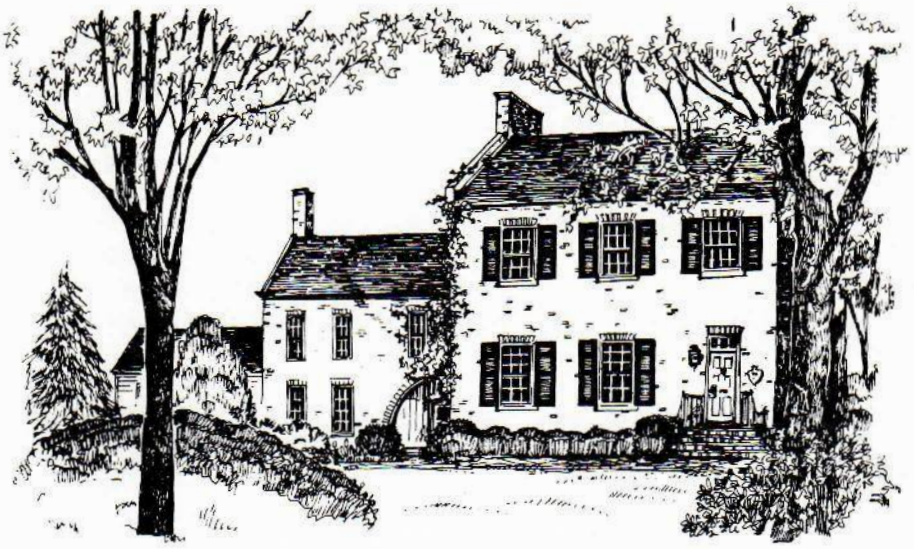

CAROL STUART WATSON

The Beall-Dawson House, c. 1815
home of the Montgomery County Historical Society
103 W. Montgomery Ave., Rockville, Maryland

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THE DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

by Mary Charlotte Crook

In 1937 the United States Navy chose a green meadow along the Conduit Road in Montgomery County as the new location of its Experimental Model Basin. This choice was the beginning of a succession of moves of Government agencies from the District of Columbia to Montgomery County which influenced the course of development in the County. Today the David W. Taylor Naval Ship Research and Development Center, as the Model Basin is now known, is a common sight to motorists crossing the Potomac River on the beltway's Cabin John Bridge, but what goes on within those large, strangely shaped buildings is a mystery to most County residents.

More than 200 years ago, Benjamin Franklin created one of the first "model basin" - a narrow, wooden trough filled with water. In this basin he pulled a small board by means of a weight attached to a string. Franklin wanted to determine if a boat really did go slower in shallow water, a phenomenon he had observed in a Dutch

canal. He timed the process at several different water levels and determined that the shallower the water, the slower the little board moved. In the middle of the nineteenth century an English engineer, William Froude, advanced the science of model testing when he proved that the behavior of a large ship could be predicted by the performance of small models of the same shape. In 1896, after more than a decade of pressure from the Navy, the United States Congress provided $100,000 to build a "Model Tank for Experiments." The tank was to be situated at the Washington Navy Yard and was to be constructed under the supervision of David Watson Taylor, a brilliant young Naval officer.

The Experimental Model Basin was housed in a long brick building in the southeast corner of the Navy Yard. The basin was 14 feet deep, 42 feet wide, and 470 feet long, the largest of its kind in the world at that time. It was filled with a million gallons of water taken from city water mains. A carriage, powered by four electric motors, towed the models through the water. At the insistence of David Taylor the models were made of wood instead of the inexpensive paraffin favored by other naval engineers. Thus his models were not distorted by the heat of Washington summers and could be kept indefinitely. More than 1000 ship designs were tested during David Taylor's 15 years at the Experimental Model Basin.

When aviation was born, its naval applications caught the imagination of Captain David W. Taylor. He designed his own wind tunnel for testing model airplanes in 1912, although the authorization for the facility did not come until the following year. In March 1914, the wind tunnel began operations. At the time it was the largest of its kind in the world and, at 54 miles an hour, had the fastest air speed. In a few short years the wind tunnel had produced results of great importance. The first complete airplane model tested was also the first two-engine Navy plane and the first airplane fully designed by the government. The NC-4, the first airplane to cross the Atlantic Ocean, was also designed at the Experimental Model Basin.

