HISTORIC STRUCTURE REPORT

THE MASONRY LOCKS

CHESAPEAKE AND OHIO CANAL NATIONAL HISTORICAL PARK

MARYLAND/DISTRICT OF COLUMBIA/WEST VIRGINIA

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PREFACE

This report has been prepared to satisfy in part the research needs for the restoration and preservation of the masonry locks of the Chesapeake and Ohio Canal. The purpose of this study has been to provide enough information on the masonry locks to ensure that the restoration and stabilization/preservation of these structures is historically accurate.

Previous to this report, a number of short historical studies were made on individual locks. Included in these studies were the following: "Lock No. 36 and Four Locks," by John F. Luzader, and "Lock No. 40," by John R. Miele. Thus, a secondary purpose of this present report is to expand upon the research of these men and to broaden the scope of their studies to include all the masonry locks on the canal. For an analytic study of the composite locks, one should consult Edwin C. Bearss, "Historic Structures Report: The Composite Locks," 1968.

A number of persons have assisted in the preparation of this report. Thanks are due to Ranger Ellwood Wineholt for assistance at the park headquarters; to Maria Joy of the National Archives, who was especially helpful in locating unpublished documents; and to Park Superintendent William R. Failor, Supervisory Historian John F. Luzader, Historical Architect Thomas N. Crellin and Chief Historian Dr. Harry Pfanz of Park Historic Preservation (WASO), and to Editor Lou Layman for reading the manuscript and offering many helpful suggestions.

Harlan D. Unrau
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ADMINISTRATIVE INFORMATION

Summary of Documentary Information

The seventy-four lift locks of the Chesapeake and Ohio Canal were built between 1828 and 1850 to overcome the approximately 605-foot rise in elevation between tidewater in Georgetown and the eastern terminus of the waterway in Cumberland. On the average, each lock had eight feet of lift, i.e., the capacity to raise or lower a boat about eight feet.

The method for "locking through" a boat was as follows: a boat ascending the canal moved from the lower level into the lock. The gates were closed behind it, and water was admitted into the lock chamber through paddle gates until the boat was raised to the upstream level. The upper gates were opened, and the boat moved out onto the higher level. For boats descending the canal, the process was reversed.

According to canal company specifications issued in 1829 and 1837, the lift locks measured 100 feet long, fifteen feet wide, and about sixteen feet deep to conform to the dimensions of those in use on the New York, Ohio, and Western Pennsylvania canals. If possible, bedrock was used as a foundation for the locks. However, when a rock formation could not be had, the lock was placed on a wooden mat formed by heavy timbers laid crosswise. Clay puddling, a mixture of wet earth and clay, was used to make the floor watertight. Upon this foundation was placed the masonry that formed the walls of the lock. These walls measured 143 feet from the end of one wing wall to the end of the other. The distance between the upper and lower main sill was 100 feet, with twenty-two feet above the upper sill and twenty-one feet below the lower sill. The cut stone facing was set with a hoist. The bed for the masonry was prepared and the stone fitted on the job by the mason. The lock gates were generally made of wood, although the canal company did experiment with wrought-iron lock gates.

Around many of the locks on the berm side there was a bypass flume. The purpose of these flumes was to allow the water to flow around the lock when the gates were closed in order to maintain the level in the canal below the lock. The amount of water flowing through the flume was generally regulated by a control structure where a board gate could be raised or lowered by adding or removing boards.

During the late 1870s and early 1880s, some of the locks were lengthened in order to accommodate two canal boats at the same time.[*] On the whole, these extensions appear to have been makeshift arrangements, built of wood cribbing and filled with stone. The extensions could not stand the test of time; hence, the wood untimely rotted or was washed away, leaving a pile of stone.

The masonry of the locks indicates some of the difficulties encountered in building the canal and shows how the quality of construction deteriorated as the financial condition of the company worsened in the later years of construction. The masonry of the locks toward the lower end of the canal is on the whole of superior quality compared to that of the locks toward the upper end of the waterway, where the company encountered great difficulties in finding an adequate source of good building stone. The stone masonry in many of the upper locks was generally of inferior quality. Because of the poor workability of the local stone in the Paw Paw area, good surface fin-

ishes were unattainable. This caused the canal company to face thirteen locks (Nos. 58–71) with kyanized wood (see Edwin C. Bearss, “Historic Structure Report: The Composite Locks,” 1968).

Statement of Historical Significance

The masonry locks are significant architectural and engineering resources because of their importance to the operation of the Chesapeake and Ohio Canal. The rise in elevation between tidewater in Georgetown and the western terminus of the waterway in Cumberland is approximately 605 feet. In order to overcome that difference in elevation, seventy-four lift locks were built to raise the level of the canal as it progressed from lower to higher elevations. On the average, each lock had eight feet of lift, i.e., the capacity to raise or lower a boat approximately eight feet.

Administrative Data

Project Identification

This is a historic research report that includes all seventy-four masonry lift-lock structures on the Chesapeake and Ohio Canal running from tidewater at Georgetown to the terminus at Cumberland, Maryland, approximately 184.5 miles. The period of historical significance of the masonry locks was from 1850 to 1924, the operating years of the Chesapeake and Ohio Canal.

Order of Significance

Based on the key part played by the locks in operating the canal’s navigation system and the important part played by the canal in the history of American transportation, the locks are judged to rate the First Order of Significance, that of National Significance.

No list of classified structures exists at present for the park, but a list is being prepared. No level of treatment has been formally established for the park. The Chesapeake and Ohio Canal National Historical Park, as a whole, is on the National Register of Historic Places.

Proposed Anticipated Development Work (treatment)

Since this report includes all lift-lock structures on the canal, future repair or restoration will depend on requirements for such work as needed at each individual lock and on work proposed to be done upon the locks in various zones of the park, as set forth in the *Environmental Assessment General Plan*.

Proposed Use of Structures and Operations and Management Requirements

The proposed use of these structures and the operation and management requirements for them will be governed by the zone of the canal in which each lock is located, as stated in the *Environmental Assessment General Plan* for various sections of the canal. Any future development plans prepared by the National Park Service for the canal will also govern the use, operations and management requirements.

No cooperative agreements exist between the National Park Service and private organizations or groups with reference to overall operation and arrangement of the locks.

INTRODUCTION

The construction of the Chesapeake and Ohio Canal represented the culmination of several attempts to develop the Potomac River as a trade route to the West. Before the canal was developed, the Potomac Company had attempted to improve navigation by deepening the river bed and building short canals in various places around the rapids and falls. By 1822 the Potomac Company was deeply in debt and still had not achieved its purpose of making the river navigable throughout the year. Attention turned to building a permanent, artificial waterway that would connect the Ohio Valley with the Chesapeake Bay.

While the House of Representatives considered the passage of an act subscribing public funds to the stock of the Chesapeake and Ohio Canal Company in 1827–28, the Committee on Roads and Canals obtained much information on the construction of other canals in the United States that already had been completed or whose construction was still in progress. These collected documents offer valuable insight into the theories and mechanisms employed in canal building during the era of internal improvements and provide an interesting background study to the construction of the Chesapeake and Ohio Canal. Documentation submitted to the Committee on Roads and Canals concerning the construction of locks on canals elsewhere in the United States thus becomes a prerequisite for a study of the masonry locks of the C & O Canal.

On February 20, 1828, M. T, Williams sent to the House Committee on Roads and Canals a volume of reports by the Ohio legislature and the Ohio Canal Commissioners and Engineers on the progress of canal construction in that state. Concerning the cost of constructing the masonry locks, the report stated:

> *Locks per perch of 16 ½ cubic feet*—The cost of masonry depends so much upon the quality of the stone, and the cost of obtaining it, that no general rule will apply to particular cases. The stone of the Miami country (limestone) is expensive to cut, is quarried at considerable cost, and, for the locks on this line of canal, has been transported mostly from two to six miles, but, in some instances, particular stone has been transported by land 18 to 28 miles. Some has been brought down the Ohio River 90 miles, and then transported 10 miles by land. The 12 locks on this canal, which are completed, were built for about $4 per perch, where the stone was obtained within an average distance of four miles. Where the stone was transported a greater distance, the extra transportation was paid in addition. The 10 locks on the upper part of this line, which are in progress, but not completed, are under contract to be built at from $3.75 to $4.12½ per perch, without any allowance for transportation. The stone is procured within a distance of six miles generally. On the Ohio Canal, (between Licking Summit and the forks of the Muskingum,) 22 locks are under contract at from $2 to $2.75 per perch: average, $2.31. The stone is a *grey sandstone*, easily wrought, and is obtained very conveniently. In some instances, the quarries are situated in the immediate vicinity of the site for the lock; in others, it is transported from two to four miles. Four of these locks are already constructed, and it is not doubted that they will be built at the contract prices in the course of the ensuing season. The price per perch, in all cases, covers the cost of foundation, gates and every fixture necessary to complete a lock for use. The excavation of the pit, and the puddling and embankment around the lock, are separate charges. Lock pit excavation is generally done for 12 to 15 cents per yard, and the puddling and embanking at about the same price per yard.

Studies by the Ohio Canal engineers on the most advantageous dimensions for locks had provided the following conclusions:

> The amount of water required to supply a given line of canal, depends on a variety of circumstances. The water is exhausted or expended by locks, by leakage, or filtration, by evaporation or absorption. The amount of water expended in passing boats through locks, can be easily estimated. It depends on the capacity of the locks, and the number of boats, which are passed through them. Thus a lock of 90 feet in length, of 15 feet in breadth, and of 8 feet lift, requires, to fill it, 10,800 cubic feet of water: or in passing a boat through it, that quantity of water is expended, or descends from a higher to a lower level, in the canal. A boat, in passing over or through the summit level of a canal, from an inferior level on one side, to an inferior level on the other, requires the expenditure of a lockful, to raise the boat from the lower level into the summit pond, and the like expenditure, to pass the boat, from the summit pond, into a lower level on the other side. Thus a boat passing a summit, by means of locks of the above dimensions, expends, or draws from the summit pond, 21,600 cubic feet of water. If one hundred boats pass per day, it will require the expenditure of 2,160,000 cubic feet, equal to an average of 1,500 cubic feet per minute. Should the same number pass, in an opposite direction, during the same period, the boats padding alternately, each way, through the same lock, no greater expenditure of water would be required. The lock being filled in raising a boat from a lower level into the summit pond, would be ready to receive the boat prepared to pass down through the same lock, as soon as the ascending boat had left it—and, when the water had been drawn out, to pass the descending boat into the lower level, the lock would be prepared to receive an ascending boat. Thus, one boat ascends and another descends, by filling and emptying the lock but once. But this method of passing boats is not always convenient—as a greater number may be proceeding in one direction than in the other; and it would be extremely vexatious to compel a boat to wait at a lock, until one should arrive to pass in the opposite direction.
>
> The dimensions of the locks should be such as to admit boats of the proper size for navigating the canal to advantage. It is a general rule, that the burthen or tonnage of a vessel should bear some proportion to the length of the voyage she is destined to perform, in order to make the voyage profitable. A canal, of the length necessary to pass from the Lake to the Ohio, through the central parts of the State, would require locks of the length and breadth above stated, in order to make its navigation most advantageous to the public. The lift of the locks must, in a greater measure, depend on the topographical situation of the country which the canal line is located. Locks of small lift are more expensive in their construction and the attendance they require, and occasion greater delay in passing boats than those of greater lift, in proportion to the difference of the levels they overcome. They are, however, less subject to accident, and expend less water. Locks of from eight to ten feet lift are generally believed to combine the most advantages.[1]

Included in the documents collected by the House committee was a report that had been written by Topographical Engineer Joseph G. Totten on November 5, 1823, regarding the method of constructing locks on the Morristown [sic: Morris] Canal in New Jersey. The dimensions of the locks on this canal were determined as follows:

> It has been said that the profile of the canal is calculated for a boat of eight and a half feet beam, and three feet draught. By giving sixty feet length to this boat, its burthen will be twenty-five tons, which has been found to be the most advantageous load for a single horse. A boat of these dimensions may navigate the Passaic from the entrance of the canal to its mouth; but it will be too small for the navigation thence to the city of New York, in rough weather, and too large for the upper Delaware and its

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[1] U. S. Congress, House, Committees on Roads and Canals, *Chesapeake and Ohio Canal*, Report No. 141, 20th Congress, 1st Session, 1828, pp. 62–63, 65–66 (hereafter cited as *House Report 141*).

> tributaries; the Durham boars, or these last, draw but two feet, with a full load of fourteen tons; and the periaugers, which run from the Passaic to the city, are about forty tons. It would be better, no doubt, if the canal could be made to receive such boats as could safely navigate the bay of New York: for then the passage through would be more rapid and cheaper; but the consideration of a much heavier first cost, and of the advantage to the State of New York, of having a place of deposit and transshipment at each extremity of the canal, forbid to hope that dimensions, in all respects suitable to the importance of the communication, will be given to it.
>
> The dimensions of the boats being fixed, those of length and breadth determine the horizontal dimensions of the locks; that there may be room for the boat, and for the play of the gates, these should be nine feet by sixty-four feet. As to the lift of the locks, it is fixed at eight feet, being that which is most commonly preferred. A system of locks with less lift, say four feet for the same total rise, of suppose 120 feet, will require an expense of construction of about one-half more than locks of eight feet lift; and while the expense of water will be one-half less, the time required for the passage will be one-third more. For this same total rise of 120 feet, with a system of locks of twelve feet lift, the expense of construction will be only about one-sixth less than for eight feet locks; and while the expense of water will be one-half more, the time of passage will be about one-quarter less, These considerations of cost of construction, expense of water, and consumption of time, have led to the choice of eight feet lifts, as a sort of mean between the advantages and disadvantages of greater and lesser lifts.[2]

On August 20, 1827, the Board of Canal Commissioners of Pennsylvania submitted to the House committee two proposed specifications for locks on the canals in their state. On the assumption that their canals would be "40 feet wide at the top, 28 at bottom, and 4 feet depth," they proposed to construct locks "90 feet clear in length, and 14 feet width." Supposing that they might decide to increase the depth of their canal to five feet, they reported that they would then revise the dimensions of their locks to "100 feet clear in length and 14 feet width."[3]

In May 1828 Congress passed an act subscribing $1 million of the public funds to the stock of the Chesapeake and Ohio Canal Company.[4] The formal organization of the canal company took place at a meeting of the stockholders in Washington on June 20–23, 1828. At the meeting, Representative Charles F. Mercer was chosen the first president of the company which he had labored so long to create. The board of directors was selected, and after completing the business of organization the directors named Judge Benjamin Wright of New York chief engineer of the canal project. Wright enjoyed a wide reputation for his ability, as he had been actively associated with the construction of the Erie Canal and was at the time of his appointment the chief engineer of the Chesapeake and Delaware Canal.[5] In choosing as chief engineer a man with experience on the northern canals, the directors adopted a course which they followed in completing the staff of engineers. The board took advantage of the availability of men experienced in the construction and operation of both foreign and domestic canals.

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[2] *Ibid*., pp. 100–101.
[3] *Ibid*., pp. 138–139.
[4] Washington *National Intelligencer*, May 27, 1828.
[5] Proceedings of the Stockholders of the Chesapeake and Ohio Canal Company A, pp. 16–17. All manuscript source materials referred to in this report are deposited in Records of the National Park Service, Record Group 79, Department of the Interior files at the National Archives, Washington, D.C. (RG 79, NA).

CHAPTER I:
Construction of the Masonry Locks From Georgetown to Seneca, 1828–1831

During the deliberations in Washington, following the organization of the Chesapeake and Ohio Canal Company, much discussion centered on the nature of the locks to be built on the canal. William Archer, a prominent figure in the struggle to secure public funds for the canal project, submitted the following resolutions on June 21:

> That a Committee be appointed to enquire into the utility of making a double set of locks on the Canal, from tidewater to the branch leading to the coal banks, at or above Cumberland; and that they report upon the advantages expected to be derived to the Company therefrom; also the number of extra locks, and their probable cost.[6]

Although the resolution was tabled temporarily, the stockholders on July 10 voted to refer it to the president and board of directors for a formal report.[7]

On July 5, the day following the formal ground-breaking ceremonies of the canal project as Little Falls, the board took steps to begin the actual construction of the waterway. The directors resolved:

> That public notice be given that proposals will be received on the 14th, 15th and 16th days of August next, at the Office of the Company, in the City of Washington, for the excavation, embankment and walling of the portion of the Chesapeake and Ohio Canal, between the head of Little Falls and the head of the Great Falls, of the river Potomac.

The board also resolved:

> That similar notice be given, that proposals will be received, from the 1st to the 20th of October next, for building from 18 to 20 locks on the line of the Canal above mentioned, and also for the masonry of the aqueducts, culverts & etc., comprised in the plan of its structure.

To enable the work of construction to commence as planned, the directors authorized immediate steps to find the most convenient points near the river at which suitable stone could be obtained for the locks and aqueducts. Similar inquires were to be made to learn where suitable lime could be had in the vicinity of the river for making hydraulic cement.[8] Two weeks later, on July 19, the board approved the following resolution:

> The Engineer having reported that another subdivision of the Chesapeake and Ohio Canal, extending from the head of the Great Falls of Potomac to Seneca Creek (about 8½ miles) is now under survey, and will be prepared for letting on contract for embankment, excavation & walling at the same time

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6 Proceedings of Stockholders, A, p. 10.
7 *Ibid*., A, p. 14.
8 Proceedings of the President and Board of Directors, A, pp. 12–13.

> with that above named [section between Little Falls and Great Falls]—proposals therefore will be received as above on the 14, 15, & 16 days of August. In this subdivision there will be five locks of 8 feet lift each, proposals for building them, as well as for the masonry of such Aqueducts & etc., as may be necessary, will be received as above, from the 1st to the 20th of October next.[9]

On August 9 the directors instructed that

> public notice be given that proposals will be received between the 15th & 20th days of October next for the entire section of the canal between the mouth of Seneca and the Eastern base of Catoctin Mountain, being about 27 miles, in half mile sections, embracing the Locks, about four in number, and the Aqueducts and culverts of that section.[10]

At a general meeting of the stockholders on September 10, President Mercer submitted a report on the proposed dimensions of the canal. The proposal was adopted unanimously. Concerning the locks and lock gates, the report stated:

> Its locks will be, throughout, of stone, with chambers 100 feet by 15 feet in the clear. The lock-gates will be of locust frames; six paddle gates opening from the lateral culverts, and four in the upper lock gates, extending to the bottom of the chamber, will facilitate their filling, while every possible facility will be provided to empty them in the shortest possible time. For this reason, it is in contemplation, by double proposals for the construction, to consider and decide upon the comparative expediency of doubling them as far at least up the line as the mouth of the Shenandoah, or throughout the first sixty miles of the canal.[11]

The board resolved on September 19 "that each Lock chamber be in breadth 15 feet in the clear, with a view to correspond with the Locks of the Ohio Canals, and of the Canals of New York & western Pennsylvania." The directors also decided to further postpone consideration of the resolution on double locks.[12]

The following week, on September 27, the board made several significant decisions concerning the locks and lock gates. First, the directors determined that proposals "be received at the next letting for double & single locks, and that the Board retain the alternative of adopting either." The board also voted to require the Board of Engineers to report "without delay the relative cost and advantage of single and of double locks on the canal from its eastern termination to the mouth of the Shenandoah River."

