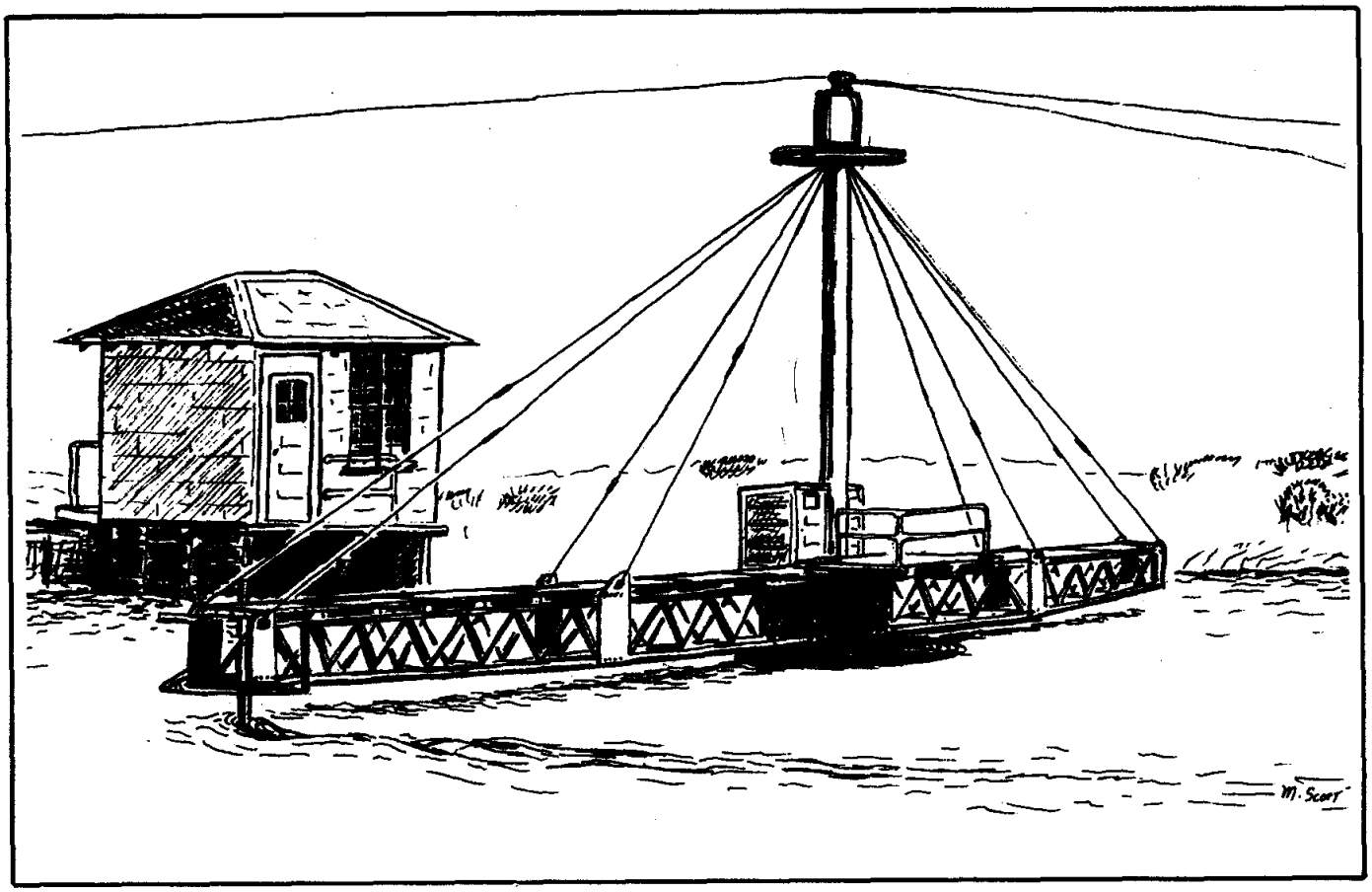
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK DEDICATION

THE ALDEN RESEARCH LABORATORY

ROTATING BOOM



Alden Research Laboratory
Worcester Polytechnic Institute
May 7, 1982

DEDICATION
NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK
THE ALDEN RESEARCH LABORATORY ROTATING BOOM

Presiding	Professor William W. Durgin Chairman, Worcester Section ASME
Welcome	Dr. Edmund T. Cranch President, Worcester Polytechnic Institute
Remarks	Ralph K. Mongeon, Chairman Worcester Section ASME History and Heritage Committee

National Historic Mechanical Engineering Landmark Program
Professor J. J. Ermenc, Dartmouth College
Chairman, ASME History and Heritage Committee

History of the ARL Rotating Test Boom
Mark Scott and John Eleftherakis
WPI Student Section ASME

Adjourn to the Rotating Test Boom

Remarks and Presentation of Plaque
Professor Robert B. Gaither
President, ASME

Acceptance — Professor George E. Hecker
Director, Alden Research Laboratory

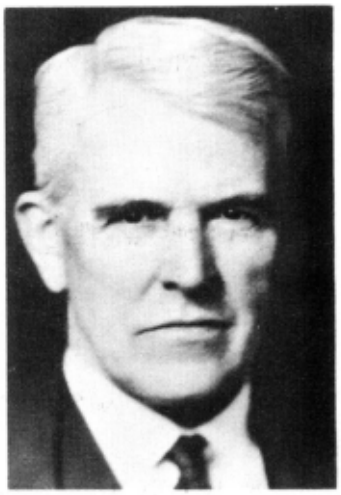
Photographs in this booklet are from the archives of Alden Research Laboratory and Worcester Polytechnic Institute. Drawings by Mark W. Scott, WPI '83.