While the Experimental Model Basin was the largest and finest installation of its kind in the world when it was constructed in 1896, it was no longer adequate by 1929. Ships were increasing in size so that the models had to be larger. But with larger models there was interference from the walls, bottom, and ends of the old tank so that errors crept into the measurements. Higher speeds required faster carriage runs, but, in its constricted space, the carriage could only run a few seconds. Sinkage was a mammoth problem: on the river end of the building, the carriage tracks had sunk 5 1/2 inches, making sensitive tests extremely difficult. In addition, there was trouble with flooding, leakage, and machinery breakdown. Captain Ernest F. Eggert, Officer in Charge of the Experimental Model Basin, suggested that a new model basin be built. A list of requirements was established to guide the selection of a site. The most important of these requirements were: First, a suitable layer of bedrock was needed as foundation for the tracks upon which the towing carriages were to run to ensure that the accurate alignment required for precision measurements could be maintained indefinitely. Second, an ample supply of fresh water for the testing basins had to be available. Third, the establishment should be within easy reach of the Navy Department so that personnel from Washington could make frequent visits conveniently.

Although there was no encouragement from the Hoover Administration and a special appropriation requested by the Navy and backed by maritime societies died in committee in the early years of the Roosevelt Administration, planning for a new model basin proceeded under the leadership of Commander Harold E. Saunders. When Saunders went to sea in 1933, design work was transferred to the Bureau of Yards and Docks where Commander Ben Moreell developed most of the architectural design.

In 1935, Commander Saunders returned from sea duty and was placed in charge of the final design of the model basin. Early in 1936, the Navy again tried to gain Congressional approval. On January 13, Representative Vinson of Georgia introduced HR 10135 authorizing $3,500,000 "for the construction of a model basin on 55 acres of land, more or less, in the vicinity of Cabin John, Maryland." The House Committee on Naval Affairs offered to change the wording of the clause specifying location to "a site at a cost not to exceed $100,000 in the vicinity of Washington, D.C." Vinson concurred, aware that the Cabin John site might not be approved. The bill passed the House without debate.

The bill's course in the Senate was not as smooth. When the bill first came up for debate on March 27, 1936, Senator Borah demanded to know what the basin was to be used for. "What is it, a bathing basin?" he asked. The bill was tabled, but, on April 24, it reappeared. Its defenders, Senators Walsh and Tydings, were ready with answers for the opposition. The bill passed without opposition and became law on May 6, 1936. It read:

Public Law No. 568 - 74th Congress (HR 10135)

An Act

To authorize the construction of a model basin establishment, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Navy is hereby authorized to acquire a site at a cost not to exceed $100,000 in the vicinity of Washington, District of Columbia, and to construct thereon a model basin establishment, with buildings and appliances, in which the Bureau of Construction and Repair of the Navy Department shall conduct the work of investigating and determining the most suitable and desirable shapes and forms to be adopted for United States vessels, including aircraft, and the investigation of other problems of ship design, at a cost not to exceed $3,500,000: Provided, That upon the authorization of the Secretary of the Navy, experiments may be made at this establishment for private parties, who shall defray the cost thereof under such regulations as the Secretary of the Navy may from time to time prescribe: Provided further, That the results of such private experiments shall be regarded as confidential and shall not be divulged without the consent of such private parties, except that the right is reserved to the Secretary of the Navy to use data so obtained for governmental purposes, subject to the patent laws of the United States. Approved May 6, 1936 (49 STAT., pp. 1263-4)

The $3,500,000 was formally appropriated in two installments, the first for $3,000,000 on April 27, 1937, and the remainder on June 25, 1938. In each case, the bill included a new clause - "exclusive of any buildings or facilities for testing other than surface or sub-surface craft." There obviously were no plans by the Congress to replace the Model Basin wind tunnels.

