

THE LABORATORY WITHIN THE UNIVERSITY

By Steven Muller

The Applied Physics Laboratory (APL) of The Johns Hopkins University serves as an illustrative example of a large laboratory sponsored by a military service—the U.S. Navy—that is owned and operated by a major research university. After an examination of how APL functions within Johns Hopkins, the positive side of the relationship is examined. It is found primarily in the combination of national service and research and teaching collaboration with the University's academic divisions. The primary negatives are public controversy and the risks and burdens of the University's obligation. The position of The Johns Hopkins University has been and remains that classified research is not necessarily inconsistent with the purposes of the University and that a major public service is legitimately rendered by the contributions to national defense made by APL to the Navy, within limits set by the University.

The military establishment of the United States contains within itself a substantial number of research laboratories of different sizes and with varied missions. In a few instances, however, laboratories exist that primarily do research for one of the military services or for another federal agency but which are neither owned nor operated by the federal government; instead they are owned and/or operated by major research universities under government contract. These laboratories exhibit considerable continuity of mission and service, and the most obvious question raised by their existence is why the sponsoring military service or other agency finds it useful over time to rely on contracted service from a university-operated laboratory rather than an equivalent in-house facility.

WHY UNIVERSITY LABORATORIES?

For this reliance there appear to be several reasons. One of some significance involves staff compensation. As university employees, staff members of laboratories owned and operated by universities are not confined within government pay scales or bound by the civil service personnel system. Their compensation is subject to review by the sponsor in the course of contract negotiations, but it is essentially determined by the employing university. While such laboratory staff are not normally treated as university faculty and have no tenure, there is no question that their compensation is on the average substantially higher than that of staff employed in government-owned and -operated laboratories. It must

also be assumed that the prestige and good name of the university involved help to retain and attract personnel

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to university-owned laboratories and that some scientists are more willing to work in university-owned laboratories than in government-owned or industrial facilities. This may be particularly the case when effective communication and some sharing of work exist between the sponsored laboratory and faculty and students in related areas of work within the university.

Perhaps the most persuasive reason for government sponsorship of laboratories owned by universities, however, is discovered in the relative independence from government control that is achieved by this arrangement. Such independence means not only that the government sponsor can look to the university to assure the quality of the laboratory's personnel and operations, but that the laboratory's work and status bear the hallmark of independence. University-owned laboratories are free to suggest research to the sponsor that does not originate within the sponsoring agency's own operations, and they are equally free to test and critique research desired by the sponsor concerning which they have reservations. The fact that an independent, university-based research effort is involved in the evolution of the sponsoring agency's work assumes considerable importance with regard to credibility and efficiency. Obviously, university-owned laboratories do not seek to offend their sponsors, and the sponsor must agree to fund the work to be undertaken, but even so, the independence of laboratory from

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sponsor remains significant. This is especially true when research conducted by university-owned laboratories leads to any kind of production. University laboratories may build prototypes but are not themselves engaged in production, which is purchased from commercial vendors by the sponsoring federal agency. University laboratories are, therefore, in a position to set specifications for production, assist the commercial producer in assuring quality control during the production process, and then test the finished product for meeting specifications. All this can be done effectively by the university laboratory as an independent resource employed by the government sponsor.

If these are at least some of the reasons why a military service or other federal agency finds it desirable to sponsor a major laboratory owned and operated by a university, the next question is why a university would wish to undertake such an obligation. Certainly this is not done for profit, which is not permitted under the contracts that govern such arrangements. There is, in fact, only one reason why a university would operate a government-sponsored laboratory with a military mission, and that is simply to provide a service to the nation. The few large laboratories sponsored by the U.S. military establishment and owned and operated by universities in fact had their origins in earlier and simpler times, when the military needs of the nation were not only relatively uncontroversial but even paramount in public perception and when the notion that a university would voluntarily elect to perform this type of public service met with less cynicism—and criticism—than is the case today.

