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TECHNOLOGY TRANSFER IN THE NAVY
THE HISTORICAL BACKGROUND

by

David Kite Allison

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SUPPORT AND ADMINISTRATIVE SERVICES DEPARTMENT
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September 1982 DTNSRDC 82/001

TECHNOLOGY TRANSFER IN THE NAVY- THE HISTORICAL BACKGROUND

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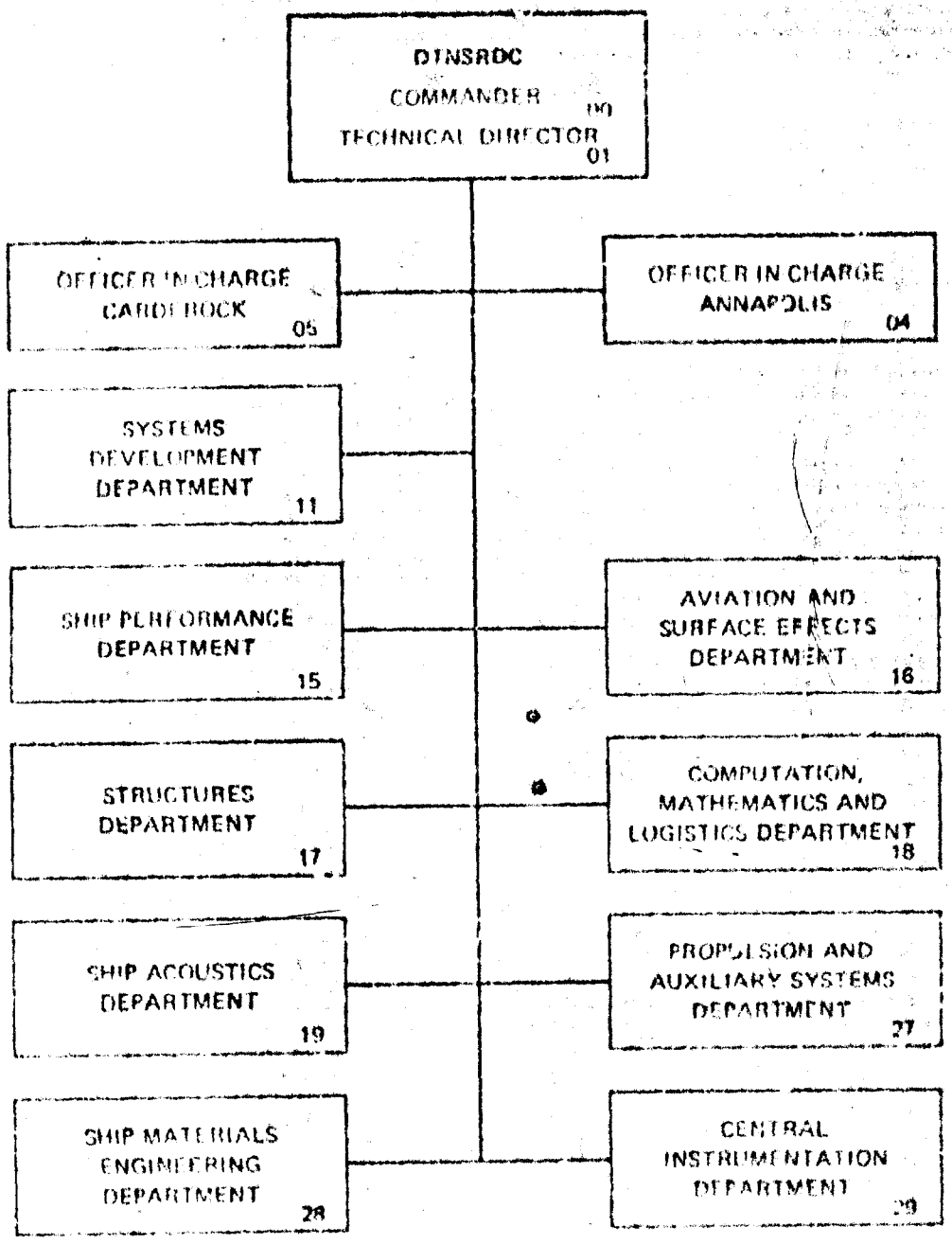

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TABLE OF CONTENTS

Page

ABSTRACT.....1

ADMINISTRATIVE INFORMATION.....1

INTRODUCTION.....1

DEFINITIONS.....2

PASSIVE TECHNOLOGY TRANSFER.....4

MILITARY INDUSTRIAL TRANSFER.....5

THE STEVENSON-WYDLER ACT AND ACTIVE TECHNOLOGY TRANSFER.....8

NASA'S TECHNOLOGY TRANSFER PROGRAM.....10

THE FEDERAL LABORATORY CONSORTIUM.....12

IMPLEMENTATION OF THE STEVENSON-WYDLER ACT.....14

CONCLUSION.....16

REFERENCES.....17

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ADMINISTRATIVE INFORMATION

This work was performed for the Laboratory Operations Division, Headquarters, Naval Material Command, Program Element 65681N, Task Area Z0832, DTNSRDC Work Unit 5040-001. The NAVMAT cognizant program manager is Howard V. Law, MAT 051.

