The Stoessel commission recommended an unmanned delivery system for deep strike, such as an air-launched cruise missile, and the Pentagon is studying two concepts: an extended-range, TV-guided "Boosted Big-eye," and a chemical warhead for the soon-to-be-deployed ATACMS missile, a battlefield ballistic missile with a range of more than 100 kilometers. But these are years away even from initial development. For now, the only concrete development work is on a semi-persistent chemical warhead for the Multiple Launch Rocket System, a battlefield artillery rocket with a range of 40 kilometers or so.

With no immediate plans for deploying any new binary munitions in Europe, though, critics charge that it is unclear how any of the proposed modernization steps can bolster deterrence. The price paid for European acceptance of the new weapons was a U.S. agreement that they would not be stored there. The existing stocks of unitary munitions, stored at a single site in West Germany, are to be removed in the early 1990's, while the new weapons, the plan goes, would be stored in the United States and airlifted to Europe in time of crisis. Proponents say that in principle binaries are much better suited to that role: "The idea is that they know we're not coming over with a C-5 full of live nerve gas that will blow up on the runway and wipe out Frankfurt," says one analyst. But a House Foreign Affairs Committee staff member says, "In a time of crisis, we're going to fly these to Europe—instead of putting troops on the planes?" Flying the equivalent of the estimated 100,000 unitary chemical artillery shells now in place in Germany would require moving a payload on the order of 10 million pounds.

For the most part, though, the case for the binary has not been distinguished from the general argument that the U.S. retaliatory capability needs to be bolstered. The binary has become a symbol of U.S. resolve to "modernize" its chemical warfare capability. And indeed a 1981 study by the Defense Science Board didn't even bother to consider the possibility of renewed production of unitary munitions: that option, the board said, was "politically unacceptable." Although the board was referring to public worries over an accident if live nerve gas were to be produced and transported once again, it might as well have been referring to the Administration's political decision to present Congress with an all-or-nothing choice for the binary program as currently conceived. ■ STEPHEN BUDIANSKY

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Office of Naval Research Marks 40th Anniversary

Set up at end of World War II to keep link with scientists, ONR pioneered postwar government-university partnership

THE Office of Naval Research celebrated its first 40 years recently with a public symposium titled "Forty Years of Excellence." If the assertion made in the title seems more than a shade self-congratulatory, it was supported by a blue-ribbon lineup of speakers who reminded the audience that ONR has made substantial contributions not only to U.S. science but also to shaping science policy.

ONR takes pride in being the first federal agency with statutory authority to contract for basic research. In getting started in 1946, it invented the machinery that still largely governs the research partnership between government and universities.

A first-hand account of the establishment of ONR was provided at the symposium by Bruce S. Old, who not only was present at the creation but had a direct hand in the process. Old, who went on to be a vice president of Arthur D. Little and now runs his own consulting firm, was one of a small group of young Naval Reserve officers who served during World War II in the office which advised the Secretary of the Navy on naval research.*

Old and his colleagues were charged with getting out, "to scout various situations," and their free-ranging style earned them the nickname "Bird Dogs." In their off-duty hours, the Bird Dogs began the discussions about postwar research that evolved into the proposal for ONR.

Old said in an interview that the Bird Dogs recognized the impact science and technology were having on the course of the war and "began to study the question of how we can maintain the liaison with the scientific community after the war." They started with "the feeling that the Navy was the best educated service." It had established its own laboratories and postgraduate school. "The Navy thought of itself as an elite service." Between the two world wars, however, funds to run the naval laboratories had dwindled and the Navy's science capabilities declined.

*The original Bird Dogs, besides Old, were H. Gordon Dyke, Ralph A. Krause, and Thomas C. Wilson. Later arrivals were John T. Burwell and James H. Wakelin.

Bruce Old, *one of the "Bird Dogs" for ONR in the early days.*

The Bird Dogs faced a problem not only in convincing Navy brass that the wartime liaison should be continued, but also of persuading university scientists to cooperate. "The scientists couldn't wait to get home," said Old. "The last thing they wanted to see was another naval officer. But when they got back, they took one look and found that the universities had no money for graduate students and badly needed equipment." The discovery made them more receptive and the way was further smoothed by visits by the Bird Dogs and other Navy officers to major research institutions such as Berkeley, Caltech, Chicago, Columbia, Harvard, and MIT.

"The key," says Old, "was the invention of a contract the scientists would accept." A substitute had to be found for the standard Navy procurement contract awarded through competitive bidding. In designing the new instrument, the Navy got lots of help from the university scientists. The result, says Old, was "a fairly simple basic contract to perform research and development without very definite scope." It was the prototype for the unsolicited research proposal that has enabled university scientists to compete for federal support of basic research and permitted them to publish the results.

During the war, the Bird Dogs had gotten to know many of the scientists working

on the major projects outside the Navy research establishment. The corps of civilian scientists engaged in research for the military was fairly small and the personal character of the wartime relationships had a formative influence on the postwar research system.