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THE APPLIED PHYSICS LABORATORY

At this point, discussion will focus on the Applied Physics Laboratory (APL) of The Johns Hopkins University, simply because it is the one with which the author is familiar and also because it illustrates most aspects of university-owned laboratories with military missions. APL is principally sponsored by the United States Navy, and its origins go back to World War II. In 1942, there was an urgent need to perfect and develop the proximity fuze. A federal agency called the Office of Scientific Research and Development (OSRD) had been created to mobilize American science and technology in the war effort. Dr. Vannevar Bush, the OSRD chairman, had decided that a central laboratory for the development of the proximity fuze was needed. He called an old

friend, Dr. Isaiah Bowman, then President of The Johns Hopkins University, who answered with eagerness to support national defense. The new laboratory was established under contract with OSRD and under management by Johns Hopkins on 10 March 1942.

The development and deployment of the proximity fuze was successfully and quickly completed, and a major beneficiary was the U.S. fleet. The Navy Bureau of Ordnance had become thoroughly familiar with APL, and in 1945 the Navy asked APL to assist the defense of the fleet by replacing antiaircraft shells with guided missiles. From this request a relationship between the Navy and APL was confirmed that has lasted to this day and that stipulates the defense of the fleet as APL's principal mission.

After the war ended, serious consideration was given by The Johns Hopkins University as to the suitability of continuing its management of APL. In 1947 an arrangement was made with an industrial organization, the Kellogg Corporation of New York, to assume responsibility for engineering and product design and maintenance of staff and facilities, while overall management remained vested in Johns Hopkins. Predictably, this dual arrangement did not work well, and it lasted only a few months. The Navy, APL staff, and Johns Hopkins collectively decided that the preferable course was Johns Hopkins ownership and operation of APL for the indefinite future. On 26 March 1948, six years after the laboratory had been formally established, APL became a full division of the University and has remained in that role ever since. Originally located in Silver Spring, Maryland, APL by the 1950s needed both new facilities and additional space. With funding supplied by the Navy, the University acquired land in Howard County, Maryland—roughly equidistant between Washington, D.C., and the Johns Hopkins Homewood campus in Baltimore—and the Laboratory moved onto these 365 acres. In recent years, APL has been operating with a professional staff of 1600, a total staff of 2800, and annual revenues and expenditures in excess of \$300 million.

APL'S PLACE WITHIN HOPKINS

Prior to a discussion of the advantages and disadvantages to The Johns Hopkins University of owning and operating APL under a Navy contract, a basic understanding is needed of just how APL functions within the University.

As has already been stated, APL has been established as a full division of the University for forty years, since 1948. The other divisions—among them arts and sciences, medicine, and engineering—are academic divisions headed administratively by deans. APL is a nonacademic division headed by a director. At Johns Hopkins, deans are appointed by the University president, customarily in consultation with the relevant faculty. The director of APL is also appointed by the University president, customarily in consultation with the outgoing director. Usually, the outgoing director will consult senior staff colleagues as well as representatives of the Navy before making a recommendation to the University president, but there is

no established process requiring such consultation, and the Navy has no formal voice in the governance or internal operations of the Laboratory. It is worth noting that there have only been five directors of APL—including the incumbent—since its founding in 1942 and that all after the first were selected from within the Laboratory.

Obviously, the major portion of APL's work is classified, and the APL campus therefore is the only campus of The Johns Hopkins University on which classified work is permitted. This does not mean, however, that the whole APL campus is closed. For decades, a major program in continuing studies has been carried on at the Laboratory, and outside visitors freely enter the classrooms and conference facilities, as well the APL Library. Other facilities are restricted to visitors, who must register prior to entry, and, as appropriate, entry is then further restricted to individuals with the required security clearances.

By means of APL, the University makes a major contribution to the quality, effectiveness, and survival capability of the United States Navy, and thereby to the national defense and national interest of the United States.

