BIBLIOGRAPHIES

William L. Peverill 1/17/27

Annual Reports of the Chesapeake & Delaware Canal Company to its Stockholders.

First	1803-1804
Second	1804-1805
Third	1805-1806
Fifth	1823-1824
Thirteenth	1831-1832
Twenty-sixth	1844-1845
Thirtieth	1848-1849
Thirty-fourth	1852-1853
Thirty-seventh	1855-1856

The Chesapeake & Delaware Canal in the Civil War by Major R. R. Raymond.

Documents relative to Chesapeake and Delaware Canal Company and the conditional transfer of the stock held therein by the U. S. Memorial of the Chesapeake and Delaware Canal Company presented to the Senate and House of Representatives. 1846.

U. S. Congress. House of Representatives. Committee on rivers and harbors. Chesapeake and Delaware Canal. Washington, 1914.

U. S. Congress. House of Representatives. Committee on rivers and harbors. Chesapeake and Delaware Canal. Washington, 1918.

FOREWORD

The object of this paper is to present the facts which are prominent and important in the history and development of the Chesapeake and Delaware Canal, emphasizing especially the Water Wheel at Chesapeake City. All passages are original unless otherwise indicated. The greater part of the information was gathered from the annual reports of the Chesapeake and Delaware Canal Company to its stockholders. Other information was taken from the Congressional Records. Dimensions and specifications were taken directly from bibliographies.

INTRODUCTION

For many hundreds of years canals have played a very important part in the progress of nations. At a very early period the Egyptians, realizing the great advantages resulting from canals, constructed several along the Nile and one from the Mediterranean to the Red Sea, thru the Isthmus of Suez, which opened the commerce of India and other maritime parts of Asia to Europe. This indeed was the reason for their great improvement in arts and power. From this time on down thru the ages we find canals paving the way for internal improvements during times of peace and offering means for quick concentration of troops during time of war. Hence we can see that the conception of the Chesapeake and Delaware Canal was nothing new, although at that time the methods of construction were necessarily crude.

During the Revolutionary War General Washington often deplored the fact that there was no canal connecting the Chesapeake with the Delaware. Most of the supplies for his army were drawn from the Chesapeake and upwards of 400 wagons were required to transport them across the Isthmus. Such a large number of wagons was never available so that he experienced considerable delay. Then in his movement to the South, the baggage, stores, and heavy artillery were transported by boats from Philadelphia to Christiana Bridge; and more than 100 water crafts were required to do

this; yet his progress across the Isthmus was so slow that he had considerable difficulty joining the Southern Army.

Realizing the tremendous advantages of such a canal, both in time of peace and in time of war, it is no wonder that the Chesapeake and Delaware Canal was conceived, planned, and executed at such an early date as 1829.

CHESAPEAKE AND DELAWARE CANAL
WITH SPECIAL REFERENCE TO THE WATER WHEEL AT CHESAPEAKE CITY

During the years 1799, 1801, and 1802, several Acts were passed by the various legislatures of the States of Maryland, Delaware, and Pennsylvania incorporating a company for the purpose of forming a navigable canal over the Isthmus which separates the Chesapeake and Delaware Bays. In pursuance of these Acts various citizens of the United States made subscriptions, after which a Board of President and Directors was duly elected to plan and execute the aforementioned canal.

The Board immediately met and appointed Mr. Benjamin H. Latrobe, Mr. Cornelius Howard of Maryland, and Mr. John Thompson of Pennsylvania, all engineers of good repute, to examine sources of supply, situations on each bay, passes which were usable and the nature of the country itself. From this examination several important principles were established. The canal would have to be one of practical water level with lockage at each end, as a tide water canal would cost more than the company could ever hope to assemble, and would be an unknown quantity as far as the action of the two tides was concerned. Methods of canal construction used before and with success would be used in preference to dubious methods which would jeopardize the money of the stockholders. A copious supply of water could be obtained from Whiteclay Creek and the Elk River, and either could furnish

enough water for extensive navigation on the canal with the advantage of using the other whenever it should be needed.