The search for an appropriate site intensified. More than 20 areas were examined and rejected, until one day a long-time Model Basin employee told Commander Saunders about a large meadow which lay between the Conduit Road and the Chesapeake and Ohio Canal not far from the original Cabin John site. This site, only 12 miles from the center of the city of Washington, fulfilled most of the basic requirements. The bedrock was essentially level and was near the surface, in some spots being covered by only a foot of clay and loam. The Washington Aqueduct under Conduit Road

was close at hand to provide an abundant supply of fresh water. So a tract of 107.136 acres of land was purchased by the Government from the Woodside Homes Corporation on July 15, 1937, for $61,424.[1] The Woodside Homes Corporation had purchased[2] 275 acres of land, which was part of the tract "Carderock," in 1927 with the intention of using it for a housing development. Building sites were laid out, and a sales office was erected on the site. But the venture was doomed to failure because of the depression. The name "Carderock" had been given to a tract of 1704 3/4 acres patented by Robert Peter of Georgetown on March 12, 1802. It was a resurvey of three tracts, "Griffiths Park," "Dyalls Delight," and "Clewerwall Enlarged" made May 3, 1786 and corrected December 14, 1793.[3] Today the name "Carderock" is commonly used by the employees of the Center as the location of the place where they work.

The Turner Construction Company of New York, with a bid of $2,675,000 was awarded the contract for construction of the basin building and three other connected buildings to house shops, offices, and laboratories. Ground was broken on September 8, 1937. Soon after the ground-breaking ceremony, the Secretary of the Navy named the establishment the David Taylor Model Basin. Construction was completed in June 1939, one month ahead of schedule. Dedication ceremonies were held on November 4, 1939, with Rear Admiral David Watson Taylor, then confined to a wheel chair, in attendance. He died the following July, but he had lived to see the completion of this new, modern facility designed to carry on the work which he had pioneered. The staff which moved to Carderock from the Navy Yard in 1940 numbered 209 civilians and 8 Naval officers.

The most distinctive feature of the David Taylor Model Basin was, and is today, the basin building. The original basin building was 1188 feet long covered by a barrel-shaped roof with a span of 110 feet. The building contained a deep-water basin, a shallow-water and turning basin, and a high-speed basin parallel to the other two. Along the sides of these basins heavy steel rails were laid on which the carriages ran which towed the models. The rails were bolted to a series of heavy, cast iron "chairs" which were imbedded in the concrete basin walls which had been poured directly onto the granite-gneiss ledge of bedrock. To eliminate errors which would be introduced into the measurements by the curvature of the earth over the 1100-foot length of the basin, the rails were leveled to match the curvature of the earth.

The main building group is a glistening white structure faced with precast reinforced concrete panels. The two-story shop and laboratory buildings are on opposite ends of the three-story office building with a taller tower rising above the main entrance. This building group was built to face the planned George Washington Memorial Parkway on the south, although access for many years was from the Conduit Road (now MacArthur Boulevard) on the north side. The architectural design of the main building group won a prize, First Award of Class A, and special commendation in the Sixth Annual Exhibition of the Association of Federal Architects in 1937.

