NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK

C & D PUMPING MACHINERY

SCOOP WHEEL AND ENGINES

Chesapeake City, Maryland

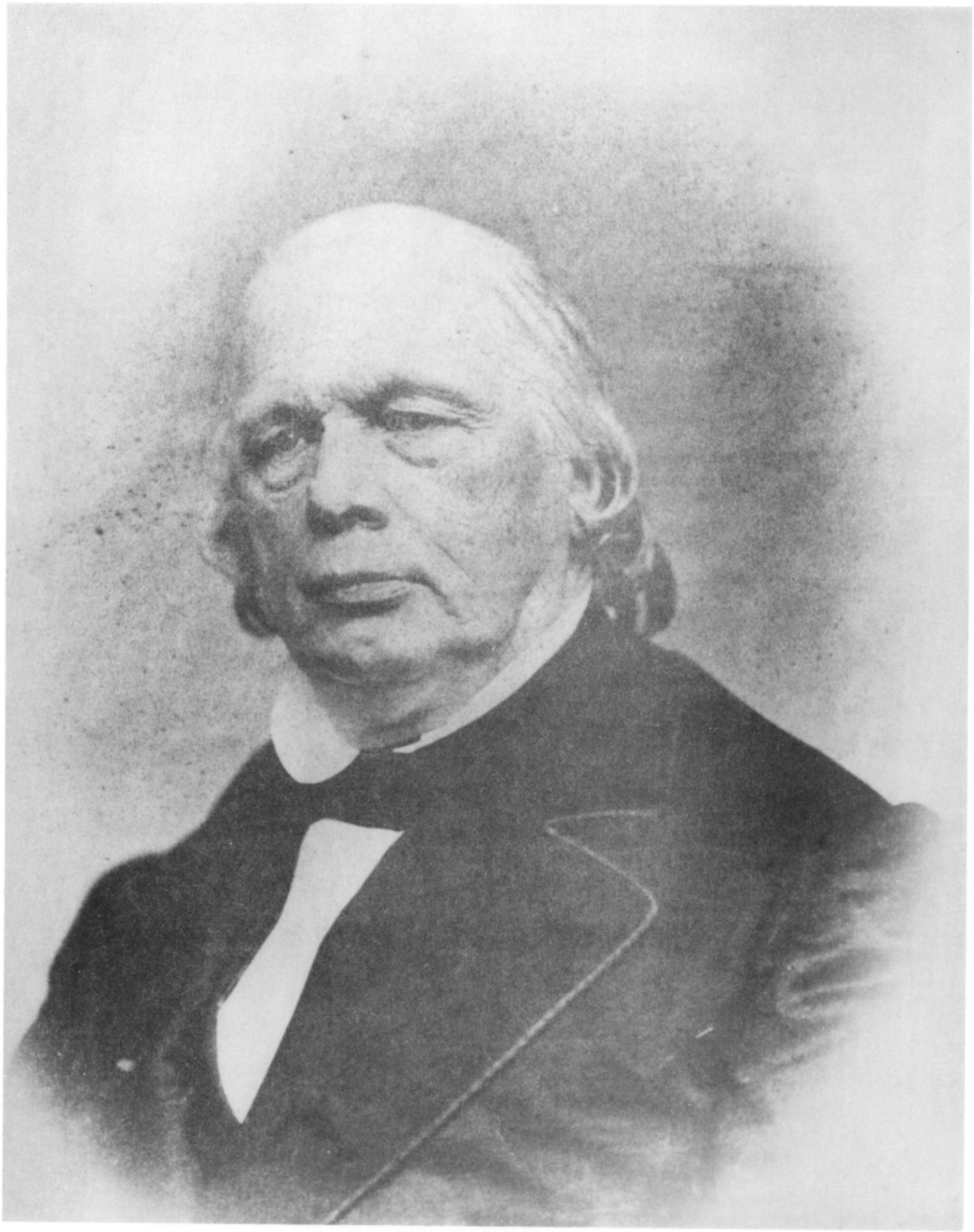
October 25, 1975

THE U. S. ARMY CORP OF ENGINEERS

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

CONTENTS

*All illustrations were provided by the U.S. Army Corp of Engineers.



Samuel V. Merrick

CHESAPEAKE AND DELAWARE CANAL

"Notice is hereby given that this canal is now open for navigation…"

That was 1829. The C & D Canal was considered an "expeditious" and "safe" channel of communication. For the next 23 years the C & D Canal witnessed the rapid growth of trade and commerce. Cargo in the boats that traveled up and down these waters contained vital goods including: lumber; flour; wheat; corn; seafood; iron and coal from Pennsylvania and Virginia. Also, six-tiered barges had gone through the Canal ladened with Virginia farm produce.

How was it possible to keep the C & D Canal a viable commercial operation? Eventually it was accomplished through the installation of the Merrick Steam Engines, and scoop water wheel.