THE ROTATING TEST BOOM

THE IDEA OF CONSTRUCTING a rotating boom for hydromechanical tests at the Alden Hydraulic Laboratory originated with Professor Charles Metcalf Allen, head of the lab from 1896 to 1950. The original boom was designed in 1908 by Professor Allen, assisted by two Worcester Polytechnic Institute students.

Professor Allen needed a moving test stand for hydraulic experiments and for rating current meters. A circular test apparatus was chosen over a towing tank because the former: (a) was much less expensive to construct, (b) allowed longer test runs, and (c) enabled larger objects to be tested without experiencing boundary effects from channel sides.

The original boom was constructed of wood on a submerged rock foundation located about 45 feet from shore in a pond adjacent to the Alden Hydraulic Laboratory in Holden, Massachusetts. This boom had a 42-foot testing arm balanced by a 21-foot arm loaded with counterweights. Rotational power was supplied by a 24-inch Hercules water turbine located onshore. The power from the turbine was transmitted to the boom through a rope and pulley drive system, producing tip speeds of up to ten feet per second. In 1911, the original boom was replaced by an equal-arm, 84-foot steel boom. The turbine drive system was replaced in 1936 by an electric motor located at the center of the boom, which increased the maximum tip speed to 20 feet per second. The boom has been used periodically since 1936 without any major changes.



Professor Charles M. Allen

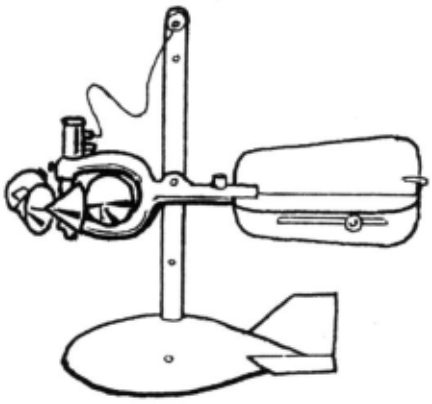
The original wooden boom, c. 1910.

USES OF THE ARL ROTATING TEST BOOM

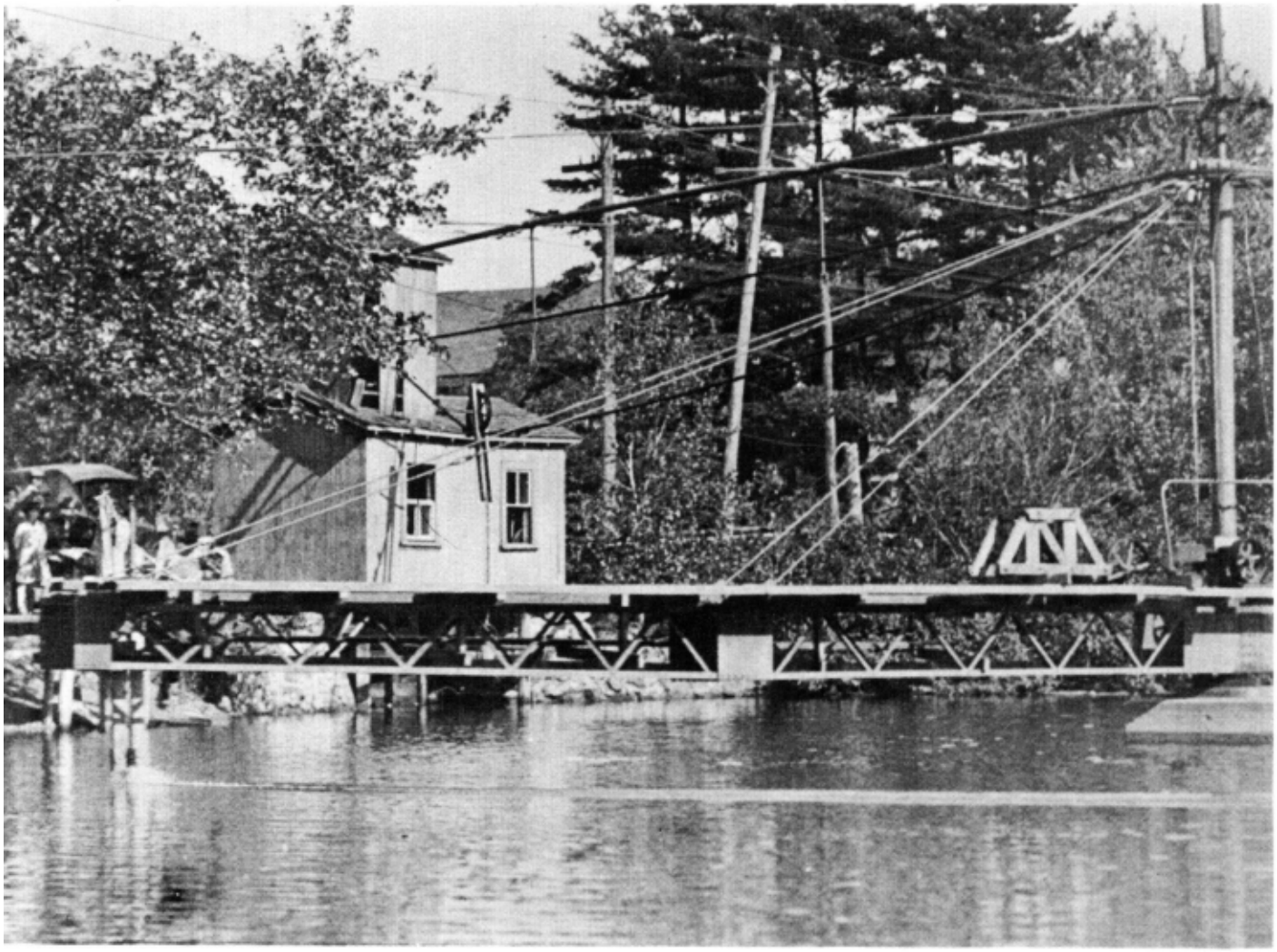
DURING ITS 74-YEAR EXISTENCE, the rotating test boom has been utilized in experiments and tests that reflect the nation's needs and its developing technology. Some examples are:

Current meter rating	1908 - Present
Aircraft propellers	1911 - 1918
Artillery shell ballistics	1915 - 1925
Ships' logs	1920 - 1950
Pitot tubes	1936 - 1950
Minesweeping paravanes	1940 - 1945
Darrieus water turbines	1981 - Present

The rating of current meters was one of the first functions of the rotating test boom and has been one of its primary uses. Due to the facility's ability to conduct long test runs, accurate calibrations can be made. Through the years these calibrations have been conducted for both the manufacturers and the users of current meters.



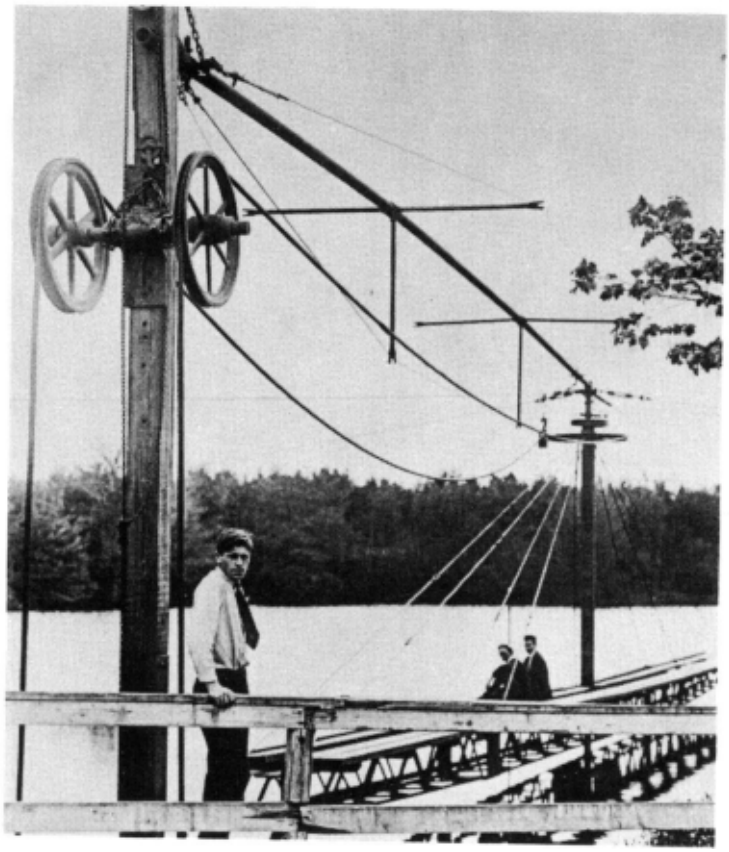
Typical current meter for measuring flows in rivers and streams.



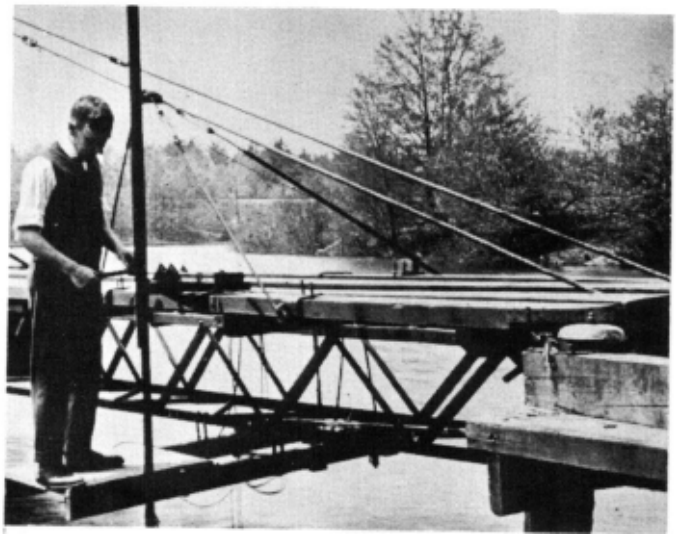
Steel boom, c. 1920.

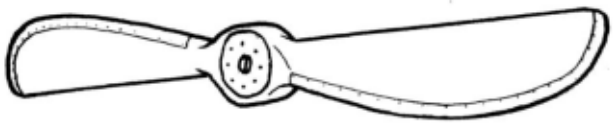
THE BEGINNINGS OF WHIRLING ARMS

Rotating booms, earlier called "whirling arms, " had been around for more than 160 years before the boom at the Alden Hydraulic Laboratory was built. Probably the first one was devised during the 1740s by Benjamin Robins in England for studying the air resistance of projectile forms. In the early 1750s, John Smeaton, another Englishman, used one for windmill tests. In addition, Jean Charles Borda of France tested various shapes in water throughout the 1760s using a whirling arm.



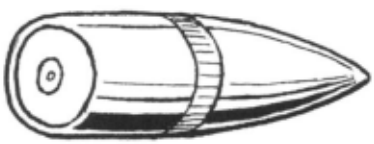
Rope drive, c. 1920.