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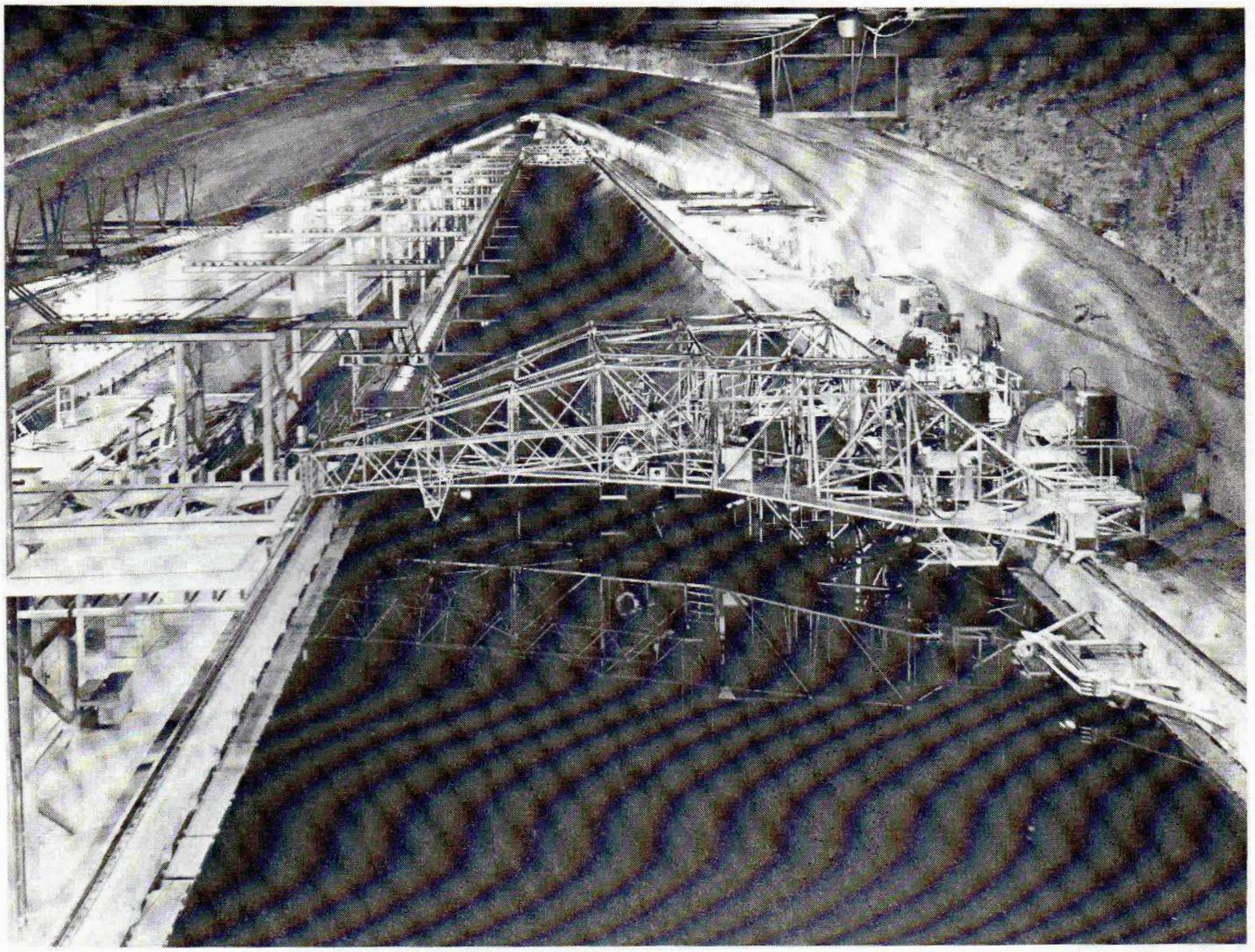
1. Montgomery County Deeds, Book 673, p. 370.

2. Montgomery County Deeds, Book 422, p. 134.

3. Edith Martin Armstrong, A Brief History of Cabin John Park (March 1947), unpublished manuscript, Montgomery County Historical Society Files.



Official U.S. Navy Photo

Interior of Basin Building Showing Carriage
for Towing Models

Another of the original requirements for selection of a site was that it be within convenient traveling distance of suitable homes for the staff. This requirement was only partially met by the small communities of Cabin John and Glen Echo. So, in December 1940,[4] the Government purchased 19.27 acres of land west of Cabin John Creek and south of the Conduit Road from Mary Ellen Bobinger, widow of William H. Bobinger. This tract had been the site of the Cabin John Bridge Hotel of which William and Mary Bobinger were the last owners. It was also the Cabin John site originally contemplated for the new model basin. By 1943, the Government had erected 100 "temporary" homes on the site for the employees of the David Taylor Model Basin. The development was named Cabin John Gardens. A smaller tract was purchased north of Conduit Road and west of Seven Locks Road in Cabin John on which 20 homes for

Official U.S. Navy Photo

Froude Circle, Cabin John Gardens, 1945

4. Montgomery County Deeds, Book 807, p. 421.

black employees were erected. These homes were the only residential construction in the County during World War II.[5] In 1955, when the Public Housing Administration was ready to dispose of its wartime housing projects, the residents of Cabin John Gardens did not want to give up their homes. So they formed a cooperative, "Cabin John Gardens, Inc.," on December 2, 1955, and purchased the development on February 28, 1957.[6]

World War II brought an expansion of facilities and staff and long working hours to the Model Basin. A 56-hour work week was the standard, and many of the test facilities were operated day and night. With no public transportation car pools were a way of life. Before the war jobs for women had been restricted to the clerical field but, within a year after the entry of the United States into the war, women mathematicians were making calculations and plotting test data for the scientists and were even operating the towing carriages!