Second, the directors resolved that the superintendent of wood work should take steps to secure "locust timber for the frames of the Lock gates." Accordingly, the superintendent of wood work was instructed to build "a saw mill at the Great falls of Potomac for the purpose of supplying timber, scantling and plank, where deemed expedient, to the Canal."[13]

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9 *Ibid*., A, pp. 24–25.

10 *Ibid*., A, p. 37.

11 *Proceedings of the President and Directors of the Chesapeake and Ohio Canal and of the Corporations of Washington, Georgetown, and Alexandria, in Relation to the Location of the Eastern Termination of the Chesapeake and Ohio Canal*) Washington, 1828), p. 15.

12 Proceedings of the President and Board of Directors, A, p. 80.

13 *Ibid*., A, pp. 82, 84. A thorough search of the canal company records failed to turn up the report from the Board of Engineers relative to the cost of building "double locks."

The board met at Leesburg, Virginia, from October 23–25 to consider the proposals that had been submitted for work on the canal. The directors accepted the following bids for the construction of the locks:

No.	5	on Section No.	1	Bennett & Brackett
No.	6	on Section No.	1	Bennett & Brackett
No.	7	on Section No.	4	Brackett & Hovey
No.	8	on Section No.	7	Brackett & Hovey
No.	9	on Section No.	8	W. W. Fenlon & Co.
No.	10	on Section No.	8	Kavenaugh, Knox, Hale & Nichols
No.	11	on Section No.	8	Kavenaugh, Knox, Hale & Nichols
No.	12	on Section No.	9	J & J Maynard
No.	13	on Section No.	9	Patrick Donnelly
No.	14	on Section No.	9	Patrick Donnelly
No.	15	on Section No.	17	J & J Maynard
No.	16	on Section No.	17	J & J Maynard
No.	17	on Section No.	18	Kenny & Roberts
No.	18	on Section No.	18	J & J Maynard
No.	19	on Section No.	18	J & J Maynard
No.	20	on Section No.	18	J & J Maynard
No.	21	on Section No.	23	Holdsworth & Isherwood
No.	22	on Section No.	29	Kenny & Roberts
No.	23	on Section No.	33	Kenny & Roberts
No.	24	on Section No.	35	Holdsworth & Isherwood
No.	25	on Section No.	51	Lafferty & Boland
No.	26	on Section No.	68	Amos Johnson
No.	27	on Section No.	72	Lafferty & Boland[14]

After the contracts were accepted, Director Walter Smith informed the board that General John Mason "had made a drawing and executed a model for iron lock gates." Accordingly, the board ordered the Board of Engineers to examine and report "their opinion as to the expediency of adopting them for the Canal."[15]

As operations on the locks began, President Mercer and Chief Engineer Wright issued instructions on the location of the locks to Resident Engineer Thomas F. Purcell of the First Residency of the First Division of the canal company. Mercer informed Purcell on November 12 that:

> Each lock will be located so that when doubled, the Double lock will occupy the breadth of the canal with the Central line of the wall dividing its parallel chambers over the centre of the Canal; and for the present the single lock will be located on the side next the towing path.[16]

Several weeks later Wright notified Purcell that the locks were to be located so that "hereafter when it may be necessary to build double locks the Second one may be so placed as to appear a

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[14] *Ibid*., A, pp. 96–98.

[15] *Ibid*., A, p. 98.

[16] Mercer to Purcell, November 12, 1828 (Ltrs. Recd., Letter Book of the Resident Engineer of the 1st Residency of the 1st Division). Apparently, economic considerations forced canal officials to postpone the building of "double locks."

part of the original Place." According to the sketch that Wright sent with his instructions, "the face of the wall of the lock on the towpath side" was to be two feet from the bottom of the Slope," or, in other words, "the center of the Lock" was to be "9½ feet from the bottom line on [the] towpath side and parallel therewith."[17]

On November 22 the board approved a measure to stimulate the pride of the contractors and to reward them for "diligence and fidelity" in building various structures on the canal. "For the best constructed lock on the first division of the canal completed within the period stipulated by contract," the directors decided to award the contractor "a silver cup, with suitable devices, of the value of fifty dollars."[18]

By the early part of December the canal company's sawmill at Great Falls was nearly completed. Accordingly, the board decided to advertise for the delivery at the sawmill "of a supply of rough timber for sawed post and rail fence, and the posts and cross-bars of Lock-gates."[19]

One week later, on December 10, the directors met at the office of the Board of Engineers in Georgetown to consider the bids for work on the canal between Rock Creek and Little Falls. Following a review of the various offers, the bids for Locks Nos. 1–4 by Isaac McCord & Co. were accepted.[20]

On January 21, 1829, the board resolved that "proposals be received for the supply of locust timber for lock Gates, according to a bill furnished by the Engineers."[21]

As early as mid-January 1829 the contractors were experiencing financial difficulties. Many of the bids had been too low for the prevailing level of wages and prices in 1828, and the general inflation which followed forced many contractors to abandon their contracts. On February 28 President Mercer informed the board that the contracts for Locks Nos. 5 through 8, 12, 16 through 18, 19, 20, 22, 23, and 26 had been abandoned. Two weeks later, on March 14, the board relet these contracts to the following builders:

No.	5	A. Knapp & Co.
No.	6	A. Knapp & Co.
No.	7	Fenlon & Bosteder
No.	8	A. Knapp & Co.
No.	12	Fenlon & Bosteder
No.	15	A. Knapp & Co.
No.	16	A. Knapp & Co.
No.	17	A. Knapp & Co.
No.	18	A. Knapp & Co.
No.	19	Fenlon & Bosteder
No.	20	A. Knapp & Co.
No.	22	F. C. Clopper
No.	23	Holdsworth & Isherwood
No.	26	A. Knapp & Co.[22]

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17 Wright to Purcell, December 1, 1828 (Ltrs. Recd., Letter Book of the Resident Engineer of the 1st Residency of the 1st Division). A copy of this sketch may be seen in Drawing No. 1.

18 Proceedings of the President and Board of Directors, A, pp. 115–116

19 *Ibid*., A, p. 123.

20 *Ibid*., A, p. 127.

21 *Ibid*., A, p. 146.

22 *Ibid*., A, pp. 173, 178.

As the contractors began the quarrying of stone for the locks in the spring, the Board of Engineers on March 16 sent a list of instructions to each resident engineer on the manner of cutting stone. Horman Boye, a Danish engineer who was the resident engineer of the Fifth Residency, was instructed as follows:

> In order to compel those who are now cutting stone for Locks to comply with the spirit and true meaning and intentions of the specifications, we require and direct the following to be your guide, in all cases where a contractor shall require an estimate to be taken of the Lock stone cut by him to be presented to the Board of Directors of the Ches. & Ohio Canal Company.
>
> 1st. For every 3 or at least for every 4 face stones or stretchers there shall be one Bond stone or header of the dimensions required by the specifications and a proportionate number of headers among the hollow quoins.
>
> 2nd. No stone to be estimated which shall be cut, having the face different from a right angle to the natural grain of the stone, or to the natural bed as it lay in the quarry (except the upper surface of the coping which is to be cut with the grain and to have at least as much bed as face, as intended by the specifications.)
>
> 3rd. A square shall be procured and a trial made upon each stone cut, the beds & ends of which shall not be more than ¼ of an inch within the square on the required width of the beds or joints.[23]

[See drawing No. 1, p. 134.]

A question of vital importance to the construction of the locks was the availability of an adequate supply of hydraulic lime for cement. Stone of a suitable quality had been discovered near Shepherdstown, on the Virginia side of the river, early in 1828, and Boteler and Reynolds had erected a mill and kiln to burn the lime.[24] On March 17 the board ordered Inspector of Masonry Robert Leckie to make a contract with Boteler and Reynolds for the delivery of 50,000 bushels of water lime to the line of the canal.[25] Subsequently, canal officials found a better grade blue stone nearby and adopted it.[26]

While operations progressed along the line of the canal during the spring months, President Mercer and the board of directors continued to keep close surveillance over the work. On May 16, Mercer reminded the resident engineers that as

> the Locks, Lock houses, culverts and aqueducts are advancing too much attention cannot be paid to the manner of constructing them prescribed to the contractors by their contracts with the company, or the instructions of the Engineer in Chief and of the Inspector of Masonry.[27]

The first annual meeting of the canal company stockholders was held on June 1 at the city hall in Washington, D.C. During the proceedings President Mercer reported:

> Stone of good quality has been found near the margin of the river, and hydraulic lime immediately on its banks.

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23 Board of Engineers to Boye, March 16, 1829 (ltrs. Recd., Letter Book of the Resident Engineer of the 5th Residency of the 1st Division).

24 Boteler to Mercer, January 14 and 22, 1828, *House Report 141*, pp. 38–39.

25 Proceedings of the President and Board of Directors, A, p. 181.

26 Leckie to Board of Directors, May 11, 1829 (Ltrs. Recd., C & O Co.).

27 Mercer to Resident Engineers, May 16, 1829 (Ltrs. Recd., Letter Book of the Resident Engineer of the 1st Residency of the 1st Division).

Among the earliest resolutions of the Board after the October contracts was one deputing a Committee of Engineers to inquire into the character of the water lime used on various canals already executed within the United States, and to compare their strengths when used in cements with that of the lime found on the Potomac shore.

> Their labor has ended in a perfect conviction of the excellence of that near Shepherdstown, for the supply of which a contract was made in the past winter. It is to be ground and delivered to the boats engaged to receive it at 17 cents the bushel. But such is the imperfect state of the navigation of the river, that much of the stone must be transported to the locks at a cost of two dollars the ton; and the transportation of the hydraulic lime, by boating, in the summer and autumn months, will double, if not triple, its cost to the contractor. The locks of the canal have, therefore, been nearly all relet at prices advanced twenty-five per cent upon those stipulated in the first contract.[28]

The board accepted two contracts on June 10 for the supply of timber for the lock gates. The bid of Nathaniel Billington was accepted for locust timber at 39 cents per cubic foot, and the proposal of James Campbell was approved for "the best heart pine, per specification, in two-inch plank" at $1.62½ per 100 feet, board measure.[29]

During the early part of June the masonry work on the canal was hindered by the delivery from Shepherdstown of a vast quantity of low-grade water lime. Accordingly, the board ordered Chief Engineer Wright to supply the contractors on the First and Second Residencies with

> such quantity of roman cement as he may deem necessary for the work thereon using Thomaston Lime as a cement for backing, until good water lime can be procured from Shepherdstown.[30]

A set of instructions concerning the construction of the locks was sent to the engineers in the field on July 3. The instructions, written by Inspector of Masonry Leckie, read as follows:

> Bottom Timbers and Puddling.
>
> The bottom timbers are to be laid solid and level and the spaces between them well filled with puddle that has been cut and treaded until it becomes a solid tenacious mass, that will adhere to the spade when stuck into it, so as to pull up several square feet several inches in endeavoring to extract the spade.
>
> Sheet Pileing and Floors.
>
> The sheet pileing under the line of long gates to be let in, or driven at least three feet below the level of the floor; and to be cut off at the level of top of bottom timbers, so that the plank of the lower may be scribed down tight on it, and should be spiked to the side of the timbers, directly under the line of the gate; the plank for the sheet pileing should be 2½ inches thick; each plank being grooved on both edges; and having tongues made that will exactly fit the grooves, set in before driving home the sheet pileing at the upper and lower ends of the lock, to be let in to the same depth, and spiked to the timbers in the same manner, and to raise to the level of the surface of the first floor and to be carefully cut off, so that the plank of the second floor may shut tight and close down on it, and in every case the sheet pileing should run several feet into the bank to prevent the water from working around

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[28] First Annual Report (1829), C & O Co., in Proceedings of Stockholders, A, pp. 38–39.

[29] Proceedings of the President and Board of Directors, A, p. 284.

[30] Ingle to Wright, June 16, 1829 (Ltrs. Recd., Letter Book of the Resident Engineer of the 1st Residency of the 1st Division). By mid-July Boteler and Reynolds had upgraded the quality of their cement, and the board again ordered the contractors to use the Shepherdstown cement.

the back of the walls; and from the sheet pileing to the head of the lock on the lower floor should extend across the whole line of the head of the lock, and be spiked to the timber that supports the floor in the forebay on the upper level, and continued across into the bank under the towing path and a puddle bed at least three feet thick should raise from the bottom of the first, or lower sheet pileing to the level of the forebay and continue for some distance into the bank on both sides, this precaution will afford additional security in preventing the water from working around, or, under the lock.

Floors of the Locks.

The lower floor, on which the masonry is started should be laid closely and carefully so as to exclude the working of the water, and as the plank differs greatly in thickness they should be dubbed off on the under side where they rest on the bottom timbers, so that the upper surface will be a level uniform plane, and that part under the cut stone facing and culverts should be tongued and grooved to give additional security.

As the plank differ in thickness from ¼ to ¾ of an inch, it is very obvious, if they are laid down without being reduced to a thickness where they rest on the timber, so as to bring the upper surface level, that the upper floor, instead of resting on a smooth uniform surface; will rest on the thickest part of the planks of the lower floor, and there will be considerable longitudinal spaces running the whole length of the lock, where the water may work between the floors.

Masonry of the Locks.

All the cut stone facing should be set with a hoisting Machine, because the heavy stone will then be completely under control—the stone should have a lewis let in the upper bed, hoisted, and then let down dry on its bed, when an intelligent and experienced mason will directly see what sort of a bed is wanting to make the stone fir exactly; the stone should then be hoisted about 18 inched and the under bed as well as the place where it is to lay on made wet with a brush and water and the bed put on and the stone carefully laid down upon it, and be settled down with a heavy wooden mallet, when, the mortar will come out all around, and the stone lie as solid as it did in the quarry.

When heavy stone are set without being hoisted, they are taken near the place with rollers (and pinch bars, generally used to the great injury of the stone), a bed is then put on at random and two pieces of plank put on, and the stone laid down on the top of the plank, crowbars are then used, and the pieces of plank pulled out, and the stone let down on its bed in the mortar; from this statement it must be very obvious, that stone laid down on this manner must be very imperfectly laid indeed; as there is no previous trial to ascertain what sort of a bed will suit the stone, it is put on by chance, and pulling out the strips pf plank will spoil it, even if it had been right at first, and the corners and face of the stone are generally much injured by the crowbars in letting it down, and as the beds of the stone are generally cut slack to the square of the face the stone "Batters" this is remedied by raising the back part with crowbars, and putting in some stone chips under the back part of the bed; and then the stone set on the back part on these chips, and on the front of the wall and the middle all hollow, for it must be observed that lifting a heavy stone after once laid as above described to remedy any defects in the bed is entirely out of the question, without the aid of a hoisting machine.

Filling in the middle of the lockwall with dry stone,
and trusting to grouting to make it solid.

This mode of masonry is in my opinion very objectionable indeed, and should never be trusted to for several reasons, among whom may be enumerated the necessity of having the grout very liquid that it may penetrate all the vacuities of the dry stone work; in this case it is very certain that when the aqueous or watery part of the grout evaporates, or settles away, that open spaces will be left in the masonry and that, where the surface of the stone touch each other, then no grout can get in. and that part of the wall is laid dry.

Grouting in my opinion ought never to be trusted to, excepting to fill the vertical joints, and the small interstices caused by the irregularities of the materials; every stone should be laid in mortar and

> struck home to its bed until the mortar come out all around and the stone feels as solid as when it lay in its natural state in the quarry.
>
> The first course of the cut stone in the lock should have the face cut fair and straight for at least six inches from the bottom to permit the upper flooring in the lock and culverts to fit up to it exactly and make it tight joint that will effectually exclude the water.
>
> When the bottom is rock and no wooden floor put in, there are generally many irregularities in the surface, in this case the cut stone should be scribe down close in the irregular surface of the rock in other words the under part of the cut stone should be cut away so as to fit down exactly on the irregularities of the rock, and the upper bed form a straight line, to receive the next course in a regular manner.
>
> I am instructed by the president and Directors to say that they unanimously approve of the preceding modes of executing the masonry &c. of the locks, and to request that you will see them carried into effect by the lock contractors in your intendancy.[31]

Chief Engineer Wright reported to the board on July 30 about the plan of a new cast-iron wicket gate recently patented by John F. King. The new paddle gates had been tested successfully on the Erie and Champlain Canals, and Wright made to following recommendation:

> I am satisfied that this is the best plan of paddle or wicker gate that I have ever seen and I can freely advise to have them adopted for the Locks on the Ches. & Ohio Canal. Mr. King is not disposed to enter into Contracts with the Lock Contractors separately and says that he will make a contract with the Board direct at 8 cents per lb. He says a gate 2 feet square with all its fixtures of castings will weigh 190 to 200 lbs. each.
>
> As I have planned the paddles we are to have two in each of the lower Gates, but they are 2 feet by 18 inches each and will probably weigh only 160 to 180 lb. Each—making 4 gates to each Lock—and as we give up the Cast Iron frames for the Paddles and for the culverts also; the contractors have no right to complain but are benefited by our making them use cast iron gates instead of wooden ones.[32]

The board agreed on August 5 to adopt the recommended improvement in the lock gates by Wright with the condition that the lock "Contractors will pay the cost thereof."[33]

Two days later King, apparently fearful that the lock contractors would not favor such an arrangement, made another offer to the board. If the canal company would agree to purchase his cast-iron culvert and paddle gates, he would deduct from his price "whatever the Engineers shall say the difference in expense is between the iron and wooden gates—the cast-iron frames which were to be used—and the difference between a 2 inch rod which was contemplated for the wooden gates—and a 1½ inch rod which was to be used for the Iron gates." He was making his proposal provided that "the Iron Gates be made of such dimensions as only to pass the same quantity of water in a given time that the wooden gates would pass."[34]

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[31] Leckie to Purcell, July 13, 1829 (Ltrs. Recd., Letter Book of the Resident Engineer of the 1st Residency of the 1st Division). A copy of these instructions may be seen in Appendix A.

[32] Wright to Board of Directors, July 30, 1829 (Ltrs. Recd., C & O Co.). For a copy of King's patent see U.S. Department of the Interior, National Park Service, "Historic Structure Report: The Composite Locks," by Edwin C. Bearss (1968), pp. 72–73. (National Park Service publications will hereafter be cited under USDI, NPS).

[33] Proceedings of the President and Board of Directors, A, p. 318.

[34] King to Board of Directors, August 7, 1829 (Ltrs. Recd., C & O Co.). At an undetermined date the board let a contract to King for his cast-iron wicket gates, which were to be used for Locks Nos. 5 through 25 between Little Falls and Edwards Ferry. King agreed to warrant the gates for one year with "good usage." The gates were cast at A. and J. Ellicott's furnace near Elk Ridge Landing, in the vicinity of Baltimore. When a wicket gate on Lock No. 18

As construction progressed along the line of the canal, Chief Engineer Wright continued to make improvements in the general plan for building the locks. In a letter to William Archer he explained some recent changes that he had made in the plan for the lock culverts and gates.