INTRODUCTION

The Stevenson-Wydler Technology Innovation Act of 1980 focused new attention on the subject of technology transfer. Among many other provisions, the law requires increased emphasis on improving the transfer of knowledge and other resources of the Federal laboratories to State and local governments and to private industry. To explain the reasons for this legislation, Congress reported a number of findings. Those of particular significance to technology transfer were:

> Many new discoveries and advances in science occur in universities and Federal laboratories, while the application of this new knowledge to commercial and useful public purposes depends largely upon actions by business and labor. Cooperation among academia, Federal laboratories, labor, and industry, in such forms as technology transfer, personnel exchange, joint research projects, and others, should be renewed, expanded, and strengthened....
>
> No comprehensive national policy exits to enhance technological innovation for commerical and public purposes. There is a need for such a policy, including a strong national policy supporting domestic technology transfer and utilization of the science and technology resources of the Federal Government.
>
> It is in the national interest to promote the adaptation of technological innovations to State and local government uses. Technological innovations can improve services, reduce their costs, and increase productivity in State and local governments. The Federal laboratories and other performers of federally funded research and development frequently provide scientific and technological developments of potential use to State and local governments and private industry. These developments should be made accessible to those governments and industry. There is a need to provide means of access and to give adequate personnel and funding support to these means.[1*]

To a certain extent, the remedies that the Congress proposed were merely further movement along a traditional path - dissemination of Federal resources to the private sector and local governments. However, the law also contained a number of new initiatives designed to make significant changes in the operations of Federal laboratories.

This report will examine sections of the new legislation in the context of a general review of the subject of technology transfer to which they relate. Analysis of the background to the legislation should help those involved in implementing it to act reasonably and responsively.

DEFINITIONS

The meaning of the phrase "technology transfer" is ambiguous. Indeed, the emergence of technology transfer as a topic of major policy deliberation during the last several years has made its meaning even less clear than it was several decades ago. Useful distinctions can be drawn, however, between current areas of meaning. In one context, the phrase denotes the transfer from one location, often one nation, to another of technical knowledge or technical devices that then will be used for essentially the same purpose in the new location as in the old. The transfer of oil refining capabilities

*A complete listing of references begins on page 17.

from the United States to Iran is one example. Technology transfer in this sense is an important national concern, but the subject is outside the compass of this report and will not be discussed further.

In another context, "technology transfer" is used to denote the adaptation of technical knowledge or information from its original purpose to another purpose in a different institutional setting.[2] An example is the adaptation of radar initially designed for military use for application in civilian airport traffic control. This meaning of the phrase is intended in the Stevenson-Wydler Act,[3] and it is this meaning that will be intended exclusively in the following discussion.

Within this second area of meaning, a useful differentiation has been made between "passive" transfer and "active" transfer. As defined in a study made by the General Accounting Office in 1972,[4] passive technology transfer means "collecting, screening, indexing, storing, and disseminating scientific and technical information upon request of a potential user," whereas active transfer involves "certain elements of passive methods supplemented by personal liaison between technology developers and potential users." The principal distinction between passive and active transfer, then, is the role of the developer of the technology. If the developer only provides information and documentation, the transfer is passive. If the developer actually aids in the process of transformation, then it is active.

Closely linked to active technology transfer is an activity more appropriately termed "technology assistance." This means sharing of technical resources, such as skilled manpower or facilities, by one organization with another, for example, the Federal Government sharing its resources with State and local governments. The distinguishing feature is that the emphasis is on simple sharing of resources rather than on adaptation of existing knowledge or expertise. Technology assistance is almost inevitably part of any active technology transfer program. Individuals do not cease their activities because some "new" development has to be conducted to supplement the merely "adaptive" development. Indeed, it is often difficult to make the distinction. The Stevenson-Wydler Act clearly requires Federal laboratories to be engaged in both sorts of activities. They are charged "... to cooperate with and assist...other organizations which link the research and development resources of that laboratory and the Federal Government as a whole to potential users in State and local governments and private industry; and to provide technical assistance in response to requests from State and local government officials."[5]

The most characteristic feature in the history of Department of Defense (DoD) policy on technology transfer, and Navy policy within it, is the shifting of emphasis on, and balance between passive and active technology transfer programs. The emergence of the current relationship will be the principal theme of what follows.