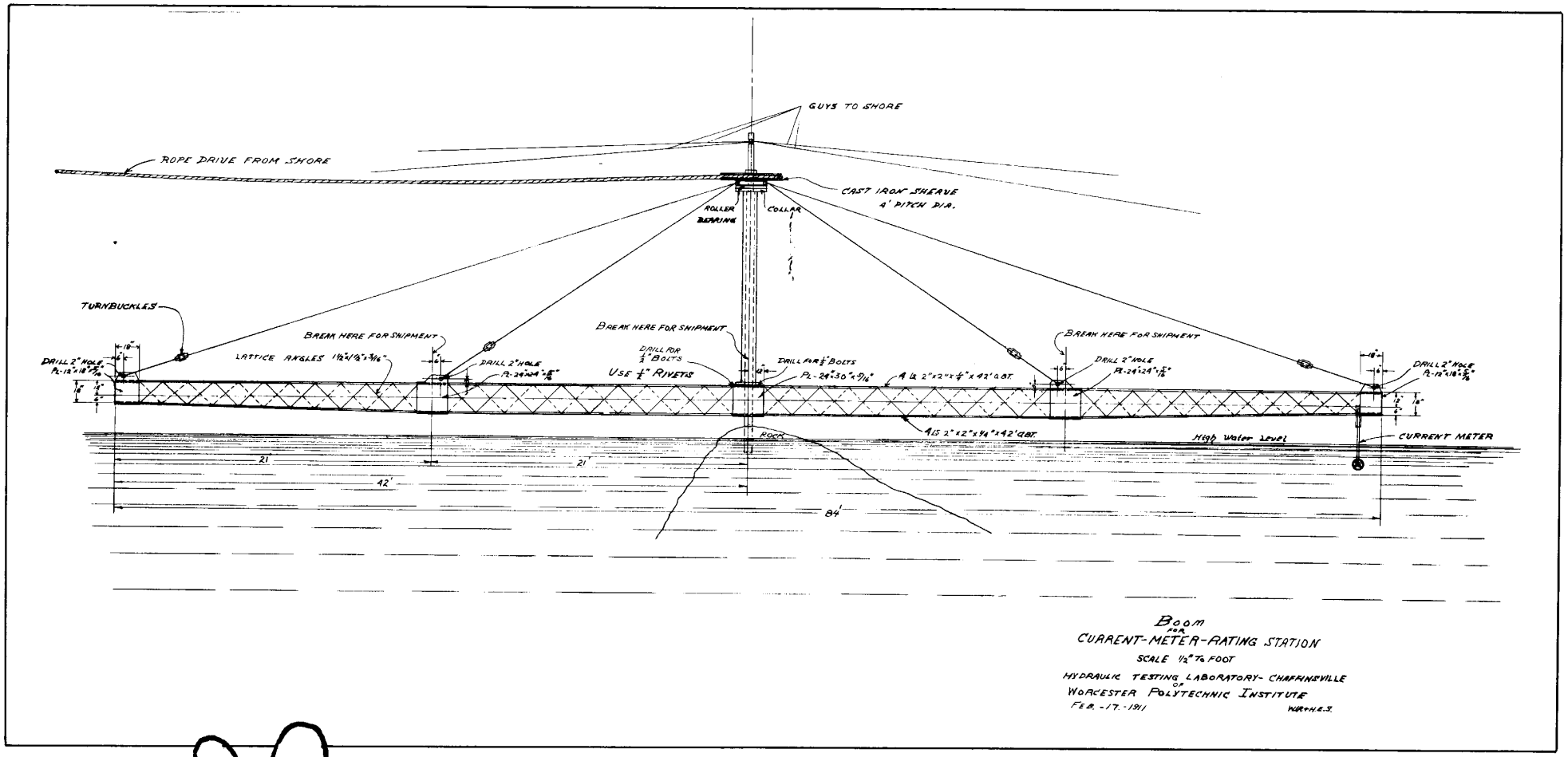


One of the aircraft propellers designed and tested on the rotating boom.

A significant adaptation of the boom occurred in 1911. The original boom was replaced by a stronger steel boom which allowed Professor David Gallup of WPI to use it as a moving platform for testing aircraft propellers. A 75-horse-power electric motor, placed at the center of the boom, transmitted power through a long drive shaft and angle drive to a propeller mounted at the end of the boom. The propeller's thrust caused the boom assembly to rotate while a drag device in the water was used to calculate the power dissipated. As one of the first non-stationary series of tests to measure propeller efficiencies, this was an important application of the boom. Several of the propellers from these experiments are on permanent display at the Smithsonian Institution's National Air and Space Museum in Washington, D. C. as well as at the Alden Research Laboratory.

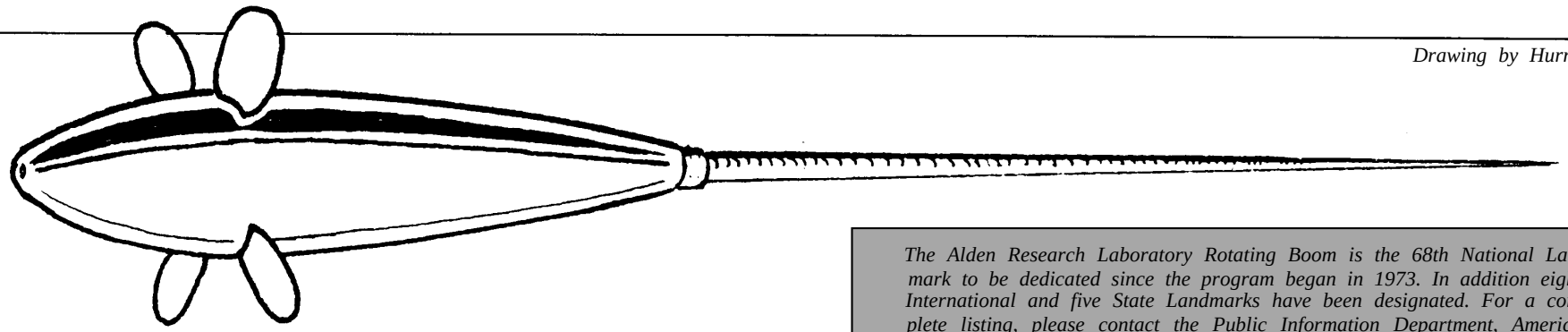


Typical artillery shell of the period.