With respect to governance, APL's operations are under the supervision of the University president, just as is true of the academic divisions. The president and other senior members of the University Central Administration who deal regularly and directly with APL therefore have security clearance for this purpose. There is also a committee of the University Board of Trustees that supervises the work of the Laboratory on behalf of the Board of Trustees as a whole, and security clearance is required for the trustees who serve on this body. The Trustee Committee for the Applied Physics Laboratory customarily meets twice a year—spring and fall—for half a day, and senior representatives of the Navy, both civilian and military, are traditionally invited to attend these meetings, at least in part, as guests—they have no vote but are invited to participate fully in discussion. In addition, there is an Academic Advisory Board to APL, analogous to the regular academic councils or advisory boards of the academic divisions. The University president formally chairs each of the divisional academic councils or advisory boards, and also chairs the APL Advisory Board. In composition and mission, however, the APL Advisory Board differs from its regular academic counterparts. The Laboratory has no professors, so the APL membership of the Advisory Board consists essentially of the director, the assistant directors, major department heads, and other members elected by the Laboratory's principal staff. The non-APL members are the University president, the provost, and faculty representing the academic divisions that have the most interaction with the Laboratory—medicine, arts and sciences, and engineering. The APL Advisory Board also meets only twice a year—the academic councils or advisory boards of the academic divisions meet monthly or even more frequently during the academic year—and

its main focus is on the non-defense-related APL programs that interact with University research and teaching in the academic divisions.

The Johns Hopkins University is uniquely decentralized geographically and administratively. There are three major campuses in Baltimore; the Paul H. Nitze School of Advanced International Studies in Washington, D.C.; the Center for European Studies in Bologna, Italy; the Center for Italian and Renaissance Studies in Florence, Italy; the Hopkins-Nanjing Center for Chinese and American Studies in Nanjing, China; a number of Centers for Continuing Studies in Maryland; and APL. In this context, therefore, the high degree of operational and fiscal autonomy of the Laboratory fits easily into the overall University system. No University dollars flow to the Laboratory. On the other hand, APL, as a full division of the University, participates in the formula funding in support of central university administration to which all divisions are subject on a proportional basis. The University also receives an annual management fee from the Navy for its services, which amounts to \$150,000 per year, having been increased from the earlier annual amount of \$75,000 during the period of high inflation in the 1970s.

A few other financial arrangements with respect to APL need to be mentioned in the interest of full candor and full understanding. The Laboratory itself receives a fee from the Navy as a fixed percentage component of the annual contract. Legally, this money is University money, because APL has no existence separate from being wholly part of The Johns Hopkins University. Indeed, APL's annual fee expenditures are subject to approval by the Board of Trustees. But the basic understanding between the Navy and the University provides that, except for formula contributions to central administration mentioned earlier, fee income is to be spent on the Laboratory itself. Fee income is therefore a principal source of funding for the maintenance and enhancement of the APL physical plant. In addition, the Laboratory annually funds a small number of named research fellowships to enable APL staff to teach and do research in one of the University's academic departments or to enable a University faculty member to conduct research at the Laboratory.

From the standpoint of the Trustees, the administration, and the majority of those associated with The Johns Hopkins University, APL has been and continues to be a major asset of the institution. By means of APL, the University makes a major contribution to the quality, effectiveness, and survival capability of the United States Navy and thereby to the national defense and national interest of the United States. Most individuals connected with Johns Hopkins have almost no familiarity with the technical programs that make so great a contribution to the Navy, but those who are aware share the pride of the Laboratory itself in its significant accomplishments.

The quality and reputation of the Laboratory have been and continue to be consistently high. APL is an impressive place to visit, and contacts with members of the staff reveal an extremely high level of scientific and tech-

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nical competence. At a research university such as Johns Hopkins, lower levels of ability would be readily recognized and would create unavoidable problems. No questions have been raised concerning the fact that APL's technical and scientific performance is at a level of quality fully commensurate with the University's highest standards.

APL'S CONTRIBUTIONS TO THE UNIVERSITY

The most tangible ways in which APL contributes to the University are found in a growing array of collaborative programs with University faculty. The most enduring, varied, and rewarding of these collaborations have been in the area of biomedical programs, involving APL staff and faculty of the G. W. C. Whiting School of Engineering and the School of Medicine. These collaborations have involved cardiovascular research, ophthalmology, neurology, imaging, prosthetic devices, biophysics, and clinical engineering. In general, technology and skills originally applied to defense-related research have been successfully applied to the solution of a whole series of biomedical problems and techniques. It is neither possible nor appropriate here to go into detail, but it is useful to note that nearly two dozen APL staff also hold appointments in the Schools of Engineering and Medicine, and an approximately equivalent number of members of the medical faculty also hold principal staff appointments at APL. Some hundred collaborators from APL, Engineering, and Medicine are working on some forty joint projects, over a hundred instruments have been developed for research and clinical applications, and hundreds of peer-reviewed scientific publications have appeared.