PASSIVE TECHNOLOGY TRANSFER

Since World War II, when research and development became a major activity of the Department of Defense, the largest programmatic efforts related to technology transfer have been in the area of passive transfer. In order to ensure adequate and appropriate dissemination of recorded knowledge and experience, DoD has a formal Scientific and Technical Information Program. Fundamental policy on the program is currently found in DoD Directive 5100.36 of October 2, 1981. It states:

> The Department of Defense shall pursue a coordinated, comprehensive Scientific and Technical Information Program (STIP) to ensure that scientific and technical information (STI) provides maximum contribution to the advancement of science and technology; permits timely, effective, and efficient conduct and management of DoD research, engineering, and studies programs; and eliminates unnecessary duplication of effort and resources by encouraging and expediting the interchange and use of STI. The STIP shall provide for interchange of STI within and among DoD Components and their contractors, federal agencies, their contractors, and the national and international scientific and technical community...

Moreover, the directive specifies that,

> Every effort shall be made, within the limits of national security requirements, to prepare technical documents and other types of defense STI in an unclassified form and, in accordance with established clearance procedures, to provide such information for public use through appropriate federal agencies. Such use of unclassified STI or of unclassified versions of defense STI shall expedite information transfer both within the Department of Defense and to the national scientific and technical community.

The head of the Defense Scientific and Technical Information Program is the Under Secretary of Defense for Research and Engineering. The major repository for Defense technical information is the Defense Technical Information Center (DTIC). It began in 1945 as the Air Documents Research Center with the mission of processing, storing, and disseminating aeronautical documents captured from the Germans and Japanese. After several changes over the years, it was reorganized in 1951 and given the broad responsibility of providing an integrated program of scientific and technical report services for DoD and its contractors. Currently, DTIC's mission is to "provide centralized operation of DoD services for the acquisition, storage, retrieval, and dissemination of Scientific and Technical Information to support DoD research, development, and engineering and studies programs."[6]

Although the principal goal of the Defense Scientific and Technical Information Program is to meet the information needs of DoD components, DoD contrac-

tors, and potential contractors, DoD policy on dissemination explicitly states that

> ... within the limits of security and access, restrictions necessary to ensure adequate intra-DoD technical information exchange, heads of DoD components shall (1) vigorously pursue a policy that ensures that technical information generated within activies under their cognizance is provided for public use through appropriate Federal agencies and technology transfer programs according to approved DoD clearance procedure; and (2) whenever possible, provide unclassified technical documents and other information to expedite the information transfer procedures.[7]

In addition to providing technical information to potential users through DTIC, the Department of Defense provides reports and other information, such as data on patents, for dissemination by the National Technical Information Service (NTIS). An agency of the Department of Commerce, NTIS is the central source for the public sale of U.S. Government-sponsored research, development, and engineering reports. Its services are available to business, educators, government, and the public at large.[8] Like DTIC, NTIS dates its origin to the immediate post-World War II period. It began in 1946 as the Publication Board, established by President Truman to declassify and disseminate Government research that had been withheld during the war. It then evolved into the Clearinghouse for Federal Scientific and Technical Information, and finally, in 1970, became the National Technical Information Service.

As is specified in DoD directive 5100.36, the DoD Scientific and Technical Information Program is generally decentralized, and the activities of NTIS and DTIC are supplemented by those of the individual services. Publication in scientific and technical journals and presentations to technical meetings are two substantial efforts. All three services also operate industry information centers with offices located in several places around the country. The DoD technical libraries regularly respond to requests for particular reports or other types of information, and DoD issues numerous special publications. One important example in the area of technology transfer is the "Navy Technology Transfer Factsheet," a monthly publication that began in 1976 and is widely distributed to potential users of Navy technology in business and industry.

In the future, the extensive, decentralized scientific and technical information program will undoubtedly remain the major DoD effort for technology transfer. What is now in question is the way it should be linked to other related programs.