THE EARLY DAYS OF THE C & D CANAL

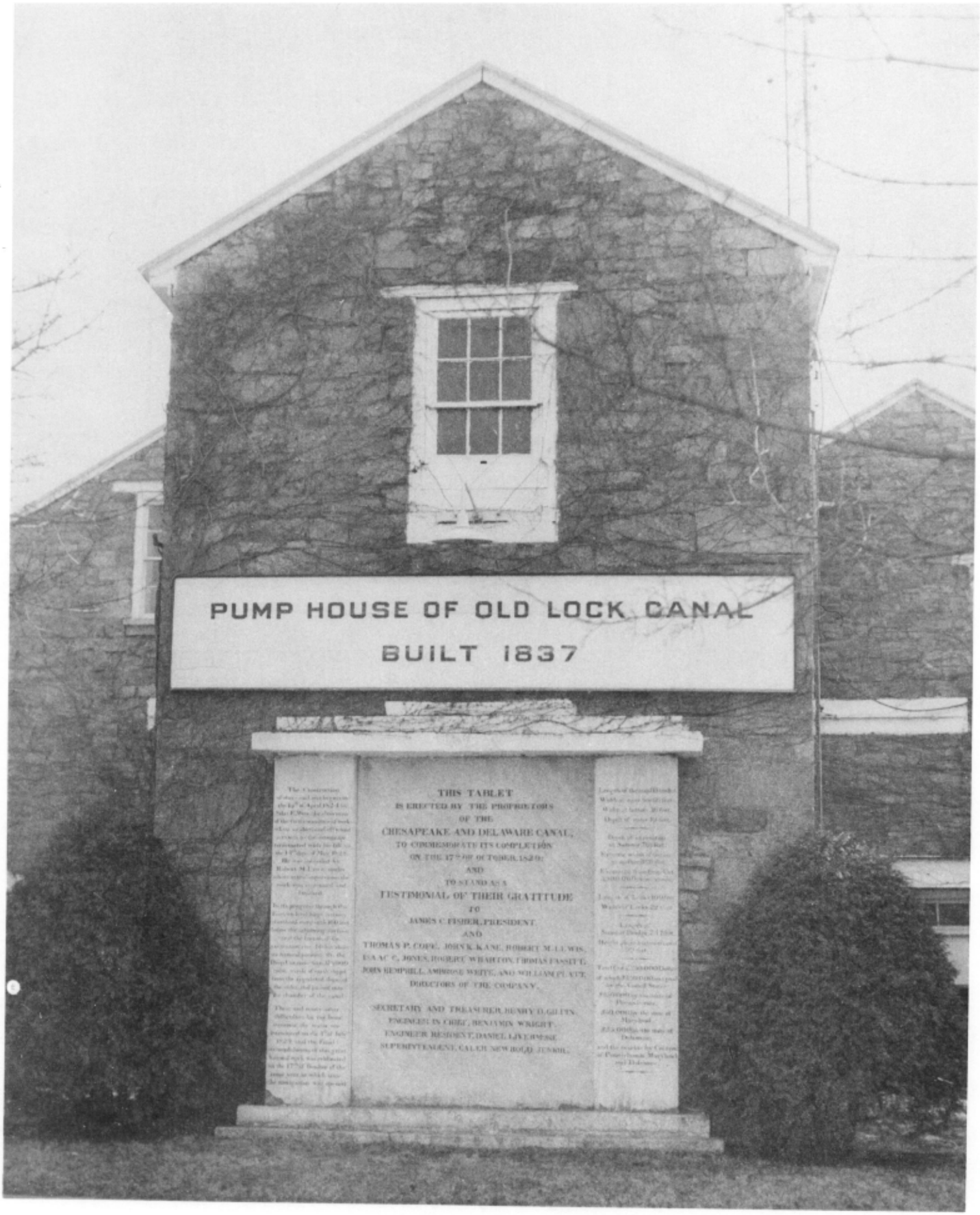
As early as 1661 consideration had been given to building a canal that would link Chesapeake Bay and the Delaware River. Lord Baltimore's surveyor, Augustine Herman, had recognized this need, but the fundamental understanding of lock navigation was not widely known then.

The American Philosophical Society of Philadelphia proposed in 1764 that route studies be made to increase contact between the Chesapeake Bay area and Philadelphia. Twenty years later Pennsylvania tried to interest Delaware and Maryland in a canal project that would help facilitate such a move. It was not met with enthusiasm. Maryland felt that Pennsylvania was trying to attract trade away from Baltimore.

In 1799, though, the proposal was favorably received. In 1800 a $500,000 stock subscription was made, and by 1801 four-fifths of it was sold. The Chesapeake and Delaware Canal Company was incorporated in 1802 in the three states involved. Engineers were retained to begin survey work.

Then in 1822 things began to happen. Pennsylvania was showing great concern over the new Erie Canal project. It felt that this would make New York the center of trade with the West. The C & D Canal board of directors was elected and a former county judge, Benjamin Wright, was engaged as chief engineer for the project.

Pennsylvania supplied $100,000 for the C & D project while Maryland put in $50,000 and Delaware gave $25,000. An additional $450,000 came from the Federal government and nearly a half a million dollars more from public subscription. In 1824 work resumed on the Canal with a capitalization of $1,000,000 and a new projected total cost estimated at $1,239,159. This projection would barely meet half of the final total cost.


PUMP HOUSE OF OLD LOCK CANAL
BUILT 1837
THIS TABLET
IS ERECTED BY THE PROPRIETORS
OF THE
CHESAPEAKE AND DELAWARE CANAL,
TO COMMEMORATE ITS COMPLETION
AND
TO STAND AS A
TESTIMONIAL OF THEIR GRATITUDE
TO
JAMES C. FISHER, PRESIDENT,
AND
THOMAS P. COPE, JOHN K. KANE, ROBERT M. LEWIS,
JOHN RUMPELL, AMBROSE WHITE, AND WILLIAM PLATT,
DIRECTORS OF THE COMPANY.
SECRETARY AND TREASURER, HENRY D. GILPIN.
ENGINEER IN CHIEF, BENJAMIN WRIGHT.
ENGINEER RESIDENT, DANIEL LIVERMORE.
SUPERINTENDENT, CALEB NEW BOLD JENKINS.

