Office of Naval Research: 20 Years Bring Changes

Nearly 20 years ago, on 1 August 1946, the Office of Naval Research finally came into being, to the immense satisfaction of the true believers who had been insisting that just such an agency would be a vital necessity in the postwar years. ONR, authorized to support the basic research of university scientists as well as to lead the Navy's "in-house" research, was the first agency to take up, on a broad scale, the challenge laid down at the close of World War II by Vannevar Bush in his influential report "*Science, the Endless Frontier.*"

Today, of course, ONR is but one of a number of research-supporting agencies. The changes that have been occurring in ONR's role and relative importance are suggestive of the momentous developments in government-science relationships during the agency's first two decades.

Celebrating its Vicennial Year, ONR held a special convocation on 4 May, bringing together some 900 scientists and science administrators to consider the theme, "Science and Public Policy." The early history of ONR was reviewed as an illuminating exploration of first principles.

Well before the end of World War II it was realized that, with the return of peace, the Office of Scientific Research and Development and the National Defense Research Committee, both temporary wartime bodies, would disappear. Unless a new agency came to the scene, government support of science would falter. As things developed, for a few years ONR filled the void. Captain Robert Dexter Conrad, U.S.N., who served as planning chief under the Navy's wartime Coordinator of Research and Development, is often credited with being a principal architect of ONR. Another vigorous proponent of ONR, Rear Admiral Harold G. Bowen, became the first Chief of Naval Research. Bowen, who had the willing cooperation of Secretary of the Navy James Forrestal and some other important Navy figures, arranged to have certain unused wartime funds transferred to ONR, permitting the new agency's program to begin promptly. Bush and other scientists helped create the political climate favorable to this Navy peacetime venture in support of basic research.

In a speech at the May convocation, Alan T. Waterman, ONR's first chief scientist and later the first director of NSF, gave Captain Conrad much of the credit for developing research-contracting policies which are deemed generally to have been enlightened and to have served as desirable models for NSF and other research-supporting agencies.

In 1945, as planning director for ONR's short-lived predecessor, the Office of Research and Inventions, Conrad—who later contracted fatal leukemia—undertook to persuade scientists at a number of leading universities to participate in the Navy's peacetime research program. As Waterman recalled, the Navy program aroused consternation in academic and some government circles. It was feared that federal support would mean federal control, which, if exercised by a military agency, would be particularly undesirable. Furthermore, if research was to have enough relevance to Navy needs to justify Navy support, would this not mean that only applied research would be supported?

Many of the scientists Conrad was trying to win over wished to forget the military and return to their prewar pursuits. Conrad rallied their support by effective speechmaking and by working out a contract system remarkably free of bureaucratic red tape. That system was to depend largely on rather informal ties between the university researchers and the specialists in the disciplinary branch units within ONR that are concerned with basic research.

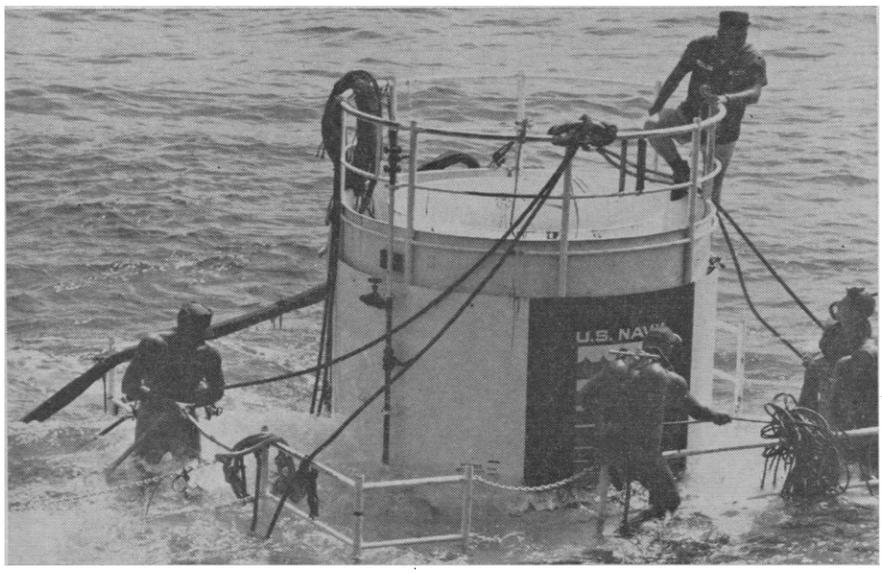
These units, run by civilian scientists, enjoy considerable autonomy and exercise policies of great flexibility. Their judgments on contract proposals, which come more or less spontaneously out of the scientist's research interests and his knowledge of the Navy's needs (proposals for basic research are not solicited on a bid basis), usually are followed.

