REPORT NO. NADC-82251-09

HISTORY OF THE NAVAL AIR DEVELOPMENT CENTER

Thomas Misa and Ed Todd
Department of History and Sociology of Science
UNIVERSITY OF PENNSYLVANIA
Philadelphia, Pennsylvania

15 SEPTEMBER 1982

PHASE REPORT

Prepared for
NAVAL AIR DEVELOPMENT CENTER
Department of the Navy
Warminster, PA 18974

TABLE OF CONTENTS

HISTORY OF NADC, 1941-1980

INTRODUCTION

The following historical narrative summarizes nearly forty years of the activities of a large and complex research and development facility. We have emphasized long-run trends and general patterns at the expense of close analysis of individual events. To provide the reader with a short introduction to the history of NADC, we have developed several specific themes. Our major theme is the relationship between the Center's technical effort and its organization. A second, and related, theme is the changing relationship of the Center and its technical projects to the sponsors and patrons in the Navy. Throughout NADC's history, the Center's laboratories have tended to develop an independence, which some NADC personnel have perceived as hindering the Center's technical efficiency. This survey describes the organizational responses to the development of the "autonomous laboratory," to changes in the Navy, and to the emergence of the "systems" approach. More extensive treatment is given to the early years of the Center than to its most recent past for two reasons. First, the history of NADC began when the Navy took over a privately-owned aircraft factory, an event surrounded by controversy. Second, there is little information on the early period, including the 1950's, that is commonly available or common knowledge. The survey is based on material available at NADC, and therefore is limited to the perspective of NADC personnel.

BREWSTER AERONAUTICAL CORPORATION, 1941-1945

The residents of Johnsville, Pennsylvania, enthusiastically greeted the announcement on January 23, 1941, of plans for the local construction of a multi-million-dollar aircraft factory. The Brewster Aeronautical Corporation had already purchased 400 acres of farmland at a cost of $2 million, and quickly began a crash program to complete construction of the new facility by July. Little existed near the site except the Friends' Meeting House on Street Road, and so the plan promised to bring "the largest industrial boom in the history of Bucks County." (1)

Brewster designed the new Johnsville plant to complement and extend the capabilities of its two other factories, and it shipped plane parts produced at its plants in Long Island City, N.Y., and Newark, N.J., to Johnsville for final assembly. The newly-created Defense Plant Corporation subsidized the $8 million cost of the new facility and leased the factory to Brewster for $1 per year. With

contracts approaching $110 million from the U.S. Navy, Great Britain, and the Netherlands, Brewster's future looked bright.

A carriage manufacturer of long standing, Brewster began expanding rapidly in the late 1930's by moving into aircraft engineering and production just as war-time demands took off. Employing only 40 people in 1932, Brewster expanded its payroll to 20,000 by 1943. In the 1930's Brewster made parts for Grumman Aircraft Engineering, but built no planes of its own until 1938 when it developed two planes for the Navy: the F1A-1, a carrier-based fighter, and the SBA-1, a two-seat dive bomber. An improved version of the fighter, the F2A-2, was sold to England, and nicknamed the "Buffalo" by the R.A.F. (2)

The plane's nickname described it well. A small number of Buffalos were first sent to Britain in the summer of 1940 during the Battle of Britain, but the British soon discovered to their dismay that with armor and ammunition the Buffalo could manage only 270 mph at 6,000 feet. This performance sharply contrasted with the projected figure of 313 mph at 13,000 feet. When the British Admiral Cunningham was offered Buffalos in early 1941 for Mediterranean service, he chose instead to use World-War-I-vintage Gladiator biplanes. Nor did the Buffalos serve the American Navy well. In the Battle of Midway the Buffalos were slaughtered: during the initial Amertcan attack thirteen of the twenty Brewster planes were shot down, and only two of the planes ever flew again. (3)

In early 1942 Brewster ran into difficulty. Shortly after Pearl Harbor, Brewster had announced the "Buccaneer," a new dive bomber to be built wholly at Johnsville. The-first Buccaneers were to roll off the assembly line by mid-February 1942, but production difficulties plagued the firm. When Brewster failed to deliver a single new dive bomber, President Roosevelt directed the Secretary of the Navy, Frank Knox, to take immediate control of the firm. Captain George C. Westervelt assumed command of the Brewster complex on April 21 and reported that "dissatisfaction with management" had caused the takeover. (4)

Explanations for the production failures varied greatly. Senator Harry F. Byrd asserted that the Long Island City plant was operating at 40 percent of capacity, and he charged that labor slow-downs had caused Brewster's ills. R. J. Thomas, a member of the War Labor 8Oard and President of the United Automobile Workers (UAW), alleged that "aliens" were managing the firm, and requested an F.B.I. investigation. The plant officials at Johnsville blamed their delays on subcontractors who failed to deliver critical parts and on the Navy's many design

changes. The Hatboro Spirit editorialized: "For months people of the community . . . have been asking each other the question--'What's the matter with Brewster; why are they not producing?' " (5)

The events soon took an unexpected turn when the Philadelphia Record exposed a complicated profit-skimming scheme that it asserted had crippled Brewster. The "mysterious Miranda brothers," Alfred and Ignateo, along with their associate F. William Zelcher, had set up three shadow corporations that controlled not only the sale of parts to Brewster, but also the firm's lucrative exports. From November 1939 to June 1941 the three men had siphoned off an alleged $5.5 million from the firm. During the same period stockholders had received only $290,000 in dividends and had filed a suit against Brewster's board chairman, James Work, for redress. Most damning to the firm was that the Mirandas had spent twelve months of the twenty-month period either in Federal jail or on parole for smuggling arms to Bolivia in 1939, in violation of the Neutrality Act. (6)

The Navy reinstated private management to Brewster one month after the Navy takeover. The company's officials had resigned, and the Navy installed a new board of directors, headed by veteran aircraft engineer C. A. Van Dusen. In early 1943, a three-man panel headed by Van Dusen took control of the Brewster stock held by Work, Zelcher, and the Mirandas (amounting to 27 percent of the total-stock). Still failing to produce planes on schedule, on May 17, 1943, Brewster again received a new set of directors, headed by Henry J. Kaiser, "the West coast shipbuilding genius." Ex-Westinghouse executive Frederick Riebel, who had been acting as production trouble-shooter for the Navy at Brewster, was elevated to president. Although Kaiser immediately launched a campaign to improve the firm's performance, Brewster remained behind its production schedule.l7)

In addition to suffering under ineffectual management, Brewster was mired in labor difficulties. The War Labor Board reported in late 1942 that a work "slowdown" was impeding Brewster's production. On August 24, 1943 a four-day strike began after a month of controversy over the classrfication of employees assigned to guard the plant. The guards, members of both the UAW and the Coast Guard Reserve, had conflicting loyalties; when four guards were arrested for disregarding Coast Guard orders the rest of the employees walked out. After a total of 39 people were arrested, the UAW demanded withdrawal of the 200 regular Coast Guardsmen that had been moved in. The striking workers, and particularly the local's contentious head, Thomas de Lorenzo, drew public wrath for betraying the war effort. A letter to the editor of the Doylestown Intelliqencer

exhorted: "Citizensl Awake! dare to demand that these strikers choose between the United States flag and their gangster leaders. Demand that our government clamp down on these saboteurs and traitors . . ." The War Labor Board demanded the workers return to work "unconditionally," and production soon began again. (8)