After a minute survey, the Board finally decided to fix the route of the canal from Welch Point on Elk River to Christiana Creek, near Mendenhall's Landing, a distance of twenty-two miles. At low tide the depth of water in Christiana Creek is nine feet, and in Elk River is twelve feet within one hundred feet from the shore. The tide rises four feet in both rivers. The highest intervening ground over which the canal will be executed extends for a distance of thirteen miles and is seventy-four feet above tide water. The descent is to be affected by nine locks on each side. The supply of water is to be drawn from Elk River by a feeder six miles in length, three and one-half feet deep, and sufficiently wide to serve as a boat canal. The feeder will be united to the main canal by a lock of a ten foot lift, which will fill one hundred forty-four locks daily. This will enable the passage of twenty-four vessels daily. A reservoir of thirty acres, which may be increased to one hundred and fifty acres, will supply occasional deficiencies. A supply of water may be also taken from Christiana and Whiteclay Creeks in case the increased navigation demands such. The canal will be eight feet deep, twenty-six feet wide at the bottom, and fifty feet wide at the top, on the water line. It will accommodate vessels of forty to seventy tons drawing seven and one-half feet of water. The size of the banks, which on the one side are three feet

above the water level and extend twenty feet to the side for conversion into a turnpike, and on the other side are large enough to accommodate a towpath, will permit a depth of water of nine feet in the canal provided the gates are increased in height by one foot. The locks, eighty feet long, eighteen feet wide, and eight or nine feet deep over the gate sills, containing each eleven thousand five hundred or thirteen thousand cubic feet of water, and with a lift of eight or nine feet each, will be constructed of hewn stone laid in tarras.

As the waters of Whiteclay Creek and Elk River had to be resorted to for the supply of water, it was decided that the most economical way to begin the construction would be by conducting the feeders from their source to the reservoir so that water could be let into all parts of the canal as soon as it was completed, and so that stone, lime, and other materials needed in the work could be transported over the feeders at a minimum cost. To this end the Board purchased water-rights on the Elk River and necessary land for the feeders. On the second of May the first sod of the feeder of the canal was broken at Elk Forge and work began on the Chesapeake and Delaware Canal.

For the first year the work progressed as rapidly as could be expected. It was necessary of course to hire men, get together tools and equipment, build construction cabins, and in other ways prepare for such a big undertaking . This was all done and a reasonably good working sys-

tem established, and approximately three miles of the prospective five-mile feeder were completed and ready for navigation. This was quite a creditable showing as much of the excavating had to be done where there were many large sized rocks.

The following year marked the beginning of real difficulties for the Chesapeake and Delaware Canal Company. The subscribers who had at first taken such a lively interest in the undertaking began to wonder if, after all, their investment had been a wise one. Other investments were enticing and offered quicker remuneration. It would be several years at least before the Chesapeake and Delaware Canal Company could pay dividends, and so it became harder and harder to collect the subscriptions, until, the company was finally compelled to go to law. After several suits were brought, practically all delinquent subscribers in Pennsylvania and Maryland settled up, but in Delaware, the state that was most vitally affected, the majority did not pay up. Owing to the lack of funds, the work was discontinued until such a time as the subscribers should have paid enough to resume the work.

During the winter of 1805-1806 applications were made to Congress and to the respective legislatures of Pennsylvania and Maryland, impressing them with the national importance of such a canal, but although they acknowledged its worth, no definite steps were taken to aid the company financially. On June 2, 1806, the time at which the Chesa-

peake and Delaware Canal Company made its annual report to its stockholders, there still remained about a mile of the feeder to be finished.

For several years it appeared that the Chesapeake and Delaware Canal was a dead proposition, but on January 19, 1817 the directors of the Chesapeake and Delaware Canal Company made application to Congress for a loan. If Congress acted upon this petition to the extent of subscribing $150,000, then the State of Maryland would subscribe $50,000, the State of Pennsylvania $75,000, and the State of Delaware $20,000.

Early in 1822 the Chesapeake and Delaware Canal Company was reorganized. The Board immediately set out to resurvey and check all the old surveys. To this end they hired several competent engineers and began work. Outside engineers were called in and consulted as to a proposed new cut which was much shorter, and reduced the summit level by several feet. The Examining Engineers assembled and submitted the following report: "After a careful investigation of all the circumstances connected with the important question of the most eligible route for a canal across the Delaware Peninsula we unanimously recommend the following--viz. Beginning on the Delaware River near Newbold's Landing, where an artificial harbor and tide-lock must be provided, the canal should be cut thru St. George's Meadows to St. George's Dam, then to be lifted by a lock of

eight feet--thence thru St. George's Mill Pond, thru the dividing ridge of the Peninsula, and thru Turner's Mill Pond to a lock of a six foot fall at Turner's Mill Dam, and thence along Broad and Back Creeks to a tide lock near the mouth of Long Creek." This report was unanimously adopted by the directors. The Examining Engineers placed the cost of construction at $1,354,364.64.