MILITARY INDUSTRIAL TRANSFER

Somewhere in between passive and active technology transfer programs is the method of technology transfer that occurs through the normal operations of private industry, particularly through companies that are defense contractors. These contractors develop extensive internal knowledge and expertise, and build large technical facilites at government expense. The primary use

of these resources, certainly, is to meet the requirements of defense contracts. But corporations obtain a secondary use by transferring personnel and resources to work on products for other markets. The possibility of such transfer is one of the attractions for corporations to enter and stay in the volatile and often unprofitable defense market. In a recent major study of the defense industry, Jacques Gansler commented:

> For military reasons, much of the technology being explored in defense R&D is on the very leading edge. Because of the high technical risk and the large expenditures required, the government tends to pay for all military R&D work - usually on a cost-reimbursement basis. Thus, there is the opportunity for firms to take part in this work with essentially no risk. The federal government makes defense R&D even more attractive by allowing a firm to retain patent rights for any potenial civilian work, while the government retains only the rights for government use. This has the desirable feature of encouraging transfer of government-sponsored R&D into the civilian sector. The advanced nature, the large dollar value, and the low risk of defense R&D are often cited as major inducements for firms to show interest in defense business.[9]

The mechanism of transferring defense technology to other uses through the activities of defense contractors has probably been the most effective technology transfer mechanism of all. The General Accounting Office, in its study of 1972 on "Means for Increasing the Use of Defense Technology for Urgent Public Problems," stated,

> Applications of defense technology to the civilian sector are well known. In electronics, defense research has helped develop radar, communication, navigation[. Satellite] mapping and weather observations [also] grew out of defense-sponsored research. Progress in commercial aviation is directly linked to defense leadership in developing new engines, fuels, and inertial navigation systems. Medical contributions include a potential vaccine for meningitis and the use of the laser in distended eye retina surgery. Infrared sensor technology has been adapted for detecting fires in mines and forests.
>
> Most of these applications of defense technology resulted from spin-offs by the private sector, primarily DOD industrial contractors that were aware of the technology and the market potential and motivated by profit. In such an environment, industry plays a significant role in technology transfer.[10]

The point was also emphasized by Dr. George Millburn, Technical Assistant to the Deputy Under Secretary of Defense for Research and Advanced Technology. Reporting to the House Subcommittee on Science, Research, and Technology during hearings on the role of Federal Laboratories in technology transfer, he stated,

> As a mission agency, our prime objective is the national defense. We realize, however, that research and development conducted and sponsored by the DoD has over the years resulted in very significant transfer of technology to the domestic sector. The DoD has long recognized that technology and products originally developed for military use also have potential for application in the U.S. domestic sector. Technology transfer to the private sector has been particularly successful because about 75 percent of the Department's total research and development and practically all production is performed by a broad base of university and industrial organizations. This assures that the results of DoD programs are in the commercial domain which is best equipped for adapting technology and products to meaningful civil uses. The process is further enhanced because the in-house/university/industry development efforts span a spectrum of activity ranging from new concepts to useful end products. This team effort has worked over a number of years and permits greater and wider use of the Department's developed or sponsored research and development.[11]

In concluding his report, Dr. Millburn said,

> Although research and development undertaken by the Department is conducted for Defense purposes, much of it ultimately appears as products and services in the private sector. Our technology work in integrated circuits, computer systems, jet propulsion, aerodynamics, body armor, lasers and communications are typical examples. The motivating force behind these successful transfers has been the industrial sector through their product engineering, promotion and marketing with their commercial constituencies. It is our view that this route is by far the most effective way for systematic and substantial transfer of technology from our laboratories. We would encourage the Committee in its search for better policies to focus on this route as a means of enhancing the use of Federally developed technology by state and local governments.[12]

The basic reasons for the success of technology transfer through industrial contractors involved in both defense and nondefense work are easy to discern. The contractors are attuned to civilian market economics and consumer demands. They know what is needed and what will sell. They have the technical infrastructure necessary to understand, adapt, and utilize defense technology. Due to the sophistication of most ongoing defense R&D, and the fact that it tends to be quality-oriented or performance-oriented rather than cost-oriented, this infrastructure is particulary important. Finally, contractors have the means to produce new developments that they have made and get them into the marketplace.

Surprisingly, little consideration has been given to the procedures that industry uses to get additional pay-off from its defense work. In formulating

policies for active technology transfer, neither the Congress nor the Department of Defense itself has followed the suggestions of Dr. Millburn in the quotation above. A "Project Hindsight"[13] to examine the significant cases of technology transfer that have been made through industry and how they occurred would undoubtedly produce some very interesting and useful results. It would indicate whether industrial transfer is more prevalent in larger or smaller firms and the degree to which the effective transfer of ideas depends on the transfer of the people who developed them. It would also show the fields in which transfer has been most prevalent. Understanding the dynamics of military industrial transfer would be a major step in understanding the dynamics of technology transfer as a whole.