Shortage of materials also ailed Brewster. Hangars were built with wooden beams due to war-time shortages of steel. Senator Harry S. Truman investigated the firm in September 1943 and found conditions "extremely bad." Two hundred mechanics had petitioned to be released to find work elsewhere, but had been refused; 24 plane motors had sat unused for a month because the necessary mounting bolts were not available. To compound matters, an allegation of sabotage surfaced in October when it became known that seven employees had been fired at the Navy's behest in the spring of 1942 on charges of subversive activity. (9)

In November 1943 the questionable past of the testy union leader Lorenzo was uncovered during his testimony before a Congressional committee. He had employed a half dozen aliases, "when they came in handy," and had falsified several official documents, including his 1940 tax return. Reelected for his fourth term as president of Local 365 in February 1944, Lorenzo nevertheless faced serious problems. In March he was indicted by a Federal Grand Jury for doctoring his application to the War Labor Board, and in August he was fined $500 and sentenced to 30 days in Federal jail. (10)

By early 1944 Brewster's prospects were grim. The Doylestown Intelligencer reported that Kaiser's reforms had boosted production by 350 percent, cut man hours per plane from 32,000 to 13,000, and decreased the payroll by one-third. (11) Nevertheless, on May 19, four days after Kaiser left Brewster, the Navy canceled the remaining half of Brewster's contract for the manufacture of Vought Corsairs--virtually the firm's entire business. Navy officials announced three reasons for the decision, and admitted that the firm was bearing the brunt of a $181 million cutback in the purchase of fighters. With 12,000 employees, Brewster held the smallest of the three major Corsair contracts. The two largest contractors, United Aircraft and Goodyear Aircraft, retained their orders. Second, Brewster had no other Navy contracts, and "no other work of importance to the war effort." Finally, Brewster's unit production costs exceeded those of United and Goodyear, despite Kaiser's improvements. (11)

To protest the Navy's decision, the Johnsville workers began a "stay in" on May 31 that lasted two days. The workers continued plane assembly and set a production record of eight planes in one day. Upset over the loss of jobs, and what was feared to be a prelude to the national chaos that would occur with demobilization, the union called for the establishment of an Office of War Demobilization and Post-War Adjustment. (12)

While Brewster moved into the manufacture of pots, pans, and suitcases, the Navy took full control of the Johnsville plant. Initially, Captain S. J. Zeigler coordinated the conversion of the factory into an aircraft engineering and modification center under the direction of the Philadelphia Navy Yard's Naval Air Material Center

NAVAL AIR MODIFICATION UNIT, 1943-1945

The establishment in 1943 of the Naval Air Modification Unit (NAMU) at the Philadelphia Naval Yard reflected a decision by the War Department to separate aircraft production from modification. To speed delivery to the armed services, planes were mass produced and then, at a separate facility, design modifications were added to produce the "latest" model for war duty. (14) The Modification Branch of the Naval Aircraft Factory (NAF), Philadelphia, modified the Factory's assembled planes, but the two functions of production and modification turned out to fit poorly in the same organization. Hence when the NAF was expanded into the Naval Air Material Center (NAMC) on July 20,1943, the Modification Branch was reconstituted separately as the Naval Air Modification Unit. (15)

During its first year of operation NAMU moved between different buildings in the NAMC complex while its personnel wrestled with an influx of projects. The availability of the million square foot Brewster plant, twenty miles north of Philadelphia, promised relief from crowded facilities, and shortly after it took possession of the Johnsville facility in July 1944, the Navy transferred NAMU there under the command of Captain Ralph S. Barnaby.

The move to Johnsville coincided with an expanded mission for NAMU. Its new tasks were to develop special weapons, to do prototype modifications for aircraft, and to perform quantity conversion of war planes. NAMU became a leader in adapting radar to Navy planes, including the TBF/ TBN, PV, PBY, F4U, PB4Y, and SB2C. Some modification work concerned the installation of improved armaments and communications equipment, (16) or involved prototyping, but most resulted from requests by the Bureau of Aeronautics to make changes based

on Fleet performance. Since many of NAMU's employees had little experience with prototyping work, having been production workers at Brewster, a retraining program was conducted by the Training Division of NAMC. In the fourteen months between its move to Johnsville and the surrender of Japan, NAMU modified, repaired or experimented with over 1,370 service aircraft. Under a tight veil of secrecy, NAMU also conducted special weapons work, with such colorful project names as Pelican, Little Joe, Gargoyle, Glomb, and Glimp. NAMU engineers coordinated their activities with the National Defense Research Committee and the Special Weapons Experimental Tactical Test Unit, and combined many elements of modern war technology to develop new guided missiles and drone targets. Experimental glider work was also important, due to Captain Barnaby's experience and interest in the field of gliders. (17)

NAVAL AIR DEVELOPMENT CENTER, 1947-1959

Between the end of the war and the beginning of the 1950's, the Naval Air Modification Unit underwent a series of changes that fragmented its technical effort. The loosely-structured but integrated NAMU was replaced by an autonomous grouping of R&D laboratories, in which control passed from the commanding officer to the laboratories and related sections of the Bureau of Aeronautics. After the war NAMU concentrated on research and development and no longer performed aircraft "modification." Therefore the Bureau of Aeronautics changed the name from NAMU to the Naval Air Development Station (NADS), under the command of the Fourth Naval District Commandant and the managerial control of the Bureau of Aeronautics. Then, on August 1, 1949, NADS was redesignated the Naval Air Development Center (NADC).

The fragmenting of the technical effort of NADS began in December 1947, when the Bureau of Aeronautics designated distinct missions for the Station's three laboratories: Aviation Armament Laboratory, Aeronautical Electronic and Electrical Laboratory, and Pilotless Aircraft Development Laboratory. When the Station's Central Planning Office was disbanded in February 1948, its functions were transferred to the various laboratories and departments. Contributing to the fragmentation was the piecemeal growth of NADS, as the Bureau of Aeronautics moved several Navy R&D laboratories located along the East coast to Johnsville. In June 1948 the Naval Air Material Laboratory in Philadelphia was disbanded and its functions were reassigned to Johnsville.

Editors Note - This is an error. The Naval Air Material Laboratory was not moved to NADC until 1971. A second floor was added to "building 2" at NADC to accommodate NAML.

In August the Aeronautical Electrical Section was transferred from the Naval Research Laboratory (NRL) to Johnsville, and in the spring of 1949 the NRL Field Station, Boston, under Dr. Harry Krutter, moved to NADS, as did the Special Project Unit CAST. The mission of NADS was also expanded to include the newly-formed Aviation Medical Acceleration Laboratory. (18)

The personnel profile changed significantly in the 1940's and 1950's. The change from modification to R&D required the retraining of many workers. On August 1, 1947, the full-time professional staff stood at 902, but one year later slipped to 532. Due to an extensive recruiting effort and the transfer of laboratories to NADC, the Center's staff grew to 1002 by June 1949. (19) Johnsville's professional staff increased since a different mix of talents were required for R&D. The 1950's saw a slow, steady growth in personnel, and by 1958 the civilian complement was 1670 and the military complement was 470.