The cost per mile to build the C & D Canal was $165,000.00. It's total cost was $2,250,000.00 - - the most expensive canal of its time. The C&D Canal was thirteen and five eighths miles long. The Erie Canal was 363 miles long and was constructed at a cost of $19,255.49 per mile.

Musclepower was the principal force in constructing the C & D. Over 2, 500 men using shovels and pickaxes excavated the channel that ran westward from the Delaware River. The canal ran across eight miles of low lying plain, of which more than a mile was tidal marsh.

In excavating the Canal, "Deep Cut" was regarded as a great work in human skill and ingenuity. "Deep Cut" was a three mile excavation of a low ridge that ran down the middle section of the Peninsula. This part of the excavation has been regarded as the key factor in the Canal's high cost.

THE ENGINES

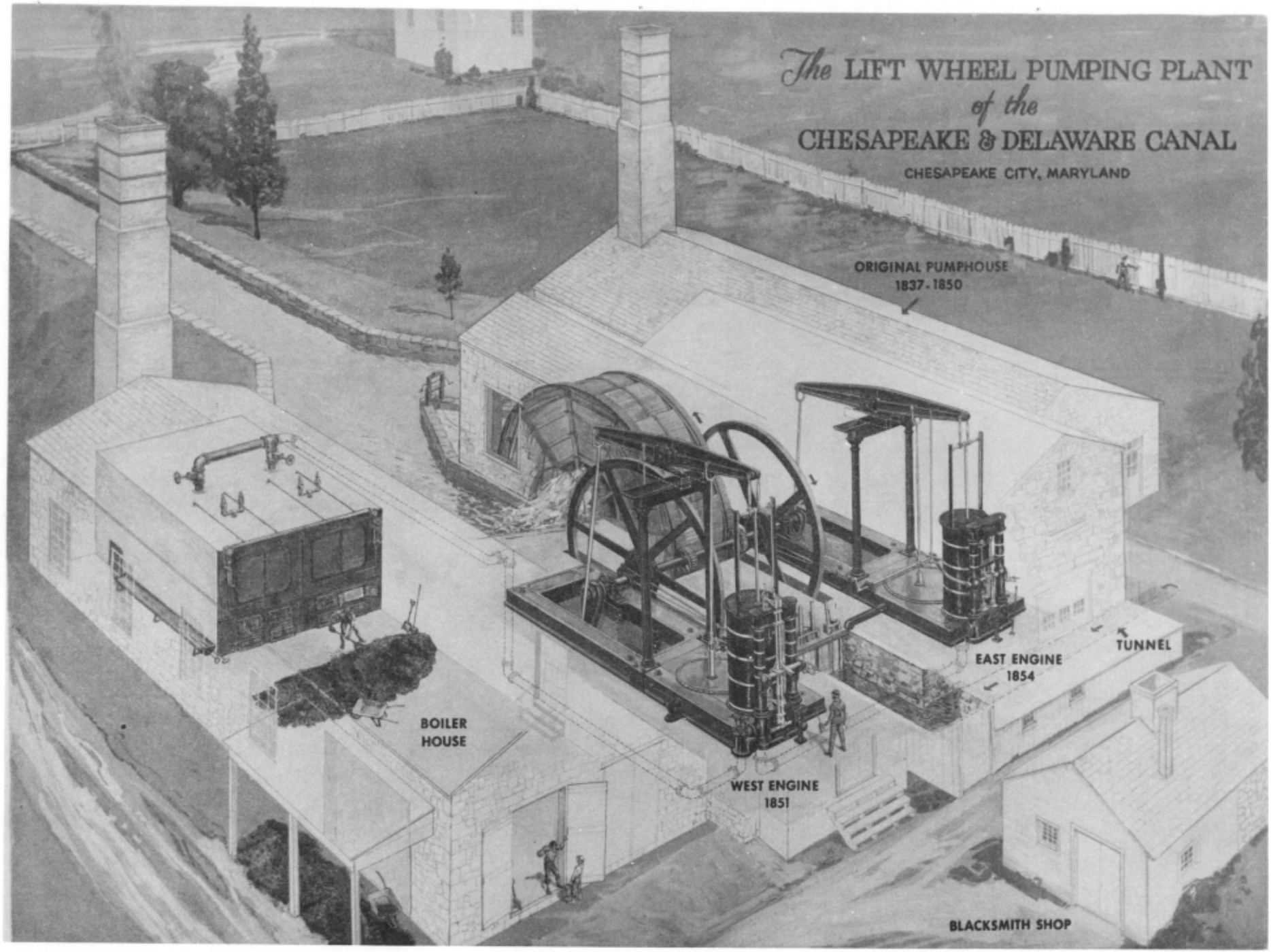
The story of the Merrick Steam Engines, used to lift water into the locks, dates back to the 1840's. During this time the increase in trade through the C & D Canal made it perfectly clear to the Canal operators that major rennovations and innovations would be needed.