Frequently, contracts supporting one or a few investigators are made that are largely independent of the institutional structure of departments and schools. The promising individual researcher can be supported even if his department is weak, and professors from different departments can receive support for joint research. An important ancillary benefit of ONR contract research, especially during the immediate postwar years, was the support it provided for graduate students serving as research assistants to professors. ONR's part in the shaping of the present-day pattern of graduate education in the sciences was thus significant.

Quite a number of distinguished science administrators who shaped (and were shaped by) ONR in its early years left the agency to take important positions in newer agencies. Waterman's departure to head NSF was a notable example. This process of direct transfusion has accounted in part for the pervasiveness of ONR's early influence on government-science relationships.

As speakers at the ONR convocation pointed out, the agency's substantive achievements in science and technology also have been important and manifold. The concept of the Polaris missile-launching submarine emerged from studies begun at an ONR-sponsored summer study group. A number of other major advances in defense technology were conceived and carried forward by ONR sponsorship. These include, for example, the electronically suspended gyro, the maser and laser, and modern electronic navigation systems. Important work in oceanography has been done by Navy laboratories and by organizations, such as Woods Hole Oceanographic Institution and Scripps Institution of Oceanography, which have looked to ONR for much of their support. Modern sonar—the use of underwater sound at long ranges for submarine detection, for probing the oceans, and for general geophysics—has resulted in large measure from work done under ONR auspices.

In making these achievements, ONR has flouted Parkinson's Law. The ONR headquarters staff and those staff people in the field who are concerned with contract research do not (and have never) numbered more than a few hundred. In fact the 94 scientists now on the headquarters staff seem to be too few to permit a healthy growth of ONR-



SEALAB II aquanauts, in an ONR-conducted test last August of man's ability to live and work undersea, prepare to descend 205 feet for 15 days on the ocean floor.

sponsored research, although there is a division of opinion on this point. ONR has coordinating authority over research activities in Navy laboratories but, even with laboratory researchers included in the staff total, ONR is said to have grown by less than one-third since 1946.

On the other hand, ONR's research and development budget is now three times larger than it was 20 years ago—having risen from $43.8 million in fiscal 1947 to $145.5 million in fiscal 1966. Of course, the budget is still small by Washington standards, and for the last 2 years it has grown little. Of the $145.5 million last appropriated, $82.2 million was allocated to research; the remainder was earmarked for "exploratory development" and other purposes.

Anniversary convocations tend to be comfortably nostalgic affairs and ONR's was, for the most part, no exception. A few disquieting notes were struck, however. Harvard's Harvey Brooks, chairman of the National Academy of Sciences' Committee on Science and Public Policy and a member of the Naval Research Advisory Committee, expressed the fear felt by a number of scientists that "mission relevance" is being overstressed in government support of research.

"One senses in talking to early participants in ONR a little of the atmosphere of early Christians spreading a new gospel of the partnership of science and government," Brooks said. "As with all evangelical movements, however, the very success of this one has brought its own problems. . . . Perhaps for the first time since the war, the assumptions on which our science policy of the past 20 years has been based are being seriously questioned and even challenged," he said.

Brooks noted that today at least eight federal agencies are deeply involved in supporting academic research and that many others are involved at least peripherally. It is no longer as easy as it once was, he said, for ONR to argue that the strength of American science—on which U.S. military strength depends—will falter without its support. "It is harder to defend one's self against those who argue, Let NSF do it, or Let ARPA [Advanced Research Projects Agency] do it," he said.