Boom
FOR
CURRENT-METER-RATING STATION
SCALE 1½" TO FOOT
HYDRAULIC TESTING LABORATORY- CHAFFINEVILLE
OF
WORCESTER POLYTECHNIC INSTITUTE
FEB. -17.-1911
WPI-H.E.S.

Drawing by Hurry Awiszio



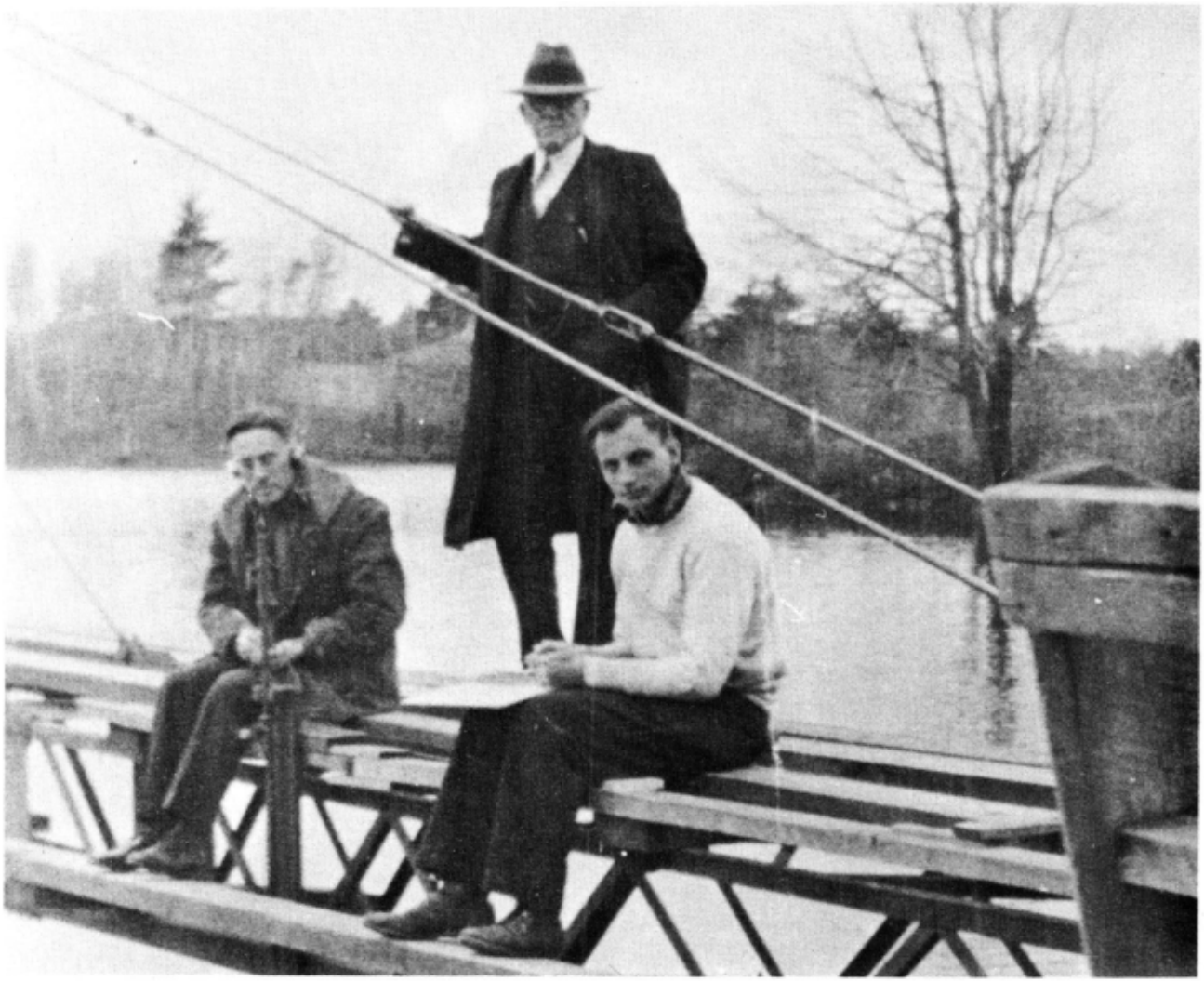
Ships' log for measuring distance traveled through the ocean.

The Alden Research Laboratory Rotating Boom is the 68th National Landmark to be dedicated since the program began in 1973. In addition eight International and five State Landmarks have been designated. For a complete listing, please contact the Public Information Department, American Society of Mechanical Engineers, 345 East 47th St., New York, NY 10017.

During World War I, Major Victor E. Edwards, WPI 1883, made another use of the rotating boom by conducting drag tests for artillery shells. The tests proved to be valuable in his subsequent studies of artillery shell ballistics at the Aberdeen Proving Grounds in Maryland.