> The principle which you suggest of never cramping the water way in a culvert—because in so doing there is danger of straining the walls of the Lock is correct and ought never to be lost sight of in all plans—but I cannot admit the whole extent of the application of these principals, because I believe that water set first in motion occupies more space than it does 10 or 20 feet from the point where it is first set in motion, or to speak more plainly—I believe that it occupies more space at the point where it enters the culvert than it does after it has fallen and gained some momentum which is continued thro' to the discharging points—according to my calculation the difference is at least 30 pct.
>
> In these plans however it is always best to be on the safe side and I have therefore altered my culverts a little and made the passage 2¾ feet square from its entrance to the first discharging point & 2½ feet from that point to the lower end of the discharge into the Lock and my paddle will not occupy more than 46 by 24 inches. As to air I feel confident from experience that the air vents immediately over the entrance of the water into the culvert are all that is necessary to prevent air doing injury or straining the masonry.
>
> By your remarks I presume you supposed that my entrance for the water above the upper gates was 4 by 2½ feet. This is the masonry, but the frame will take up 4 inches of this and leave only 2 feet 2 inches and then the Gate will occupy at least two inches—leaving not exceeding two feet by 4 feet. There the first discharging place comes on so immediately after the entrance of the water as to give it vent and prevent any strain to the Lock walls when they are not very strongly supported.
>
> I have objections to going to the extent you mention of making the culverts 3 by 4—this would weaken the lock walls unless one whole plan was changed and indeed then it would be objectionable to have so large a culvert passing thro' the lock walls. If we prevent strains upon the masonry we have all we wish.
>
> I believe we can fill & discharge the Lock in 2 or 2½ minutes with a boat and that is but a little detention and hereafter if it's thought necessary to pass them sooner we can easily have gates put into the upper & lower gates so as to fill & discharge sooner—this change may be made on one lock to see how much difference there is and what advantages result therefrom.
>
> As to the groove at the head of [the] Locks to put in stop plank—that I have always been in the habit of having done and shall have it done in certain locks where there are logs found above them: it is a necessary and useful improvement & precaution.[35]

After Wright had examined the locks in mid-January 1830, he became alarmed by the way the contractors were constructing the heel posts for the lock-gates. On January 26 he sent the following letter to Resident Engineer Purcell:

> I perceive the contractors are doing wrong in getting Heel posts to their gates only 12 inches square; they were intended to be 12 by 14 inches—pray correct this—and it was intended the gate should be framed with the mortices going through the heel and toe posts or mitre posts, and made very true, &

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was broken in April 1831, it was determined that the difficulty was that the iron box that held the foot of the gate was improperly fitted into the wooden frame. When he was advised of this difficulty, King suggested that it was possible the wicket gate was not strong enough and that therefore the company should have A. and J. Ellicott increase its thickness. See Proceedings of the President and Board of Directors, B, pp. 301, 322; Ingle to King, April 16, 1831, Ingle to Ellicott, and Ingle to King, April 25, 1831 (Ltrs. Sent, C & O Co.); and Wright to Ingle, April 19, 1831, and King to Ingle, April 21, 1831 (Ltrs. Recd., C & O Co.).

[35] Wright to Archer, September 1, 1829 (Ltrs. Recd., C & O Co.).

> the tenons fill them very close. The end of the tenons in Heel post was to be cut off 2 inches & this filled with oak of similar character so as to have a uniform substance to wear upon the Stone Quoins.
>
> I pray you also to have the contractors informed that they can reduce the Rods for the lower Gate paddles to 1¾ inches diameter instead of 2¼ as given in their specifications.
>
> Pray that the timber is full & sound before they put it together.[36]

In reply to President Mercer's request for information on the "length and breadth of such a boat as shall be at the same time adapted to our Locks," Wright reported:

> The Locks on the Ches. & Ohio Canal are 100 feet by 15 in the Chamber; consequently a Boat with its extreme length from stem to stern, 90 feet, will pass through these Locks and if we say 14½ feet for the extreme width having 6 inches play, it is ample—3 inches would do very well. Such a Boat would be the greatest burthen adapted to a Canal & would have its shape not unlike the little sketch I enclose [drawing not now enclosed]. A Boat of this form drawing 5 feet water would displace water equal to 78 x 14 x 5, 5460 Cubic feet equal to 341,300 lbs. or 152 tons & 2801 lbs. Now if we suppose the Boat to weigh when empty 22 tons, 820 lbs. we shall then have 130 tons of lading which such a Boat would carry in the Canal and pass our Locks.[37]

During the winter and spring months of 1830 there were a number of complaints by canal officials concerning the quality of the masonry work on the locks. On January 14 Purcell notified Contractor O. H. Dibble that the wall he was building at the head of Lock No. 1 was "so very bad that I cannot include it in an estimate until the last 3 feet built is overhauled & built better."[38] Inspector of Masonry Leckie complained to Purcell on March 6 about the poor quality of granite being used for the facing of Lock No. 7 as follows:

> You will perceive that these facing stone are not only very small generally, but the joints and beds very bad indeed; many joints are not 2 inches wide and in some cases the joint is a very accurate angle the arm of which is nearly as sharp as the back of a case knife.
>
> I am also sorry to say that the men employed in setting the facing of the Lock are totally ignorant of the principles of solid masonry, the stone are laid dry with the exception of a small part in front, the back part is supported by wedges, and then plastered over, on taking out one of these chips I found the stone dry as above described and had some lifted, and showed the masons how to lay them solid as they should be, the backing seems to be better laid than the front, but that also will have to be watched.[39]

Less than a week later Wright informed Purcell that a portion of the Lock No. 6 wall was leaking badly. In addition, he had found "some mortar or other substance in the horizontal culverts which ought to be got out tomorrow."[40]

Perhaps the most scathing criticism of the masonry work on the canal came from Superintendent Van Slyke. Not only was he dissatisfied with the procedures being used in laying the ma-

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36 Wright to Purcell, January 26, 1830 (Ltrs. Recd., Letter Book of the Resident Engineer of the 1st Residency of the 1st Division).

37 Wright to Mercer, February 3, 1830 (Ltrs. Recd., C & O Co.).

38 Purcell to Dibble, January 14, 1830 (Ltrs. Sent, Letter Book of the Resident Engineer of the 1st Residency of the 1st Division).

39 Leckie to Purcell, March 6, 1830 (Ltrs. Recd., Letter Book of the Resident Engineer of the 1st Residency of the 1st Division).

40 Wright to Purcell, March 12, 1830 (Ltrs. Recd., Letter Book of the Resident Engineer of the 1st Residency of the 1st Division).

sonry of the locks, but he also disagreed with the instructions given by Inspector of Masonry Leckie. In the following letter to President Mercer he reported:

> I cannot refrain from repeating the remarks which I have heretofore repeatedly made to the Engineer in Chief on the system of laying the masonry of the locks in mortar instead of grouting the center of the walls, particularly as the hoisting machine is not used. By the present mode of laying the walls in mortar throughout it requires twenty five per cent more cement than would be necessary if grout be used. As the masons frequently use this mortar profusely where it is quite unnecessary in filling vacuities which otherwise would be occupied by stone of the suitable dimensions.
>
> If the work could be done exclusively under the eye of an inspector it would be barely possible to make it sufficiently tight with the masons who are now employed. As I have become satisfied from repeated instances where I have been at a lock on which a number of masons were engaged and notwithstanding my frequent instructions, I have repeatedly in the same hour detected the same workman in some instances in laying stone without using the proper quantity of mortar, and again in other cases they would use much more than was requisite.
>
> The present mode (and I do not know how to better it if mortar alone is used) is to spread on the wall which is leveled to receive another course a light covering of mortar, and then place upon it the succeeding course of stone, which considering the uneven surface of the wall and the rough bed of the stone laid seldom makes a tight joint, although it might in this case be well done if judgment was exercised in using the proper quantity of mortar. This judgment does not exist among the class of men who are in this employment, and notwithstanding masons have frequently at my instance been discharged for this neglect, the same heedlessness prevails. To lay masonry in mortar as is requisite, much more care than is common, and a different style of work than that which is generally practiced, is necessary. And it may not be expected that in the short space of a few weeks, a mechanic can be used to change the mode of work which he has pursued for years, and this would be absolutely requisite to produce such work as is required to make a wall impervious to water unless grout be used. The chief objection to grouting which is urged by the inspector of masonry is as follows: "When the watery part of the grout evaporates or settles away that open spaces will be left in the masonry." In this I must beg leave to differ with him in opinion, as with me it is not a mere matter of opinion but a full knowledge of the fact obtained from repeated trials and minute observation having laid locks myself as a contractor and superintended the work daily in person. I have always found that the watery part of the grout does not settle away, but that the thick part settles and the watery part is seen to rise to the top of the wall where there are vacuities if any and are filled by the succeeding course of grout.
>
> If the face stone be well bedded in mortar made of cement without the use of sand, the back part of the wall for one foot in thickness well laid in mortar with the usual portion of sand, and the reminder of the wall laid dry and the stone packed as perfectly as possible and not more than one foot in height at a course laid before grouting, and each course of this kind inspected before the succeeding one is laid. I cannot doubt but that work would be better than I can hope for, if the present course is preserved [sic] in.[41]

At the second annual meeting of the canal company stockholders, which was held on June 7, 1830, President Mercer reported:

> The necessity of transporting over bad roads, or by the often obstructed and always difficult navigation of the main river, and for considerable distances both the stone & Hydraulic lime for the masonry of the canal, not only swelled its cost, but sometimes occasioned its actual suspension, and required the reletting of the most costly Aqueducts, and of nearly all the locks and culverts at a large advance of price.

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[41] Van Slyke to Mercer, February 27, 1830 (Ltrs. Recd., C & O Co.).

> … It is not, however, deemed immaterial to state, as the result of these details, that the expectation is now confidently cherished of bringing into use twenty of the new locks, and the entire canal from Seneca to the Old Locks below the Little Falls, by the next fourth of July; a period of two years from the nominal, and but little more than eighteen months from the actual commencement of the Chesapeake and Ohio Canal.[42]

Following the president's report a special committee informed the stockholders of the progress on the canal between the tide lock in Georgetown and Little Falls. Included in their summary review was the following observation:

> The three Locks and Bridges in Georgetown now nearly finished, give evidence of the skill of these employed in their construction; the material appear to be of good quality, and are put together in a workmanlike manner: every part of the work through Georgetown is executed in a manner highly satisfactory to your committee. . . [43]

Superintendent Daniel Van Slyke informed the board on September 20 that the gates of Locks Nos. 19 and 22 had not been painted. This job had not been done because he had been unable to find a man who would paint them as he desired for less than $35. He thought that the proper procedure for painting the gates should include "an abundant covering of hot oil after which two coats of paint [should be put on]." However, he informed the directors that he could have each set of lock gates painted with "two common coats" for $25. While he disapproved of this practice, he admitted that many of the lock gates had been painted in this manner.[44]

The board resolved on September 25 that

> suitable provisions be made for passing horses and foot passengers across the locks from the towing path to the lock-keepers houses in such manner as not to obstruct the navigation of the Canal.[45]

Superintendent Van Slyke reported to the board on October 2 that the waterway "generally is in good repair." The previous day a boat had passed from tidewater in Georgetown to Seneca Falls. A breach has occurred in the embankment near the lower end of Section No. 15 that evening. It would take four or five days to repair. This incident caused him to urge the directors to enforce the provisions of the lock specifications relating to flumes.

> The flumes which were contemplated by the Lock Specifications are indispensable as being the means of regulating the level of the water to any required depth as without these a slight inattention amounts to serious damage. As I have repeatedly found at some parts of the line the water running over the locks and at other parts entirely dry—where the instructions in both cases were similar.
>
> I hope the Board will see the necessity for them and order that the flumes be forthwith constructed as the breach which occurred last night was unquestionably in consequence of the water having raised two feet higher than the instructions to the Lockkeepers require. I therefore fear that without

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[42] Second Annual Report (1830), C & O Co., in Proceedings of Stockholders, A, pp. 84–85. Only Locks Nos. 9, 12 and 19 were still unfinished.

[43] *Ibid*., A, p. 20.

[44] Van Slyke to Board of Directors, September 20, 1830 (Ltrs. Recd., C & O Co.). The board approved his proposal to have the remaining lock gates painted with two coats of paint.

[45] Proceedings of the President and Board of Directors, B, p. 189.

> these flumes the like damages may occur, whereas with them it is barely possible that the like evil can occur—even in case of the total neglect of the Lockkeepers.[46]

On November 22 Wright, who had recently resigned from his post as chief engineer and was now living in Reading, Pennsylvania, wrote to President Mercer about work that still needed to be done on the canal between Georgetown and Seneca. First, grooves "similar to those in the tide lock" should be put in the stop planks at the lower ends of Locks Nos. 1 and 4.

Second, 30 to 50 perch of large round stones called "niggerhead," which had come from the excavation near High Street in Georgetown, should be placed into the black mud at the foot of Lock No. 1. These stones should extend 30 to 40 feet from the tail of the lock and should be placed no higher than the lower mitre sill. The purpose of these stones was to prevent the water of the lock "when rushing out of the lower paddles, in emptying the Lock, from digging out a deep hole, in that soft and light matter."

Third, Lock No. 2 and 3 were located on sandy ground and needed their foundations stabilized. To prevent serious effects to their foundations from the water current passing out of their paddle gates, Wright recommended that

> it is important that a paving of large stones at least 12 to 18 inches deep be made on the bottom and to extend as far into the pool as a line drawn from the extremities of the wings of the Bridge at each of these locks and that a small triangle of stone [be] placed at the foot of the Dry wall below the bridge on each side to extend 30 feet or more below the extremes of the wing walls.

This would prevent eddies from undermining the walls as water passed out of the locks. Wright urged that this precaution be taken at all locks that had no rock bottom.

Fourth, as he had observed that many lockkeepers were filling the locks through the wickets of the lower gates, Wright warned Mercer that this practice caused "a powerful current to be thrown out when there is no water, or very little in the lower level." Thus the lockkeepers "should leave the lower Gates open and feed through the Culverts."

Fifth, Wright urged that precaution be taken with the lock gates "particularly the face of the lower Gates of each Lock to prevent their being injured." He feared that the lower gates would be injured with the best precaution "by those long-pointed River Boats which are well calculated to jam a hole through two Inch Plank, if those who man them do not take great care." His solution to the problem was:

> The spiking on 2 inch White Oak or the equally hard and durable wood, 10 spikes or more wide and 9 feet long on the face of the Mitre posts, thus a vertical section a. a. represents the end of the Plank as they are spiked on the Posts and these plank are to extend to the top of the Balance Beam where it connects with the Mitre post.
>
> It is found by experience that the Boats are apt to strike the Mitre post and soon bruise them very badly and these are put on to receive the stroke of the stems of the Boat—the space is left open about 3 or 4 inches to receive the Stem into it and keep it steady and let the Boat rise and fall with the Stem kept steady in this kind of groove—The intention in the length is to have them down as low as the face of the Mitre post as a Boat can ever strike the Gate and perhaps 9 feet may not be enough.[47]

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[46] Van Slyke to Board of Directors, October 2, 1830 (Ltrs. Recd., C & O Co.).

[47] Wright to Mercer, November 22, 1830 (Ltrs. Recd., C & O Co.). See Drawing 2 for a copy of the sketch that accompanied Wright's letter describing his proposed improvements to the lock gate.

[See drawing No. 2, p. 135.]

A report by President Mercer on November 26 observed that the section of the canal between Georgetown and Little Falls was "rapidly advancing to a conclusion." The previous week many boats had passed through the twenty locks above Little Falls, showing this section of the canal then to have been in partial use. Regarding the operation of the locks, the report stated:

> The use of the new locks has clearly developed the important benefit resulting from the extension of their lateral culverts, as far forward as the middle of the lock, and the addition of two inlets to the four usually provided for the admission of water from the head into the chamber of the lock. It is now ascertained that the greatest detention in passing from one level to another, thro' any lock, will not exceed 3 minutes; that this may easily be reduced to two minutes and a half, and it is confidently hoped to two minutes only, or one-fourth of the time usually allowed for passing a lock of eight feet lift.[48]

When navigation on the canal above Little Falls was reopened on March 19, a new difficulty faced the board. Superintendent Van Slyke described the chaos at the locks in the following letter to Mercer:

> The canal has been so thronged with boats since the opening of the navigation on the 19th March last that it is with great difficulty we have been able to preserve order among the Boatmen, who in striving to push forward for a preference in passing the several Locks are sometimes disposed to injure each others' Boats as a means of carrying their point. An unfortunate instance of this kind happened on Wednesday last at the Locks on the 9th Section. A strongly constructed Boat ran her bow against a Gondola loaded with flour, and so much injured her as to render it necessary to transship the load. But no damage was done to the cargo. It would seem important that some rule be adopted by the Board to govern the Lock Keepers, so that the Boats may pass the Locks by turn as they arrive, as it frequently occurs that fifteen or twenty boats arrive at a Lock within half an hour. Hence the contention for right of preference, which I believe would be allayed if it was known that they must be permitted to pass only by turn as they arrive.

Accordingly, the board reacted to these reports by adopting a list of navigation regulations for the canal on July 16.[49]

Resident Engineer Purcell reported to the board in April concerning "the expediency of constructing stop gates on the canal below Seneca" that

> the design of Stop Gates appears to be; not as a preventative of breaches, but a device to render them less destructive when they shall occur; by arresting a portion of the water which would otherwise run through the fractured embankment & carry with it a quantity of earth. To the success of this design it is all important that the gates be placed in proper position and secondly; that if a breach takes place, the gates next above and below, should immediately be shut after the accident has occurred. In short levels such a contrivance is apparently unnecessary; as the locks answer the end for which the gates are designed. On long levels, exposed to danger, with a person appointed to regulate them, these gates might answer a valuable purpose. I know of no attempts that have resulted successfully; where these

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48 Proceedings of the President and Board of Directors, B, p. 232.

49 Van Slyke to Mercer, April 2, 1831 (Ltrs. Recd., C & O Co.). See Appendix B for a copy of the "Regulations for Navigating the Chesapeake and Ohio Canal." The regulations were revised on February 18, 1835. A copy of these revised regulations may be seen in Appendix C.

> things have been constructed on the self acting principle, and if attendants are hired to open and shut them they become expensive. Still however it is better to incur this expense where a breach is apprehended; for the extra earth taken off by one breach will generally pay for two or three of them and their keeping.
>
> In conclusion, however, I know of but one point on the canal below Seneca where such a fabric could be considered useful; I allude to the lower extremity of the great pond at Bear Island; here perhaps a stop gate placed under the direction of the Superintendent of repairs might be useful.[50]

Resident Engineer Alfred Cruger instructed Contractor Andrew Small on the method of installing paddle gates in Lock No. 27. In the lower gates he was to place two cast-iron Venetian blind or lattice gates (one in each fold). In the upper gates he was to "insert in each fold one paddle of similar shape and dimensions" as he had placed in the lower gates of a lock that he had completed below Seneca. For the culvert through the lock wall he was to "procure a paddle gate 3 ft. 6 in. by 2 ft."[51]

[See drawings No. 3 and No. 4, pages 136–137.]

On May 27 the board took steps to solve three problems that had developed with the increased use of the locks, because the board ordered "that a small sluice gate be constructed in the upper gates of some one lock to be worked by a lever, in order to facilitate the filling of the locks." At the urging of Superintendent Van Slyke, the directors ordered that

> the flumes be constructed of sufficient capacity to answer the purpose intended, and at as great a distance from the body of the lock as is practicable; that the bottoms be five feet above the bottom of the Canal, and that sills and gates be constructed in them.