For example, the question of whether ONR should provide research support to institutions or to individual scientists was apparently decided almost automatically in favor of individuals. "It was definitely influenced by acquaintanceships," says Old. "You didn't pick Carnegie Tech, you picked Fred Seitz."

The decision to support graduate students through research grants was made on the same grounds. "We knew the top professors." One of them would be asked what he thought was of interest in the way of research projects. "If he hired a couple of people it was OK."

What might have been expected to be a sticking point with Navy officials—classified research—proved not to be a problem. "Publication was not a big issue with Navy brass." Classified research could be done in Navy laboratories and university scientists brought in for summer studies under classified wraps.

If Navy officials were amenable to the idea of ONR, its proponents still had to steer it to what they considered the right berth in the Navy bureaucracy. For the Bird Dogs and their allies, the essential thing was to give the office the freedom to concentrate on long-term issues. If ONR were to be put under the control of the Chief of Naval Operations, for example, they were sure it would be submerged in dealing with immediate problems.

Four founding principles, therefore, were advanced for it: ONR must have a budget of its own, it should report to the Secretary of the Navy through an assistant secretary for research, it should have a flag officer as chief, and the Naval Research Laboratory should become ONR's in-house laboratory. When the legislation creating ONR was passed in August 1946, most of the grand design was included in the bill, although it took until 1959 and sputnik for an assistant secretary for research to be installed in the Pentagon.

ONR did get off to a flying start. What made that possible and gave ONR crucial momentum, says Old, was that some $40 million in unspent wartime project money was shifted to ONR's account to fund research.

The ONR system became the acknowledged model for federal funding of basic research not only for military research agencies but for the National Science Foundation, which won its own legislative charter in 1950, and the National Institutes of Health, which experienced major growth in the later 1950's. But in one major respect these civilian agencies diverged from the model—peer review.

ONR's current director Marvin K. Moss says that the agency has "no mandatory peer review." Because ONR was established to support the Navy's mission, it has a more difficult job than NSF, says Moss. It must support the best science, but also the best science that is relevant to the Navy.

ONR relies heavily on "state-of-the-art scientists to manage the program," says Moss. When a scientific officer, as he is called, joins ONR, he is expected not only to know the field he will be responsible for, but to be active in it, for example, by continuing to publish. ONR gives considerable authority in research selection to its scientific officers, but they work within a system designed to ensure that decisions on research funding meet ONR's dual criteria.

To establish relevance, ONR systematically consults fleet needs documents generated by operating units of the Navy. Also influential are a network of 14 National Academy of Sciences panels, which meet periodically to review the ONR program and make recommendations on opportunities for research in particular disciplines. This is peer review, but in an advisory style.

ONR remains a relatively small operation with about 100 scientific officers at headquarters. The big increase in military R&D funding during the Reagan Administration has not affected the ONR budget dramatically. For the current year, the budget is $365 million. ONR officials say that in terms of current dollars this amounts to less than the agency received in 1965. And because of the impact on costs of the sophistication of research equipment, the budget now may finance only 50% of the research "effort" it did then. ONR also manages $150 million in research projects funded by the Defense Advanced Research Projects Agency and the Strategic Defense Initiative.

The focus of ONR's anniversary symposium was mainly retrospective. ONR-sponsored research has figured prominently in advances in many fields of science and the agency claims credit for backing major developments, for example, in computers, lasers and masers, and deep-diving submersibles. On the program as living testimony were Nobel laureates and sometime ONR grantees Charles H. Townes (Physics, 1964), Kenneth Arrow (Economics, 1972), Leon Cooper (Physics, 1972), and Herbert Simon (Economics, 1978). Also on hand was the Naval Research Laboratory's resident Nobelist, Jerome Karle (Chemistry, 1985). ■ JOHN WALSH

Elections Bring Some Financial Relief for British Scientists

The British government, sensitive to increasing criticism of its parsimony toward both science and higher education, has decided to loosen the purse strings. In his autumn economic statement, delivered in London last week, the Chancellor of the Exchequer, Nigel Lawson, announced that the government's grant to the five research councils financed through the Department of Education and Science will be increased by close to 7%, to a total of $950 million, for the financial year 1987–88.

Previously the government had only been intending to increase the science budget by 2.4%. The new generosity, which comes soon after the publication of two reports claiming that financial stringencies have led to a decline in both the quantity and quality of British science (*Science*, 31 October, p. 538), means that spending on science will increase considerably more than the anticipated inflation rate of 3%.

Lawson also had good news for British universities, announcing that they can expect about $80 million more than they had been anticipating for the financial year that starts next April. There will also be an extra $9 million to cover equipment costs.

The increased spending on research and universities is part of the Conservative government's decision to raise public spending across the board by 1.5% next year. Opposition groups claim that the change in strategy is based primarily on election politics; a general election must be held in 1988.

Nevertheless, the increases have been widely welcomed in the research community, particularly since they come at a time when a dramatic fall in the value of the pound compared to other European currencies has substantially raised Britain's contribution to international scientific projects. Its annual contribution to the European Laboratory for Nuclear Research (CERN) in Geneva alone is expected to be almost $30 million higher than had previously been budgeted, for example. ■

DAVID DICKSON