As Brooks indicated, a welter of new external circumstances has altered ONR's position and role within the government and within the scientific community. The inevitable decline in ONR's relative prestige and importance from the peak reached during the immediate postwar years has brought penalties. ONR still has strong and effective ties with the academic community, but many scientists who, 10 or 15 years ago, would have come to ONR with their proposals now go to NSF, the National Aeronautics and Space Administration, the National Institutes of Health, or some other agency where money is relatively plentiful. NSF, for example, since starting life 15 years ago with $225,000, has grown up to be a half-billion-dollar-a-year agency.

Within the Navy itself ONR's influence seems to have declined. F. Joachim Weyl, who recently resigned the position of ONR's Chief Scientist to become special assistant to the President of the National Academy of Sciences, speaks of ONR as a "magnificant instrument" of which the Navy makes too little use. He would have ONR serve as the "brains of the Navy." He means in part that from its research ONR would draw—far more effectively than at present—concepts of what the Navy of 10, 15, 20 years hence should look like and be doing. Weyl says that he had not found Rear Admiral John K. Leydon, Chief of Naval Research, unsympathetic to this idea. But Leydon has indicated, he says, that the Navy is far more interested in research promising an earlier and more readily discernible payoff than that which might ultimately come from speculations about a distant future.

Admiral Leydon believes that greater use would be made of the agency's expertise—for which there is considerable demand even now—if ONR were more aggressive in making known what it has to offer. But he cites reasons why ONR is not, and perhaps will never become, the Navy's brains. ONR now must compete with a number of other "brains" which once either did not exist at all or were rather feeble organs. ONR once reported to an Assistant Secretary of the Navy for Air, a position always held by a nonscientist who had to depend on ONR's Chief Scientist to advise the Secretary of the Navy and the Chief of Naval Operations on technical matters. Now ONR reports to an Assistant Secretary for Research and Development, who, because he is always a technically trained person, can feel freer to second-guess the Chief Scientist's advice. Also, groups such as "WSEG" (Weapon Systems Evaluation Group) are, in a sense, a source of expertise that competes with ONR for attention.

Moreover, during the last few administrations a strong research and engineering office under the Secretary of Defense has been built up. Secretary Robert S. McNamara has, in addition, given a high place to his systems-analysis people in Pentagon decision making. Another development has been the creation of the President's Science Advisory Committee and the Office of Science and Technology. Thus, the number of experts and advisers ministering to the officials who decide questions of defense and research policy

Rear Admiral John K. Leydon

has been multiplying rapidly. In Weyl's view, however, this very proliferation of centers of technical expertise means that unless the Navy is able to visualize and plan its future make-up and role, others will preempt that responsibility.

(One notes in passing that old associations may affect the lines of influence in government science administration. For example, two directors of defense research and engineering, John S. Foster, Jr., who holds the job now, and Harold Brown, who held it until he was made Secretary of the Air Force, have long known Gerald W. Johnson, assistant to the Assistant Secretary of the Navy for Research and Development and director of Navy laboratories. All three were once associated at Livermore Radiation Laboratory, where Brown and Foster served successively as director before coming to Washington and where Johnson was associate director.)

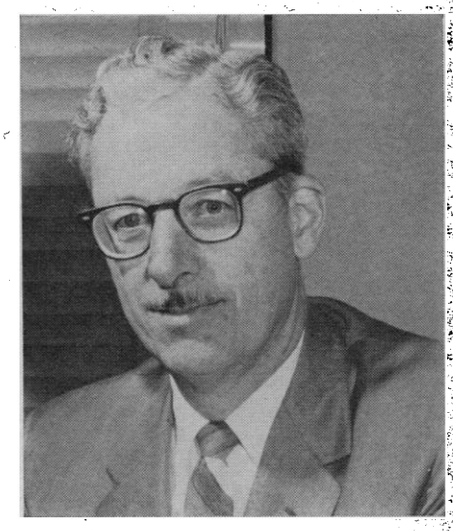
The decline in ONR's prestige probably contributes to the agency's personnel problems. In Weyl's words, ONR is so understaffed it must "tread water awfully fast to keep its head up." In many cases, the positions vacated by scientists leaving ONR to take attractive jobs with newer agencies have been filled by promotion instead of by recruitment from outside. According to Weyl, the quality of the replacements has been high, and, if this fact has not always been recognized by outside observers, it is because many of the replacements are younger men little known to the older generation of scientists.