Finally, the board resolved that

> a pivot bridge for wagons and carriages be constructed on the 13th lock, and that a broad plank be substituted at the several lock gates for the plank and timber now thrown across locks for passing the same in such manner as to enable the lock keepers more promptly to discharge their duties.[52]

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[50] Purcell to Board of Directors, April 12, 1831 (Ltrs. Recd., C & O Co.). Seven stop gates, also called stop locks, were eventually built at various points along the canal. Their general purpose was to maintain the level of the canal in one section while the level in an adjacent section was being changed. They also served as flood control devices. The stop gates consisted of two parallel masonry walls with a groove in each wall. The water level could be regulated by the addition or removal of boards. Grooves found in the masonry of several locks and at the lower end of the Paw Paw Tunnel indicate that these structures at times also served the same purposes as the stop gates. The locations of the seven stop gates were as follows: just above Lock No. 16, opposite to the Maryland abutment of Dam No. 4, approximately two miles below Fort Frederick in the vicinity of McCoy's Ferry, the lower and upper ends of Big Pool, the lower end of Little Pool, and just below the basin at Cumberland. See USDI, NPS, "The Chesapeake and Ohio Canal: A Physical History," by Miele (1968), pp. 107–109.

[51] Cruger to Small, April 21, 1831 (Ltrs. Sent, Letter Book of the Resident Engineer of the Fifth Residency of the 1st Division). For a copy of Cruger's sketch of the culvert paddle gate, see Drawing No. 3. The cast-iron Venetian blind or lattice gates mentioned in Cruger's letter were patented in 1829 by Bradford Seymour of Hampton, New York, and were already in use on the Erie, Pennsylvania, and Ohio Canals. After considerable debate, the board purchased four of the gates for $100 from Seymour on January 16, 1832, and installed them in the lower gates of Locks Nos. 26 and 27. A copy of Seymour's patent may be seen in Drawing No. 4. Proceedings of the President and Board of Directors, B, p. 34; Seymour to Mercer, September 20, 1830, and February 4, 1832 (Ltrs. Recd., C & O Co.); and Ingle to Seymour, December 14, 1831, and January 16, 1832 (Ltrs. Sent, C & O Co.).

[52] Proceedings of the President and Board of Directors, B, pp. 324–325.

The board soon let a contract to John C. Rogers to construct the flumes around the locks. Accordingly, the directors instructed Resident Engineer Purcell to furnish James C. Lackland, the newly appointed superintendent of the canal, with a plan for the construction of the flumes. They also ordered that Rogers "be directed to construct such thereof as the Engineer shall direct."[53]

Shortly before the section of the canal between Georgetown and Seneca was officially opened for navigation, the waterway was examined by two "engineers of the topographical corps of the Army, by order of the President of the United States, at the request of the president and directors" of the canal company. In June Lieutenant Colonels John J. Abert and James Kearney made a survey of the canal, reporting favorably in detail on the type of construction actually done on the canal and upon its existing conditions. The report of these two officers furnishes an excellent view of existing conditions along this section of the canal.

After making some observations on the tidelock and the Rock Creek Basin, two officers reported that the "canal communicates with the basin" by means of Lock No. 1. This structure was "a stone lock, faced with the Aquia creek freestone" and had "the appearance of a good piece of masonry." However, they found that one end of the side walls

> which joins on to the basin, has, from a defect in the foundation, yielded at the hollow quoin, and left an opening of about one inch.
>
> The chamber of this lock is 100 feet long by 15 feet wide, and it has a lift of 8 feet, but it has not yet been in use, and has, consequently, not yet been exposed to the pressure of the water. The masonry appears remarkably well, except at the defective end, of which we have just spoken, the durability of which we are disposed to doubt.

In an appended footnote to their report, the two engineers noted that since they had examined this lock, they had been informed that the defective end had been taken down and was to be rebuilt from its foundation.

After noting that Locks Nos. 2 through 6 were of the "same dimensions, style of masonry, plan and lift" as Lock No. 1, Abert and Kearney observed that the "use of Aquia creek freestone appears to have ceased at Lock No. 6." Lock No. 7 was "composed entirely of granite" and had "the appearance of faithful workmanship and of great durability."

Lock No. 8 was the first lock in which they found that the facing was "made with the red sandstone of Seneca creek." They considered this to be "an excellent stone, and well adapted to the use to which it is applied; inferior, however, to granite."

Lock No. 9 was somewhat different from the previous locks in that it was "laid entirely in cement mortar, and not grouted in any part." Although it had "leaked a little from the walls soon after it had been first used," a "careful pointing with cement had since entirely remedied this." The structure was "built of granite, except the coping, which is of Aquia creek stone."

Built entirely of granite, Lock No. 10 was "a fine structure, extremely tight, and has every appearance of durability."

At Lock No. 11 the engineers found that a "small stone flume was being made" to "feed the lower level." They noted that this "course is to be adopted for all the small pools." The front ranges of the lock were of Seneca stone and its backing of rubble granite.

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[53] *Ibid*., B, pp. 428–429.

Locks Nos. 13 and 14 were "well built," "entirely of granite," and of "the same dimensions and plan as those previously noticed." However, Lock No. 13 had one exception in that it passed "the water through the gates, and not by a culvert through the side walls."

Locks Nos. 15 and 16 were faced with the "red sandstone of Seneca." Both structures were free from leaks, showed no sign of "yielding in any part," and appeared "to have been faithfully built."

Locks Nos. 17, 18 and 19 were "all similar to each other" with their "front range work, with hammered faces, of the Seneca stone—the backing of rubble granite." Lock No. 19 differed from the other two "only in its lift, which is nine feet."

Having "the general lift of the locks of this canal of eight feet," Lock No 20 completed "the series necessary to surmount the elevation of the 'Great falls' of the Potomac."

Locks Nos. 21 and 22 were "similar to those previously noticed" and had "all the appearances of faithful work." However, Lock No. 22 had a lift of only seven feet.

Lock No. 23, "the last in the extent of the canal, now filled and in active use," had "a lift of eight and a half feet." The lock and the adjacent Guard Lock No. 2

> were laid throughout with the cement, or hydraulic mortar, and no grout was used. The facing, or front ranges of masonry, are of the red sandstone of Seneca. They had the appearance of faithful workmanship. We were informed that at one time a spouting of water had been observed from the side walls of these locks, immediately after being emptied; but we observed nothing of the kind when we examined them.

Concerning the method of admitting the water into all the lift locks which they had passed up to that point, Abert and Kearney observed:

> The method of admitting the water into all the lift-locks we have passed, is, with one exception [No. 13], by a walled well and culvert, constructed in the masonry of the side walls of the locks. The discharge into the lock-chamber is by three rectangular openings on each side of the locks, under the water and at the bottom of the lock. The opening into the well, from the level above, is regulated by a cast iron paddle-gate, turning on a pivot.
>
> This plan admits water without violent ebullition, and avoids a forcing of the boat against the gates. We found it generally agreeable to the officers of the canal, but that the frequent breakings of the paddle-gates were subjects of complaint. This method, though often alluded to by writers on these subjects, has not, we believe, been elsewhere so generally adopted, nor do we consider it as having any marked advantages over that now frequently followed, of having the upper gate to extend to the bottom of the lock, and of admitting the water through the lower part of the gate, by a common pivot-valve, or by a valve raised by rack-work.
>
> The admitting of the water by a well and culvert, lessens the strength of the side walls, requires more care in workmen than is usually obtained, and a more vigilant inspection of the work. The passages are liable to be choked up by billets of wood and by stones; and the plan presents difficulties, and occasions great expenses, when repairs are required, while it at the same time exposes a greater surface to accidents. For ourselves, we think the more simple these structures are, and the more accessible to repair, the better.
>
> The gates of the locks are tight, well made, and remarkably well hung. They fit to the hollow quoins with great exactness, are well balanced, and generally move with ease. We were particularly struck with the secure anchoring of the upper hinge. The irons extending well over the masonry, and being embedded and firmly belted to it.

> The usual time employed in the passing of a lock, by the packet-boat, is four minutes. A passage, however, may be readily effected in three minutes and a half, and we were informed that, in an experiment of several passages, the average of the time occupied was but three minutes.

Proceeding to examine the still unfinished work above the Seneca feeder, the two engineers noted that the masonry of the lower abutment of Aqueduct No. 1 was connected with Lock No. 24. The "width of the canal over the aqueduct" was "the same as that of a lock chamber."

Eight miles above Seneca Creek, Lock No. 25 "was nearly completed, the walls were laid up, and in want only of a part of the coping stone, which the workmen were then laying." The timber for the gates was framed and ready to be put together. The work "had the appearance of faithful execution and a judicious choice of materials."

At Lock No. 26, the pit was completely excavated, the foundation laid, and some of the masonry raised a few feet." The Seneca sandstone for this structure "were well chosen, and the joints of the range work square and close."

Lock No. 27 was more advanced than No. 26, and "shows similar evidence of faithfulness in its execution."

Having finished their survey of the canal at the Monocacy River, the two engineers concluded their report by describing the general methods used in building the locks:

> In all cases where a rock foundation can be conveniently obtained, it has been resorted to; the rock carefully cleaned, its loose and defective parts removed, and the required extant of surface leveled to receive the masonry. Where the rock was not accessible, and the earth, after excavation, did not appear sufficiently firm, it was carefully rammed and paved with stone, before the timber foundation for the masonry was laid. Where the earth was judged to be sufficiently firm, the timber was at once laid upon it without further preparation. And in proof that the foundations have been carefully secured, we can bear testimony, that in no instance whatever, except in the tide-lock, and in Lock No. 1, at the Georgetown basin, did we perceive any yielding of the masonry, which could be attributed to any defect in the foundations.
>
> ….
>
> When the pit is prepared for a lock, a strong frame of timber is laid, united, and leveled. This frame work consists of ninety pieces of timber, eighty-two of thirty feet in length, and eight of thirty-eight, squaring ten inches by twelve. The whole is then covered by a course of two and a half inch plank, well secured to the timbers. A second course of planking is also laid from above where the culvert opens into the lock, to three feet below the lowest opening of the culvert. Three courses of plank piling are driven five feet below the timber frame, one at the head, one at the foot, and one at about the centre of the frame-work, before the planking is applied. This frame-work extends over a width of thirty feet, and a length of one hundred and forty-one, and is the prepared foundation for the masonry. The main walls of the lock are seven feet thick, with a buttress of one foot from the head to three feet below the lowest opening from the culvert, and are continued at this thickness for a height of three feet. The wall then falls in one foot, but not the buttress, and maintains this thickness of six feet to its top.
>
> All the facing stone in every part of the lock exposed to view is cut, and coursed with parallel beds. No range is admitted less than one foot thick, nor with less bed than its face, and each stretcher is to be four feet long. A header is required to every ten feet, to extend not less than four feet into the wall, and to be two feet long at its exposed face. The coping stone are not less than twelve inches thick and three feet wide.
>
> After the masonry is finished, an additional course of two inch plank is laid throughout the whole chamber, and below the lower gates, and an embankment of earth is raised against the back of the walls, and up to their height.

> The range-work of these walls is laid in cement or hydraulic mortar; the backing, or dead wall, which is of rubble stone, is carefully grouted with the same material at every range.
>
> These are the general principles and methods which have governed in the masonry of this canal, varied in some instances according to the discretion of the engineer. We are assured that they have been the guide in such works as have been completed, and we had proof in our examination that they were observed in such as were being made.
>
> There is no lock built upon an inverted arch.[54]

The following month President Mercer traveled the distance of the canal between Georgetown and Seneca to determine the quality of construction. After reviewing the work, on July 16 he directed Superintendent James C. Lackland to take several measures for preserving the locks:

> Let the balance beams be well, that is, thoroughly oiled with warm linseed oil and afterwards, cause the cracks made in them by drying to be filled up carefully with putty and the surface again painted the original color. Let suitable plank be obtained and have the sides of the gates not now planked on both sides, be planked up so as to preserve the gates from further injury from the striking of the ends of the boats against the planks and their gliding as they rise in the lock under the cross bars or timbers of the gate or hanging on them in letting out the water. At the same time cause a brace to be attached to the slight bridges at the lower ends of the locks so as to keep the boats in like manner from lifting them up as they rise beneath them in the lock.

So that the locks would be properly identified, Mercer ordered Lackland to use the following procedures in painting numbers on the locks:

> It is a special direction of the Board also that each Lock have painted on it the number of the Lock, reserving the denomination of tide lock to distinguish that in the mole at Rock Creek from the rest and numbering the locks as hitherto in our contracts from upwards to 22 [23] which will be the number of that in charge of Offutt. In numbering them, let the number be in black letters on a white ground and on the coping stone on the berm side, or side opposite the towing path side of each lock, which is at first, at the turn, or curvature of the face of the lock, below the lower gate: as follows (ground view of this stone) (stone to be painted on the face, manner of painting [(No. 1)] [(No. 2)] and so on). Let the guard locks be designated by the words painted in like manner [(Guard Lock)]. These jobs had best be done by contract, with one individual for each description of work: at so much a letter and figure, and before making each contract ascertain who will do it on the cheapest terms of those who will do it well.
>
> The engineers have been instructed to measure the distances between the locks and to cause them to be denoted in the face of the lock in the manner I have above described. In denoting these distances, they can be expressed in miles, yards and parts of yards where such fractions occur in measurement on the stones next below the coping as thus.

And so on.

> As the painting on the lock had better be done because it can be cheaper done at once, it may be well to call on Mr. Purcell or Mr. Williams to have the distance measured in time for the painter to include them in the same job, and this being a season of comparative leisure will answer best for both. Chain carriers would suffice, indeed two of your hands with proper instructions for carrying the chain would

[54] U.S. Congress, House, Committee on Roads and Canals, *Chesapeake and Ohio Canal* H. Report 414 to accompany H. R. 94, 23rd Congress, 1sr Session, 1834, pp. 88–105 (hereafter cited as *House Report 414*).

> answer to measure from the lower end of one lock to the lower end of the next above which is the distance to be inscribed upon the lock: the measurement being designed mot to denote the distance from the basin but the length of each level.[55]

The board on July 22 passed a resolution officially opening to trade that portion of the canal "between the Seneca feeder and the wooden lock next above the foundry [in] Georgetown." This section of the canal was "declared open and free for trade and passing, subject to the Regulations of the Company."[56]

Two months later (on September 19) Resident Engineer Purcell informed the board that water was "now admitted into the Canal through Georgetown." That afternoon, the directors "embarked on the Packet Boat, 'C. F. Mercer' and descended through Locks No. 1, 2, 3 and 4 into the Basin at Rock Creek, and landed upon the Pier."[57]

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[55] Mercer to Lackland, July 16, 1831 (Ltrs. Sent, C & O Co.)

[56] Proceedings of the President and Board of Directors, B, p. 432. For a listing of the "Regulations for Navigating the Chesapeake and Ohio Canal" adopted by the board on July 16, see Appendix as heretofore noted.

[57] Proceedings of the President and Board of Directors, C, p. 5.

CHAPTER II
Construction of the Masonry Locks From Seneca to Cumberland, 1832–1850

Construction on the section of the canal above Seneca was hampered by the legal controversy between the canal company and the Baltimore and Ohio Railroad over the right of way through the narrow passage between Point of Rocks and Harpers Ferry. A series of court injunctions in 1828 prevented both the canal and the railroad from building their respective works beyond Point of Rocks, and the matter was not settled until 1832. The stalemate in construction through these passes also adversely affected the progress of work below Point of Rocks as this portion of the canal was designed to be watered by the Dam No. 3 complex at Harpers Ferry[58] In early January 1832, when the Court of Appeals of Maryland confirmed the canal company in its claim to the right of prior location, the directors wasted little time in resuming the full-scale construction of the waterway. On January 14 the board instructed the resident engineers "to have, as much of the Canal, ready to let, on the 23rd February next, as will extend it to the head of the falls next above Harper's Ferry."[59]

Because the winter weather remained severe, the letting of the contracts was postponed until mid-March. At the annual meeting in June President Mercer reported that after the injunction obtained by the railroad had been lifted:

> fourteen miles of canal, extending from the 84th, to the end of the 112th section, comprising the guard lock and the dam across the Potomac, immediately below the Shenandoah; eight lift locks [Nos. 28–35]; an aqueduct of three arches over the Catoctin; and nineteen culverts, were let, on the 14th of March, under an obligation to commence the whole of these works immediately, and to complete them by the first of December next.

On June 2 the directors had proceeded

> to place under contract twenty two and a half miles of Canal, between the 112th and the 157th sections including the last, which comprehends, the dam and feeder near the mouth of Opeccon.
>
> In this distance are embraced an Aqueduct across Antietam, twenty four culverts, and six lift locks [Nos. 34–39] together with a guard lock and dam of considerable elevation, across the Potomac.[60]

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58 USDI, NPS, "The Chesapeake and Ohio Canal: A Physical History," by Miele (1968), pp. 11, 128–131.

59 Proceedings of the President and Board of Directors, C, pp. 52–53.

60 Fourth Annual Report (1832), C & O Co., in Proceedings of Stockholders, A, pp. 204–205. The contracts for Locks Nos. 28–39 were as follows:

Nos. 28–29	L. B. and D. K. Cahoon
Nos. 30–31	Obadiah Gordon
No. 32	Louis Wernwag
No. 33	James O'Brien [relet in May to Littlejohn, Thompson & Co. who finished structure]
Nos. 34–35	James O'Brien [relet in May to Frieze and MacDonald who finished structure]
No. 36	Frieze and MacDonald

By the summer of 1832 the canal company was beginning to experience financial difficulties. In an effort to reduce the cost of constructing the canal, various proposals were considered to change the structure specifications, In early June President Mercer recommended that funds could be saved in the construction of Locks Nos. 28 and 29 "by substituting up to the water line of the level, below each lock, hammered, for cut stone facing." He was hopeful "that the dispensing with cutting the face stone, for every 5 or 6 feet from the bottom of the two locks, we might reduce the price of their construction."[61] On June 7 the board authorized Mercer "with the advice of the Resident Engineer, to dispense with cutting the front face of the stone for Locks No. 28 & 29."[62]

The board on June 23 adopted a measure to hurry the construction and reduce the cost of construction above Point of Rocks. The resolution was as follows:

> That they be, in like manner, permitted to dispense with the coping of the Culverts and Aqueducts 'till the water, necessary to the transportation of the stone, be admitted into the Canal, and with the coping of the Locks, except that required for hanging the Lock-gates—provided, in all cases of a postponement of any part of the work, a due reduction be made, having reference to the contract price of the deferred work, of the cost the Company must incur in its subsequent completion.[63]

As the work of construction progressed up the Potomac Valley, the directors continued to experiment with changes in the lock specifications to improve the operation of the canal. On August 1 the board ordered

> that the beams of the Lockgates not put in a state of preservation be puttied and painted that such of the head gates as have not been lined inside be lined with plank and that in one of them sliding gates be provided after the plan of the head gates of the New York Canal, in order to ascertain the time in which such improvements may reduce the filling of a lock.[64]

In June and again in August King informed the board that he would supply the canal company with his patent gate for 5½ cents per pound, thereby lowering the cost of the gates by 2½ cents per pound. If the company should introduce a horizontal paddle, he would have them cast accordingly. In the past, he admitted, four or five of the 3½-foot wicket gates had been broken. This had been caused, he theorized, by an "insufficient quantity of metal in them," so a small quantity added to the thickness would make them safe. Indeed, the firm was willing to grant a one year's warranty.[65]

Nos. 37–39 Gibson, Noonan, Medler and Fresh

Locks Nos. 28–35 were actually let on March 14, while Locks Nos. 36–39 were let on June 2. See USDI, NPS, "Historic Structure Report: Lock No. 40," by Miele (1964), pp. 33–40.