The physical resources of the Center grew rapidly in the early 1950's. Several new facilities were constructed at costs not approached again until the 1960's. (20) The extent of these expenses are evident in the table below.

NADC Facility	Fiscal Year	Amount (thousands of dollars)
Human Centrifuge	1949	2,381
Development and Test Facilities for AEEL, AAL, EDL	1951	2,600
Runway Extension for Jet Operations	1952	1,667
	1956	28
Computer Room Construction	1953	232

During the 1950's, NADC operated not as a unified Center, but as a collection of independent laboratories. Many of the laboratories had their own support services, including technical writing staffs and libraries. Relatively independent of Center

control, the laboratories or parts thereof developed direct connections with the related technical sections of the Bureau of Aeronautics, or, in the case of the Aviation Medical Acceleration Laboratory, of the Bureau of Medicine. The Bureau-Center relationship was a "parent-child" one, and what follows is an account of these children. (21)

Aeronautical Computer Laboratory (ACL)

Computer work began in 1947-1948 when the Center purchased two new Reeves Instrument analog computers. These "REAC" units were the outcome of the Navy's "winds" program, which began in 1946 to develop a series of computers. The Reeves' project "Cyclone" employed available technology to construct a computer as soon as possible, while R.C.A. carried out Project "Typhoon" at its Laboratories in Princeton, N.J., to develop the ultimate computer using state-of-the-art technology.

After designing and building the Typhoon computer, R.C.A. reconsidered its connection to the Navy and decided to rid itself of Typhoon. In August 1950, Harold Tremblay, an NADC electrical engineer who had worked with the Reeves firm on REAC, and George Caffrey began training on the Typhoon in preparation for its move to NADC. A hybrid analog-digital machine, Typhoon consisted of an F-shaped complex of some 50,000 tubes that occupied floor space of nearly 10,000 square feet. (22) It was not until the spring of 1952 that the transfer of Typhoon to NADC was completed.

NADC organized a Computer Unit in July 1950 and soon reorganized it as the Analytical and Computer Department (ACD). The civilian supervisor of the ACD was Professor William H. Boghosian, from the Moore School of Electrical Engineering at the University of Pennsylvania. The ACD's two divisions provided a large-scale analog computer facility for Department of Defense use. The ACD's Systems Engineering Division conducted long-range research studies of the effectiveness of air weapons systems and the vulnerability of aircraft. In June 1955, the Division was removed from the ACD and became the core of the Air Warfare Research Department (AWRDJ, which developed many advanced weapons concepts, and carried out studies of the Fleet Ballistic Missile, the CORVUS missile, and the EAGLE missile, an early version of the Phoenix. The Computer Division carried out theoretical studies and simulations of aircraft and guided missile designs. With the departure of the Systems Division, the Computer Division became the Aeronautical Computer Laboratory. In the late 1950's the

Typhoon was broken down into components called "Gales," and finally, in 1968, the Typhoon was completely dismantled. Five analogue computers replaced Typhoon and provided twice its capacity. (23)

Engineering Development and Services Department (EDSD)

The Pilotless Aircraft Development Laboratory (PADL) was the pioneer activity at the time of the establishment of NADS; its responsibilities included the design and development of pilotless aircraft and target drones. In 1950 its mission was expanded, and PADL was renamed the Engineering Development and Services Department. When its shop facilities were transferred in 1958, the EDSD became the Engineering Development Department, with a diverse mission. Through the 1950's with a staff of 400, the EDSD--known as Everybody Does Something Different--worked on ground and airborne instrumentation and control systems and other aircraft development projects.

Aeronautical Electronics and Electrical Laboratorv (AEEL)

The AEEL was the second original laboratory that comprised NADS. A shortage of technical personnel due to the demands of the Korean War and a recognition that too many organizational barriers existed within AEEL prompted an organizational streamlining of the AEEL under Technical Director Dr. Harry Krutter in 1950. To centralize control of the Laboratory's 400 personnel and six divisions--undersea warfare, control and guidance, radar, electrical, radio, and technical services-- the Program Officer's power and responsibilities were increased. Moving personnel to match project demands continued to be a difficulty that was addressed by organizational changes, as can be seen in the reorganization of the Control and Guidance Division in 1954. In January its Analysis Branch was split into the Physics and Systems Analysis Branches, but in July the two Branches were again recombined as the Analysis Branch.

Antisubmarine warfare work was a major part of the AEEL. To promote undersea warfare work, AEEL created in April 1958 two new divisions, Sonar and Special Methods. These two divisions formed the core of the Antisubmarine Warfare Laboratory organized in the fall of 1958.

Aircraft Armament Laboratory (AAL)

AAL was formed at Johnsville when NAMU was reorganized in 1947 as NADS. With approximately 270 members it was slightly smaller than PADL and AEEL. During the Korean War AAL expanded to 340 members, and provided support for U.S. warplanes. From 1954 onward, the members of AAL conducted analytical studies of aircraft vulnerability, and mounted an effort to persuade manufacturers to be "vulnerability conscious" during the design stages of aircraft development. In 1958 the AAL was disbanded, and its divisions transferred to AWRD and the newly formed ASWL.

Aviation Medical Acceleration Laboratory (AMAL)

Planning of a medical acceleration laboratory began in 1944. The centerpiece of the group that became AMAL was a new high-performance Human Centrifuge with a 50-foot radius. Work on the new facility at Johnsville began in June 1947, with the McKiernan-Terry Corporation of Harrison, N.J., constructing the centrifuge building under the direction of the Special Devices Center of the Office of Naval Research. On November 2, 1951, Captain J. R. Poppin, the director of AMAL, became the first human subject tested on the centrifuge. The facility's ties to the University of Pennsylvania were reinforced in July 1954, when Dr. James D. Hardy, Professor of Physiology in the School of Medicine, became Research Director of AMAL.

The centrifuge's capabilities were demonstrated through a series of experiments. In 1956 a joint Navy-Air Force study revealed that chimpanzees were able to sustain 40 G's for 6C seconds. Two years later R. Flanagan Gray of NADC set the world's record of 31.25 G's, which he sustained for five seconds in the "iron maiden," a water-filled protective apparatus, attached forty feet out the arm of the centrifuge. The combination of the human centrifuge and the Center's computer facilities, the first step in the development of dynamic flight simulation, was first used in 1957 for the X-15. Perhaps the most celebrated program of AMAL was the flight simulation training for Project Mercury astronauts. In the early 1960's, the centrifuge received its own analog computer,
which is still in use. (24)

Aeronautical Instruments Laboratory (AIL) and Aeronautical Photographic Experimental Laboratory (APEL)

The AIL and APEL were transferred to Johnsville in December 1953 from NAMC, in Philadelphia, to provide more space for them. AIL grew from 92 people in 1953 to 134 in 1958, as three new branches were added: Simulation, Inertial Navigation, and Systems and Computers.