Nevertheless, losses cannot be made up solely from within an organization. ONR, in common with other government agencies, has had difficulty recruiting men of high talent. This has been due partly, but not exclusively, to the government-wide policy of placing strict limits on the number of jobs available in higher salaried categories (say, $15,000 a year and above). Even when vacancies in better paying positions exist, the candidates attracted are not often of the caliber desired. Admiral Leydon is attempting, within the limits imposed by what he regards as highly rigid civil service rules, to ease ONR's personnel problems by greater use of transfers, by greater flexibility in matching jobs and pay-grades, and by term appointments of people from outside the government.

Peter King, formerly an associate director for materials research at the Naval Research Laboratory and now head of ONR's London office, has been assigned as Chief Scientist to replace Weyl (who chaired the selection committee that recommended King). King, a chemist, holds the Navy's Distinguished Civilian Service Award for his contribution to the atmospheric radiation detection program, which resulted in the detection of the Soviet's first atomic bomb test. He is said to be highly respected by his former colleagues at NRL, a circumstance which should make it easier to achieve a closer relationship between NRL and the ONR headquarters staff—a current ONR goal.

Admiral Leydon, under whom King will be serving, came to ONR about 2 years ago and is said to be something new in the agency's experience. Leydon, energetic and dynamic, was—at 47—the youngest man ever named to the job. Usually the Chief of Naval Research has been a man serving his last tour of duty. "I think Leydon is the first to try to run ONR," one well-placed observer remarked recently. "His predecessors were dignitaries." Such remarks do not represent the literal truth but they are heard.

Leydon, a Naval Academy graduate who has studied aeronautical engineering at Caltech and advanced management methods at Harvard, has tried to make ONR a more unified organization and to have ONR's endeavors in basic research and those in applied research draw more on one another for inspiration and support. A specific illustration of this effort was the moving of ONR's newly formed ocean science and technology group last March to the Naval Research Laboratory,



Peter King

where its activities will be coordinated with parallel groups that belong to NRL and the Naval Oceanographic Office.

Robert W. Morse, assistant secretary of the Navy for research and development until 1 July, when he became president of Case Institute of Technology at Cleveland, thinks highly of Leydon's leadership at ONR. "He's one of the best naval officers I've ever met," Morse remarked recently. While Leydon does not lack admirers in ONR's scientific staff, he seems to have increased the discontent among some scientists whose morale already may have been shaky. A few scientists are said to have left ONR because of dissatisfaction with conditions under Leydon. Weyl observes, however, that with time and the changes it brings, any organization will have some plaster fall off the wall.

Such unrest as exists is perhaps more due to the forcefulness with which Leydon has dealt with changing circumstances and new demands on ONR than to any sharp philosophical differences between him and the scientists. The same statement of research policy drafted 2 years ago by Weyl, who takes no narrow view as to what is relevant to the Navy, is still being circulated. ONR still holds that a "listening post" commitment should be made in a number of fields which have no immediately apparent potential for naval exploitation.

Admiral Leydon did not come to ONR under the most favorable of circumstances. Just before his arrival in the summer of 1964, ONR had vacated "T-3," a temporary wartime

building on Constitution Avenue, and moved to the main Navy building across 17th street where it occupies the offices off several long corridors on the fourth floor. Up there in the "attic" ONR people seem to have felt a certain isolation, from one another and from professional colleagues on the outside. Leydon has regarded the talk that one hears of isolation as a "canard."

Upon his arrival at ONR, Leydon found that the agency's budget had almost ceased its modest upward climb and was leveling off. The Office of Defense Research and Engineering, aware that NSF support of basic research had grown enormously, and sensitive to congressional sentiment that the military should narrow the focus of its research, was being anything but free-handed.

Meanwhile, the strengthening of the oceanography program was becoming of increasing concern to the Navy. The difficulties encountered in finding the remains of the *Thresher*, which was lost in 1963, had pointed up how limited the Navy's capabilities were for deep undersea operations. Confronted by a static budget and requirements for stronger oceanographic research, Leydon, far more than his predecessors, had to give close attention to budget priorities.