Expansion even included the arrival of the Army. In 1942, the Commanding General of the U.S. Army, Military District of Washington, asked the Navy to provide space for an Army camp. Three battalions were soon quartered at Carderock.

Late in 1940, work had been resumed on plans for new wind tunnels, plans which had been specifically eliminated from the Congressional appropriation of 1936. On March 17, 1941, funds were finally authorized by Congress for their construction. Two similar wind tunnels with 8-foot by 10-foot test sections were completed at Carderock in 1943. The Aerodynamics Laboratory staff was officially transferred from the Washington Navy Yard to the David Taylor Model Basin on January 1, 1944. However the wind tunnels at the Navy Yard continued to be used intermittently until their decommissioning in 1952.

By 1945 the Model Basin employed 706 civilians and 164 Naval officers and enlisted men. Even with the end of the war, growth did not stop. Another 50 acres was acquired to the east to extend the basin building. The need for higher speed meant that the basin was not long enough for the towing carriage to accelerate to the desired speed, have a significant length of test run, and still have enough distance to stop safely. The basin building was extended in length to 3200 feet. With this addition the deep-water basin was extended to 2775 feet, and the high-speed basin to 2968 feet, more than half a mile! Two supersonic wind tunnels brought from Kochel, Germany, were assigned to the Aerodynamics Laboratory in May 1946. A transonic wind tunnel was completed in March 1956, and a hypersonic tunnel was installed in 1959-1960.

In 1952, the Applied Mathematics Laboratory was established as a computer center for the Bureau of Ships. A building to house this laboratory and its first computer - a Universal Automatic Computer (UNIVAC) - was completed in 1953. The new laboratory immediately proved its worth. When Congress needed 122 tables of 400,000 entries to include in a veterans' survivors bill, the UNIVAC completed the project in four weeks at a cost of $15,000. By conventional methods, the calculations would have taken months and cost some $200,000.

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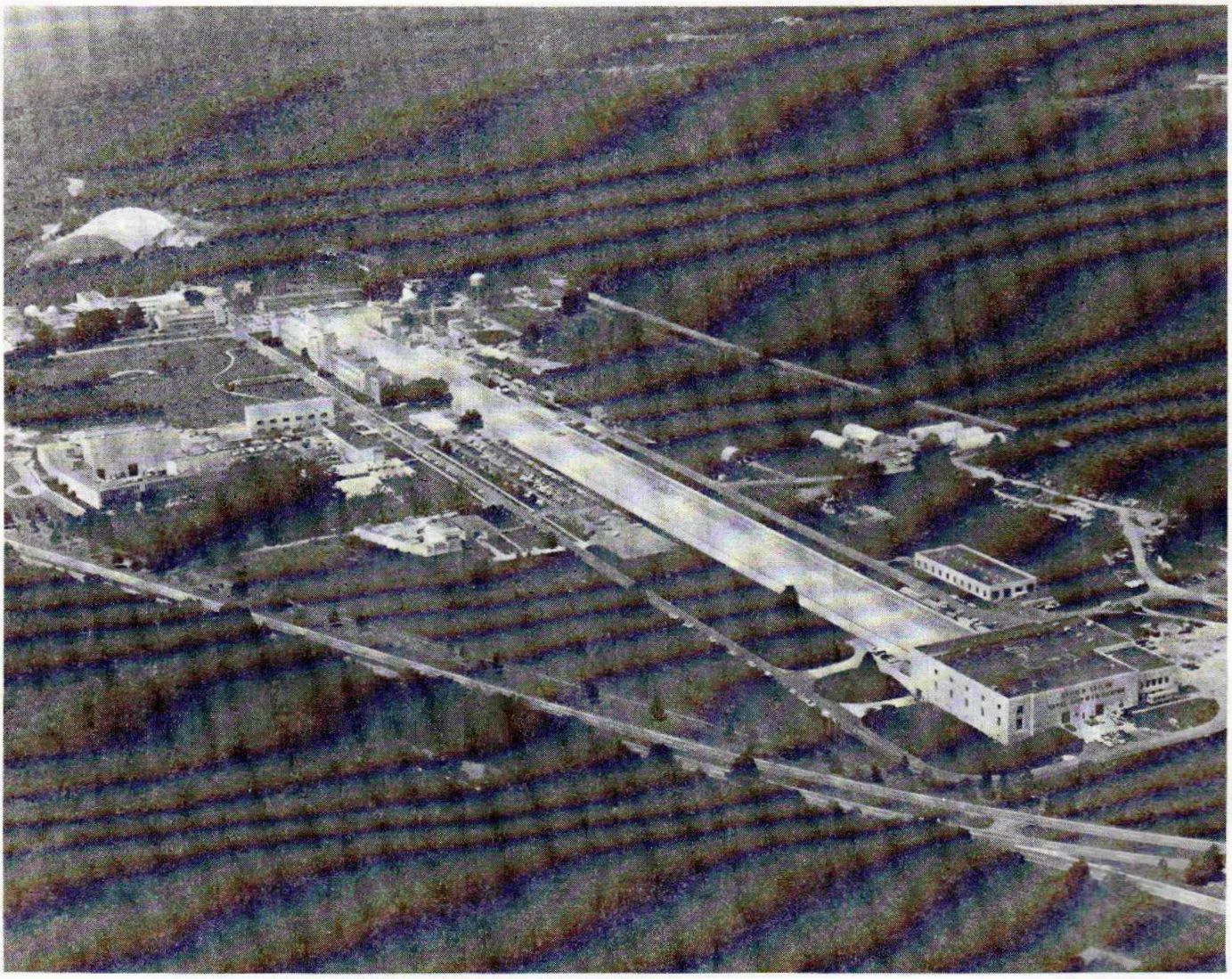
5. Ray Eldon Hiebert and Richard K. MacMaster, A Grateful Remembrance, the Story of Montgomery County, Maryland (Rockville, MD: Montgomery County Government and the Montgomery County Historical Society, 1976), p. 331.