THE STEVENSON-WYDLER ACT AND ACTIVE TECHNOLOGY TRANSFER

The Stevenson-Wydler Act was passed because Congress believed the Government was not doing enough to promote technological innovation for the achievement of national economic, environmental, and social goals. The stated purpose of the bill was five-fold: (1) to establish organizations in the Executive Branch, especially the Department of Commerce, to study and stimulate technology; (2) to promote technology development through the establishment of centers for industrial technology; (3) to stimulate improved utilization of federally funded technology development by State and local governments and the private sector; (4) to provide encouragement for the development of technology through the recognition of individuals and companies which have made outstanding contributions in technology; and (5) to encourage the exchange of scientific and technical personnel among academia, industry, and Federal laboratories.[14]

Clearly, Congress believed that extenive active technology transfer efforts had to be introduced to supplement existing programs. Initiatives should be made to increase payoffs from Federal science and technology for State and local governments in fields such as health care, transportation, housing, law enforcement, food production, and others of direct social relevance to large numbers of citizens.

The major changes required by the bill were to be in the Department of Commerce, where an Office of Industrial Technology was to be established to monitor technical development throughout the Nation and the world, assess national technological needs, and determine means whereby Government action could advance U.S. technological innovation. But the law also mandated changes in all Federal laboratories. Each laboratory was required to establish an Office of Research and Technology Applications to asses laboratory research and development projects, disseminate relevant information, and actively assist in the process of technology transfer. In laboratories whose annual budgets were greater than $20 million, at least one full-time staff member had to be assigned to the office. Furthermore the agencies that operated laboratories were required to fund technology transfer activities, including the Offices of Research and Technology Applications, at levels of at least 0.5 percent of the Agency's total research and development budget.

The rationale for these provisions was set forth most clearly in a House Committee report on the legislation that recommended passage by the full House. The report stated:

> It is generally recognized that there is a need to improve the productive capacity of the nation's Federal laboratories by utilizing them more fully, not only as R.&D. centers for the Federal mission agencies, but also as national resources - resources that State and local governments, as well as the private sector, can turn to for sound scientific and technological know-how.
>
> One very promising approach to increasing the effective utilization of the Federal laboratories is the establishment of active technology transfer programs throughout the Federal laboratory system. However, a strong national policy concerning technology transfer in the Federal Government has not been developed. This lack of a national policy has prevented the institutionalization of the process and reduced the effectiveness of attempts, by many of the Federal laboratories, to provide technical assistance to help solve the problems of the public and the private sector.[15]

What led Congress to adopt this point of view? In the years following World War II, it had been fully convinced of the value of liberal support for large-scale research and development efforts. Recommendations for increasing virtually all forms of research in the physical sciences were favorably received, and strong legislative action was taken. In 1946, the Office of Naval Research was formed, and in 1950, the National Science Foundation. Laboratories within the Department of Defense and other Federal Agencies were expanded and strengthened. In 1958, the National Aeronautics and Space Administration (NASA) came into being.

In more recent years, however, the Congress has been more critical of the value of the types of science and technology it supports. This point of view was evident in a background study that the House Subcommittee on Science, Research, and Technology prepared in 1978 entitled "Domestic Technology Transfer: Issues and Options."[16] The purpose of the report was to stimulate new policy action by the Congress. The study reviewed prevailing theories of technology transfer, existing Federal programs, and previous attempts at Federal legislation. Its central theme was clear in the opening passages:

> Since World War II, the national investment in R&D has... been increased substantially. The Nation has been willing to support more R&D on a growing diversity of topics, but more is now being expected from the R&D enterprise. Thus, as the era of the 1980's emerges, and especially because of the realization of a limited resource base, there has been a gradual concern that scientific efforts be more effectively targeted on national

programs, which are explicit attempts to apply R&D knowledge to existing societal needs.[17]

Congressional ideas on the increased role that Federal laboratories in particular should play in domestic technology transfer came from a series of hearings the Subcommittee held on that subject in June and July of 1979. Witness after witness argued that the potential for increased technology transfer was great, but that formal policy requiring active technology transfer was inadequate, that current funding was too meager, and that present administrative arrangements within laboratories were inadequate. Mr. George Linsteadt, Chairman of the Federal Laboratory Consortium, summed up the preaviling situation of active technology transfer programs in the Department of Defense in this way,

> Currently there is no legislation that asks or tells all of the Federal agencies to be involved in technology transfer. Maybe this is implicit, but they are not accountable to anybody to do this. The only department that really does secondary utilization that has enabling legislation is NASA. The Department of Defense does not have any kind of legislation that says it will do this. They have a memorandum that states that if the departments within the Defense [Department] would like to do technology transfer, they may. And that is the total sum of a technology transfer policy, although they recognize [the Federal Laboratory Consortium], and to them that is their active technology transfer mechanism.[18]

From the hearings, the Congressmen drew several major conclusions. First, new policy mandating active technology transfer programs in Federal laboratories and increased funding for them was necessary if they were to increase and improve. Second, the efforts of several existing government programs, in particular Technology Transfer Division of NASA and the Federal Laboratory Consortium, should be used as the models to be studied and followed in developing that policy.[19]

Because of the importance of the NASA program and the Federal Laboratory Consortium to Congressional policy making, both will be examined in some detail below.

