space to recommendations of research areas in particular scientific disciplines as it does to interdisciplinary and problem-oriented research. The shopping list of research projects mentioned in the report is lengthy, and the implication seems to be that all of them should be funded. Recommendations on research priorities, division of limited funds among the participating institutions, and the balance between problem-oriented and discipline-oriented research are not to be found, omissions for which the report gives as justification a lack of "sufficient wisdom and information."

In effect, the report leaves the most difficult decisions about the research program up to the proposed consortium. But how the consortium director will be better able to set research priorities for the bay than a committee that included three of the region's top biologists is not clear.

Nonetheless, the proposed consortium appears to be the most important offering of the report. And despite the vague and cursory description that is given of its role and structure, the consortium may ultimately turn out to have a significant influence in coordinating research on the bay. In the meantime, however, a number of thorny details, such as the degree of autonomy the new organization will have and the extent to which participating institutions will commit resources, remain to be worked out. Of particular interest to those Chesapeake Bay research institutions that were not involved in writing the report is the question of membership in the consortium. As presently planned, the consortium would initially include only the Big Three, with additional members to be admitted to the club "later." The concern of the excluded institutions, as expressed to *Science* by a spokesman for Old Dominion University and other groups, is that the consortium might become a prime conduit for research funds, or gain a larger role in approving research plans for the bay than its representation would justify. Indeed, the NSF has already put off funding a few proposals for bay research until it could compare them to the report's plan.

Experiment in Coordination

Officials of NSF frankly admit that the grants which supported the Chesapeake Bay report are part of an experiment to bring together institutions that have previously operated from separate fiefdoms on the bay. Hence, according to RANN program director Joel Snow, the most significant fact about the report may be that it exists at all. In a larger context, the report also marks the beginning of a renewed effort by NSF to nudge academic researchers into broad programs of applied research.

Whether or not scientists working on the Chesapeake Bay can organize themselves enough to deal with the bay's problems effectively may not be immediately decisive, but, in the long run, the well-being of the bay is certainly dependent on a more comprehensive understanding of its functions than is now available. The bay is too vital a resource to allow institutional chauvinism or personality clashes to inhibit the necessary research, as they apparently have, at times, in the past. The NSF is vigorously applying pressure for a more coordinated approach, but it is encountering scattered opposition to this and to other RANN programs from purists in the research community who disdain practical problems—especially those involving interdisciplinary efforts for their solution. As to the consortium, the next 2 years will determine the fate of this attempt to coordinate research on the bay.

As a prototype of academic involvement in socially useful research, the Chesapeake Bay report is not a particularly inspiring model. But it does serve to illustrate the difficulties to be expected in RANN-type research. And university researchers may be well advised to expect that multidisciplinary, multi-institutional programs of applied research, for all their attendant difficulties, will be increasingly attractive to funding sources.

—ALLEN L. HAMMOND