The new canal was to be sixty feet wide at the water line, thirty-six feet wide at the bottom, eight feet deep, less than fourteen miles long, and lined with stone. It had many advantages over the one proposed in 1804. It was shorter, led into deeper water at its mouth, didn't have aqueducts or tunnels, had fewer locks, hence fewer attendants, and possessed the practicability of being converted into a ship navigation canal should occasion demand. The cost of the new one was $110,000 more than the old one.

Benjamin Wright, Esq. was chosen Engineer in Chief and on April 15, 1824 construction was begun by the removal of the first sod near Newbold's Landing. The Board and a large assemblage of people were present.

After six years of hard toil the canal was completed, and opened on the seventeenth day of October 1829. It was thirteen and five-eights miles long, sixty-six feet wide at the water line, thirty-six feet wide at the bottom, and ten feet deep. The depth of the excavation at the summit was seventy-six and one-half feet, the extreme width of

any section at the surface was three hundred sixty-six feet, and the excavation from the deep cut was 3,500,000 cubic yards. The canal was divided into seven sections. Section number one extended twenty-nine chains to section number two which was thirty-two chains long. Section number three was three and one-half miles long, extending from section number two to the village of St. George's. At St. George's a lock of an eight foot lift connected sections three and four, the fourth section being the summit level. Section number four extended three and one-fourth miles from the village of St. George's to section number five where the deep cut began. The length of section five was three miles and fifty-eight chains, and crossed the ridge which divides the Chesapeake and Delaware Bays. Sections six and seven terminated the canal. At the end of section seven was a lock which communicated with Back Creek, a branch of Elk River. The locks were one hundred feet long and twenty-two feet wide, there being two tide and two lift locks. The length of Summit Bridge was two hundred forty-seven feet, and its height above the bottom of the canal, ninety feet. The total cost of construction was $2,250,000, of which $450,000 was paid by the United States, $100,000 by the State of Pennsylvania, $50,000 by the State of Maryland, $25,000 by the State of Delaware, and the remainder by citizens of Pennsylvania, Maryland, and Delaware.

The canal continued to operate until the twenty-ninth of January 1830, when it was closed because of an ice

jam in the Delaware River. On the twenty-third of February the Delaware became navigable, and the canal was again opened. From this time until the first of June, 1834, vessels and boats passed, the tolls on these amounting to $18,613.20. This was indeed a very good beginning for the Chesapeake and Delaware Canal.

Each year the canal made money, but not enough to pay dividends. On the seventeenth of June, 1846, "A Bill Directing the Conditional Transfer of the Stock Held by the United States in the Chesapeake and Delaware Canal Company to the Said Company" was reported in the House of Representatives. The conditions were that no tolls should be charged on United States boats, and that locks one hundred and fifty feet long, and twenty-eight geet wide, should be constructed within five years. Needless to say, the bill did not pass.

The trade on the canal steadily increased until in 1853, at the end of the year, the company had a large enough surplus on hand to pay dividends. In 1856 a Bond issue of $2,800,000 provided for the construction of new locks and a pumping station.

The Chesapeake and Delaware Canal played a very important part in the Civil War. When the Confederate Troops were marching on the city of Washington and the Union Troops were over a hundred miles away with no apparent way of reaching there in time, it looked as though the Capital was doomed. All railroad bridges around Washington had been

burned so that it was practically impossible to get there by land. But some one thought of the Chesapeake and Delaware Canal. Using this canal, the Union troops arrived in Washington just as the Confederate troops reached the South end of Long Bridge.

As the steam railroads developed, the Chesapeake and Delaware Canal began to decline. For several years after 1900 the company made no profit at all.