APEL provided contract monitoring and technical assistance to the Navy. One important project involving Antarctic exploration, OPERATION DEEPFREEZE, required a large winterization program for over 200 cameras.

NADC REORGANIZATION AND ESTABLISHMENT OF ANTI-SUBMARINE WARFARE LABORATORY, 1957

The growth of the NADC during the early and mid-1950's was due in large measure to the transfer of outside laboratories to the Center, as well as the rearrangement of existing labs. In January 1954, the Aeronautical Instruments Laboratory and the Aeronautical Photographic Equipment Laboratory were transferred to the Center from the NAMC, Philadelphia. The Analytical and Computer Group was established in 1950, and given departmental status a year later. In July 1955 the group's analytical and computer components were divided to form the Air Warfare Research Department and the Aeronautical Computer Laboratory.

The Center's labs developed a high degree of autonomy during the 1950's. The 1957 NADC Appraisal Committee, chaired by CDR H. L. Anderton (AEEL), wrote: "Presently, the primary mode of operation appears to be that each laboratory, acting in autonomous fashion, goes out and gets its own work and does its utmost to avoid Center-wide operation." (25) One result of the autonomous growth of NADC Laboratories was that many areas of "overlap and conflict" developed. The Committee identified four areas in which this was a problem: study and research, in which AWRD and the Armaments Systems Division overlapped; aviation systems, in which both EDSD and AAL worked on separate programs for target drones and towed targets; sub-systems and components, in which airborne computer work was prosecuted by Al L and AEE L without coordination; and anti-submarine warfare work (ASW) which was carried out by many laboratories.

An examination of the NADC personnel similarly revealed an unorganized R&D effort. Of the 454 professionals at NADC, 10 percent were involved in study and

research activities, 40 percent with R&D, and 10 percent with "design, approval, test," a category of unclear meaning. The remaining 40 percent performed "routine" tasks, described by the Committee as "type test, or design work significantly lacking in engineering challenge." Organizing the number of professionals by laboratory affiliations indicated that the Target Drone division of the EDSD was the largest Center activity with 33. But the R&D work area that was actually the largest activity on Center was ASW, which had 56 professionals scattered across AEEL, AAL, AWRD, and ACL, but with no laboratory to focus the effort.

The Appraisal Committee concluded that an organizational change would benefit the Center's effectiveness, and it made a two-part proposal. First, to provide a means by which the Commanding Officer could plan and integrate Center-wide technical effort, a "technical alter ego" for the C.O. was necessary to be filled by either an officer or civilian. A line position directly under the C.O., with the title of Director of Development, was suggested. In response to the perception that more systems work should be performed by the Center (revealed by the Committee's interviews), the Director of Development would have the assistance of Ad Hoc Systems Managers to coordinate large complex programs.

The second recommendation of the Committee concerned utilization of technical personnel: "The Center does at present suffer from an inability to handle Center-wide projects without jurisdictional battles and wounded feelings and morale." Most of the troublesome projects concerned aircraft systems development, and a possible solution would have been to set up another administrative entity to coordinate this area of work. Since the number of entities reporting to the Commander was already unmanageable, the Committee favored a comprehensive reorganization of the Center's into five new laboratories: Study, Aeromechanics, Electronics, Medical, and Services Department. This suggestion was not followed.

An NADC Ad Hoc Committee was, however, appointed by Command Officer Emerson E. Fawkes on May 5, 1958, to study the need for the coordination of the Center's ASW efforts. The Committee, chaired by F. M. Gloeckler, concluded that the Center faced a real need for a comprehensive ASW laboratory, and several of its recommendations were soon enacted. The AAL and AEEL had substantial ASW activities that were merged into the new Anti-Submarine Warfare Laboratory (ASWL). The remaining non-ASW activities in AAL and AEEL were mainly avionics, and the Committee recommended to merge these into a new Avionics Laboratory, never officially created. The AAL was disbanded on

September 1, 1958, and its personnel combined with the ASW staff of the AEEL. The resulting ASWL had six divisions (Administration, Programs, Special Methods, Sonar, Attack Systems and Development Support), and, at the time of its establishment, had 63 projects.

1963 AD HOC NADC APPRAISAL COMMITTEE REPORT

Many of the problems identified by the 1957 Ad Hoc Appraisal Committee continued to plague NADC in the 1960's. A new Ad Hoc Committee studied the NADC's activities in 1963 and produced a report which stated that the Center lacked clear goals and that the various laboratories often acted independently of the Center. (27)

The Committee feared that parochial laboratory objectives had replaced any meaningful Center objectives, and it noted that the Center's mission did not provide "any effective guidelines for senior people in the present, largely autonomous operation of the separate laboratories." The Center also did not have clearly delineated objectives. In response to a survey, a majority of senior professionals expressed "a complete lack of knowledge of any expressed or implied Center objectives." The Center's management did not define objectives of performance for the Center or long-range goals. One NADC employee told the Ad Hoc Committee: "NADC doesn't have the foggiest idea where it's going."

The Center's various laboratories were autonomous entities, and even the divisions within the laboratories were often independent. Self-sufficiency and autonomy persisted within the organizational structure of the laboratories. Some central control remained in dealing with such administrative details as travel, fiscal affairs, material ordering, and general support, but if the laboratory segments found such administrative functions important, they set up unofficial mechanisms to supply the need.

The lack of Center coordination resulted in part from the relationship between NADC's laboratories and the Bureau of Aeronautics. The laboratories, or even subsections of the laboratories, were closely related to specific parts of the Bureau. Following product lines, the major flow of work, communication, and trust was between these divisions and the related areas in the Bureau of Aeronautics. For all practical purposes, the Center's commitments of resources therefore were made at the divisional level, which limited the size of the development effort on which the

Center could work and prevented the handling of large projects. The laboratories' tight connection to their sponsors made impractical central control over the operations of the laboratories.

The attitudes of the Bureau of Aeronautics towards NADC were ambivalent. The Ad Hoc Appraisal Committee reported that when the Bureau viewed NADC as a large number of separate contributors, it did not seem dissatisfied. However, Bureau personnel had also complained that NADC lacked initiative, consistently took the small view, and followed too slavishly the Bureau's often inadequately planned directives. Many at the Bureau also complained that assessing NADC was almost impossible since it had produced no major products. Nevertheless, the Bureau mentioned favorably several new NADC programs, specifically A-NEW and the Captured Air Bubble Foundational Research Project. (28)

EXTERNAL PRESSURES FOR CHANGE

The Navy's system for research, development, testing and evaluation (RDT&E) faced significant personnel and management problems in the early 1960's. There were no clear goals or long range plans for the system. An attempt to create "lead laboratories" had confused lines of

(In 1963 there were eight laboratories: the Aeronautical Computer Laboratory, the Aero Electronic and Electrical Laboratory, the Aeronautical Instrument Laboratory, the Aviation Medical Acceleration Laboratory, the Aeronautical Photographic Experimental Laboratory, the Anti-submarine Warfare Laboratory, the Air Warfare Research Department, and the Engineering Development Department.)

responsibility and work assignments, and there was overlapping and duplication of work done at the various Navy laboratories. Another problem was that some laboratories were trying to develop special competencies, while others acted as "job shops." This confusing situation was compounded by the Navy's top-heavy managerial structure: an inverted pyramid with laboratories at the bottom. (29)

The trend in the Department of Defense in the early 1960's toward centralization and consolidation of functions, together with the Navy's desire to improve the quality and status of its laboratories, led to changes in the Navy's administration of its laboratories. In December 1965, the Navy created the position of Director of Navy Laboratories, and in April 1966 transferred 15 major RDT&E centers from the material bureaus to the Chief of Naval Material. The laboratories in this new "federation" were ordered to develop similar management, organization, and

research program structures. Another change came in the laboratory budgeting procedure. Prior to 1966, the bureaus had controlled and determined laboratory budgets in a "parent/child" relationship.