NASA'S TECHNOLOGY TRANSFER PROGRAM

The technology transfer program at NASA has often been cited as a model for active technology transfer,[2,4] and among the technical agencies of the Government, NASA has unquestionably been the leader. Contrary to what witnesses told the House Subcommittee on Science, Research, and Technology, however, NASA's policy has not been due to requirements of Federal law. The legislative basis for NASA's active technology transfer program is a simple passage of the 1958 National Aeronautics and Space Act (Set 203(a)(3)) that states, " [The Administrator of NASA shall] provide the widest possible, practical, and

appropriate dissemination of information concerning its activities and the results thereof.[20]

This quite obviously did not require a major, active transfer effort. The real origin of the active program was NASA management initiative. Samuel Doctors, in his well-known treatise," The Role of Federal Agencies in Technology Transfer," offered this explanation:

> NASA [was] the first major science procurement agency to establish an agency-wide program to promote the transfer and aplication of its area of technology outside its own institutional setting.
>
> This program was not established as an agency focal point for scientific and technical transfer, but to justify, in part, large NASA expenditures. When little tangible spin-off was found to have occurred automatically, it was hoped that an expanded [Technology Utilization] Program would not only measure spin-off but also promote secondary usage....
>
> The earliest group formed to implement the dissemination mandate of the Space Act was the Office of Technical Information and Educational Programs formed in May 1960....An action transfer program was not initiated until June 1962 when Morton Stoller was placed in change of what later grew into the Technology Utilization Program. In August 1962, an Industrial Applications Advisory Committee (IAAC) was established ...[and] in April 1963, the Technology Utilization and Policy Planning Group was officially established....This flurry of activity... appears to be directly related to increasing concern over the very low contractor reporting rates and public criticism.[21]

In other words, NASA was afraid that if it did not prove that spin-off resulted from its activities, it would lose support and might not survive as public enthusiasm for space exploration waned.

This understanding of the origin of NASA's active technology transfer program is not a commentary on its value. Indeed, it should be said that Congress, even though it has not provided guiding policy for the program, has continually endorsed it by providing funds for its operation over the years. What the explanation does provide, however, is illumination of one of the main reasons why NASA has been a much stronger proponent than DoD of active technology transfer.

The Technology Transfer Division in the Office of Space and Terrestrial Applications is in charge of technology transfer at NASA.[22] Currently its effort is divided into two major programs: (1) technology utilization, which is concerned with technology dissemination and with secondary, nonaerospace-related applications of inventions and technology innovation, and (2) satellite remote sensing transfer, which seeks to develop the capabilities of a wide

variety of organizations, including State and local governments, to use space-acquired data.

The Technology Utilization Program is a large-scale effort (for fiscal 1981, Congress authorized expenditives of 12.6 million dollars for this program alone[23]) that encompases a number of elements. First, it includes passive transfer through publications, principally the quarterly "Tech Briefs," which are distributed to subscribers (currently approximately 48,000) at no cost. The subscribers include not only industrial concerns, but also public libraries and State and local engineers. Second, the program has six "applications teams" composed of multidisciplinary groups of non-NASA technologists who identify public sector problems and provide technology matching and problem solving assistance. Three of the teams work in the area of biomedicine, one in transportation, one in manufacturing, and one in support of State and local governments. Third, NASA has seven regional Industrial Applications Centers, located at university campuses throughout the nation, to provide information retrieval services and technical assistance to industrial clients. Two state Technology Applications Centers were started in Kentucky and Florida in 1977 to extend this concept to provide technology assistance to public and private clients in these jurisdictions. Fourth, a NASA Computer Software Management and Information Center at the University of Georgia collects, screens, and stores computer programs developed by NASA and other government agencies and makes them available to users at low cost. Finally, NASA establishes special Applications Engineering Projects to direct NASA technical expertise toward solving specific needs of other government agencies and public sector institutions.

The Remote Sensor Applications Program is designed to transfer to State and local governments, as well as other users the ability to use data from the NASA LANDSAT program for resource management and planning decisions. The emphasis is on disseminating applications that have been previously developed, demonstrated, and validated by NASA R&D. The transfer is assisted by project offices in three NASA field centers.