In the C & D's 31st annual report of 1850, C. Newbold, Jr., C & D President noted:

"For several years, the supply of water on the Summit Level, has been so deficient,in the dry months, as to make it necessary to restrict vessels to a less draft of water than usual, to the manifest injury of tolls; this, added to the increasing trade of the Canal, makes it necessary to obtain a larger supply of water than the present works can furnish; and, in order to accomplish so indispensable an object, the Board invited machinists, and other men of science, to present them with plans for that purpose. Accordingly, a large number were furnished by gentlemen in this country and from Europe…"

Water supplies at the summit of the Canal were limited. The size of the Canal locks needed to be increased because vessels used in bay and coastal trade could not use the Canal. As well, bridges and lockgates were decaying. Passage through the Canal was limited to barges and boats drawing less than seven feet of water. Horses for towing could be hired at each end of the canal.

After a number of unsuccessful attempts to obtain a government loan, the Chesapeake and Delaware Canal Company considered ways in which it could finance the needed improvements. At this time it was decided to sponsor a contest "for the best design of a steam pump" for use at Chesapeake City. The company's


The LIFT WHEEL PUMPING PLANT
of the
CHESAPEAKE & DELAWARE CANAL
CHESAPEAKE CITY, MARYLAND
ORIGINAL PUMPHOUSE
1837-1850
BOILER
HOUSE
WEST ENGINE
1851
EAST ENGINE
1854
TUNNEL
BLACKSMITH SHOP

criteria -- the engine had to lift at least 200,000 cubic feet of water per hour at a distance of 16 feet.

The contest was announced in 1848. First prize -- $300. Second prize - $200, and $100 was given "for any other design the company chose to retain. All submissions were reviewed by engineers, John C. Cresson and M. W. Baldwin.

Fifty plans were submitted. The design of Barnabas H. Bartol caught the eyes of the company. Bartol was an engineer with Merrick & Sons, Philadelphia, an engineering firm. Bartol's plans were submitted by Samuel V. Merrick and John H. Towne, junior partner and engineer.

The C & D Canal Company asked for a model and estimates on the construction and operation costs of the steam engine powered scoop wheel. The selection committee stated ". . . the scoop wheel and the kind of engine proposed by Merrick & Sons under such guarantees as to both performance of the Engine and Wheel as the Board may deem entirely satisfactory.

Early in 1851 a contract was drawn up for the amount of $22,000.00. Machinery was to fit specifications previously drawn up by the C & D Canal Company. Merrick & Sons guaranteed that less than 560 pounds of coal would be consumed by the engine to raise 200,000 cubic feet of water per hour.

By April, 1852 the Merrick engine and wheel were ready for a brief tryout. More extensive tests were made in July when it was left in continuous operation for 78 1/2 hours. During this test period it was found that 227,160 cubic feet of water was raised with a coal consumption rate of 613 pounds per hour or about 540 pounds for every 200,000 cubic feet of water lifted.

The 33rd annual report of the C & D Canal Company in 1852 stated:

"The machinery is now, and has been for some time, at different periods, in operation on trial. It is now working smoothly, and raising so much water as to give promise of its furnishings supply for a large amount of lockage. But it has not been so long or completely tested as to warrant a decision as to its competency to fulfil the requirements of the contracts under which it was erected."

The wheel is 39 feet in diameter and 10 feet wide and made of wood and iron. It has 12 buckets or scoops. As the wheel revolved, water scooped into the buckets flowed out lateral discharge openings located near the center of the wheel. Toothed segments, forming spur wheels 39 feet in diameter at pitchline and 11 inches face, 3 1/4 inches pitch, are bolted on each rim and gear into two pensions four feet in diameter, keyed to the fly wheel shaft of a condensing beam engine, the cylinder of which is 36 inches in diameter and 7 foot stroke.

Under normal conditions the engine ran at 24 revolutions per minute, the wheel at 2.46 revolutions while it delivered the contents of 29.5 buckets. The "dip" of the scoop wheel was 20 inches which was held by gates located between Back Creek and the feeder sluice and regulated by floats.

In November 1853 Andrew C. Gray, President of the C & D Canal Company, stated that he believed that the wheel should be braced and reinforced and that a powerful steam engine of like power with the present one be attached on the other end of the wheel.

Again the firm of Merrick & Sons, Philadelphia, was approached and the second engine was added in 1854. With the addition of the new engine the speed of both engines was timed at 18 revolutions per minute, the scoop wheel at two revolutions while the wheel's dip was increased to 28 inches.

The year the second engine was installed, 1855, marked the highest expenditure for improvements. Costs totaled $219,959.00. The second steam engine had a Sickels expansion or cut-off valve gear, which was somewhat more sophisticated than the Stevens gear, gave noticeable difference in economical operation.

In 1873, a Delaware newspaper article, "The Big Canal Wheel at Chesapeake City," related to readers that "the immense wheel.. . is one of the curiousities of the country. There is none like it in the United States." The article recounted that the wheel could lift 170 tons of water per minute running 18 to 24 hours per day and was powered by two 150 horsepower engines that consumed 8 tons of Cumberland coal daily,

The boilers were a type used by Oliver Evans in high pressure steam engines he designed in 1814. Wrought iron tubes were set in brickwork and were underfired. Water was channeled from Back Creek into a well located under the scoop wheel and carried into the canal about 960 feet east of the lock. These were replaced in 1865 by two locomotive boilers which operated until 1895. In 1895 Pusey and Jones, of Wilmington, DE., installed a pair of large round boiler tubes that had a combined capacity of 500 horsepower. They were in use until 1927 when the pumping plant shut down.