6. Montgomery County Deeds, Book 2315, p. 67.

Another of the Model Basin's impressive buildings was completed in 1961. This enormous building, covering five acres at the west end of the complex, houses the Maneuvering and Seakeeping Facility, two huge basins. One basin is rectangular, 240 feet wide, 360 feet long, and 20 to 35 feet deep. It is equipped with wavemakers on the west and north sides so that waves of various types can be generated. In this basin the performance of ships in rough seas can be predicted. The other basin, the Rotating Arm Basin, is circular, 260 feet in diameter and 21 feet deep. Here models are towed in circular paths through still water to analyze turning maneuvers.



Official U.S. Navy Photo

Aerial View of David W. Taylor Naval Ship Research and Development Center Looking West

The long, window-less building is the Basin Building. The original main building group is to the left of it at the far end. The large building at the top left is the Maneuvering and Seakeeping Facility. The Structures Laboratory is at the left center.

Among the members of the Experimental Model Basin at the Navy Yard was a group of structural engineers who were concerned with the strength of ships and the effects on ship structures and personnel of the blast from the firing of the ship's own guns and from the bombs and torpedoes fired by the enemy. By the 1950's, there was greatly increased interest in submarines. The limiting factor in the depth at which a submarine can operate is the strength of its pressure hull. Two pressure tanks for testing models of submarine hulls were constructed during this period. In 1967, a modern building to house the Structures Laboratory was built at the southeast end of the establishment near the parkway. Today it houses test tanks ranging in diameter from 17 1/2 inches to 13 feet. Each tank has the highest operating pressure for its diameter of any quick-opening test tank in the United States.

By 1960, the David Taylor Model Basin had grown beyond the confines of its 186 acres at Carderock. A field station was established at Bayview, Idaho, where submarine and underwater sound test could be made in the deep water of Lake Pend Oreille. Subsequently, other detachments were established: the Acoustic Trials Detachment, Cape Canaveral, Florida; the Underwater Explosions Research Division, Norfolk Naval Shipyard, Portsmouth, Virginia; the Hydrofoil Special Trials Unit, Puget Sound Naval Shipyard, Bremerton, Washington; and the Experimental Trials Unit, Panama City, Florida. But the major reorganization was yet to come.