Another set of collaborations evolved from the development in the 1950s of APL's work in space, prompted by the Navy's need for satellite-assisted navigation and ocean mapping. APL's Space Department consequently developed links to the Department of Physics and Astronomy. The decision in the early 1980s to locate the Space Telescope Science Institute, the ground station for the Hubble Space Telescope, at The Johns Hopkins University was, of course, reached for many reasons, but unquestionably APL's record of space research was among them. APL has been involved in a number of non-defense-related space missions and built much of the instrumentation designed and required for the Hopkins Ultra-Violet Telescope, a project of the University's Department of Physics and Astronomy funded by the National Aeronautics and Space Administration.

Substantial joint work also goes on between APL staff and members of the faculty of the Whiting School of Engineering. The largest collaboration, however, involves

APL's participation in the continuing education programs of the Engineering School. At Johns Hopkins, the bulk of continuing education is carried on at the graduate level, and one of the largest centers of continuing education in engineering is located at APL, with annual enrollments of over 2000 students. Formally, this is an activity of the Whiting School of Engineering, but the majority of those serving as faculty for the programs located at APL are APL staff, who thus have the opportunity to teach. On the one hand, APL's location away from the Homewood campus headquarters of the Engineering School is a major advantage, enabling the educational program at APL to attract a geographic population substantially removed from the Baltimore area. On the other hand, a microwave relay network links several of the Johns Hopkins campuses, and two interactive computerized classrooms—sharing simultaneous sound and sight—make it possible for a single instructor to teach a single class in two remote settings—in this case, at APL and Homewood.

A variety of other interdisciplinary APL-University faculty interactions exists in other fields as well, including applied mathematics, environmental protection, oceanography, transportation, energy, and fire-related studies. Over the last two decades, the volume of these interactions has continued to increase, and the participation of APL in the rest of the University, and vice versa, has become ever more substantial. While the single Navy contract remains both the core and bulk of the Laboratory's annual funding, non-defense-related smaller contracts or grants from agencies such as the National Aeronautics and Space Administration, the Department of Energy, the National Institutes of Health, and departments of the State of Maryland now represent somewhere between 10 and 18 percent of APL's annual work load. Overall, then, APL is in these many—and a few lesser—ways a major asset of The Johns Hopkins University. In the circles that are most closely familiar with its work, it clearly contributes favorably to the University's reputation. Also, it has now been part of Johns Hopkins for decades and is therefore accepted as part of the University in a far easier manner than would be the case were it of only recent origin. For alumni and friends of Johns Hopkins who have an interest in national security, or at least respect the University's contribution to national defense, APL is a showpiece and an attraction.

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THE NEGATIVE SIDE

The other side of that coin is that APL is also a source of controversy within Johns Hopkins, among faculty, alumni, and friends, and in the public arena. At the most thoughtful level, there continues to be debate as to whether a university committed to freedom of teaching

and research can and should legitimately own and operate a laboratory most of whose work requires secrecy.

At another level, APL is, of course, perceived as part of the nation's military-industrial complex, and its work on the defense of the nuclear subsurface as well as the surface fleet—in addition to its work on the guidance systems of missiles capable of bearing nuclear warheads—links it directly to the nuclear threat. At this level, the principal argument is that University operation of APL is an immoral act, life threatening and evil especially insofar as it contributes directly to the possibility of nuclear warfare. Anti-nuclear activists have made the Laboratory a regular target of protest over many years, both at APL's campus and at other Johns Hopkins campuses and in public settings. When protest of this kind involves trespass and/or damage to property, as happens with some frequency, the resultant arrests and court proceedings receive wide publicity and the University is pilloried. At present, some of the University's adherents of Physicians for Social Responsibility and a more aggressive organization called the Committee for the Conversion—of APL to peaceful purposes—have played leading roles in public debate and protests directed against the Laboratory and the University's responsibility for its work.