After 1966, the laboratories under the Chief of Naval Material developed a new "producer/ consumer" relationship with the newly-constituted Systems Commands, which succeeded the material bureaus. The new relationship was formalized in 1969 with the implementation of the Navy Industrial Fund cost accounting procedures. Under this accounting system, sponsors of research could shop around for RDT&E services, and Navy laboratories actively had to seek customers for their services and had to stay attuned to customer needs. (30)

The changes in the Navy's RDT&E system removed one of the causes of divisional autonomy at NADC, but continued the earlier pattern of uncoordinated growth. The "producer/consumer" relationship with the new Naval Air Systems Command ended the close connection divisions had had with the Bureau of Aeronautics. This change could have strengthened the Center's control of its divisions, but at the same time the Navy began moving various laboratories to NADC in an attempt to consolidate the RDT&E system. The Navy wanted its RDT&E centers to carry out complete systems development in a broad systems approach to Naval warfare. To promote this new approach, the Navy consolidated activities engaged in similar types of work. To make NADC the Navy's center for aeronautical systems, three departments from the Naval Air Engineering Center (NAEC) in Philadelphia were transferred in July 1967 to NADC. The three--the Aerospace Crew Equipment Department (ACED), the Aero Structures Department (ASD), and the Aero Materials Department (AMD)--remained initially at the Philadelphia Naval Yard. In a sense they were being reunited with NADC, since the forerunner of NAEC was the Naval Air Material Center, which had earlier control led NAMU . (31)

NADC faced the problem of integrating the three departments into the Center. Early in 1969, NADC formed an Ad Hoc Committee to investigate the problems associated with the move from the Naval Yard to Johnsville. In its report, the Committee declared that it was financially feasible to move the departments, but, because major improvements at NADC were required for ACED, recommended that only AMD and ASD be moved at that time. Project High Mountain and a Project Team, made up of representatives from all departments, developed detailed plans and recommendations to accomplish the relocation. AMD and ASD moved first, with ACED eventually being integrated into the Crews Systems Department

at NADC in 1971. A further integration of the new departments occurred in 1972, when the AMD and the ASD were combined with the Aero Mechanical Department (originally the Pilotless Aircraft Development Laboratory) to form the Air Vehicle Technology Department. This new department was designed to realign and consolidate related technologies to permit maximum concentration on design concepts for air vehicle and aerospace systems. (32)

A further addition to NADC came in 1974, when, in accordance with the Shore Establishment Realignment Program, the Naval Strategic Systems Navigation Facility (NSSNF) in Brooklyn was relocated at NADC. The Center formed the Ships Navigation Department to combine the functions of the NSSNF with various navigation technology tasks formerly assigned to the Aero Vehicle Technology and Aero Electronic Technology departments. The new department was responsible for research, development, testing and evaluation of ship navigation systems and related fields of science and engineering. (33)

Reorganization of the Navy's RDT&E structure effected the NADC in two ways. The Navy added new laboratories to NADC which then had to be integrated. The Navy also removed the Center from its "parent/child" relationship with the bureaus--a relationship that had contributed to the fragmentation of the Center due to the direct ties between the laboratories and corresponding sections of the Bureau of Aeronautics. The establishment of the Navy's Industrial Fund cost accounting procedures led to a new "customer/producer" relationship that forced the Center actively to sell itself. These changes reinforced the internal pressures for reorganizing the Center, which were exacerbated by the development in the late 1950's and early 1960's of several large “systems" projects.

INTERNAL PRESSURES FOR CHANGE

The development of the systems approach in the 1960's had an important impact on NADC. The problems caused by the autonomous laboratory and by the development of "systems engineering" can best be seen in the development of the ASWL and one of its most important projects. A-NEW. The term "systems" had several different meanings. For some it was a technological need, whereas for others it represented a managerial goal. The A-N EW project grew out of the need to integrate a technical system. Airborne antisubmarine warfare developed during the 1950's according to the "additive approach," whereby each new sensor or capability added a new box that the airplane crew had to monitor. A-NEW began as an attempt to integrate a dozen or more sensors into one airborne antisubmarine

system. In this project, NADC's ASWL began engineering an entire airplane using a Univac 901 computer as the heart of the new system. The first airborne, integrated ASW avionic system (A-NEW MOD 1) was given its first flight test on October 28, 1963, some four years after the project was initiated. (34) The A-NEW project heavily emphasized in-house analysis and hardware development. Although there were other systems projects in the early 1960's, the A-NEW project was the first and the only one in which the in-house effort played the leading role. (35)

While the A-NEW project emphasized the technical need to integrate sensors into one system, the Ad Hoc Appraisal Committee in 1963 emphasized a managerial view of systems. To the Committee the systems approach meant more than simply a "higher level of engineering development activity"; instead, it emphasized "planning, concept synthesis, analysis, experimentation and observation, technical supervision or review of development, feedback, and documentation of all these activities for management decision."

The enlarged technical and managerial needs of A-NEW and other "systems" projects taxed NADC resources in the 1960's. Systems engineering required the use of many senior people and demanded inter-disciplinary arid inter-laboratory cooperation which the Center's organization did not readily allow. The 1963 Appraisal Committee feared that the four systems projects then handled by the Center, including A-NEW and the Phoenix missile system, would create a significant problem by absorbing the Center's technical manpower. (36) Indeed this is what happened, with the ASW Laboratory leading the raiding of other parts of the Center for manpower. Since the Center had fixed personnel ceilings, the only way to expand a project's manpower was to take it from other parts of the Center (37)

The very success of the ASWL and the A-NEW project exacerbated the problems identified in the late 1950's and early 1960's, and led to a reorganization of the Center in 1965. ASWL was an example of an autonomous laboratory directing the Center. The ASWL engineers who promoted the systems approach had to force the Center to accept their ideas, and in the process they attracted a large amount of money and developed direct ties to high-level Naval officers, who helped them promote the systems approach. By the early 1960's the ASWL had become a powerful force in its own right. (38)

NADC was able to use a request of the Bureau of Naval Weapons, which had succeeded the Bureau of Aeronautics, to reorganize the ASWL and the systems projects. Increasing its emphasis on major weapons projects, the Bureau requested in 1964 that the Center reorganize itself to strengthen these capabilities. The Center disbanded the ASW Laboratory and reorganized the eight Center laboratories into four technical departments and one systems project department. The new organization was designed to use more efficiently the Center's limited technical manpower and to facilitate the management of weapon-system development. The Systems Projects Department had two major subdivisions: Aero Space Systems Projects and Antisubmarine Warfare Systems Projects, which included the A-NEW program. (39) A remnant of the ASWL, the Sonar Division, moved to the Aero Electronic Technology Department. (40) A second reorganization in 1967, designed to increase the manageability of the Center, merged the Air Warfare Research Department and the Systems Projects Department into the Systems Analysis and Engineering Department.