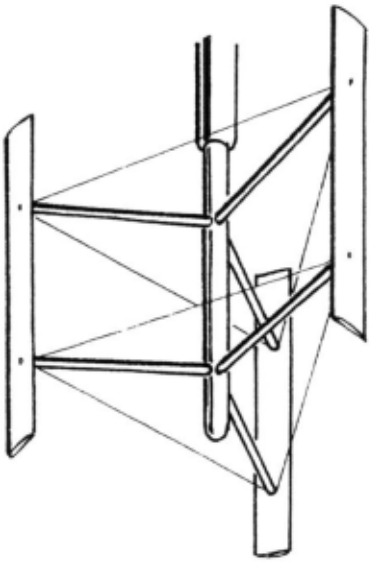
Ships' logs, distance measuring instruments for oceanic travel, were also developed and calibrated using the boom. Final production models of ships' logs—the result of prototype testing on the boom—were used on many ships during World War II. In addition, the designs for many of the paravanes used by minesweepers in World War II were a direct result of model tests which were conducted on the boom.

Pitot tube for measuring local velocity head.

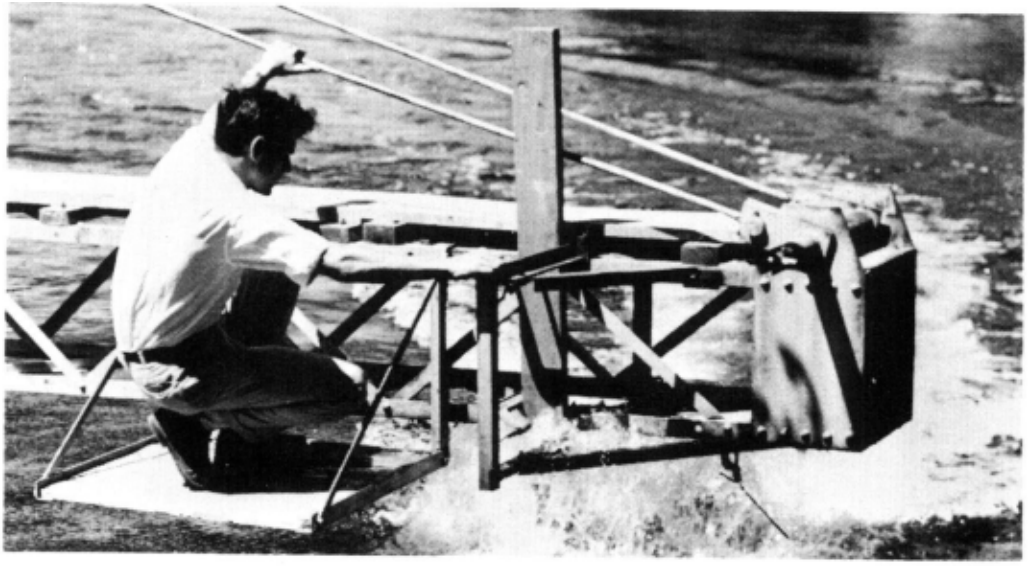


Left to right: L. J. Hooper, C. M. Allen, C. W. Hubbard.

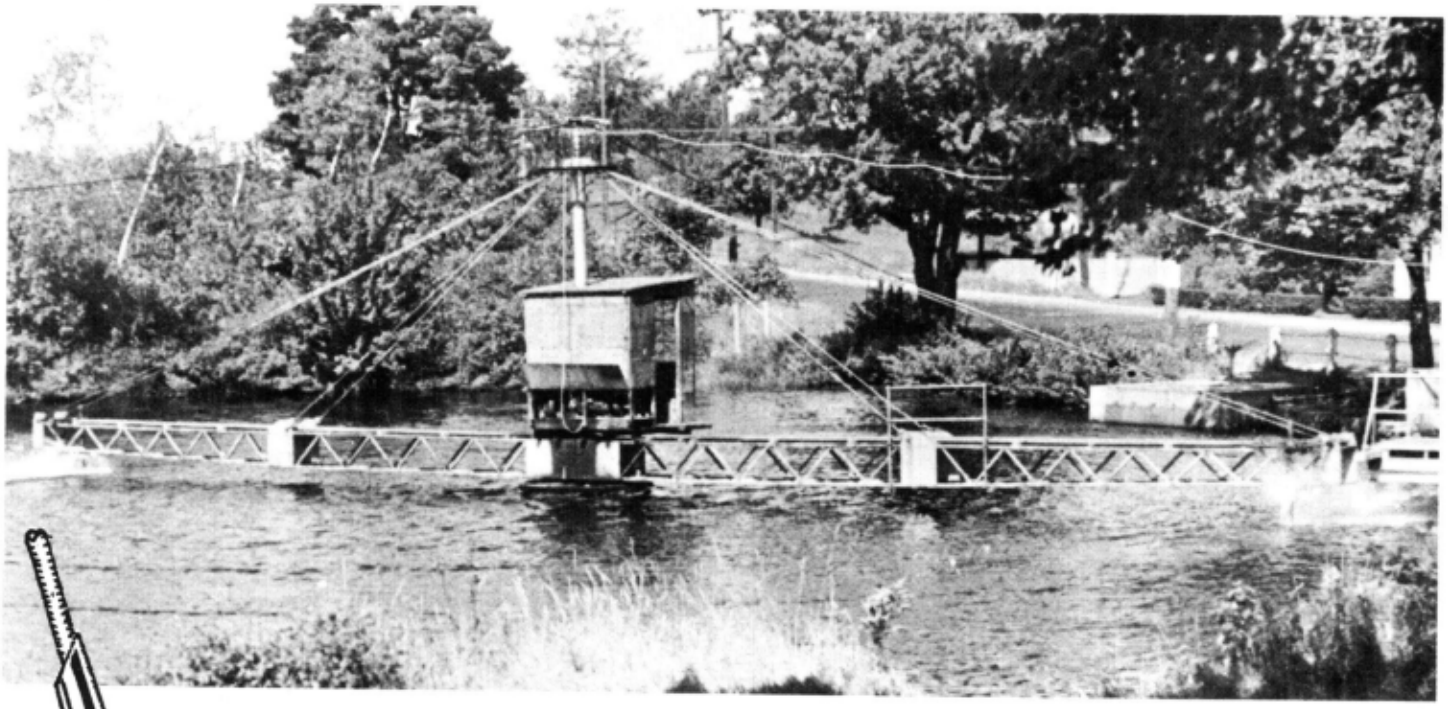
In the 1930s, the boom was used by Clyde W. Hubbard during extensive investigations of errors in pitot tube measurements. His work greatly clarified the understanding of the behavior of pitot tubes. As a result of these and other investigations, the pitot tube became an accepted measurement device for fluid flow.