Obviously, the most intense controversy surrounding APL arose during the period of the Vietnam War, particularly in the late 1960s and continuing into the early 1970s. This was the time when several other universities that had been operating defense-related laboratories under contract disengaged from these operations. While there was vigorous protest at Johns Hopkins as well, the trustees and administration reaffirmed the University's intention to continue the APL mission and ownership and operation of the Laboratory.

More recently, APL accepted significant specific research tasks requested by the Strategic Defense Initiative Office and has been publicly identified as a significant Strategic Defense Initiative contractor. Predictably, the decision to engage in this work—which involves fundamental scientific and technical problems of great interest, but whose details are classified and therefore cannot be made public at this time—represented an additional factor in the sporadically recurrent protests concerning the Laboratory.

On the one hand, opposition to APL has consistently remained at a relatively low level and cannot to date be characterized as a major problem of the University. On the other hand, it cannot be dismissed as trivial. While there is literally no evidence that members of the faculty or students have either selected Johns Hopkins or have failed to select or have separated from the University because of APL, it is clear that a minority of alumni and other potential donors are withholding support because of their opposition to the Laboratory. Over the long run, a great deal of time and energy on the part of University Central Administration as well as on the part of the APL leadership is devoted to responding to queries and challenges to the Laboratory's presence at Johns Hopkins and its work. The University President's Office has been vandalized at least once as part of a protest against

APL, demonstrators have appeared at private residences off campus as well as on campus, and critical comment continues to appear occasionally in the public information media.

There are some other negatives for the University with respect to APL which are not publicly controversial. A huge responsibility and significant risk attach to the ownership and operation of such a large and complex laboratory plant and staff. APL's funding under the contract is annual, which means that legally there are no guarantees as to its future. A sudden decision by the Navy to terminate its relationship with APL would present an enormous problem. As a hedge against such an unforeseen but not impossible development, the contract has allowed for the establishment of a multi-million-dollar stabilization and contingency reserve, whose accumulated capital mostly serves as a working capital reserve for the Laboratory but would, of course, be fully replenished were the contract to be terminated. Even so, however, the disestablishment of APL would not be easy, and the conversion of all of the facilities and persons involved to other purposes, absent the Navy contract, does not appear to be possible.

The contract itself presents all of the difficulties associated with the need for annual renewal and funding. Negotiations with the Navy at both the uniformed and civilian levels of administration, and concern with Congressional attitudes and initiatives, have become virtually a year-round preoccupation, not only of APL leadership but of relevant personnel in University Central Administration as well. There are also all of the normal problems of audits, personnel administration, litigation, and so on. Above all, however, is the University's full responsibility for the scope, nature, and quality of the Laboratory's work.

The Johns Hopkins position with respect to APL is unambiguous. Operation of the Laboratory is a national service that remains a valid mission of the University as long as the mission is clear and the service remains necessary.

THE UNIVERSITY'S POSITION

The subject of the University's responsibility prompts some conclusions and reflections on APL as part of The Johns Hopkins University that may or may not apply at other universities with analogous laboratories but that do appear to be valid for this particular case. The Johns Hopkins position with respect to APL is unambiguous. Operation of the Laboratory is a national service that remains a valid mission of the University as long as the mission is clear and the service remains necessary; as long as the quality of service performed remains at the highest possible levels of scientific and technical excellence; as long as the University's authority over the Laboratory remains absolute; and as long as the means are furnished to do the job to be done with the needed resources.

Secret work is not acceptable as part of the University's academic divisions. On a separate campus, however,

it is no less acceptable than the long-established acceptability of professors' obtaining clearance to participate in classified activities—or than the proprietary secrecy of commercial corporations—away from the academic campus. The military needs of the nation are as much a part of the national interest as non-defense-related concerns. University contributions to national defense are traditional in times of need and can range all the way from the operation of Reserve Officers Training Corps programs to the ownership and operation of laboratories.