The organizational changes in the 1960's did not solve the Center's management problems. Writing in July 1970, D. W. MacKiernan, Technical Director of the Aero Electronics Technology Department, identified many of the same problems as had the Ad Hoc Appraisal Committee of 1963. MacKiernan stated that the Center was plagued by almost autonomous laboratories and departments, which were able to shift workloads and manpower to meet their own changing needs. Their ability prevented the "radical internal reorganization" of NADC. The problem was that the Center had never found the mechanism for shifting manpower between departments. Neither the Center Commander nor the Technical Director had the detailed information necessary for this purpose. The Center's Technical Director, MacKiernan noted, had opposed forming a sizable Center staff, because it might dilute management and leadership at the operating level. (41) These problems continued to plague the Center during the 1970's.

The initial step toward introducing the current matrix system was taken by the Systems Analysis and Engineering Department in its 1974 reorganization. The matrix system allowed project heads to bid for the use of manpower according to the needs of the projects. A control group regulated relations between the various divisions of the department. The reorganization eased the pressures within the department and provided experience for the reorganization of the Center in 1977. At that time the Systems Analysis and Engineering Department was split into three parts: the Systems Directorate, the Software & Computer Directorate, and the Command Projects Directorate. The other three directorates were the

Communication Navigation Technology Directorate, the Sensors & Avionics Technology Directorate, and the Aircraft & Crew Systems Technology Directorate. A control group, Planning Assessment Resources (PAR), was created to act as a staff to the Technical Director. This reorganization solved many of the problems that had plagued the Center in the 1960's and early 1970's. The directorates could call on expertise throughout the Center, and there- fore did not need to try to move personnel permanently into their area. More importantly, the Center could more easily coordinate its RDT&E effort.

**The technology departments were: Air Warfare Research Department, Aero Electronic Technology Department, Aero Mechanics Department and the Aerospace Medical Research Department.*

CONCLUSION

From the standpoint of its management, NADC has been plagued throughout its history by autonomous laboratories that prevented the Center from coordinating its resources to meet the demands of its sponsors. The accretion of personnel and laboratories from other centers in the Navy's effort to organize its RDT&E activities was one cause of constant Center reorganizations. Another cause was the development of systems projects in the late 1950's and 1960's which exacerbated managerial problems because the systems projects absorbed personnel from other sections of NADC. Those interested in promoting a coordination of Center activities were able to broaden the "systems" concept into a managerial concept and take advantage of Navy reorganizations to break up ASWL in 1965 and bring about further reorganizations of the Center thereafter. It is not clear that these reorganizations benefited the Center's technical effort or whether the "autonomous" laboratory benefited this effort. Whether the Bureau of Aeronautics found the effort adequate or not, for instance, is not clear from the sources available at NADC. A full history of NADC would require an investigation of its technical effort and its relation to the Bureau of Aeronautics, the Naval Air Systems Command, the Naval Material Command, the Navy, and industry.

FOOTNOTES

(1) Doylestown Intelligencer, 23 January 1941. Hereafter cited as D.l.. Newspaper articles cited below are bound together in an untitled volume available in the NADC library (#5800285-1).

(2) D.l., 28 January 1941, 20 August 1943.

(3) Brian Johnson, Fly Navy: The History of Naval Aviation (New York: William Morrow, 1981), pp. 178- 179, 196- 197, 200-201, 2-64268

(4) D.l., 19 December 1941, 22 April 1942.

(5) Hatboro Spirit, 24 April 1942.

(6) Philadelphia Record, 24 April 1942; D.l., 28 November 1942.

(7) D.l., 26 December 1942, 18 March 1943.

(8) D.l., 26 December 1942, 24-27 August 1943.

(9) D.l., 22 September 1942, 29 October 1943; Philadelphia Inquirer, October 1943.

(10) D.l., 5 November 1943, 10 February 1944, 11 August 1944; Associated Press, 31 March 1944.

(11) D.l., 29 February, 9 March, 18 May, 22 May 1944.

(12) D.l., 31 May, 1 June 1944.

(13) D.l., 6 June, 22 June, 31 July 1944; I.N.S., 23 June 1944.

(14) Alan S. Milward, War, Economy & Society: 1939-1945 (Berkeley: University of California Press, 1979), p. 192.

(15) The following information on NAMU is drawn from Navy Department, "U.S. Naval

Administration in World War ll, 250 Vols. (Washington, D.C.: Naval History Division) Unpublished manuscript Vol.111e; "The War History of the Fourth Naval District,"pp.1-16tol-18,111-15 to lll-17.

(16) Interview with Charles E. Keener, NADC, conducted 28 June 1982. Taped interviews cited are in the NADC History Project files.

(17) Interview with Harold Tremblay, 6 July 1982.

(18) NAOC, "Historical Report, 14 July 1957 to 31 December 1949." Unpublished manuscript. In the NADC Library.

(19) Ibid.

(20) "Compilation of Data on Navy R&D Activities, NADC, 1 December 1966," in file "Naval Air Development Center, 1949-1957," NADC History Project file.

(21) See David K Allison, “Evolution of Missions and Functions of CNM-Commanded Laboratories and Centers, “report to NAVMAT Headquarters, November 1981.

(22) Interview with Harold Tremblay, 6 July 1982.

(23) The following discussion is based primarily on NADC, "Historical Reports," 1950 to 1958. In the NADC Library.

(24) Interview with Richard Crosbie, 2 July 1982.

(25) The following discussion is drawn from the "Report of the Ad Hoc NADEVCEN Appraisal Committee, 17 June 1957, to Commanding Officer, NADEVCEN." Available in the NADC History Project files.

(26) NADC, "ASW Lab Ad Hoc Committee Report," 18 June 1958. Available in the NADC
History Project files.

(27) "Preliminary Report of the 1963 Ad Hoc NADC Appraisal Committee," 1 May 1963. NADC History Project Files.

(28) I bid.

(29) Booz, Allen and Hamilton, Inc., Review of Navy R&D Management, 1946-1973 (Washington, D.C.: Department of the Navy, 1976), pp. 127-128, 142.

(30) Ibid, pp. 150-158; David K. Allison, "Evolution of Missions and Functions of CNM-
Commanded Laboratories and Centers," November 1981.

(31) Reflector, June 1967; Commanding Officer, NAEC to All Employees, 9 January 1967,
memorandum in NADC History Project Files.