[61] Mercer to Cruger, June 6, 1832 (Ltrs. Sent, C & O Co.).

[62] Proceedings of the President and Board of Directors, C, p. 165.

[63] *Ibid*., C, p. 174.

[64] *Ibid*., C, p. 195.

[65] King to Board of Directors, June 5 and August 25, 1832 (Ltrs. Recd., C & O Co.). By June 13, 1834, the canal company had contracted for and received 132 of King's wicket gates. The company had also received other gates from King, for which he had not been paid. In the opinion of King's lawyer, Orville B. Dibble, the slight changes made to secure the top gudgeon in its place, whether it slid or was secured to the frame of the gate, made no difference. A compromise was reached, and the board agreed to reimburse King for infringing on his patent. Dibble to the President and Board of Directors, June 13, 1834 (Ltrs. Recd., C & O Co.).

The directors also began to explore the possibilities of using the water passing around the locks in the flumes for "manufacturing purposes" to partially offset the financial difficulties of the canal company. After some discussion, the board passed the following resolution on May 30, 1833:

> that the Resident Engineers ascertain and report the volume or quantity of water needed to pass around each Lock of their respective Residencies in order to supply the levels and Lockage next below the said Lock, and above the next feeder of the Canal that they report also a plan adapted to each Lock of applying the water, passing around the same, to manufacturing purposes and receive proposals to rent or purchase the same.[66]

The only reply to this resolution that was found in the canal company records was that submitted by Resident Engineer Thomas F. Purcell about June 1:

> This resolution contemplates three distinct propositions: 1st The quantity of water that must pass by each lock; 2nd The plan best adapted to render this water available for manufacturing purposes; 3rd The rent value of the water thus proposed to be used.
>
> The quantity of water that must necessarily pass each lock, depends on the amount of leakage, soakage, and evaporation, incident to the extent of the canal next below it; the leakage of water need not enter into the estimate as it is assumed that a boat descending the canal will need but the one lock full of water, which will always be supplied from the level next above the one into which it has descended.
>
> The quantity of water expended on canals by leakage and evaporation must vary with the climate, soil, and situation as well as with the degree of perfection given to the works of the canal itself; thus porosity of soil increases leakage; and the evaporation will be greater in a warm than in a cold climate; but it is probable that more depends on the manner in which the embankments are formed, than on either of the above circumstances, for the filtration through an embankment loosely and hastily thrown up, as are most of those in this country, will greatly exceed that through a bank gradually formed, and well puddle, as are most embankments on the European canals. The engineers of the U. States Service, in their reports on the Chesapeake and Ohio Canal, have deduced from experiments made on five of the best canals of France that the average escape of leakage and evaporation is 55 13/100 [cubic] feet per minute per mile; and it is presumed that those canal were constructed in the best possible manner, with all the precautions to prevent the escape of water usually recommended by European engineers. . . .

Purcell rejected this estimated figure. His calculations indicated that the amount of evaporation and soakage on the C & O Canal was approximately 91.56 cubic feet per minute per mile. Basing his comments on this figure, he stated:

> To apply this to practice there must be a sufficient quantity of water [to] pass through the Guard lock at Dam No. 4 to supply a distance of 22 miles; and consequently 2014.32 cubic feet of water must pass this lock in each minute. Lift Lock No. 40 is five miles below the dam, and of course 1556.52 [cubic] feet per minute should pass by this lock; No. 39 is 5½ miles below Lock No. 40, 10½ miles below the feeder; therefore 1052.94 cubic feet per minute should pass around it; No. 38 is opposite Shepherdstown, 12½ miles below the feeder, and 869.82 cubic feet per minute will pass by this lock, which is at the termination of my Residency.
>
> The length of the canal to be supplied by the feeder at Dam No. 5 is 19 miles; of course 1739.64 [cubic] feet must pass this lock per minute; from the Guard Lock to [Lock] No. 44 is 8 miles, and the water which must pass it will be 1007.16 cubic feet per minute. [Lock] No. 43 is 17 miles from [Lock

[66] Proceedings of the President and Board of Directors, C, p. 361.

> No.] 44 and 15 miles from the feeder, consequently 366.24 [cubic] feet per minute must pass this lock. These are the only locks around which it will be necessary to convey the water.

Concerning the place for adapting the water flowing around the locks to manufacturing purposes, he reported:

> 1st That space may be allowed for the building, it will be proper to convey the water around the lock and entirely below its lower wing walls.
> 2nd To prevent the water from getting to the back of the lock wall; it will be proper to make the waterway of flume perfectly water tight; to this end timber and plank are the best material that can be used, and for the accommodation of the building a sufficient excavation at the lower end of the lock will be required. . . .
>
> The relative value of these sites at locks will depend on the fall of water or lift of the lock, a lift of less than 8 feet will be of little value, for the power would be so weak that it could not be applied to any useful purpose.[67]

Apparently canal boats had caused considerable damage to some of the locks below Seneca Falls by the early summer of 1833. Accordingly, the board on June 4 ordered

> that the locks, which have had their wing walls and coping loosened or broken at their heads, by the boats, entering the same, be immediately repaired; that such as need repointing, be repointed, with such composition or cement, as the Engineer of the 3rd Residency may prescribe; and that, in these repairs, larger stone be obtained, from any practicable damage, and inserted in the head of each Lock to receive and guard against injury from the stock of the descending boats, or suitable posts be provided for that purpose.

Furthermore, after the locks were repaired, the lock-keepers were to be notified

> that each will be held responsible for any damage done his lock, by violently entering the same, or using iron pointed poles, while in the same, unless in each case of injury he report the number and description of the boat, by which such injury is occasioned; and when practicable, the name or names of the person or persons having the same in charge, to the Collector in Georgetown, before the Boat shall have returned thro' his Lock: and the cost of repairing such injury, shall in each case, be deducted from his next month's wages.[68]

Engineer Philbert Rodier recommended to the board on June 5 "that the wrought iron paddle gate, made by William Easby, for the Guard Lock [No. 4], should be used in some Lift Lock, where its advantages could be more fully tested." The board approved the suggestion and directed the engineer's office to determine which lock would be best for the experiment.[69]

Pursuing their continuous battle to protect the locks from sharp-pointed boats, the board on June 28 ordered

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67 Purcell to Board of Directors, ca June 1, 1833 (Ltrs. Recd., C & O Co.).
68 Proceedings of the President and Board of Directors, C, p. 368–369.
69 *Ibid*., C, p. 370.

> that particular instructions be given by the Superintendent to the Lock-keepers, to prohibit after the 1st of July next, any scow (not including Gondolas) from entering the Canal, unless she is fitted for use according to the 9th Article of the "Regulations for Navigating the Canal."[70]

The second official inspection of the canal by a United States Topographical Engineer was made in June 1833. After a survey of the route of the canal during that month, Captain William Gibbs McNeill reported:

> Every part of the work may be said to have been entirely completed to the "*Point of Rocks*," 48 miles from the basin at Georgetown, and with very unimportant exceptions, (where the discovery of slight imperfections has already lead to their repair,) exhibited all that faithfulness of execution which ensures stability.

Concerning the locks between Georgetown and Point of Rocks, McNeill observed:

> To surmount the elevation of 217 feet, (the level of the canal at the Point of Rocks above the basin in Georgetown,) 27 locks, generally of 8 feet lift, have been constructed, the total cost of which has been, (as per statement furnished me by Mr. Fisk, an assistant engineer in the service of the company, to whom, as also to Messrs. Cruger and Purcell, the resident engineers, I am indebted for a mass of valuable facts) $265,142, being an average of $1,221.85 per foot lift, inclusive of the cost of foundations, and of gates, and, in part, the excavation of the lock pits, as well as in part the embankment around the locks.
>
> These locks being nearly all of them, as before remarked, of 8 feet lift, the above average of $1,221.85 (deducting for excavation and embankment,) is equivalent to $1,136 per foot lift; or, as there are about 1,084 perches in a lock of 8 feet lift, it is equivalent to $7 per perch for the masonry, and $1,500 for the foundations and gates. The subjoined table (A) will exhibit the locality of the several locks, the lift of each, the description of materials of which they were constructed, and the locality whence these materials were procured, which, with all the details of their plan, as enumerated in the report of Colonels Abert and Kearney, have permitted such an analysis as enables me to say that, under all the circumstances, a due economy has, in my opinion, obtained, both as it respects the prices paid, and the character of the work. The general dimensions of the locks are 15 feet in width in the chambers, and 100 feet between the upper sides of the mitre sills, and with one exception, from [Lock] No. 1 to [Lock] No. 25 inclusive, they are all filled through culverts in the side walls. (See report of Colonels A. and K., p. 97.) Locks Nos. 26 and 27 are filled through culverts in the side walls, and through a paddle in each of the upper gates; the upper being nearly of the same length as the lower gates. As the dimensions of the locks are uniform, and all information respecting their character and locality will have been furnished by table (A), it may here be added that, from Lock No. 28, inclusive, upwards, the culverts in the side walls (which mode of construction is liable to some objections) are dispensed with, and four paddle valves in the upper gates, (which are one foot shorted than the lower gates,) 2 feet by 2½ feet each are substituted. (See specifications.) It is not apprehended, however, in the present case, that from either mode there will result insecurity to the works, or inconvenience in the operation of filling the locks. Of the character and condition of the culverts, if, in all instances, I am not able to bear as favorable testimony, it results from exceptions too unimportant to be worth of any other comment than that they consisted in imperfections which were soon discovered, and easily remedied, and which, doubtless, ere this, have ceased to exist; and from the precautions which were taken (as stated in the reports of Colonels A. and K., p. 103) to secure their foundations, as well as from the ample dimensions of all parts of these useful and important appendages to the canal, there is ample assurance of their stability.

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70 *Ibid*., C, p. 392.

After reviewing the line of the canal below Point of Rocks, McNeill examined the works under construction above that town. Regarding the locks on this stretch of the canal, he stated:

> The total cost of the seven [locks] which lie between the Point and the feeder, at the head of Harper's Ferry Falls, and which, as has been stated, were almost completed in June, will have been $56,646 for the masonry, $7,870 for the foundations, $3,850 for the gates, and $10,404 for the excavation of pits, and for the embankments around the locks, (the uniform practice, above the Point of Rocks having been to estimate the excavation and embankment with the lock;) these several items make an average $1,280.43 per foot lift for the masonry, gates and foundations; and, as there are 7,649 perches of masonry in the seven locks, it is equivalent to $7.40 per perch of masonry, to $1,052.89 for each foundation, and to $550 for the gates of each lock.*
>
> From the foregoing statements, then, it appears that the twenty-seven lift locks below the Point of Rocks, of 217 feet total lift, built entirely of cut stone, have averaged, including foundations and gates, $1,136 per foot lift; the seven next above the Point of Rocks, (53 feet total lift,) similarly built, $1,280 per foot lift; the eight above the head of Harper's Ferry Falls, (64 feet total lift,) built as before, will average $1,120; and the remaining two, (19 feet total lift,) built of hammered stone, will average $800 per foot lift.
>
> The greater cost of the masonry between the Point of Rocks and Harper's Ferry, than elsewhere, is to be attributed to the difficulty with which suitable stone were obtained; as an evidence of which, the contractor for Lock No. 30 found it cheaper to go 32½ miles to Seneca, for his cut stone, than to work any of the quarries nearer; and although the prices for the unfinished work would seem a little less than the actual average cost below Harper's Ferry, they are thought to be fully as adequate, considering the greater facility and less cost of obtaining cut stone: that cement will cost less, and that the healthiness of the country is better; this latter cause, especially being one which, as the work advances towards the mountains, may be expected hereafter to operate advantageously to the interests of the company.
>
> *In a lock of eight feet lift, as these in general are, there are in the foundations 2,506 feet lineal of timber 10 by 12 inches; and in the two courses of planking, and in the sheet piling, 17,900 superficial feet (board measure) of two and three inch plank; the price of which at Harper's Ferry, where the plank for these seven locks was mostly obtained, has been, for more than a year past, from $17.50 to $20 per thousand feet, at the saw mill.
>
> There are also in these locks, of eight feet lift, about 1,084 perches of masonry in each; 4,426 superficial feet of ashlar, (excluding coping and hollow quoins,) 436 lineal feet of coping, one foot thick by three feet wide, making four feet of cut work for every foot lineal, and 61 ⅔ feet rise of hollow quoins; and there the cut stone are exactly of the size required by the specifications, there are 384 perches of the cut stone and 700 perches of backing. The quantity of cement used in the construction of each lock of eight feet lift has varied from 3,000 to 3,300 bushels. That used below Seneca was furnished to the contractor at 50 cents per bushel; from Seneca to the head of Harper's Ferry Falls, its cost has varied from 30 to 40 cents per bushel; and, generally, above Harper's Ferry Falls, (as it has much more conveniently been obtained,) its cost has been, exclusive of transportation, but about 21 cents per bushel of 70 pounds.
>
> Two of the lift locks above the head of Harper's Ferry Falls, Nos. 41 and 42, of (10 and 9) 19 feet lift, are to be built of hammer dressed lime stone for $800 per foot lift, including gates and foundation; and all the remainder, eight in number, and of 64 feet total lift, are to be of cut stone, at an average price, per contract, of $1,120 per foot lift.[71]

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[71] *House Report 414*, pp. 140–157. An important document describing the masonry work and sources of stone for Locks Nos. 1–45 was appended to the McNeill report. A copy of this document may be seen in Appendix E. The contracts for Locks Nos. 40–45 had been let as follows: No. 40 to Gilson and Company on August 25, 1832; Nos. 41–44 to Michael Byrne and Company on August 25, 1832; and No. 45 to Michael Byrne and Company on April

President Mercer, who was also a member of the House Committee on Roads and Canals, appealed to Congress on April 17, 1834, for additional aid to the virtually bankrupt canal company. In reviewing the progress of construction, he observed:

> Of the whole line of canal, the progress of which has thus been very minutely detailed, 64 miles were completed, and capable of navigation, in October, 1833. Of the residue of the line, under contract, it is ascertained that 21 miles await, to be brought into use, the completion of a single lock only, and the aqueduct across Antietam creek, the labor of a few weeks. The line of 24 miles passing from dam No. 4, by Williamsport, it is very confidently stated, can be readily completed in the present year: the far greater portion of it being already done.

Concerning the locks, he reported:

> Its lift locks of cut freestone, limestone or granite, 45 in number, average eight feet lift, and are one hundred feet by fifteen in the chamber, being designed for one hundred ton boats, to be drawn, each, by two horses, attended by two men and a boy.

In order to answer the critics who charged that the canal company had been wasteful in its use of public funds in building the waterway, Mercer compared the original estimates with the actual cost of the various structures. Regarding the locks, he noted:

> Supposing the substitution of *cut* for *hammered face stone* in the ashlar of all the lift locks, the exclusive use in practice, for the very limited *estimated use* of water lime in their cement, and the addition of one foot to the breadth and depth of each lock, to counterbalance the difference in the plan of their foundations, where those are not sunk, as in many cases they have been, deep in solid rock, and the reduction of the length of their chamber from 102 to 100 feet, the estimated, compared with the true cost of 45 lift locks, is as 1,500 dollars to 1,156, making a difference of cost, in this item singly, of 123,840 dollars.[72]

At the sixth annual meeting of the stockholders on June 2, 1834, President J. H. Eaton stated:

> At present, the work is completed to Holman's dam [Dam No. 4], twenty-six miles above Harper's Ferry, or eighty-six miles above Washington. Twenty miles more remain in a state of forwardness, but cannot be further progressed in with their present funds.[73]

On June 1 of the following year, President George C. Washington informed the stockholders that the lack of good building stone above Dam No. 5 had caused the board to make the following suggestions:

> We regret to find that, as we ascend the Potomac, (unless in the immediate vicinity of Cumberland,) stone of suitable quality for the construction of locks and aqueducts is both scarce, and very inferior to the quarries we have passed. The superintendent of masonry has been engaged for some time in an

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20, 1833. The latter contract provided only for constructing the lock below the waterline; in July 1835, a contract was let to W. Morrow to finish the lock.

[72] *House Report 414*, pp. 20, 32–33. For a list of the "Construction Costs of Lift Locks, So Far As They Were Paid or Estimated as of March 31, 1834," see Appendix F.

[73] *Sixth Annual Report* (1834), C & O Co., p. 4.

> examination of the country adjacent to the canal, with the view of ascertaining the supply of this material to be relied on.
>
> In the contemplation of a failure to find suitable stone for locks, and their enhanced cost where the material is not very accessible, or has to be transported a distance by land, it has been suggested that, at the points where these difficulties are found to exist, temporary wooden locks might be used with advantage, which would probably last for fifteen years, and might be replaced, when they begin to fail, by stone, which could be dressed at the splendid quarries below, and transported on the canal at a comparatively small cost. The materials all being prepared, and on the spot, by a simultaneous operation the whole work might be accomplished in from four to six weeks, selecting the season when the least inconvenience would attend the interruption of trade. The region where stone of good quality ceases to abound is heavily timbered, and the latter material could be had, of any description required, on the most reasonable terms. The time required for their construction would be much less than if built of stone, and the probable difference in cost would be three to one. By this course, the early completion of the canal to Cumberland would be hastened, and the large sum saved in the construction of the locks be applied in furtherance of that object. The board, in offering these suggestions for the consideration of the stockholders, do not wish to be understood as recommending any permanent departure from the plan of execution heretofore contemplated, and that this deviation should only be adopted should the necessity of the case, on further inquiry and examination, justify it.[74]

Two weeks later (on June 15) the General Committee of the Stockholders concluded that the board was more competent than they to determine the advisability "of the temporary substitution of wood for stone in the erection of the locks and other works upon the canal." The board was to exercise its "powers freely, and untrammeled even by the expression of a wish or a doubt from the stockholders.[75]

The following day Chief Engineer Fisk issued a lengthy report to Commissioner George Bender concerning a revised location of the canal between Dams Nos. 5 and 6. He had written the report at the request of the directors. Included were his observations on the locks already built below Dam No. 5 and his recommendations for the locks on the 27.3-mile stretch of the canal between the two dams:

> I have lately had the locks from Berlin [today the town of Brunswick] to Shepherdstown measured with a view to ascertain whether any effect had been produced by the settling of the foundation or the pressing in of the walls. The measurements were taken about every 20 feet in length of the locks. The result of my examination was that where the locks were founded on Rock bottom they will hold very nearly their width of 15 feet from face to face of the walls; where the foundation is on timber, the walls average only 14 8/10 feet apart at top within the chamber, and some of them are only 14.75 feet; that is they have pressed together from 2½ to 3 inches. The only part of the lock on timber bottom, that holds its own, is that immediately in a line with the breast wall. The reason is obvious. I account for the settling in this way. It is not owing to the lightness of the walls, else the effect would have been the same upon those founded on rock bottom. It must be owing to the timber bottom. The present mode of forming the foundation is by placing timbers transversely of the lock with a space of about one foot between them; over these timbers longitudinally are placed 3-inch planks upon which

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[74] *Seventh Annual Report* (1835), C & O Co., p. 8. During the spring of 1834 Engineer Alfred A. Cruger had made the first survey of the line of the canal between Dam No. 5 and the Cacapon River. In his report submitted to the board on March 20, 1834, he had recommended that the locks on this stretch of the canal "be of cut stone, in courses, fifteen feet wide, and one hundred feet between the gates." See *House Report 414*, p. 200. For a general summary of his estimates see Appendix G.