According to Sidney Reed, ONR's director of research, all programs outside the field of oceanography have received less money than the scientists responsible for them wanted. Leydon is sympathetic to the scientists' desire for more money for their programs, but he feels that, without additional personnel of high quality, ONR is getting all the money it can spend effectively. The ONR budget for fiscal 1967, now awaiting final approval by Congress, is roughly the same size as last year's. No major cuts in the ONR budget request have been made this year either at higher echelons in the Navy and Defense Department or in Congress.

Reed disagrees with Leydon's view that funds should not be increased until the staff is strengthened. "I do not feel that we have reached a saturation point at all," he told *Science*. Weyl, on the other hand, feels that, at present staff strength, ONR should improve the use of existing research funds rather than assume the burden of administering additional funds.

If more funds for research should be sought the amount would be about $7 million, Leydon says. Although contracts in oceanography sometimes exceed $1 million, those in other fields usually involve comparatively small sums, often no more than $20,000. This being so, a budget increase of only a few million dollars, assuming the money is properly spent, can increase significantly the research program's vitality.

Leydon stirred some emotion among ocean scientists last December with a speech in which he said that ONR was shifting a larger fraction of its support for oceanographic research to areas of "direct Navy relevance." The technology for research at sea had advanced to the point where truly significant experiments could be conducted, he said. Such experiments, he added, would require important and continuing support and plans setting forth well-defined scientific problems.

According to Leydon, his speech raised apprehensions among some scientists that ONR would be looking over their shoulders. These fears, he believes, were allayed by the appointment of John B. Hersey, a distinguished Woods Hole oceanographer, as head of ONR's new ocean science and technology group. ONR will not interfere in the research of ONR-sponsored investigators, but their work must have clear objectives, Leydon says.

Unless ONR's budgetary and personnel problems somehow are resolved, the demands of the oceanography program, to which the Navy will give increasing support, surely will result in continued rebuffs to those who seek additional funds for other areas of research. This is likely to be especially true of investigations which, at their present stage, can be only vaguely related to the Navy's predictable requirements.

Many ONR staff scientists undoubtedly would endorse the view expressed at the ONR convocation by Harvey Brooks. Science cannot be divided up into neat little packages, each of which is related uniquely to the mission of one agency, Brooks observed. "Scientific work involves a multiplicity of choices of direction, many of which depend on very small influences in the mind of the investigator," he said. "Even in a system of complete scientific freedom the cumulative effect of the small biases placed in the mind of the investigator by his sponsor can have a profound effect on the direction and impact of his research."—LUTHER J. CARTER

Announcements

The University of California has opened its **Bodega Marine Laboratory** at Bodega Head, a pensinsula with ocean conditions on one side and a sand- and mud-flat harbor on the other. The laboratory, about 65 miles north of Berkeley, will be used primarily by faculty and students from the Berkeley, San Francisco, and Davis campuses. Cadet Hand, a zoology professor at Berkeley, is the director.

Costs for building and equipping the laboratory totaled nearly $1.5 million, much of which came from an NSF grant. The site includes, in addition to the class and research facilities, dormitory room for 40 people and dining space for about 50.

Discussions of environmental pollution, management of natural resources, and technical information are presented in a new publication from the Engineers Joint Council. The 44-page booklet "National **Engineering** Affairs," summarizes a 2-day seminar held in Washington in January; condensed versions of 18 papers are included. Copies of the booklet are available for $1 from EJC, Department P, 345 East 47th Street, New York 10017.

Scientists in the News

Vikram A. Sarabhai is the new chairman of India's Atomic Energy Commission and Secretary of the Department of Atomic Energy for the Indian Government. He succeeds **H. J. Bhabha**, who was killed in a plane crash in January. Sarabhai, a professor of cosmic ray physics at the Physical Research Laboratory in Ahmedabad, has been director of the laboratory since 1965. He is also the first chairman of the Indian National Committee for Space Research.

General Maxwell D. Taylor (U.S. Army, ret.), former U.S. ambassador to Vietnam, will succeed **J. P. Ruina** as president of the Institute for Defense Analyses (IDA) in September. Ruina, a professor of electrical engineering at MIT, returns there this month as vice president for special laboratories; he had been on leave since 1964.

Gordon J. F. MacDonald, chairman of the department of planetary and space science at UCLA, has been named vice president for research at IDA, effective 1 September; he will be