Also around 1865, a pair of Sewell direct acting steam pumps were installed in a small brick building between the engine houses. They pumped water out of the wheel pit and would circulate cold water to the condensing system.

43rd. Annual Report of the Chesapeake and Delaware Company (1862) President Arthur Gray wrote:

"The importance of the Chesapeake and Delaware Canal has been fully demonstrated during the past year. From the commencement of the war to suppress the rebellion, it has been used by the Government of the United States and by contractors

for supplies and munitions of war, not only with great advantage at all times, but during portions of this period, it was the only route by which the national troops could be transferred..."

On April 17, 1861 the state of Virginia seceded from the Union. Washington, D. C. had been left undefended either by troops or fortifications. Federal troops were blocked in Baltimore en route to Washington. Bridges between Baltimore and the Susquehana River had been destroyed by Confederate troops.

By April 20th the Government commandeered all the propellor steamers in Philadelphia capable of negotiating the locks of the Chesapeake and Delaware Canal. The "troop ships" sailed down the Delaware through the Canal, arriving at Perryville, MD at dawn the following morning. The troops then moved by rail to Baltimore then by steamer to Annapolis and then again by rail to Washington, DC.

The Chesapeake and Delaware Canal provided a vital link of men and supplies to Union forces. This action continued throughout the course of the Civil War. It should be noted here also that the Canal also aided the transportation of munitions during World War I as well.

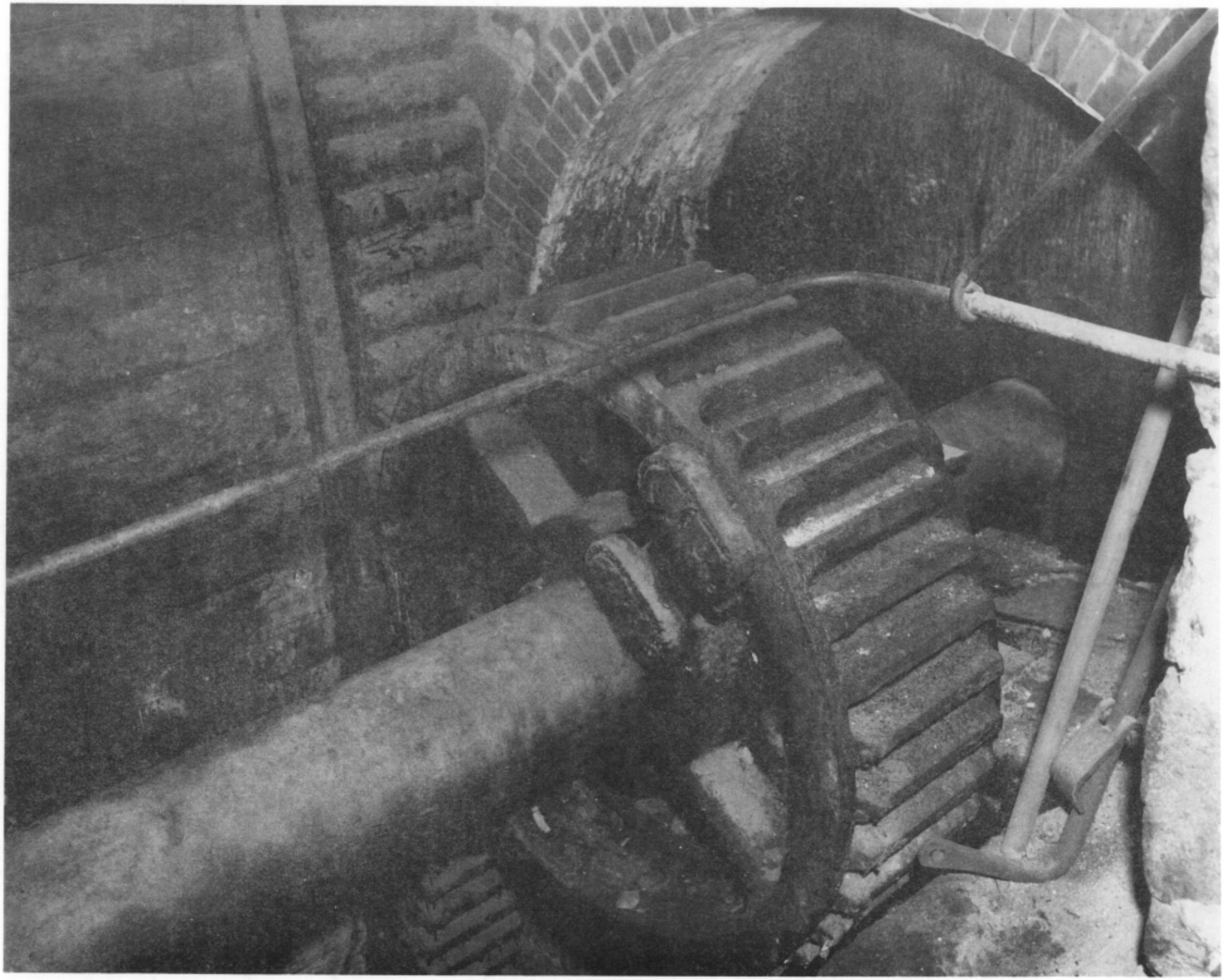
THE U.S. ARMY CORP OF ENGINEERS

Since 1919, the U.S. Army Corp of Engineers have operated and maintained the C & D Canal when it was purchased by the government for over two mil1ion dollars.