During the decade of the 1960's, the Department of Defense directed increased attention to the in-house research and development laboratories of the Army, Navy, and Air Force. The proposed changes, intended to strengthen the laboratories, included the elimination of some of the management layers between the Assistant Secretaries for Research and Development and the principal laboratories, the extension of laboratory responsibilities from basic research through operational development, and the assignment of increased authority and responsibility to the laboratory directors. These changes also encompassed the concept of larger laboratory centers. Thus, in 1966, the David Taylor Model Basin was placed under the direct control of the Chief of Naval Material rather than the Bureau of Ships, its parent organization for many years. The following year, on March 31, 1967, the Navy formed its first laboratory center through the merger of the David Taylor Model Basin and the Marine Engineering Laboratory in Annapolis, Maryland, under the name Naval Ship Research and Development Center. The omission of David Taylor's name was not popular with some of the former staff at Carderock - a staff which had worked long and hard to make the name David Taylor Model Basin known and respected in its field. Thus, in 1975, in response to pressures from the naval architectural community, the name was again changed, becoming the David W. Taylor Naval Ship Research and Development Center.

At the present time there are six technical departments at Carderock: the Ship Performance Department, the Aviation and Surface Effects Department, the Structures Department, the Computation, Mathematics and Logistics Department, the Ship Acoustics Department, and the Systems Development Department. Currently the Ship Performance Department is working on changes in the shapes of hulls and appendages of submarines to increase their speed; the Structures Department is working on changes in hull material and design to increase the strength of submarines so that they can dive deeper; the Ship Acoustics Department is working on changes in submarine design to reduce noise so that the submarine will be more difficult to detect. Work at the Center covers the full scope from basic analytical studies of new ideas through their verification by small-scale model tests to tests of full-scale operational ships. Two modern programs aptly demonstrate this scope. They are the hydrofoil program and the surface effect ship program. Both began with theoretical studies of the basic concepts: the hydrofoil boat which lifts off the water and rides on its foils and the surface effect ship which lifts off the water and rides on a cushion of air.

Both programs have now reached the point where work is concentrated on large experimental craft. The largest hydrofoil boat in the world, USS PLAINVIEW, based at the Puget Sound Naval Shipyard, is operated by the Center to evaluate performance under a variety of conditions and to explore capabilities of importance to the Navy. In the development of surface effect ships, two 100-ton experimental craft have been tested to demonstrate this new concept and to provide performance data for the design of a 3000-ton ship. One of these 100-ton craft has attained a speed of 100 miles per hour.

The Center also is involved in the testing of operational Navy ships. Full-scale acoustical trials are conducted to measure the noise generated by the ship. Underwater explosion tests are made to determine equipment which might be rendered inoperable by shock. New submarines are instrumented for their initial deep dives to confirm that stresses and strains are as predicted in laboratory tests. Engineers and scientists are called upon to go to sea to diagnose problems in the operating Fleet and to make recommendations for their solutions.

Many changes have been brought about in the last 25 years by the advent of electronic computers. The early computers relieved the tedium of hand calculation and plotting of data. With modern computers a ship can be "modeled" in the computer, and the effects of changes in dimensions and arrangements can be determined quickly and cheaply. Because of the Center's vast computer capabilities, it has been assigned responsibility for logistics research and development, that is, the use of computer equipment and communications technology to control supply, transportation, and maintenance of equipment.

Today the David W. Taylor Naval Ship Research and Development Center is the principal Navy research and development center for naval vehicles and logistics. The 1767 civilians and 11 Naval officers at Carderock are proud of the Center's accomplishments in satisfying the Navy's requirements and supporting the operating Fleet for more than 80 years. With its outstanding facilities and competent staff, the Center will continue to extend the frontiers of knowledge and generate new ideas for ships, submarines, and aircraft.

Acknowledgments

The David Taylor Model Basin, A Brief History, published by the Naval Historical Foundation in 1971, was the basic source document for this Story. This document and others were provided by the Public Affairs Office of the Center. Special thanks are due Mrs. Jane Wootton and Mrs. Florence Becker of that office for their willing assistance and enthusiastic support.