(32) Reflector, January 1970, April 1970; NADC, "Command History," 1972.

(33) NADC, "Command History," 1973.

(34) Interview with Jim Howard, 9 June 1983; Interview with Tom Willey, 15 July 1982.

(35) "Preliminary Report of the 1963 Ad Hoc NADC Appraisal Committee."

(36) I bid.

(37) Interview with Tom Willey.

(38) Ibid. Willey suggested this interpretation of the reasons for the reorganization of 1965. See Howard Cole to James H. Wakelin, Jr., 16 July 1963, NADC History Project Files, for a direct approach to the Assistant Secretary of the Navy for R&D for increased ASW support.

(39) Reflector, 21 May 1965.

(40) Commanding Officer NADC to Special Distribution List, 1 June 1965, NAVAIRDEVCEN 5400. In NADC History Project Files.

(41) D. W. MacKiernan to Capt. E. J. Kingsbury, 22 July 1970. In NADC History Project Files.

(42) Interview with Tom Willey; NADC, "Command History," 1977.

GUIDE TO SOURCES

INTRODUCTION

This guide to sources is designed to facilitate further investigations of the history of NADC. The guide presents the historical sources currently available, assesses their value, and suggests the areas in which further work will be needed. This guide is divided into eight sections: organizational files in the NADC History Project files; formal historical reports compiled by the Center; collections of in-house newspapers; bibliographies of reports, articles, and books of use to historical investigations of NADC; interviews conducted with Center personnel for this project; NADC records held by Federal Records Centers, technical reports written for Center projects; and a collection of miscellaneous sources. The appendices to this report are also described in the relevant sections of the guide.

ORGANIZATIONAL FILES

The NADC History Project files located in the Public Affairs Office contains past organizational files from the office of the commanding officer. This material consists of approximately one metal file drawer of miscellaneous reports, correspondence, promotional brochures, organizational charts, and photographs. The material is organized according to two criteria. First, material that pertains to the Center as a whole is filed according to chronological periods. Second, material is filed under the name of individual departments or laboratories. This collection also includes a file containing material describing NADC's past technical directors.

FORMAL HISTORICAL REPORTS

Formal historical reports compiled by the Center can be found in the NADC library. These reports were generally produced annually. Individual departments were responsible for their respective sections of these reports, so the quality varies. These reports overwhelm the reader with their detail and are a valuable source of specific information. For example, the personnel of individual laboratories are listed, as are individual projects on which the Center worked. If analyzed systematically this data could be revealing, but, as written, they convey no sense of historical patterns or trends. These reports have two names corresponding with two slightly different formats. Reports from the late 1940's

and 1950's are titled "Historical Report." Beginning in the late 1950's, a better integrated version was compiled, named "Command History." The library's collection is incomplete. Although the reports began in 1947 and were presumably compiled continuously until the present, no reports from 1964 to 1971 are in the library, and their present location is unclear. Supplementing the historical reports in the 1950's is a document titled "Accomplishment Summary." The library has the editions from 1950 and 1954-1957

IN-HOUSE NEWSPAPERS

A nearly-complete run of issues of the Center's various newspapers is located in the NADC History Project files. The articles vary greatly in quality, and are difficult to use since they lack an index. The Brewster Builder (1943-1944) was published twice per month, and covered all three of the Brewster Corporation's factories. It is unreliable. A complete series exists of the monthly NADC News, published from 1949 to 1952, and from 1955 to 1957. The Reflector began monthly publication in 1958, and a complete series through the present is available.

BIBLIOGRAPHIES

Bibliographies listing reports, articles, and books pertaining to the history of NADC are in the NADC History Project files. A selected bibliography is included in this report as Appendix A.

INTERVIEWS OF CENTER PERSONNEL

Tapes and files for nine interviews conducted with Center personnel for this project are with the NADC History Project files. The tape-recorded proceedings range in length from one to three hours, and average approximately one and one-half hours. The finding guides listing topics discussed on each tape are included in this report as Appendix B. A file for each interview contains a copy of the finding guide, miscellaneous biographical information, notes from the interview, and consent forms.

RECORDS HELD BY FEDERAL RECORDS CENTERS

NADC records held by various Federal Records Centers provide a rich historical source that merits further investigation. These records include documentation of

many of the Center's most significant projects, central correspondence files, and technical reports.

Finding and retrieving some of these records may be difficult. In the 1950's records were sent to the Navy records facility in Mechanicsburg, Pennsylvania, and thereafter to the Federal Records Center (FRC) in Philadelphia. Almost no accession numbers for the material in Mechanicsburg are available. Some early NADC records were transferred from Mechanicsburg to Philadelphia, but were destroyed in 1974. Records have also been sent to federal records facilities in Washington; Garden City, NY; Alexandria, VA; and St. Louis, MO. With rare exceptions no accession numbers are available for these records.

Records at the Philadelphia FRC are retrievable. A preliminary survey of all known NADC records in federal facilities is presented in tabular form in Appendix C. The NADC Records Office files contain descriptions of material sent to Federal Records Centers, but accession numbers are often not available for shipments in the 1950's. Appendix C thus represents a correlation of information from the NADC Records Office files through 1977 and the computer printout which shows NADC material stored at the Philadelphia FRC. Where accession numbers were not available an "UNK" (unknown) appears in the column for accession numbers. Appendix C shows accession numbers, subject descriptions, period in years, location and quantity in boxes or cubic feet. Since this is a working document, some correlation’s are tentative and some of the material may have been destroyed.

TECHNICAL REPORTS

There are two ways of locating NADC technical reports: through the Defense Technical Information Center (DTIC) which publishes bi-weekly indexes and maintains an on-line data base and through the Center's library. DTlC's bibliography is indexed by author, report number, DTIC accession number, corporate author, subject, contract number, and title. This agency is limited to indexing reports it receives. Since it is the responsibility of the individual author and/or contractor to submit reports to DTIC, gaps in the collection are created.

Within NADC library are several finding aids. One is the card catalogue, which is organized by laboratory and within this division by year. It too contains only those reports received by the library and has gaps. A second listing is an inventory of early reports that were in the library and have been sent to the Philadelphia Federal

Records Center for storage. A third tool is the NADC Report Log which lists reports by NADC report number followed by author, title, contract number, DTIC number, and library holdings. If a report was written for a particular contract, it can be located by contract number in a separate card file which starts with the year 1967.

Locating specific reports may be difficult, particularly those from early years. DTIC sometimes receives reports not sent to the library and vice versa. Finding aids have varied in coverage over the years. As a result of these problems, all finding aids must be used to ensure locating the desired reports.

MISCELLANEOUS HISTORICAL SOURCES

Several miscellaneous sources may also be of help. The NADC Records Office has a collection of old organization manuals and telephone books An ex-NADC staff member, Russell Mason, is preparing a history of sonobuoy and anti-submarine warfare work under a contract with the Naval Air Systems Command. Mason's projected book will deal not only with development at NADC, but also with sonobuoy work elsewhere in the United States, Canada, and the United Kingdom.