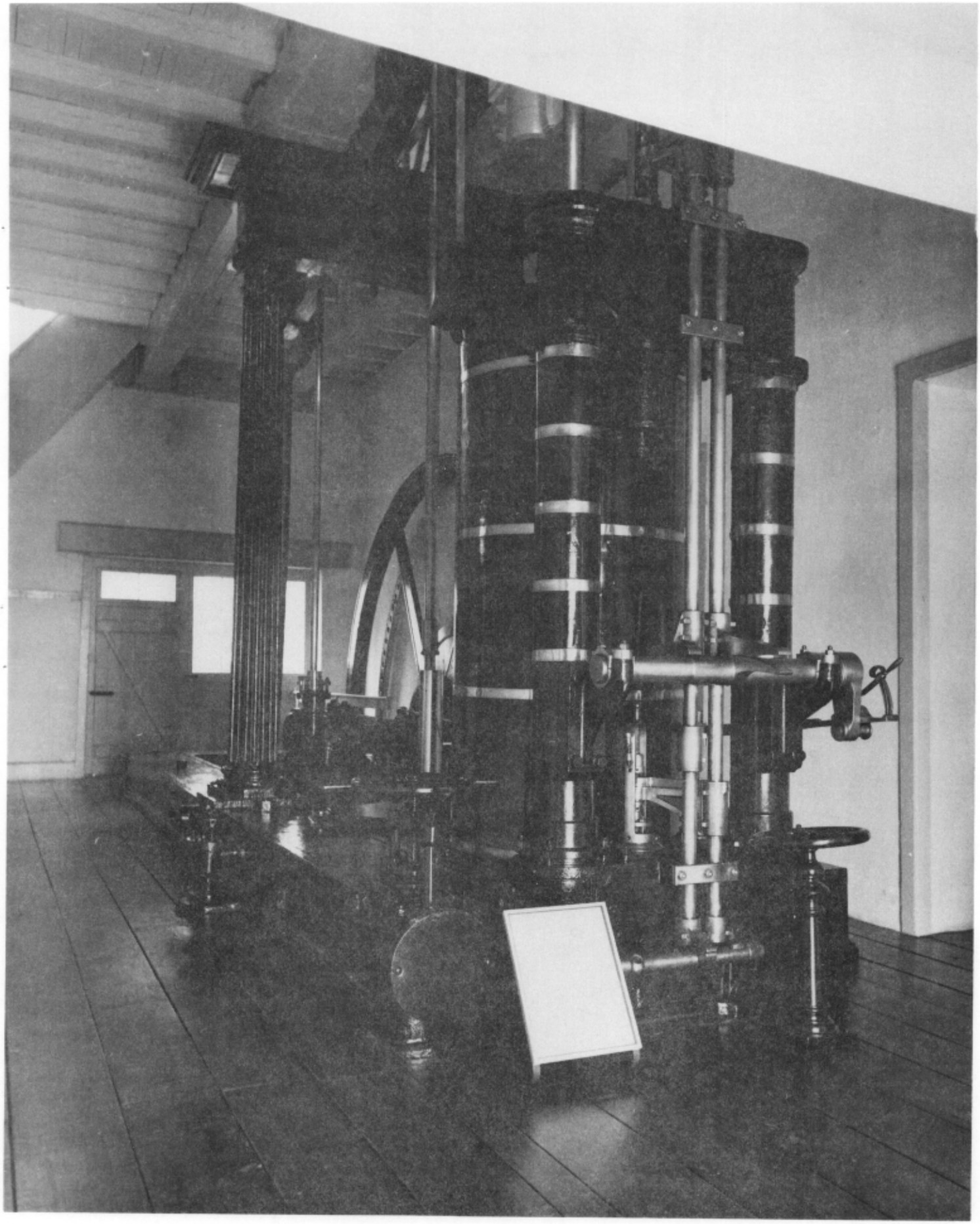
Over the years the Army Engineers has widened and deepened the Canal. In 1921, $10, 710,000 was spent on widening the canal to 90 feet and deepening it to 12 feet, as well as removing locks, putting in highway and railroad lift bridges.

During World War II it was of special value for vessels that could eliminate the necessity of sailing through 143 miles of submarine infested waters.