Not all military research needs, however, are equal in terms of suitability for university involvement. Aside from the question as to whether a university can make a unique and irreplaceable contribution by operating a laboratory, the university must also be able to choose and limit the work to be done. Defense-related work should not conflict with the university's academic programs. There was, for instance, a case, in years past and not at Johns Hopkins, in which a university laboratory under military contract covertly offered counterinsurgency training to nationals of certain Southeast Asian countries, to the embarrassment of the academic community involved in that university's program of Southeast Asian studies. A university will regard certain kinds of defense-related research as unacceptable. Johns Hopkins, for example, will not involve itself in the development of chemical or biological weaponry. A university also has the responsibility to facilitate and encourage the availability of scientific and technological innovation developed as part of defense-related research to non-defense-related science and technology.

APL's mission remains focused on the defense of surface and subsurface vessels of the United States Navy. Not only is this clear as an overall context, but the specif-

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ic activities of the Laboratory are carefully defined and reviewed within APL and by University administration and trustees on a continuing basis. APL has been asked but has refused—and would not be permitted by the University to accept—wholly black contracts, that is, commitments to conduct work, knowledge of which would be limited only to those directly involved and would exclude officers of the University with responsibility for the Laboratory. The degree of comfort with APL at The Johns Hopkins University rests above all on the fact that the nature of the work done is fully known to the University's leadership, which therefore can and does take responsibility on an informed basis.

Johns Hopkins has been fortunate that APL has had directorship of exceptional competence throughout its existence and that the quality and morale of the Laboratory's professional staff also have been consistently very high. The degree of integration of APL into the University and the expanding interaction between Laboratory staff and University faculty represent another boon,

among other things reinforcing faculty respect for APL's level of effort and performance. The basic contract, with all the occasional difficulties attached to it, has nevertheless proven to be an effective and—relatively!—simple administrative mechanism. And obviously what will soon be five decades of successful and productive existence represents an experience capable of generating momentum and respect of its own.

Were there no such history and no APL, would The Johns Hopkins University today agree de novo to undertake responsibility for an analogous effort in support of the national defense? The answer is, of course, doubtful, but if the University could be assured that its services were urgently needed and that the experience would be as positive as the APL experience has been at Johns Hopkins, the response very likely would be affirmative.

THE AUTHOR



STEVEN MULLER became the tenth President of The Johns Hopkins University on 1 February 1972. Between 1972 and 1983, Dr. Muller also served as President of The Johns Hopkins Hospital. Currently, he is Chairman of the Trustee Policy Committee for The Johns Hopkins Institutions, and he remains a Trustee of the Hospital.

In addition to his duties at Johns Hopkins, Dr. Muller is also a Director of the Baltimore Museum of Art; Beneficial Corporation; Alex. Brown, Inc.; CSX, Inc.; Maryland Academy of Sciences; Millipore Corp.; and Organization Resources

Counselors, Inc. He is a member and former Chairman of the Association of American Universities, a member of the Committee for Economic Development and the Conference Board, a Trustee of the German Marshall Fund of the United States and the Consortium for the Advancement of Private Higher Education, and a Director of the American Institute for Contemporary German Studies. Dr. Muller is also a member of the American Association of Rhodes Scholars, Phi Beta Kappa, the Council on Foreign Relations, and the International Institute for Strategic Studies. He is a member of the Board of Editors of *Daedalus* and a Fellow of the American Academy of Arts and Sciences.

Dr. Muller is a specialist in comparative government and international relations, particularly concerned with political developments in Europe. He is the author of a textbook in comparative government and of a number of professional articles in this field. In recognition of his contributions to German-American relations, Dr. Muller was awarded in 1980 the Commander's Cross of the Order of Merit by the President of the Federal Republic of Germany. In addition, in 1988 he was named Commendatore of the Order of Merit by the President of the Republic of Italy.

Dr. Muller was born in Hamburg, Germany. He first came to the United States in 1940 and has been a naturalized citizen since 1949. He graduated from the University of California at Los Angeles in 1948. From 1949 to 1951, he was a Rhodes Scholar at Oxford University in England, where he received the B.Litt. degree in politics in 1951. He first went to Cornell University in 1951 as a graduate student in the Department of Government and received his Ph.D. in 1958. He served in the U.S. Army Signal Corps from 1953 to 1955.