CONCLUSION

A history of NADC could be of great value both to the Navy and to historians of science and technology. For example, several NADC staff members we interviewed had not considered why their projects had been successes. A thorough investigation of several NADC development projects would provide valuable insight into the factors that promote the success of development projects. This information would be of value to NADC and to the Navy. Historians of science and technology are interested in technological change and the factors affecting it. NADC could provide a useful focus for investigating the complex relationships between the Navy, industry, fleet needs, RDT&E programs, Washington politics, Center reorganizations, and technological change. For example, the "systems approach" surfaced and became an important issue at NADC starting with A-NEW in the late 1950's, and in the 1960's the approach swept the Department of Defense under the direction of Secretary McNamara. The relations between these two events deserves further study. NADC also could provide a useful focus for investigating the relationship between the organization of the Center and the Navy and the technical effort of the Center. Many questions of mutual interest to Navy RDT&E management and to historians may be asked about NADC

There are two main sources for writing a history of NADC: interviews and printed material. The Center traces its history back to World War II and many of the participants in this history are still available for interviewing. This is an opportunity that should be pursued forthwith: the passage of time will weaken memories, scatter people, and diminish this resource. Some individuals are at the Center, including those who came in the late 1940's and early 1950's, others have moved into consulting work or retirement, but still may be available. Those interviewed for this project have expressed a willingness to supply additional names of strategic persons. The interested researcher can also identify many important people by consulting the recent Center document, "Twenty-Five Years of Accomplishments," which lists contacts for many important NADC projects. Two specific people should be contacted. Mr. Jim Howard, who is on Center, is collecting information on the development of sonobuoy work at NADC and is interested in assisting a larger historical effort. Mr. Russell Mason, a former Technical Director of the ASWL in the early 1960's is preparing a history of sonobuoys since World War l l. Both men should be contacted concerning sonobuoy and ASW history and to develop a list of further interviews.

The interviews for this project have demonstrated a significant difference between those Center personnel who have remained primarily involved in technical work and those who have moved into management. The scientists and engineers were most helpful in describing technical details of development efforts, whereas those who moved into management provided useful insight into the problems of organizing the Center's technical efforts. Each supplement the other and both should be included in future interviews.

A second source for writing a history of NADC is the material found in NADC records, most of which is stored at the Federal Records Center in Philadelphia. In the course of this project, we have correlated NADC records of shipments sent to the various Federal Records Centers with the computer printout showing material now stored at the F RC Philadelphia. This was a difficult task that should be pursued further in order to establish the existence and location of material described in Appendix C. We could not locate accession numbers for many shipments; hence, if these documents still exist it will be difficult to locate and retrieve them. In one case, a large (312 cu. ft.) collection of records from the period from 1938 to 1952 was destroyed because it contained only copies of originals. But it is unclear if the originals are available, and now there is no easy way to gather material on the Center's early history. Another problem lies with the

unknown quality of the material that is retrievable. The next step in assessing the value of written sources should be to go to the Philadelphia FRC and examine the stored NADC records.

In addition, we were not able this summer (1982) to obtain a computer printout of records held in a second location at the Philadelphia FRC, the archive, which may have NADC holdings.

A further source to be explored vigorously is historical material presently stored informally around NADC. Several of the people whom we interviewed intimated that "bottom drawer" collections were full of valuable sources Although we collected, copied, and filed material on several NADC projects, this remains a largely untapped resource. Some of this material only becomes available when the person holding the material retires. A concerted effort to locate, survey, and store this material will reserve a valuable historical source

A thorough study of NADC history will take several years, even with a concerted effort. This project focused on NADC records and organizational history, and a great deal of records work, interviewing, and collecting of on-Center material is still needed. In section 2 we described the frequent reorganizations of NADC, some caused by the addition of laboratories and others by the perceived threat of autonomous laboratories to the Center. The documents used for the survey history in section 2 were generated by those who wanted reorganizations. Little is known about those who might have opposed the reorganizations, or about the positive or negative impact of the reorganizations on NADC's technical achievements. Nor is much known about NADC's relations to its sponsors, especially from the perspective of those sponsors. A full evaluation of NADC and its technical achievement requires a broader perspective, which can be attained by evaluating NADC's relations with its sponsors. This requires locating sources on NADC from the Bureau of Aeronautics, the Navy Materials Command, the Navy Air Systems Command, and the Secretary of the Navy.

APPENDIX A

BIBLIOGRAPHY

Selected Bibliography of Historical Materials

Booz, Allen and Hamilton, Inc. Review of Navy R&D Management, 1946-1973. Washington, D.C.: Department of the Navy 1976.

Boyd, Kenneth A. "A Discussion of the Responsibilities of Functions of the Navy Research and Development Centers," Naval Engineers Journal 90 December 1978, 63-66.

Christman, A.B. Interview of Dr. Harry Krutter in April 1978 at NADC. Interview T-18-78 at DNL. An unedited transcript and tape of the interview is available in the NADC History Project files.

Christman, A.B. Interview of Captain Ralph S. Barnaby in April 1978 at the Franklin Institute. Interview T-19-78 at DN L. An unedited transcript and tape of the interview is available in the NADC History Project files.

Hardy, James D. and Clark, Carl C. "The Development of Dynamic Flight Simulation," Aero/ Space Engineering 18 June 1959), 48-52.

U.S. Congress. House Committee on Government Operations, Subcommittee on Military Operations. Organizations and Administration of the Military Research and Development Programs. Hearings,83rd Congress, 2nd Session, 1954. pp. 117-150, 475-500.

Johnson, Brian. Fly Navy: The History of Naval Aviation. New York: William Morrow and Company, 1981.

Mindak, Robert J. Management Studies and their Effect on Navy R&D. (ONR Report ACR 205) Washington, D.C.: Office of Naval Research, 1974.

Naval Air Development Center. "Accomplishment Summary" 1950-1956, unpublished.

Naval Air Development Center. "Historical Report" 1947-1960, unpublished.

Naval Air Development Center. "Command History" 1954-present, unpublished.

Naval Air Development Center. "NAVAIRDEVCEN 25 Years of Accomplishments." 25 May 1982. In NADC History Proiect file.

Navy Department. "U.S. Naval Administration in World War ll." 250 volumes. Washington, D.C.: Naval History Division, unpublished ms. Vol. 11 la-f: "The War History of the Fourth Naval District." Available on microfiche from Navy Department Library, Washington Naval Yard.

Christman, A.B. "Bibliographic Essay and Preliminary List of Books, Articles, and other Sources for Historical Studies on the Navy Laboratories." November 1980. Unpublished manuscript. In NADC History Project file.

NADC. "Aviation Medical Acceleration Laboratory Reports (formal and letter reports," covers years from 1961 to 1969. In NADC History Project file.

NADC. "8ibliography of Aviation Medical Acceleration Laboratory Publications, 1950-1960." (September 27, 1962). NADC-MA-6211

NADC. "Cumulative Bibliography." (January 1974). NADC-U-7400069.

NADC. "Cumulative Bibliography of Journal Articles, Conferences, Books by Naval Air Development Center Personnel." TIDBITS, Special Issue no. 2 (May 1975). In NADC History Project file.