The Agnus report of 1907 showed the cost of reproduction to be as follows:

Dry excavation--15,000,000 cu. yds. @ 16¢	$2,400,000.00
Dredging, 1,435,760 cu. yds. @ 14¢	200,996.00
80,000 linear feet bank revetment	70,000.00
44,000 perches masonry @ $3	132,000.00
Lock at Delaware City	120,000.00
Lock at St. George's	118,220.00
Lock at Chesapeake City	147,970.00
Average of land holdings, 8000 acres @ $50	400,000.00
Pumping plant at Chesapeake City	50,000.00
Auxiliary arrangements for summit level supply	5,000.00
Bridges	31,000.00
Houses, Offices	30,000.00
Tools, Machinery	1,000.00
Telephone Line	2,000.00
Total	$3,708,186.00

Finally in 1918, after much discussion pro and

con, it was taken over by the Government. Since then it has been operated by the Government with the intention of some day making it a ship navigation canal. Within the last few years, four vertical lift bridges have been constructed across the canal. There is one at Chesapeake City, one at Buck Tavern, one at St. George's, and one at Delaware City. The largest of these is at Chesapeake City, Maryland. The span alone weighs one thousand tons, and is counterbalanced by two weights, weighing approximately five hundred tons each. The span is lifted by a Westinghouse, Type M. C. Motor, Frame--#90, Series Wound, 550 volts, D. C., 100 H. P. at one hour rating. In case anything goes wrong with this motor there is a gasoline engine which can be belted to lift the span. This is an Industrial Unit, The Buda Company, Harvey, Illinois, 40 H. P., four cylinder, four cycle engine, completely equipped with fan, radiator, gasoline tank, and clutch. These bridges embody the very latest in bridge design and construction.

The present locks of the canal are 220 feet long and 24 feet wide. At the low level the depth is ten feet. The total depth of the lock is twenty-five feet from top to bottom.

The Chesapeake and Delaware Canal will never attain the place in transportation that its originator hoped it would. They did not foresee the rapid rise and development of railroads, and the consequent effect it would have on canals. But the railroads cannot take the place of

water navigation altogether, and so the Chesapeake and Delaware Canal will still remain a very important asset to the Government, both in time of peace and in time of war.

THE WATER WHEEL AT CHESAPEAKE CITY, MARYLAND

In 1854 a Bond issue of $2,800,000 was floated by the Chesapeake and Delaware Company. Part of this was used to construct new locks for the canal, and the remainder to construct a water wheel. This wheel was used to raise the water from a level lower than that of the canal, and pour it into the canal. Several years later two centrifugal pumps were installed. The largest of these pumps has a capacity of 35,000 gallons of water per minute, and is run by an internal combustion engine of the Fairbanks Morse type. This engine is a semi-diesel, type Y, six cylinders, and is rated at 300 H. P. The other pump has a capacity of 250 gallons per minute and is better to a Fairbanks Morse, two cylinder engine rated at 100 H. P. At the present time these centrifugal pumps supply most of the water used by the canal, as the water wheel is used only in case it becomes necessary to shut down one of the others, or in case an increased supply is needed.