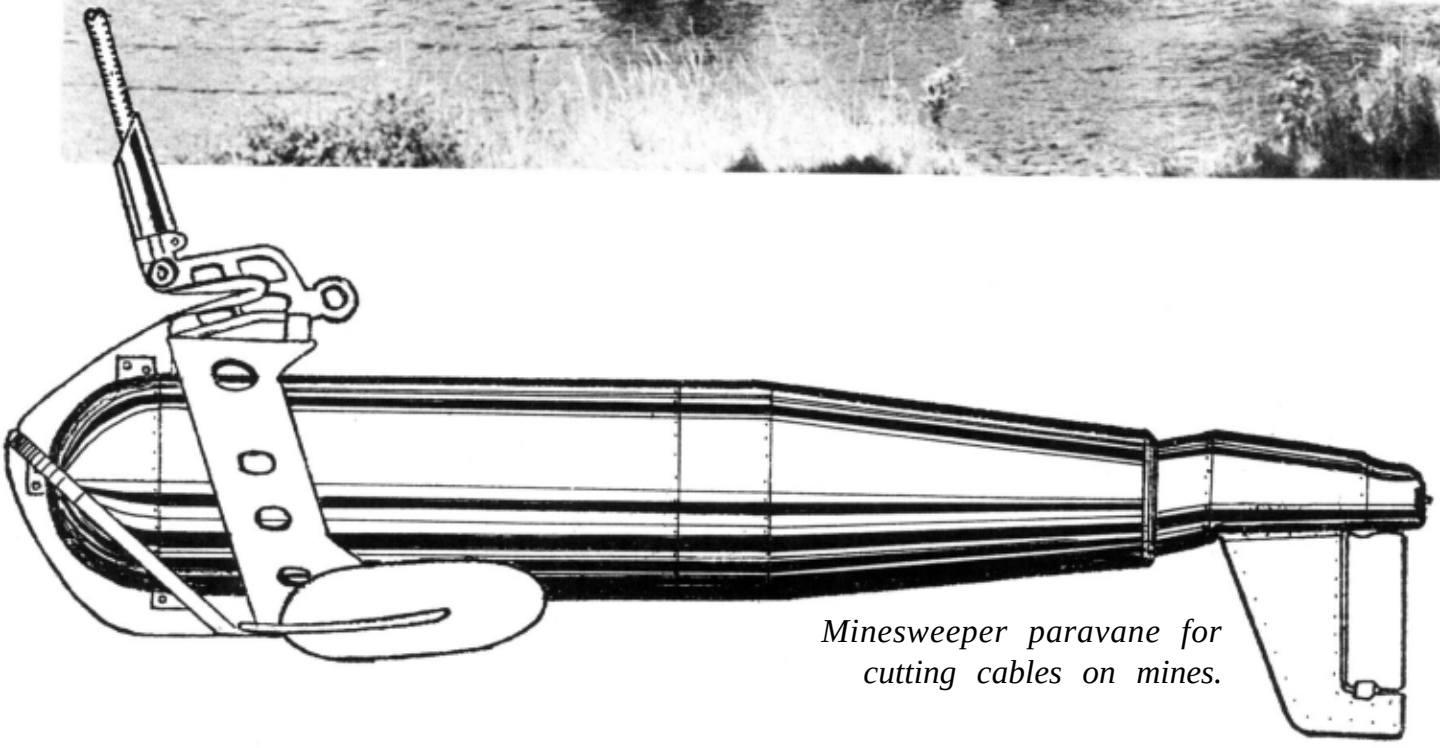


Darrieus rotor for generating power from a flowing fluid.