[75] Proceedings of the Stockholders, A, pp. 405–406.

is placed the masonry; and then between the walls there is a second course of plank two inches in thickness.

Now it is only necessary that the timber under the front of the wall at **b** & **c** [see Drawing No. 5, a copy of drawing that accompanied Fisk's report] should settle or give about ½ inch an inch below a straight line drawn from **a** to **d** in order to account for the whole settling. Now that it should do so, if the timber has not strength enough, or if the pieces of timber are not sufficiently close together is easily to be accounted for as the walls have heretofore been built in the front plumb and battering or narrowing on the back thus throwing a heavier weight over **b** than over **a**. Again the pressure of the puddling from the back has a tendency so far as it is felt by the wall to overturn it on the point **b**.

[See drawing No. 5, p. 138.]

To remedy these problems, Fisk recommended that the following changes in the specification for locks be made:

To guard against this pressing in of the wall is first to dispense with the three inch planking altogether and in place of the timber as now laid, to substitute one foot squared white oak timber fitted closely together, and covering over the whole foundation. By so doing you require but very little more timber, as the dispensing with the three inch plank which upon this plan would be of no sort of use will nearly make up the additional timber required. Again you have more strength as you have at least half more timbers, and then in place of these being a space of one foot left between the timbers, you have a solid mat of timber fitting closely over every inch of the puddling underneath, thus pressing it all together instead of permitting it to rise between the timbers as an additional security. I have provided in the plan a square timber of similar dimensions to the other timbers, to run longitudinally of the lock, one under the face of the wall. The object of this will at once be perceived, it will prevent unequal settlings lengthwise of the masonry, and is an additional security against the pressing in of the walls. Upon this plan of fitting closely together one foot of square timber we have all the advantages of the inverted arch as by calculation it is easily shown that the strength of the timber is abundantly sufficient. I have further planned the locks with a batter between the gates of 15/100 of a foot in the chamber of the lock for each wall; in other words making the lock as heretofore 15 ft. wide at bottom, and 15 30/100 feet at the top. This batter is not continued regularly throughout the chamber, but swells gradually to the centre from either end.

The examination of the plan will show that the two inch course of planking between the walls is retained. It will be seen that some other changes have been made in the plan the object of which it is believed will be understood from a simple examination.

It will be seen that flumes have been planned with all the locks, and that provision has been made for them even from the end of the shortest levels as well as at the long ones, for they are as important if not more so to the regularity of the heights of those levels than for the longer ones.

With a view to preserving as great a regularity as possible in feeding, the flumes at the lower end of the long levels have been planned narrower and deeper, in other words, the shorter the level the broader and shallower the flume at its termination. A moment's reflection will show the propriety of this, a short level is soon drawn down if from any cause the supply from above is stopped; not so with a long level, from this may be inferred the reason why I do not agree with Mr. Cruger [the engineer who made the original survey between Dams Nos. 5 and 6 in the spring of 1834] in dispensing with the flumes [as] part of the locks at Prathers Neck. Dispense with them or what would be nearly as bad, make but one flume around the four locks, and you have to depend on the lock keeper to act as a flume. But force the water through the short levels by the flumes, and you are sure of keeping them in order, as to the proper height of water unless the lock keeper exerts himself very much to go wrong. I have spoken more particularly about flumes as I am well aware that instead of being looked upon as

> they ought to be, as the regulator of the canal, they have been considered merely as very convenient for lock keepers who are disposed to get along with little labor.

In describing the nature of the masonry that he desired for the locks, Fisk proposed:

> The lift locks already built are all faced with cut stone, but the work has never in any instance come up to specifications for if it has it could have been done for the price that has usually been paid for it.
>
> The present estimate is for a description of work equal in strength and tightness to good cut work though a little somewhat inferior to it in smoothness of finish. I speak of scabbled work, in dimension as to bed and joints, the same as cut work. The difference consists in the stone not receiving after it has first been dropped that smoothness of surface that constitutes cut work. Require work of this kind with specifications the same as for cut work in every other respect, and compel a strict and literal compliance with the specifications and we shall have work superior to our present locks at a price at least $600 less per lock. While if we have cut locks and hold the contractor down strictly to his contract we shall have to pay at least $600 over the old prices, a difference of $1,200 in favor of the scabbled work, by on means inferior to the other in point of usefulness, strength and durability.

Regarding the lock Gates, Fisk urged that a contract for all of them be let to one person "who shall be required to cut his timber at the proper season of the year." By "using timber cut when it should be and not painted until it has been thoroughly seasoned," the company would "obtain water tight and durable gates."

In answer to a board request to examine "into the expediency of substituting wood instead of stone in our locks & Aqueducts," Fisk commented that the directors had been misled into believing "that there is a scarcity of good stone suitable for cutting between Dam No. 5 and the mouth of the Cacapon." On the contrary, he had found that

> 6 [locks are] within two miles of Dam No. 5, all of which are very favorably situated with regard to an excellent limestone quarry within one fourth miles of the site of four of them. The quarry itself being within 200 feet of the still water of the pool of the Dam. . . .The next body of masonry requiring cut work is at the Great Tonoloway where we have two locks and an Aqueduct. The stone for this work will be obtained from a good limestone quarry up the Little Tonoloway at no unreasonable distance, two miles, the greater part of the way upon the Cumberland Road. The next lock is three miles below the Cacapon the backing for which can be obtained near but the cut stone will be more expensive to obtain than that for any of the other locks. The distance, however, will not exceed three miles to either of the two quarries, from whence the stone may be had, over a road not very bad. The next Locks are at the site of the Dam [No. 6]—a guard lock and two lift locks. The stone may be had from a good limestone quarry within two miles.[76]

On June 24 the board accepted the recommendations contained in Fisk's report. Upon further discussion, the board resolved that the work between the two dams be contracted for within two weeks.[77]

At the July 3 meeting the board examined proposals "for executing the masonry and difficult sections between Dam No. 5 and the Cacapon [River]." The following contracts were let for the construction of the locks:

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[76] Fisk to Bender, June 16, 1835 (Ltrs. Recd., C & O Co.).

[77] Proceedings of the President and Board of Directors, D, pp. 347–349.

No. 45	W. Morrow
No. 46	I. C. Lissig
Nos. 47–50	Daniel K. Cahoon
Nos. 51–52	Robert Brown
No. 53	Patrick McGinley[78]

Superintendent of Water Power Charles C. Starbuck notified Chief Engineer Fisk on July 14 that in

> forming the flumes for the Locks on the sections of the Canal now locating, it will be necessary to break the area of cross section at least one square foot to each two hundred cubic feet for water required to pass from one level to the other when the upper level shall not exceed in length one half of a mile—if it shall exceed that length, the proportion to be increased in a corresponding ratio that a level of ten miles or more may have a ration of one sq. foot area to one hundred cubic feet required to pass, these to be the lowest limits, this increase to be made at discretion.[79]

Resident Engineer Purcell on July 26 sent a letter to the board strenuously objecting to Fisk's earlier recommendations for changing "the mode of preparing the [lock] foundations." He wrote:

> The only material defect in the Locks built on the Chesapeake and Ohio Canal, which has yet been developed, is a tendency in the walls that form the chamber of the Lock to contract at the top, and this to render the Lock too narrow for the passage of boats of the full size adopted to the navigation of the canal. This defect I first detected at Lock No. 3 of this canal (which is located in Georgetown) in the year 1833: a large scow nearly 15 feet wide was passed into the Lock from the lower level, and in ascending to the upper level got fast between the walls which form the sides of the lock chamber; further examination of this subject has led me to know that in *all* the locks this partial collapse of the walls has taken place, & that the quantity of it, is proportioned to the degree of firmness of the foundations on which the timber rest, that sustains the weight of the walls.
>
> Thus the contraction is greatest in the walls of those locks which rest on a loam and sand foundation.
>
> When this disposition of the walls to approach at the tops was first detected, I attributed it to the want of sufficient strength in the foundation timbers on which they rested, but this opinion was relinquished when on further investigation it was found that the same effect took place (tho not to so great an extent) on the walls, the foundation of which was solid rock.
>
> If any doubt remained as to the cause it was entirely dissipated at a subsequent period by the discovery of the fact that the more extensive experience afforded by the New York Canals, had enabled the Commissioners of that state so early as the year 1829 to detect not only the defect of which we are now treating, but the cause which produced it, and the means of preventing its recurrence. The Commissioners in their annual report to the Legislature of New York under date of January 21st 1830 say "The chambers of some of the locks on the Erie and Champlain Canals have been contracted at the top by the external pressure of the banks produced by the expansive power of frost. Four of these which had become too narrow for large boats must in part be taken up & relaid; and the others can probably be maintained by placing shores of timber from side to side, during the periods of instance frost." Thus we have in this report the annunciation of the fact, its cause, and of course the remedy is easily applied. I should here rest the question on the authority of the New York commissioners but for the fact that my new plan has been formed, & I presumed recommended for use on this canal, predi-

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78 *Ibid*., D, p. 360. The contracts for Locks Nos. 54–55 were let to Henry Smith on January 16, 1836.

79 Starbuck to Fisk, July 14, 1835 (Ltrs. Recd., Chief Engineer).

cated on the assumption that the collapse of the walls has been occasioned by weakness of the foundation on which these walls depend for support.

This opinion to a certain extent is correct, or rather the cause remaining the same, the magnitude of the effect is inversely as the firmness of the material on which the timbers of the foundation depend for support. As the timbers are bedded on the solid earth for their entire length and the weight is uniformly diffused over them by the gravity of the stone matter, we ought not expect an unequal settling of the foundation or that a curvature would be given to the timbers on which the walls stand; neither would it happen if the walls were not acted on by an extraneous and powerful agent. I am aware that it has been supposed that the slope of the wall on the exterior side, by reason of which the inner face of the wall is heavier than the outer one, has produced an unequal settlement in the foundation; it is believed that this cause is not sufficient to produce the effect, and farther it is known that the Lock walls of which the New York Commissioners speak have both their interior and exterior surfaces parallel.

It may be asked, if the fault is not ascribable to the foundation, why is it that the effect of the collapsing cause the greatest in the loose & sand foundations? This question might be answered by propounding another—if the collapse of the walls is attributable to weakness of the foundation, why is there any collapse in those that rest on a rock foundation? The reason why the effect of the frost is more perceptible in loose foundations, is because the resistance opposed to this expansive power of the frost by them is much more feeble that that offered by rock, or hard clay, and the timber on which the walls rest, has not power to recover its former position, but its elastic force is overpowered by the superior weight of the wall.

Having thus considered the cause which has produced the collapse of the lock walls, let us now proceed to consider the plan which has been proposed for the foundations as a substitute for those now in use—In reviewing the works that have been constructed in the United States since their origin down to the present day, the engineer will be struck with one remarkable fact, that while the numerous locks constructed on different works, at different periods & by a great number of Engineers each eager to distinguish himself by the introduction of new plans & novel practices into the profession, have been altered in their shape & constructed of different material, yet in this solicitude for innovation or improvement, with very few exceptions the artificial foundations of all the Locks are planned and constructed alike. The usual mode of constructing them is to lay oak timbers one foot thick & the same distance apart extending entirely under the lock chamber & across the breadth of the walls; the spaces formed by these timbers are filled level with their upper surfaces with good water proof puddle; the whole surface thus formed by these timbers is then covered with three or four inch plank well tree-nailed, & on this foundation the lock walls are erected. Three, sometimes a great number, of rows of sheet piling pass across this foundation.

This mode of constructing the foundations was practiced on the canals made by the State of New York, Ohio, Pennsylvania & Virginia and by all the incorporated canal companies of whom works I have any knowledge. So great uniformity of practice as we have perceived in this important matter warrants us in assuming that this plan has been discussed, the fitness of its parts compared, and its merit as a whole established by the concurrent assent of all the Engineers to whom skill has been confided the construction of the very many public works which have been executed in this country within the past twenty years. When therefore an apparent defect appears to exist in this important part of the general plan of a lock prudence admonishes us to proceed with *caution* and approach with diffidence for the purpose of a change, a plan which appears to have matured by time & experience & which has received the sanction of the most eminent of American Engineers. Proceeding therefore in this spirit of careful investigation, I propose to examine the elementary parts of an entire lock foundation, the purpose served by each, & how far any one of them may be modified or entirely dispensed with, without injury to the whole.

A lock foundation such as has been described above is composed of four parts: 1st The timbers placed across the Lock—; 2nd The puddling between these timbers; 3rd The sheet piling & 4th The planking on the top of the timbers & which form the flooring for the walls:—

1st Of the timber—The purpose to be served by these timbers, is manifestly to furnish an uniform, hard and even surface, by which the great weight of stone & water in the lock, will be sustained, & its effective pressure uniformly diffused over the surface of the [foundation. The] consequence of this limitation is, that a solid rock cannot be generally obtained for a foundation, neither can we always procure the most firm & tenacious clay, but very frequently place a lock on a light clay, loamy and sometimes even a sand foundation. It is a known property of earth that it will sustain great weights without yielding, while it is dry; but as soon as it becomes wet it loses this quality to a great degree, becomes soft, slippery & will yield under very slight pressure.

2nd Now one of the purposes of the puddle, between the timbers of a Lock bottom, is to keep the earth on which the whole work, timber, stone & water, depends for support, in dry & firm state & thus enable it [to] resist the great pressure to which it is exposed. It is very easy to conceive a position in which if a lock were placed & the filtration of the water through the bottom permitted to saturate the earth below the foundation the whole work would slide down; this effect would take place if the lock was placed on a hillside in light sandy soil—Another purpose served by the puddle is to prevent the wear of the earth from under the bottom of the timber; its office is more effectually to intercept any leaks which may happen in the foundation & force the water to pass over the top of the timbers & puddle.

….

4th We will now pass to the fourth & last component of a lock foundation, to wit, the "Planking on the timbers."

The object of the planking is to diffuse, with greater uniformity than could be done without it, the pressure of the walls on the timbers. The advantage of this uniform diffusion of weight, is that it produces a uniformity of settlement if any takes place, and prevents those fractures of the walls, which would happen from irregular settling if this precaution was omitted.

Having thus passed in review the different component parts of a Lock foundation, & exhibited their respective agencies it only remains to state my objections to the foundation lately prepared. It is unnecessarily expensive because it contemplates an unusual & unnecessary quantity of timber prepared in a more expensive manner than is usual. It is defective, because by omitting the puddling the stability of the work is hazarded. It is deemed essentially defective, by the [force of the] current of [water] thus formed. If longitudinal timbers are ever admitted they should be placed on cross timbers & all the spaces must be well filled with puddle.

It is defective because by the introduction of two longitudinal timbers, the bearing of the walls is limited to two points of support; if these longitudinal timbers are places as proposed a greater number will improve the plan.[80]

There is very little documentary evidence on the construction of the lock gates in the C & O Canal Company records. The only detailed specifications for the lock gates during the period of construction that was found was appended to a contract proposal by Thornton C. Bradley on February 4, 1836. While this bid applied only to Locks Nos. 51–55, it can be assumed that it was a general specification that had been prepared by company officials. The specification is as follows:

Specification for the gates of a lock of 8 feet lift

All of the timber and planking shall be of heart white oak, except only the planking on the upper side of the gate which shall be of heart yellow pine.

[80] Purcell to Board of Directors, July 26, 1835 (Ltrs. Recd., C & O Co.). No "3rd" section appears in original letter.

The rectangle out of which the keel post is formed shall be 12 by 14 inches, and in like manner for the toe post; 11 by 11 inches shall be the square. There shall be 7 arms in each leaf, the upper one measuring vertically 6 inches—the 2nd, 4 inches—the 3rd, 4 inches—the 4th, 5 inches—the 5th, 6 inches—the 6th, 8 inches—the 7th, and lower arm 8 inches.

Two vertical pieces between the two lower arms, rendered necessary by the two valves, will be 6 inches each, measured in the direction of the balance beam.

The balance beam will be 24 feet long, 18 inches square at the larger end and 10 inches vertically by 11 inches at the smaller end.

The spaces between the arms will be between the two upper ones 17 inches—the two next 20 inches—the 3rd space 21 inches—the 4th [space] 22 inches—the 5th [space] 18 inches and the 6th [space] 28 inches. These spaces added together in addition to the several arms as given above will make 13 feet 11 inches for the height of the gate from the bottom of the lower arm to the top of the upper arm (the latter point being on a level with the water surface in the upper level, and the former being one inch above canal bottom on the lower level, the lower arm shutting 3 inches above the mitre sill). From the level of the top of the upper arm to the bottom of the balance beam, at that point in the toe post, which is directly over the vertex of the mitre sill (when the gate is shut), will be 6 inches and the balance beam throughout its length on the under side from the small towards the large end shall have an accent of 1½ inch to the foot. There shall be a strap over the balance beam to connect it to the toe post of 2 inches by 5/8ths iron. This strap shall extend down the toe post on each side 18 inches below the middle of the upper arm and will brankle out 18 inches along each side of the upper arm—5 5/8" bolts will be required to secure this 'strap and L's', the screws used upon the bolts will be 5/8ths iron.

There shall be a set of T's at the angle formed by the upper arm with the heel post—its length from the angle upwards shall be 12 inches and, as before, will be required for this T. The heel also the toe post will each extend down 2 inches below the bottom of the lower arm, and around each will be a 2 inch by 5/8 iron band.

The thickness of the gate measured at right angles to the lower side through the centre of the curve of the heel post shall be 12 inches—measuring in like manner it shall be 11 inches at the toe post (at the point above referred to as corresponding to the vertex of the mitre sill).

The heel post and toe post shall be so framed together as to suit the hollow quoin curve of the masonry and the angle of the mitre sill.

They shall also together with the arms be so framed that the latter shall be two inches longer on their upper than on their lower side (one inch at each end), this shall be done by boxing into the two posts.

The dimensions of the arms horizontally of the gate shall be such as will allow of the putting in the 2 inch plank on the upper and lower side of the gate in the manner hereinafter provided—the whole gate, including the plank on the lower as well as on the upper side, being left with a full and fair surface on each side 12 inches thick at the heel and 11 inches at the toe post as before stated. The upper planking will be 2 inches in thickness, and shall run diagonally of the gate in a direction parallel to a line drawn between the two inner angular points, the first formed by the upper arm and the toe post, and the second being the intersection of the lower arm by one with the heel post—The face of this planking being flush with the heel and with the toe post, with the upper and lower arms, as well also as the valve uprights next to the toe post, and that portion of the lower arm but one that is over the two valves shall be let into each of these by a rebate of two inches.