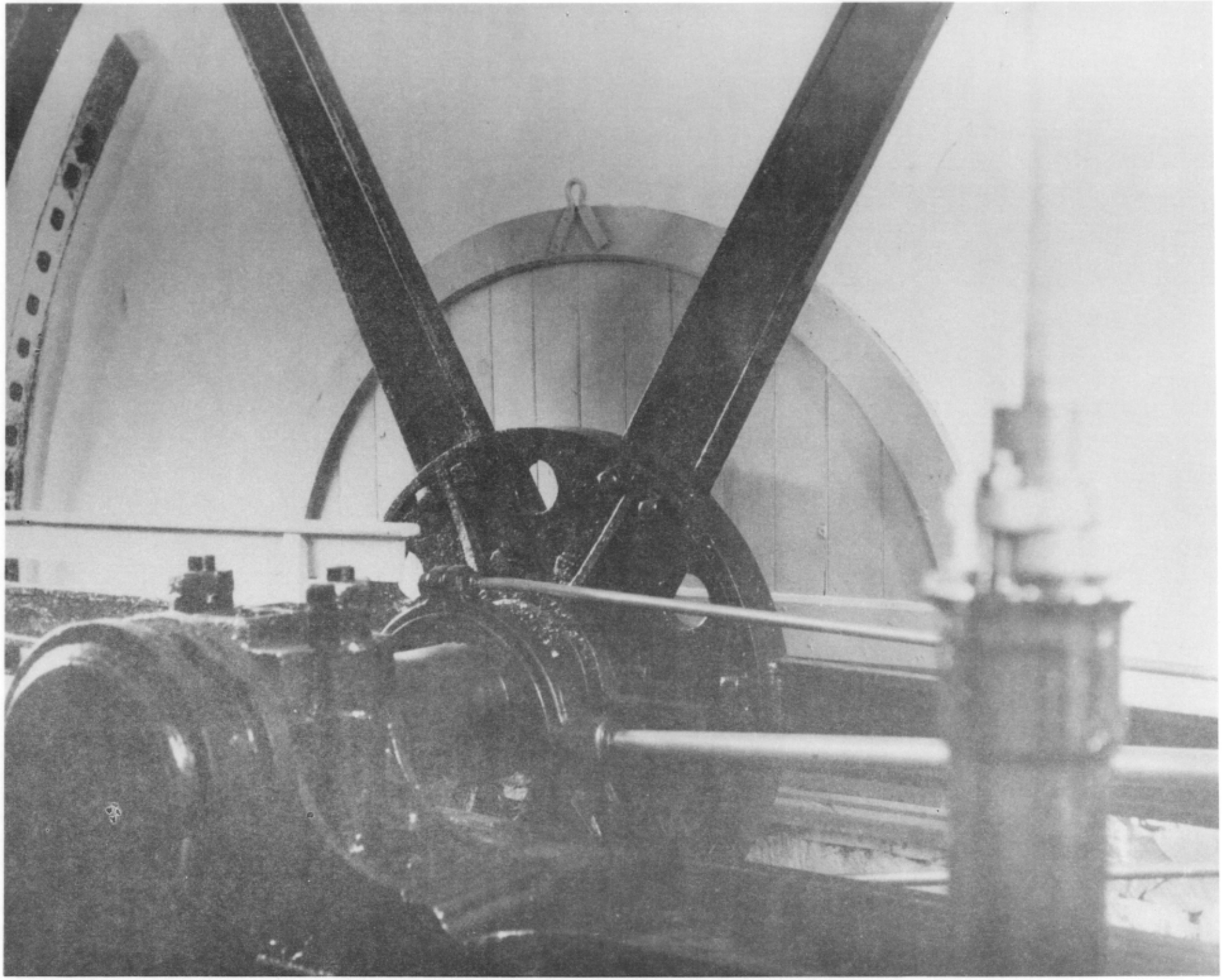
Today the canal is over 400 feet wide and over 30 feet deep. Canal traffic is monitored through radio contact from the Army Engineers canal office in Chesapeake City, MD. Today more than 22,000 vessels of all types use the canal making it one of the busiest waterways in the world.