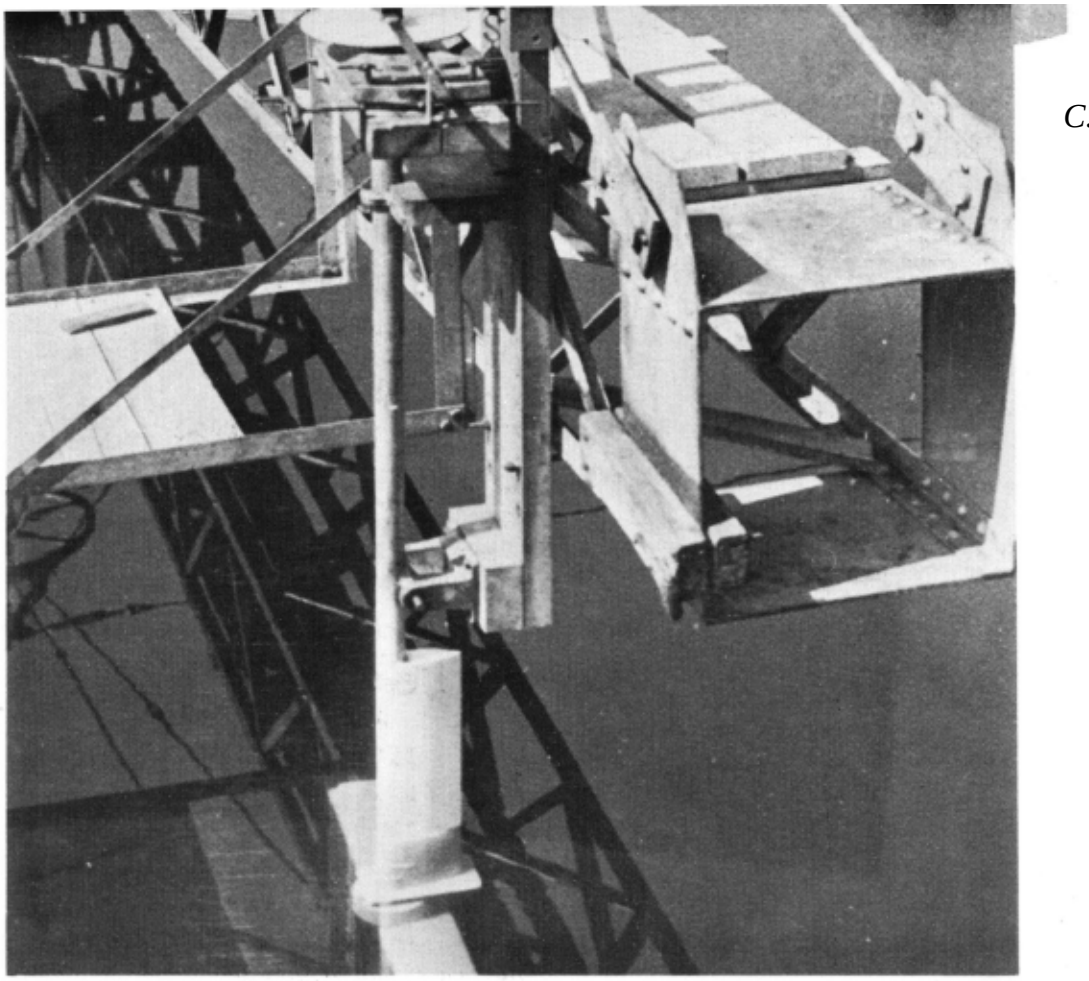


Graduate research assistant Matthews testing ships' log on steel boom, 1936.

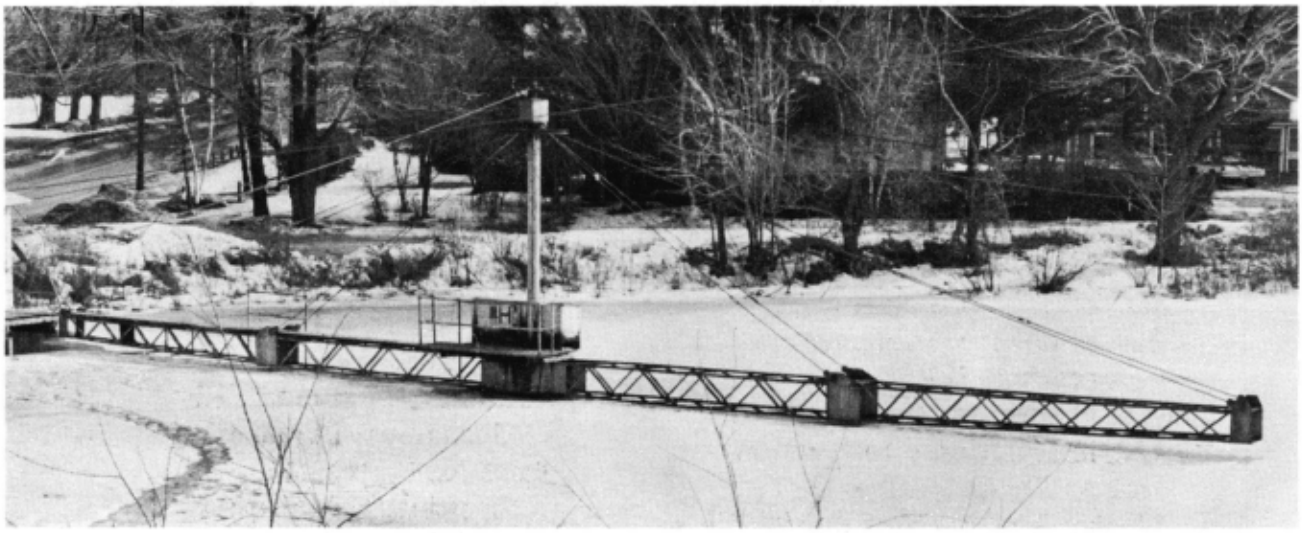




Minesweeper paravane for cutting cables on mines.



C. 1950.



The boom as it appears today.

THE EQUIPMENT TESTED on the boom has been representative of the technology and the needs of the nation at different times in its history. The most recent use of the boom, the testing of Darrieus water-turbine designs, and the other examples demonstrate the variety and the importance of the Alden Research Laboratory's rotating test boom applications.

After 74 years, the boom is still operational and is available for further imaginative uses to meet national interests and needs.

CONTRIBUTORS TO THE PREPARATION OF THE NOMINATION OF THE ROTATING BOOM AT THE ALDEN RESEARCH LABORATORY OF WORCESTER POLYTECHNIC INSTITUTE AS A NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK – THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS –

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- Harry Awiszio, 1980-81, Morgan Construction Company
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