The lower planking shall be placed vertically of the gates with 2 inches left between adjoining planks. For this lower planking in like manner as for the upper shall a rebate of 2 inches be cut into the heel and toe posts, upper and lower arms &c. The joints for the upper planking shall be thus formed; for the ½ inch next the arm, at right angles to its surface; but for the remaining 1½ inches, they shall be beveled of 1/8 of an inch from the square so that the joint immediately upon the work being furnished shall show upon the surface an opening of ¼ of an inch. All of the timber and planking shall be cut as nearly as practicable in the month of February.

> The spikes used shall be 5½ inches long, of 5 to the lb.—wrought spikes.
>
> The irons and spikes immediately upon being made, must be heated to a blue heat and be immersed, when thus heated, in linseed oil. In addition to the irons already mentioned, there shall be L's on each of the lower angles of the gates, each by measuring 18 inches—each set of L's shall be secured by 5 bolts the diameters of which also of the screws and of the L's themselves shall be the same as those of the irons put on the upper angles of the Gate—The horizontal part of these L's will run along the middle of the lower arm, & from their angular points shall run down a bank connecting respectively with the bands around the bottom of the heel post and the bottom of the toe post—
>
> The upper Gates will be about one foot less in height than the lower ones—The only difference this will occasion will be to divide the posts equally among the five upper spaces between the arms, which spaces as given above refer to the lower Gates diminishing them that much, the number and dimensions of the arms remaining the same N B and the planking on the lower side of the Gate will be required over the whole surface of the upper ones—but on the lower ones it will not be required higher than to the 3rd arm from the top—Into this arm therefore a rabbit of two inches shall be cut, and the arms left naked will come out flush with the mitre and heel posts.
>
> All the materials of every kind must be of the best quality—the workmanship also shall be the very best.[81]

On August 17, 1836, the board ordered that a new procedure be followed in painting the numbers on the locks. After that date the number of each lock and its elevation above tidewater were to "be painted upon the Balance Beams of the Lower Gates."[82]

At the annual meeting of the stockholders in Washington on June 12, 1837, President George C. Washington reported that the masonry between Dams Nos. 5 and 6 had "been executed in a workmanlike manner, and of excellent materials, chiefly of limestone." Good quarries had been found at several points, although in some instances it was necessary to haul stone a considerable distance. On the aqueducts, culverts, and locks between these two points, strength and durability "have been the desideratum with the Board, and all unnecessary ornament, which would enhance their cost, has been dispensed with."[83]

With the aid of a $3 million loan from the state of Maryland in June 1836, the board had begun preparations that summer to let contracts for the work above the Cacapon. However, delays had occurred in the implementation of this authorization, and the directors had been forced to cancel their plans. When funds became available during the spring of 1837, Chief Engineer Fisk recommended to Commissioner Bender that whenever the board deemed it advisable "to put more work under contract," he would recommend the letting of the entire line from Dam No. 6 to Cumberland.[84]

The board determined on June 15 to let contracts in August, "embracing all the line between Cumberland and the Narrows, a distance of ten miles." At the Narrows, temporary locks could be placed by which the navigation from Cumberland could be accommodated one year earlier than by a continuous canal. Between the Narrows and Dam No. 6, the most difficult sections would be put up for contract, together with such less costly sections as Chief Engineer Fisk believed necessary. Proposals at the same time would be invited for the remaining locks, culverts and aqueducts.[85]

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81 Contract Proposal of Thornton C. Bradley, February 4, 1836 (Drawings and Other Records Concerning Construction, C & O Co.). A copy of this specification may be seen in Appendix H.

82 Proceedings of the President and Board of Directors, E, p. 122.

83 *Ninth Annual Report* (1837), C & O Co., pp. 5–6.

84 Fisk to Bender, May 1, 1837 (Ltrs. Recd., C & O Co.).

85 Ingle to Bender, June 15, 1837 (Ltrs. Sent, C & O Co.).

On June 14 the canal company inserted the following announcement in the area's newspapers:

> At the Office of the Commissioner of the Canal at Hancock until the 2nd day of August, and at this Office until the 3rd day of August next, inclusive, proposals will be received for constructing fifty-eight sections of the Chesapeake and Ohio Canal, three aqueducts, twenty locks of 8 feet lift each, and seventy culverts on the line thereof.[86]

The committee on contracts reported on September 27 and 29, after opening and abstracting the bids, that the following contracts for the construction of the locks had been accepted:

No. 56	John Cameron
Nos. 57–58	W. C. Steedman
No. 59	Edward H. Fielding
Nos. 60–66	Michael Byrne
Nos. 68–71	William Pratt
No. 72	G. W. Henry
Nos. 73–75	George G. Johnson[87]

These locks were to be completed by November 1, 1839, and were to be built in accordance with specifications formulated by Chief Engineer Fisk and his staff earlier in the summer. The specifications were the most detailed plans for the locks to be printed by the canal company during the period of construction. A copy may be seen in Appendix I.

During the fall or winter of 1837–38 the board let a contract to William Easby to build lock gates for the locks above Dam No. 5. Although he was instructed to make the lock gates similar to those in the Georgetown area, he soon made some modifications of his own. In a letter to Fisk, Easby explained the changes he had made: (1) the mitre posts had been increased in size by 25%; (2) the lower side of the gates was lined with 2-inch oak plank; and (3) more iron work was required on the gates, i.e., 8 screw bolts, 5 feet long and 1 inch in diameter and 32 smaller bolts.[88]

During the summer of 1838 Chief Engineer Fisk drew up a standard list of calculations for the locks of eight feet. The calculations were located in the correspondence of Principal Assistant Engineer Ellwood Morris on August 1, 1838. The calculations (which did not include the masonry of the flume walls beyond a line perpendicular to the end of the twelve-foot wing walls because of the great variation in wing walls) were as follows:

Towpath Masonry	510.5139 perches
Berm Masonry	548.7055 perches
Breast wall	21.9524 perches
Total	1,081.1718 perches

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86 Journal of Proceedings of the President and Directors, Advertisement No. 58.

87 Proceedings of the President and Board of Directors, E, pp. 319–321. In an effort to reduce the costs of construction and to speed the pace of the work, the plan of Locks Nos. 58–71 was ultimately changed to one of a composite nature. For a study of these locks, see USDI, NPS, "Historic Structure Report: The Composite Locks," by Edwin C. Bearss (1968). For some undetermined reason, the contract for Lock No. 67 was not let until May 24, 1838,

88 Easby to Fisk, January 23, 1838 (Ltrs. Recd., Chief Engineer).

Of the 1,081.1718 perches, there were 692.5030 perches of backing and 388.6688 perches of cut work. The lengths of the face work, which included the "measuring [of] all that shows and following every indentation & curve & excluding the flume wall beyond a vertical plane passed perp. To the end of a 12 ft. wing [on the] Berm side of [the] lock," were as follows:

Length of face on towpath side	159.5776 ft.
Length of face on berm side	176.8343 ft.
Total	336.4119 ft.

The cut work was broken down by item:

61 2/3 ft.	rise 2 ft. x 10 cu. ft. per foot rise	616.6666 cu. ft.
272.3112 ft.	rise 1 ft. coping x 3 cu. ft. per ft. rise	816.9336 cu. ft.
56.0671 ft.	rise 2 ft. coping x 6 cu. ft. per ft. rise	336.4026 cu. ft.
17 2/3 ft.	rise breast coping x 4 cu. ft. per ft. rise	70.6666 cu. ft.
339.7267 sq.	ft. of rounds x 1 8/10 per sq. ft.	611.5081 cu. ft.
4,035.8564 sq.	ft. of ashlar x 1 8/10 per sq. ft.	7,264.5415 cu. ft.
		9,716.7190 cu. ft.
		or 388.6688 perches

The scale quantities were:

693	perches of backing	
61 2/3	ft. rise of quoins	
272	ft. rise of one ft. coping 264	ft. straight
	8	ft. curved
56	ft. rise of two ft. coping 35	ft. straight
	21	ft. curved
18	ft rise of breast coping	
340	supl. Feet of rounds	
4,036	supl. Feet of ashlar[89]	

The canal company stockholders were informed at the eleventh annual meeting on June 3, 1839, that the "entire line of the canal, from the District to Dam No. 6, at the mouth of the Great Cacapon, 135 miles, is now in order for navigation." The water had been admitted into the new 27½ mile stretch of the canal between Dams Nos. 5 and 6 early in April. Work on the line above the Cacapon was progressing rapidly with a force of from 2,500 to 3,000 men employed.[90]

In June 1839, the General Committee of Stockholders inspected the line of the canal between Dam No. 5 and Cumberland. The committee reported on August 5:

> Locks Nos. 45 and 46 are of seven feet lift each, and the four next have a lift of eight and a quarter feet each. The whole six are constructed of limestone. . . . Locks No. 51 and 52 are each of 8 feet lift,

[89] Fisk to Morris, August 1, 1838 (Ltrs. Recd., Principal Assistant Engineer). A copy of the handwritten calculations may be seen in Appendix J. For a list of the calculations of the masonry for Lock No. 73, of nine feet lift, see Appendix K.

[90] *Eleventh Annual Report* (1839), C & O Co., pp. 3–4.

> and are constructed of a limestone obtained from quarries about 2½ miles distant, in the rear of Hancock. . . . Lock No. 53 is of sandstone, taken from quarries about 3 miles distant, and has the usual lift of 8 feet. . . . A short distance below Dam No. 6 is Lock No. 54, which connects with the canal above the dam. The feeder from the river enters the canal at the foot of this lock, running close alongside of the canal between Locks Nos. 54 and 55; the latter lock, of 8 feet lift, being connected with the abutment of the dam. [As the Maryland abutment of Dam No. 6 and Guard Lock No. 6 were built with sandstone from a quarry located 1 mile from the mouth of the Cacapon in Maryland, it can be assumed that the same stone was used to construct Locks Nos. 54 and 55.]

The general committee also inspected the unfinished portion of the canal above Dam No. 6. Included in this section of the report were the following comments on the locks:

> Lock No. 56 is of eight [feet] lift. Some progress has been made in the construction, and the greater part of the materials have been prepared. It will be composed of limestone, a portion of which is obtained from the Virginia quarries near Dam No. 6, and a part from the quarries in the rear and vicinity of Hancock.
>
> This lock [No. 57] is of 8 feet lift, and the stone employed in its construction is from the limestone quarries near Dam No. 6, and in the vicinity of Hancock. Considerable progress has been made in this lock, and it may soon be completed.
>
> The stone required for Lock No. 58, at the upper end of this five-mile level, must be transported a considerable distance, from the limestone quarries near Dam No. 6, and the neighborhood of Hancock. They are in part prepared, but the construction has not been commenced. . .
>
> Lock No. 59, of 8 feet lift, lies at the lower end of the seven-mile bottom. Although under contract, none of the materials have as yet been prepared, on account of there not having been discovered any good quarry within a reasonable distance. . .
>
> Lock No. 60, also of 8 feet lift, although under contract, has not, owing to the same circumstances which have been stated in relation to the last-mentioned lock, yet been begun. . .
>
> The materials for Lock No. 61 are in part prepared, having been procured from a quarry within a short distance, which has, however, been nearly exhausted, and which cannot be relied upon to furnish the materials for the next five locks. These locks are situated at the lower end of the deep-cut at the entrance of the tunnel; they are under contract to the same individual who has the next three locks below. The quarry before spoken of was opened in the confidence that it would supply a sufficiency of stone for six of these locks, but it is much to be regretted that this expectation has not been realized. . .
>
> The five locks situated at the lower end of the deep-cut conducting to the tunnel, will each be 8 feet lift. In consequence of the want of a competent supply of the ordinary material within a reasonable distance, it has been suggested that these locks, as well as those Nos. 59 and 60, should be constructed temporarily of wood. With a view to this alteration in the plan, experiments have been instituted, and inquiry made into the practicability of preventing the decay of timber by the use of corrosive sublimate, which has recently attracted much notice on both sides of the Atlantic.
>
> Lock No. 67, which is of 8 feet lift, is not now under contract; it was formerly let, but abandoned by the contractor.
>
> Lock No. 68 is of 8 3/10 feet lift. This also is not under contract, having been abandoned.
>
> Locks No. 69, No. 70 and No. 71, are of 8 feet lift each, and are situated in Oldtown.
>
> Lock No. 72, is of none feet lift, is under contract, and the work upon it has commenced, the foundation having been prepared.
>
> Lock No. 73 is of nine feet lift, and Locks Nos. 74 and 75 seare] of ten feet lift each. . . . They are all under contract to one individual, are in a satisfactory state of progress. One of them is more than half completed, and a large part of the materials for all is prepared. The material employed is a lime-

> stone, obtained principally from the Evitt's creek quarry, to which we shall have occasion presently to advert.[91]

At the annual meeting of the stockholders on June 2, 1840, Chief Engineer Fisk reported that there were "22 lift-locks of 182 feet total lift" between Dam No. 6 and Cumberland. Of the twenty-two locks, five were nearly finished. The materials for five others had been mostly prepared, but economic difficulties had prevented the commencement of work on the remaining twelve.[92]

On July 17 Chief Engineer Fisk submitted a report to the stockholders describing the progress of construction on the canal above the Cacapon. Concerning the locks, he noted the following:

Lock No. 54	on Section No.	257	Two-fifths done; not now under contract; contract was abandoned by the Board in December, 1839.
55	do.	258	Will in a month or two be finished, except the gates.
56	do.	262	One-half done; not now under contract; contract was abandoned by the Board in December, 1839.
57	do.	267	The masonry of this lock is finished.
58	do.	277	Two-fifths done; not now under contract; contract was abandoned by the Board in December, 1839.
59	do.	282	A very small amount of work (about one-fifteenth of their estimated cost) has been done on these locks. They were under contract to a responsible person, but were given up in consequence of suitable materials not being found; they are not now under contract.
60	do.	288	
61	do.	295	
62	do.	298	
63	do.	299	
64	do.	299	
65	do.	299	
66	do.	299	
67	do.	322	Nothing done towards the masonry; was under contract, but abandoned; not now under contract.
68	do.	329	(Opposite the South branch,) nothing done; was once under contract, but abandoned; not now under contract.
69	do	331	In Old Town. Were once under contract, but were scarcely commenced when they were abandoned. They are not now under contract.
70	do.	332	
71	do.	332	
72	do.	347	Three-fifths done. Now under contract, and will be finished this year.
73	do.	350	These three locks are under contract to the same person, and will easily be finished this year. In fact, two of the locks may be regarded as already finished; and the third one is very well advanced.
74	do.	350	
75	do.	350	

Regarding the progress of the work above the Cacapon, Fisk observed:

> Three thousand men in constant employ from this time would complete the canal in two years, provided they were properly distributed as laborers and as *mechanics* among the respective works.
>
> There are, at present. (in July,) about one-half of the above number at work.

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91 *Report to the General Committee of the Stockholders of the Chesapeake and Ohio Canal Company* (Washington, 1839), pp. 7–19.

92 *Twelfth Annual Report* (1840), C & O Co., pp. 14–15.

> It has been seen that the masonry is most sadly behind all the rest of the work; and, unfortunately, even the present reduced force upon the canal is largely deficient in the proportional number of mechanics, (whose employment is always chiefly upon the masonry.)
>
> It has been shown that the masonry done is mostly confined to the two ends of the line, leaving an intermediate distance of nearly thirty miles with its masonry scarcely commenced.
>
> The sections are so far and so well advanced, that the time of the completion of the canal to Cumberland is now entirely dependent upon the masonry, by far the greater part of which is at this time not under contract. The masonry is fully one year behind the sections.
>
> The works now under contract, with perhaps two or three exceptions, to which attention has been called, are in the way of being completed in less than two years.
>
> Unlike the construction of sections, there are from four to five months of the year during which the operations upon masonry are, to a very considerable extent, suspended; and, during the building season of the year, it has, heretofore, almost invariably happened that frequent delays have arisen from the want of cement; which circumstances generally require (particularly when the Company is embarrassed) to be manufactured not long in advance of the time when it is needed for use.[93]

Because of the deterioration of the canal company's finances, work on the canal slowly ground to a halt in 1841–42. When work came to a standstill in the latter year, Fisk informed the stockholders that there remained "in cost, only eighteen and three-tenth miles of distance to be constructed, which is a fraction less than one-tenth of the entire length of the canal from Georgetown to Cumberland."[94]

While construction operations on the canal were halted, several major floods in 1843, 1846, and 1847 inflicted heavy damage on various sections of the waterway. The damage caused to Locks nos. 41–44 by the freshet in March 1846 and the frequent breaking of the lock gates during the day-to-day operations of the canal brought about a slight modification in the construction of the gates. According to Superintendent John G. Stone of the Hancock Division, the new lock gates on his division had been modified in accordance with Fisk's latest instructions. All now had cast-iron frames, while the arms had been framed "with a shoulder of 2 inches on the upper side, which will prevent what is now almost daily occurring, the breaking of the tenons of the arms, to remedy which we are compelled to put bars of iron from the heel post to the toe post secured by iron bolts."[95]

The deteriorating condition of the lock gates was amply illustrated in a report sent by Stone to Chief Engineer Fisk in July. The report, which covered only the Hancock Division of the canal between Dams Nos. 4 and 6, was as follows:

Length of time the gates had been in use on the 1st June, 1846	Their present condition	When they ought to be renewed	Number of feeding valves	Kind of valves, whether with iron frames or not	Present condition
12 years	Very bad	Immediately	4	Paddles without frames	Paddles and Shears are all in good order
2 months	New	10 years	4	Paddles with iron frames	
12 years	Very bad	Immediately	4	Paddles without frames	

93 *Thirteenth Annual Report* (1841), C & O Co., pp. 56–57, 61.
94 *Fourteenth Annual Report* (1842), C & O Co., p. 28.
95 Stone to Fisk, March 21, 1846 (Ltrs. Recd., Chief Engineer).

1 month	New	10 years	4	Paddles with frames	
7 years	May last 2 years	2 years	2	Shears with iron frames[96]	
“	“	“	2		
“	“	“	2		
“	“	“	2		
“	“	“	2		
“	One of the gates very bad	Next spring	2		
“	May last 2 years	2 years	2		
“	“	“	2		
“	“	“	2		

Work on the canal was resumed on November 18, 1847, under a contract with Hunter, Harris & Co. to complete the waterway to Cumberland. The directors, in an effort to facilitate the completion of the canal, adopted various economy measures. They decided to substitute kyanized wood for stone in Locks Nos. 58–66, and they postponed construction of lock-keeper’s houses and the arching of the tunnel until after the canal was formally opened to Cumberland. All efforts were to be concentrated on the sole object of finishing the waterway in some manner at the earliest possible date.[97]

The stockholders were informed on June 5, 1848, that sixteen locks were still unfinished. Of these locks, eight were masonry and eight were composite locks. The firm of Hunter, Harris & Co. sublet the contracts for these locks to the following contractors:

Lock		on section		Moyle, Randal & Jones.
No. 54		257		
56		262		“ “ “
58		277	not let.	
59		282	(comp.)	Ritner & Co.
60		288	“	“ “ “
61		295	“	“ “ “
62		298	“	Buel & Watt.
63	1/3	299	“	“ “ “
64	2/3	“	“	“ “ “
66		“	“	“ “ “
67		322	“	Wm. P. Steritt
68		329	(mas.)	Fallan & Ambrose
69		331	“	“ “ “
70		332	“	“ “ “
71		“	“	“ “ “

[96] Stone to Fisk, July 11, 1846 (Ltrs. Recd., Chief Engineer). A thorough search of the canal company records failed to turn up similar reports by other superintendents on the condition of the lock gates on their divisions.