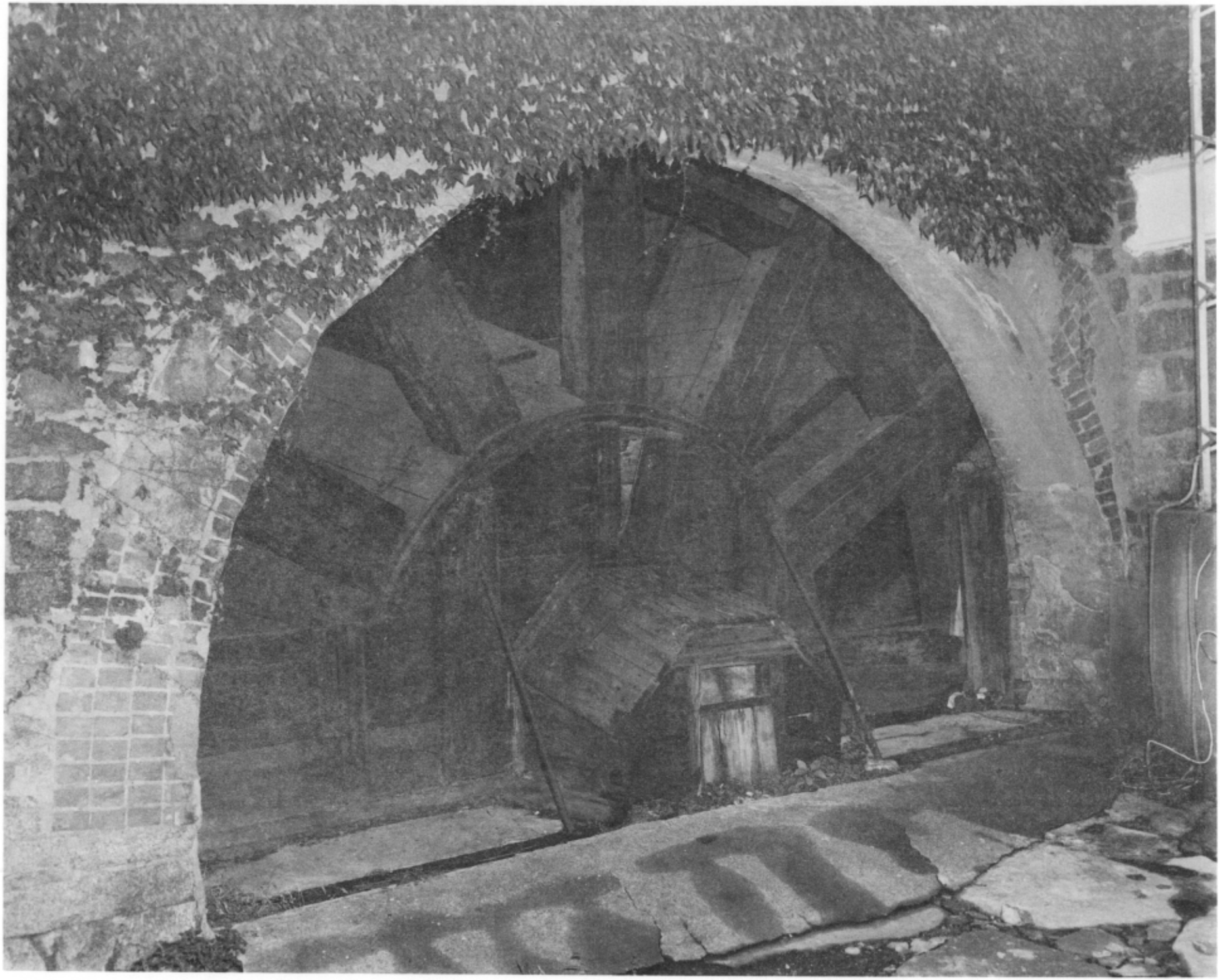
DETAIL - Pinion to liftwheel ring gear



West Engine with Stevens Valve Gear, 1851



Crank, Pedastal, Eccentric and Flywheel, West Engine



Liftwheel Hub and Discharge Port, West Side

THE ASME NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK PROGRAM

This nation's Bicentennial Ce1ebration has sparked The American Society of Mechanical Engineers to institute a History and Heritage Committee. The charge given these people is to use volunteer assistance to gather data on everything that has a mechanical engineering connection 75 or so years ago. Each Section of the ASME has such a committee to gather data on local sites and artifacts.

The History and Heritage Committees have settled on attaining two objectives: (1) a listing of industrial operations and related mechanical engineering artifacts in what they have designated as a "Historic Engineering Record," and (2) a "National Historic Mechanical Engineering Landmarks" program. The former is a record of detailed studies of sites in each local area; the latter is a demarcation of local sites which are of national significance -- people or events which have contributed to the general development of mankind.

The overall objective of the ASME's History and Heritage Committees is to promote a general awareness of our technological heritage among both engineers and the general public. To attain this objective, new material is continually being gathered with a veiw toward publishing a supplement to the local Record when sufficient new sites and artifacts of mechanical engineering have been uncovered.

The C & D Pumping Machinery is the ninth landmark to be designated since the program began in 1973. The first eight include:

Ferries and Cliff House Cable Railway Power House, San Francisco - 1973
Leavitt Pumping Engine, Chestnut Hill Pumping Station, Brookline, MA - 1973
A. B. Wood Low Head High Volume Screw Pump, New Orleans, LA - 1974
Portsmouth-Kittery Naval Shipbuilding Activity, Portsmouth, NH - 1975
102-inch Boyden Hydraulic Turbines, Cohoes, NY - 1975
5000 KW Vertical Curtis Steam Turbine-Generator, Schenectady, NY - 1975
Saugus Iron Works, Saugus, MA - 1975
Pioneer Oil Refinery, Newhall, CA - 1975

ACKNOWLEDGMENTS

The Society would like to acknowledge the efforts of Linwood C. Robinson, Delaware Section History & Heritage Chairman, Charles Shaw, past chairman Delaware Section and James D. Quinn, past ASME Vice President and current member of its Committee on Constitution and By-Laws. The Society would also like to acknowledge ths historical contributions of the U.S. Army Corp of engineers, and the efforts of all persons who were involved in the making of this ceremony a success.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Charles L. Tutt, Jr.	President 1475 - 1976
Earle C. Miller	President 1976 - 1977
Dr. Rogers B. Finch	Executive Director and Secretary
Gilman L. Graves, Jr.	Vice President - Region III

THE ASME NATIONAL HISTORY AND HERITAGE COMMITTEE

Dr. Donald E. Marlowe	Chairman
Dr. R. Cars on Dalzell	Secretary
Professor R. S. Hartenberg	
Professor J. J. Ermenc	
Dean John G. Burke	
Curator R. M. Vogel	Ex-Officio (Smithsonian Institution)
Clarence E. Davies	Consultant
Maurice O. Jones	ASME Staff Director of Operations

ASME - LOS ANGELES AREA REPRESENTATIVES

Marvin Specht	Chairman, Los Angeles Section
Charles Shaw	Past-Chairman, Delaware Section
Linwood Robins on	Chairman, History and Heritage Delaware Section
Edward Hatchdoorian	Vice Chairman, Delaware Section

THE U.S. ARMY CORP OF ENGINEERS

Col. Harry V. Dutchyshyn, U.S.A. District Engineer, U.S. Army Corp Engineers
Bryan Gus, District Historian, U.S. Army Corp of Engineers
J. Perry Sterling, Public Affairs Office, U.S. Army Corp of Engineers
Bernard Schwartz, Resident Engineer, C & D Canal, U.S. Army Corp of Engineers
John Thursh, Museum Guide, C & D Canal.