Well-funded and supported, the NASA Technology Transfer Program appears to have earned a secure place in the agency. It also appears to be meeting, to the satisfaction of agency officials, its two major goals: transferring space technology to terrestrial applications and maintaining support for NASA.

THE FEDERAL LABORATORY CONSORTIUM

The Federal Laboratory Consortium is a much more loosely organized effort than NASA's Technology Transfer Program.[24] The Consortium traces its origin to a meeting in July, 1971, when, at the suggestion of the Special Assistant to the Deputy Director for Research and Advanced Technology of the Department of Defense, representatives from 11 DoD laboratories met informally to discuss how they could coordinate their efforts to transfer military-related technologies to the civilian sector. This led to a Technology Transfer Laboratory Consortium, which was authorized by a policy memorandum issued by the Deputy Secretary of

Defense in June, 1972. Representatives of Navy Laboratories were leaders of this effort.

In 1974, the DoD program was expanded to include other Federal laboratories, and renamed the Federal Laboratory Consortium for Technology Transfer. In addition, support was obtained from the National Science Foundation to coordinate the activities of the Consortium. By 1978, approximately 185 laboratories and research centers were participating. Special project funding was coming from the National Science Foundation, the Navy, the Army, and NASA, in addition to the salaries of individual participants, which were paid by their laboratories. The sums involved were small, however, when compared to the multimillion dollar program of NASA.

The principal objective of the Consortium is to provide the environment, operational structure, and necessary technology transfer mechanism required to facilitate the fullest possible utilization of Federally sponsored R&D. Emphasis is placed on active liaison between laboratory representatives and users in State and local governments and the private sector. All attempts are made to keep costs for users low. When requisite technology exists, knowledge of it is provided cost free, and when modifications are required, charges are assessed on a simple cost-reimbursable basis. The Intergovernmental Personnel Act is frequently used to assign laboratory personnel to work in other governmental units. The Naval Research Laboratory, for example, has assigned one of its employees to work as a technology "circuit rider" to aid several local governments in the Washington D.C. area. The Intergovernmental Personnel Act can also be used to bring nongovernmental employees into the Government for one or more years. In other cases, volunteers are marshalled under guidance of technology transfer offices. The Naval Underwater System Center, for instance, has developed a large program using the voluntary services of Center retirees or employees in off-duty hours to answer technology assistance requests from regional organizations.

In addition to answering specific requests for help, Consortium members organize meetings of technology transfer experts and potential users to stimulate interchange of information. An example is the Technology and Business Opportunities Conference convened by the Naval Air Development Center in 1979 to bring together representatives from Federal, State, and local governments; the business and industrial community; and representatitives of the Federal Laboratory Consortium. Finally, the publication of a Directory of Federal Technology Transfer, which includes a listing of programs, resources, and contact points has helped orient potential users to the service available to them from the Consortium.

In spite of the efforts of the Consortium, Defense policy on active technology transfer, when compared to that of NASA, must be characterized as lukewarm. There is no DoD-wide directive on the subject. Navy directives specify that "It is the policy of the Department of the Navy to promote military-civilian technology transfer and cooperation on a systematic basis,"[25] they assign responsibility for carrying out a coordinated technology transfer program to the Assistant Deputy Chief of Naval Material (Technology),[26] and they establish some

responsibilities for what the program must include. However, they give little specific direction to the Navy laboratories community on how to manage technology transfer, and they set no specific requirements. In practice, Navy policy on active technology transfer has largely been resticted to the voluntary participation of some of its laboratories in the Federal Laboratory Consortium.

IMPLEMENTATION OF THE STEVENSON-WYDLER ACT

Proponents of an expanded role for Federal laboratories in active technology transfer have frequently argued that a Congressional mandate was required if more was to be done. The Stevenson-Wydler Act has now provided this mandate. The appropriate way to implement the provisions of the act, however, is far from clear, for many issues remain unresolved.

Perhaps the most important of these is the extent to which additional resources should be devoted to active technology transfer. Congress set minimum levels of involvement for major laboratories, but also allowed agency heads to waive the requirements if alternate plans for conducting technology transfer were being used. To date, the Department of Defense has used the waiver provision and has not substantially modified its prevailing structure to meet the new Congressional requirements. Thus, the demand for additional resources has not yet been great. This will change, however, if Congress, through oversight hearings or other methods, puts additional pressure on DoD to do more.

Department of Defense reluctance in the past to devote additional resources to active technology transfer has stemmed from several sources. There has been constant pressure on the laboratories over the last several decades to reduce personnel. Increasing the size of active technology transfer programs, it has been felt, would further erode the manpower available to accomplish the laboratories' principal missions. Moveover it has been feared that larger efforts would provide rationale for ever more ceiling cuts.