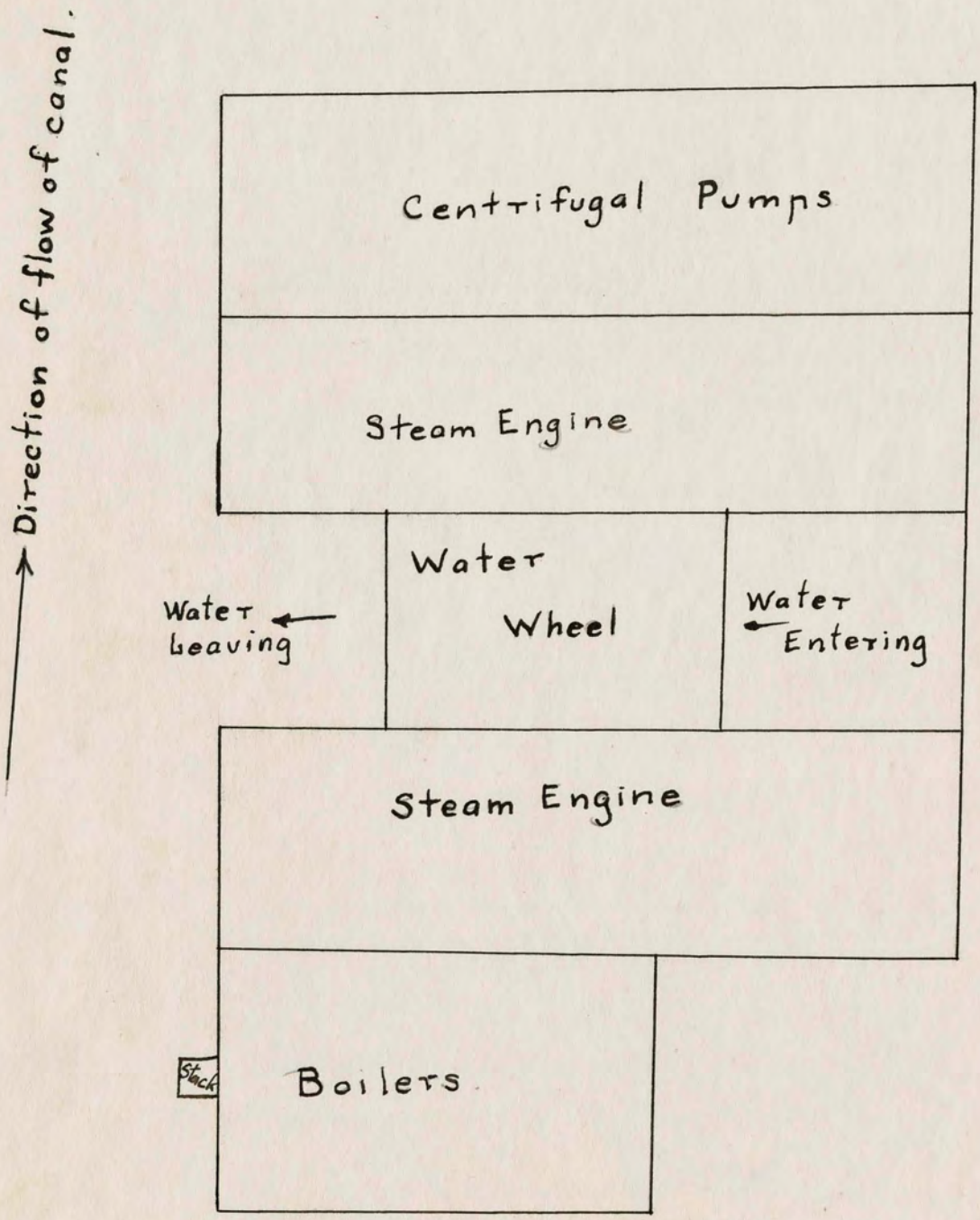
The water wheel at Chesapeake City is the largest of its kind in the world. Constructed of wood, it is thirty-nine feet in diameter and seven feet wide. The shaft which supports the mammoth wheel is twelve inches in diameter, and runs in bearings which are enclosed so that the water cannot get to them. The twelve buckets in the wheel serve to deliver 34,000 gallons of water per minute when the wheel makes one and one-half revolutions per minute. Around the

outer circumference of the wheel are two gears, one on each side. Two smaller gears meshing with these larger ones serve to turn the wheel. Power is gotten from two steam engines of the rocker beam type such as are commonly used on ferry boats. These engines are vertical, each having a high and a low pressure cylinder, and each rated at 350 H. P. Steam is supplied by boilers which were constructed by the Pusey and Jones Company, and installed at Chesapeake City in 1894. A layout of the plant is shown hereafter.

The entire wheel and its prime movers are enclosed in a brick building, a picture of which is shown.

The principle of operation is as follows: the wheel dips into the lower level of water, scooping up a large quantity. As it revolves the water is lifted, and at the same time runs to the center of the wheel, where it flows out and around the bearings into troughs which carry it into the canal. The bearings of the water wheel are about two feet above the level of the canal itself. The water at the lower level is conducted into the pit into which the water wheel dips. By means of a valve it is possible to control the depth of the water in the pit, and hence the amount scooped up by the wheel each time.

At the present time most of the water is put into the canal by the centrifugal pump mentioned above. The water wheel, however, is in good running order, and although its efficiency has decreased through the years, it is always ready to use when needed.



Layout of Pumping Station at Chesapeake City.

PUMPING STATION, C. & D. CANAL. CHESAPEAKE CITY, MD.

LORD BALTIMORE ENTERING LOCK, C. & D. CANAL. CHESAPEAKE, MD.

Dec. 19, 1926.

A tug coming down the canal into Chesapeake, City, Md.

Dec. 19, 1926.

Pushing ice from behind the gate of the lock at Chesapeake City, Md.