Additional pressure for restrictions has also come from the lingering effects of the Mansfield Amendment of 1969 to the Military Procurement Authorization Act, which required all defense research projects to have a direct relationship to a specific military project. Close scrutiny by the Armed Services Appropriation Committees has also had its effect. As Dr. George Millburn told the House Subcommittee on Science, Research, and Technology:

> I think the Defense Department today has a very proper appreciation of technology transfer. I think we are well aware of it. We do, however, have to respond to our basic mission requirements, which are in support of the Military Service. As I said, all of our efforts are scrutinized very carefully by the House and Senate Armed Services Committees and they go over this line by line and they are very careful to satisfy themselves that the work that we intend to do is needed by the military services.[27]

The new law does not erase these pressures. Congress has given Federal

laboratories no new personnel and no new funding for increasing active technology transfer. It has only set requirements for the quantity of resources that must be diverted from other uses.

Determing the level of resources to devote to active technology transfer, then, is a very important issue. But it is not the only one. Another concern is determing the appropriate relationship between the new active technology transfer programs and the established passive programs. This issue has hardly been considered by policy makers. It was not examined by the Congress in its deliberations on the subject and is not covered by Navy directives. Individuals involved in Navy Technology Transfer usually cooperate with and utilize the resources of science and technology information programs, but they have no official connection to them. It appears that the Congress wishes active technology transfer programs simply to supplement the existing passive programs. There is evidence, however, that these themselves also need attention. As Andrew Aines, Director of Scientific and Technical Information in the Office of Resource Application at the Department of Energy, recently told a colloquium of Navy Laboratories Technical Information Directors:

> I think you will agree that there has been considerable erosion in the husbandry of Federal scientific and technical information programs since the 1960s. At the highest level, COSATI, the Committee on Scientific and Technical Information, disappeared more than a decade ago. Within agencies, the high level STI [scientific and technical information] focal point has virtually disappeared as well. The Smithsonian Science Information Exchange has now vanished, its mission to be picked up by the National Technical Information Service, which is not being given any funds or manpower spaces for the purpose. The Office of Science Information Service, a legislated program in the National Science Foundation, has long departed, along with the Science Information Council. The once respected National Referral Center for Science and Technology at the Library of Congress has become a shadow of itself. The close cooperation between government agencies and professional societies has vanished for the most part....
>
> By and large, STI programs receive much too little attention from leaders of government R&D programs. One reason is that only on rare occasions do R&D managers interact with their STI managers. In DoD, I found that the R&D managers did not include their STI managers in their staffs. The kind of information that the STI managers could provide is almost exclusively bibliographic. R&D managers need some bibliographic knowledge, but they survive on other forms of data: financial, statistic, environmental, political, demographic. These data come from other sources. STI managers are not encouraged to produce and deliver such data, even if they wanted to do so. Information Resource Management approaches in laboratories and R&D head-

quarters may change the picture somewhat in the future, certainly not today.*

The point here is that currently the roles and functions of scientific and technicial information programs themselves are not firmly fixed and that support for maintenance of even their current level of activity is not guaranteed. Since the policy of managing technology transfer activities in the Navy will most likely undergo major change in the next several years, it clearly seems advisable to consider seriously what the appropriate links between active and passive efforts should be in the future.

Finally the issue of transfer through the community of defense contractors remains as a subject meriting serious consideration. One frequent criticism of many of the current active technology transfer efforts of the Federal Laboratory Consortium is that they specialize in specific answers to specific problems. Large-scale or long-term technology advances, such as those affored by the transfer of integrated circuit technology or laser technology can only be made through the work of private industrial corporations. Here again, however, the relation this form of transfer should have to the increases in active technology transfer mandated by the Congress by the Stevenson-Wydler Act is simply not clear.

As the Navy formulates its policy on technology transfer, it is important that it examine the means for technology transfer through private industry that has been so successful in fields such as electronics and aerospace to see if similar methods might be used for technology transfer through State and local governments and small businesses to meet social and environmental needs.

CONCLUSION

Technology transfer is an area of public policy in flux. The Stevenson-Wydler Act is only the most recent Congressional initiative aimed at providing more secondary utility from Federal research and development. Congress has not taken the necessary actions to ensure that what it is requiring will be well integrated with efforts already in existence. The administrative agencies of the Executive Branch must now do so.

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*This quote by Andrew A. Aines is from an unpublished address, "You Can't Separate Information from R&D," delivered at a Conference of Technical Information Directors of Navy Laboratories on January 26, 1982 at the Naval Research Laboratory.

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