[97] Walter S. Sanderlin, *The Great National Project* (Baltimore, 1946), pp. 157–158.

Nearly all the cut stone for Locks Nos. 54 and 56 was prepared and delivered, and most of the stone for Lock No. 58 was cut. Concerning the arrangements made by Hunter, Harris & Co. for furnishing the cement for the masonry works, the stockholders were told:

> They have contracted with George Shafer, at the Mill below Dam No. 6, to burn, grind and deliver at the Mill 120,000 bushels at the rate of 12,000 bushels per month, if required, and with Charles Locker, at Cumberland, for 60,000 bushels at the rate of 6,000 bushels per month, if required. Both parties have their Mills full of cement, ready to deliver, and the delivery along the line has commenced this week, and no doubt is entertained that the cement will be ready as fast as required.[98]

As construction progressed on the final "Fifty Miles" above the Cacapon, a number of letters relative to the plan of building the locks were transmitted through Chief Engineer Fisk's office. On April 26, 1848, Superintendent W. S. Elgin of the Harpers Ferry Division submitted to Fisk a communication containing the dimensions of the shoes for the lock gates:

> I find the Diameter to be 6 inches,—the 3½ inch diameter has a depth of 2 inches, for the Pivot to work in. The weights of those used is 24 lbs. with 4 in. depth in all. The Pivots (there is none on hand) have flanges of about 6 in. diameter, with 8 square,—I would proffer tho—diameter of the flanges about 8 in. with four heads for Bolts; with small heads, as some of the Pivots have been troublesome, in consequence of getting out of their places; It takes about 130 lb. Spikes to each gate or 520 to a set of Gates. It takes 8 5-inch spikes to the lb. and about 10½ of the 4½ in. to the lb. The collar to the cast iron valve weighs 9 lbs. The average weight of the casting that have been furnished me by Gilluce, including the wrought screw bolts for the collars, is 417 lbs., which I paid him 3½ cents per lb. delivered.[99]

[See drawing No. 6, p.139.]

In reply to a request by Fisk for information on the dimensions of the recesses and sub-recesses of the locks, Elgin notified Fisk that there were no sub-recesses in the locks in his division. Sub-recesses were included only in locks that were filled through culverts. However, he sent the following information on the dimensions of the lock recesses and sub-recesses:

> Large recess 10 feet by 1¼ feet; sub-recess bottom 4 inches above mitre sill, 1 foot 2 inches above or from the Back of Hollow quoin, and 2 feet 4 inches being the height of the Paddles, and would require 4 feet 6 inches for Both paddles; where Paddles open, project 9¾ inches outside of gate; so the depth of sub-recess would have to be regulated accordingly; 1 foot would be ample depth as 2 ft. 4 in. x 4 ft. 6 in. x 1 foot. . . .[100]

At the annual meeting of the stockholders on June 4, 1849, Chief Engineer Fisk reported that he had recommended changing the plan of constructing Locks Nos. 68–71 from cut stone to composite, and the directors had agreed. The reasons for the change were as follows:

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98 *Twentieth Annual Report* (1848), C & O Co., pp. 17–18, 20.

99 Elgin to Fisk, December 16, 1848 (Ltrs. Recd., Chief Engineer). See Drawing No. 6, a copy of the drawing Elgin enclosed with his communication to Fisk.

100 Elgin to Fisk, December 16, 1848 (Ltrs. Recd., Chief Engineer). See Drawing No. 6, a copy of the drawing Elgin enclosed with his communication to Fisk.

> The substitution of composite, for masonry locks, four in number, at and near Old Town,—advised by me and agreed to by the Board,—during the past year,—was advisable for several reasons.
>
> The quarries that had been relied upon to furnish stone for the masonry locks were found to be very expensive and difficult to work—Quarries, nearer at hand and easy to work, which it was hoped, upon being opened, would furnish stone that might be used to a large extent in masonry locks, were then resorted to. After much time had been spent and money expended in these quarries, it became evident that the stone from them were unsuitable for masonry locks, but were such as would make good and substantial composite locks. By the change of plan it is rendered more certain that the locks will be built in time, and although the cost of maintaining composite is greater than that of keeping up masonry locks, yet the difference in this respect is far more than made up by the interest on saving in the first cost of the locks.[101]

On January 10, 1850, Fisk sent information relative to the dimensions of the locks to Col. John Pickell, a Baltimore boat builder interested in constructing boats for the canal company. The following information was to be used to determine "the size of the boats that may be passed through the locks":

> The distance from the upper side of the lower mitre sill to the upper side of the upper mitre sill, or from point to point of lock gates,—is 100 feet.
>
> The width of the lock chamber is 15 feet.
>
> The angle formed by the mitre with the main sills is 26˚.
>
> The thickness of the lock gates at the heel posts is twelve inches,—and at the toe post ten inches.
>
> The breast wall of the 25 locks nearest Georgetown is directly under the mitre sill, and rises up nearly to the bottom of the upper level, (its front being in a line with the downstream side of the main sill,) the upper gates, therefore, of these locks are short.
>
> The breast wall of the remaining 49 locks is entirely above the upper Gates. The upper gates of these locks are, in consequence, long ones.[102]

Seven days later Superintendent Stone, who was building new gates for Locks Nos. 46–50, requested information from Fisk on the proper method of constructing them. The following day the Chief Engineer notified Stone that he wanted the lock gates made in two pieces "like those that have been, or are to be, put on at the gates of Locks No. 54 and 55 at Dam No. 6."[103]

As the construction of the canal approached completion during the summer of 1850, various engineers began inspecting the entire line of the waterway. Engineer William Bryan was directed by Fisk to measure the dimensions of the locks and to determine their operating capacities. He reported the following:

> It may not be amiss to say that in April 1849, I noted a leaning in of Lock No. 36, and found that at top where narrowest it was only 14 6/10 [feet] wide and 14.8 [feet] at the gates. This I suspect is the worst lock upon the Canal.
>
> I have long been under the impression that there should be some maximum dimensions as regards [the] width of [the] beam & [the] draft of water, prescribed for boats. Those which so nearly fill a lock give severe blows upon entering, doing injury to both locks & boat. And if boats 14½ feet wide are allowed, I think there would be a great saving of water, both to boats & locks by extending a heavy bumping timber for 100 feet above & below the lock, precisely in a line with the face of the

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101 *Twenty-First Annual Report* (1849), C & O Co., pp. 4, 26.

102 Fisk to Pickell, January 10, 1850 (Ltrs. Sent, Chief Engineer).

103 Stone to Fisk, January 17, 1850 (Ltrs. Recd., Chief Engineer) and Fisk to Stone, January 18, 1850 (Ltrs. Sent, Chief Engineer).

> towpath side of same. This would enable the boat to glide in by that side of the lock and would avoid, in most instances, any striking—or if any, at a very slight angle, with the side of the lock.[104]

The eastern section of the canal, the only part ever completed, was formally opened to trade at Cumberland on October 10, 1850. Following gala ceremonies, five coal boats, the *Southampton*, *Elizabeth*, *Ohio*, *Delaware* and *Freeman Rawdon* descended the canal. Two of these boats, the *Southampton* and the *Freeman Rawdon*, began a race to Washington. The *Freeman Rawdon* won, reaching the national capital on October 17.

Engineer Bryan, who was a passenger on the *Southampton*, made a number of observations during the journey down the canal. When he arrived in Georgetown he immediately wrote a letter to Fisk concerning his fears about the locks.

> I have, I think often expressed to you my fears of boats going through the lower gates of the locks, when descending the canal, with the locks full—which may be occasioned by any one of three causes—bad snubbing or bad ropes—the boatman's fault—or bad snubbing posts, the Company's.
>
> Today I witnessed serious risk, from each of these causes, least however from the first. At Lock No. 22, the boat was allowed to touch rather hard. Lower down, the snubbing rope, a new one which had been chafed some where above, got very weak & I was afraid of its breaking; & if it had been as bad at the Falls as it was at Lock No. 5, I should have insisted upon its being cut & spliced.
>
> The most danger today, however, was from the insufficiency of the snubbing posts. Some large new ones had just been put in, but the foremost boat seems to have loosened them all, and the 2nd was very near pulling several out. I saw a large one, 1 foot in diameter 4 feet in the ground, turn like a top.
>
> Boatmen will snub at the top of the post. They should therefore be not more than two feet above ground. Snub posts are more easily moved and are soon worn into. They should therefore be at least one foot in diameter. When planted, fine stone should be rammed around them or they will give totally, if not come out. Three at a lock is the number heretofore used. I think there should be four. The middle one is sometimes too weak to snub sufficiently & also too far down to snub sufficiently, while the upper one throws a great strain upon the boat to club, as the side will strike the work at the head in that case. [The four snubbing posts should be] at the distance of 20 feet from the m[itre] sills & each other. They would be stronger, & more to lean from the lock & it would be better perhaps if the two lower posts should also lean toward the head of the lock.[105]

When construction of the canal was completed, the board of directors compiled a report that was submitted to the stockholders on February 27, 1851. The report said the average lift of the locks was a little over eight feet. The locks were "100 feet long and 15 feet wide in the clear" and were capable of passing boats carrying 120 tons (of 2,240 lbs.)."[106]

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[104] Bryan to Fisk, August 19, 1850 (Ltrs. Recd., Chief Engineer). On August 30 Bryan informed Fisk that Lock No. 36 was the "narrowest Lock I have yet found except the Shenandoah [outlet lock]." Lock No. 36 was 14.55 feet wide 40 feet below the upper gates and 14.62 feet wide 60 feet below the upper gates. Bryan to Fisk, August 30, 1850 (Ltrs. Recd., Chief Engineer).

[105] Bryan to Fisk, October 17, 1850 (Ltrs. Recd., Chief Engineer).

[106] *Report to the Stockholders on the Completion of the Chesapeake and Ohio Canal to Cumberland, with a Sketch of the Potomac Company, and a General Outline of the History of the Chesapeake and Ohio Canal Co., from its Origin to February, 1851* (Frederick, MD, 1851), p. 112.

CHAPTER III
The Masonry Locks, 1851–1924

As soon as the canal was put into operation, efforts were commenced to improve the fenders of Locks Nos. 60–75 on the Cumberland Division. Of these structures, all were composite locks except for Locks Nos. 72–75. Superintendent H. M. Dungan forwarded to Chief Engineer Fisk a bill of timbers for the improvement of the fenders at each lock. Included for each lock were to be:

2 pieces—14 ½ ft. long, 12 in. x 12 in.	= 29 cu. ft.
2 pieces—10 ½ ft. long, 12 in. x 15 in.	= 26 ¼ uprights
2 pieces—12 ½ ft. long, 9 in. x 9 in.	= 14 bearing pieces
44 pieces—6 ft. long, 6 in. x 6 in.	
	1,351 ¼ cu. ft.

The cost of such an undertaking would be:

1,351 ¼ cu. ft. x 10¢	= $ 13.53
Workmanship	= 10.00
For each lock	= $ 23.53
Cost of 16 locks	= $376.48[107]

The following day Dungan submitted to Fisk a plan of the fenders drawn by J. C. Stuck. This plan (Drawing No. 7) closely followed Dungan's recommendations, with some slight modifications.[108]

[See drawing No. 7, p. 140.]

On January 20, 1851, Dungan reported that he had contracted for the timber for the fenders for the sixteen locks. The ironwork, consisting of bolts and spikes for the fenders, would be forged by Mr. Stiles at his shop near Lock No. 62.[109]

After receiving several complaints from boat owners that several lock chambers were not wide enough for their boats, the board took steps to correct this problem. Chief Engineer Fisk notified Shepherdstown Division Superintendent L. Benton that

> the owners of several of the boats that are somewhat too wide for a few of the locks on the Canal, say that taking off of each wall, not exceeding 3/4th of an inch, for a few courses down from the top, will

[107] Dungan to Fisk, December 18, 1850 (Ltrs. Recd., Chief Engineer).
[108] Dungan to Fisk, December 19, 1850 (Ltrs. Recd., Chief Engineer).
[109] Dungan to Fisk, January 20, 1851 (Ltrs. Recd., Chief Engineer). The project was carried out by day labor. Carpenters were brought from Washington, and the fenders were completed by March 3. Dungan to Fisk, March 3, 1851 (Ltrs. Recd., Chief Engineer).

> enable all their boats readily to pass the locks. The Board desire that this shall be done as early as practicable. You will therefore give it your immediate attention.
>
> I understand that Locks Nos. 36, 37 and 40 on your division are the ones that are too narrow. Perhaps there may be others.
>
> As the walls have not pressed in equally throughout their entire length, and as a few feet of their top have yielded more than that below, it will be unnecessary to dress off more than is sufficient to give at those places that have pressed in least a width, after trimming, equal to that where the pressing in is the greatest. And again, some of the locks do not require as much dressing as others.
>
> To bring about uniformity, I have concluded, after writing the above, to adopt 14 feet 8½ inches as the least width the locks should have at all points. You will therefore work with reference to that width.
>
> You can determine, upon trial, whether it will be cheaper to dress down the face of the coping or to move it back.[110]

Engineer and General Superintendent Thomas L. Patterson told stockholders on June 6, 1853, that the "Locks are, generally, in good order." Several locks required new gates and other minor repairs which could be accomplished "by the mechanical force ordinarily employed by the several superintendents without any suspension of the navigation."[111]

Four years later (on June 1, 1857) President William P. Maulsby reported that a number of locks and lock gates which had been in "bad order" had been repaired the preceding winter.[112]

On July 1, 1857, the board ordered the division superintendents "to measure all the locks on their respective divisions and to report…any such locks as do not entirely correspond in their dimensions with the established standards of 100 feet by 15 feet."[113]

A thorough search of the canal company records turned up only two replies to this order. Locks Nos. 56–75, which had been measured during June in anticipation of the order, were all found to be 100 feet in length, but their width varied from 15 feet to 15 feet 7 inches measured at the narrowest point. Locks Nos. 27–40, measured by Engineer Charles Clark, were reported to vary in width from 14 feet 7 inches to 14 feet 10 inches.[114]

John G. Stone, who had recently been promoted from the position of division superintendent to that of engineer and general superintendent of the canal, reported to the stockholders on June 6, 1859:

> During the last year many important repairs and improvements have been made on the Canal. Flumes have been built at the different Locks where they were needed. . . a large number of locks have had new gates put in, and many others new mitre sills and new bottoms. . [115]

Engineer and General Superintendent Charles P. Manning on June 4, 1866, told stockholders:

> In general, the masonry of the aqueducts, culverts and locks is both substantial and in good repair. . . .

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[110] Fisk to Benton, July 3, 1851 (Ltrs. Sent, Chief Engineer). Similar letters were sent to the other division superintendents. In the letter to John G. Snow, Fisk mentioned that the boatmen had complained that Lock No. 42 was too narrow.

[111] *Twenty-Fifth Annual Report* (1853), C & O Co., p. 9.

[112] *Twenty-Ninth Annual Report* (1857), C & O Co., pp. 11–12.

[113] Proceedings of the President and Board of Directors, K, pp. 364–365. Also see Ringgold to Wade, July 2, 1857 (Ltrs. Sent, C & O Co.).

[114] Sprigg to Ringgold, July 1, 1857, and Clark to Ringgold, July 22, 1857 (Ltrs. Recd., C & O Co.).

[115] *Thirty-First Annual Report* (1859), C & O Co., p. 10.

> Generally speaking, the lock gates are in excellent condition; but there are many that should be taken out and replaced by new ones as rapidly as circumstances may permit, and numbers thus removed might then be sufficiently repaired to answer all the purposes of reliable substitutes, or duplicates in case of accident. These perishable appendages of the Canal are liable to great abuse at the hands of reckless boatmen, and therefore are a constant source of both anxiety and expense.[116]

Three years later, at the annual meeting of the stockholders on June 7, 1869, President Alfred Spates gave a more pessimistic report on the condition of the canal structures:

> During the past ten years, little or nothing had been done towards repairing and improving lock-houses, bridges, culverts, aqueducts, locks, lock-gates, and waste weirs of the Company; many of them had become entirely unfit for use and were becoming worthless, rendering it absolutely essential to the requirements of the Company to have them repaired. This the Board have done, and, although at heavy cost, they now present a comfortable and substantial condition, and the fact may now be confidently stated that the condition of the canal in all its departments is such as to justify a largely decreased expenditure during the current year, unless overtaken by unforeseen and unexpected disaster.[117]

Engineer William R. Hutton on June 1, 1870, announced that while the locks were serviceable, few were in good condition. The coping was loose in many, while the mortar was out of the joints, resulting in much leakage through the masonry and around the gates. Several locks needed to be rebuilt. Most of the lock gates were "good and have recently been put in good working order, and new ones are kept always on hand to replace such as may fail or be accidentally destroyed."[118]

During the early 1870s, the canal company enjoyed five years of unprecedented financial profits. For the first time the waterway gave promise of fulfilling the hopes of its promoters. Under the leadership of President Arthur P. Gorman, the board began a program of restoration and improvement, fostered the growth of trade to record levels, and continued payments on the long-term debts of the company.[119]

Despite the repairs already made, much remained to be done. Chief Engineer Hutton recommended a thorough overhauling of the canal in 1871, including repairs to the masonry structures and the canal prism itself. That summer he began plans to replace the deteriorating lock gates. As part of these repairs, canal officials drew up a general specification for cast iron and wrought iron for the lock gates as follows:

> Specification of cast and wrought iron for lock gates.
>
> 1. The castings required are paddles and frames. They will conform in all respects to the drawings and to the dimensions marked thereon; will be made of soft gray iron, well shaped, smooth, out of wind, without flaws, cracks or airholes. Paddles will be made with socket and loose plug for upper journal and a wrought iron case hardened plug, keyed in for the lower journal and shall be cleaned out, and those for the heads of collar or keeper bolts to be square.
>
> 2. Wrought iron shall be of the best American rolled iron, fibrous and tough. Bolts to have square nuts and heads of a thickness equal respectively to the diameter and to four fifths of the diameter of the bolt. Threads to be machine cut, so that any nut will fit all bolts of the same diameter.

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116 *Thirty-Eighth Annual Report* (1866), C & O Co., pp. 7–8.
117 *Forty-First Annual Report* (1869), C & O Co., pp. 4–5.
118 *Forty-Second Annual Report* (1870), C & O Co., pp. 30–32.
119 Sanderlin, *The Great National Project*, p. 226.

> 3. **T** and **L** irons will be made in the Company's shops, or procured as wanted on the respective Divisions.
>
> 4. All irons and castings furnished under this specification shall be delivered at such point on the Canal, accessible by the Baltimore and Ohio Railroad, as may be described in each order, and will be subject to the inspection of such officer of the Canal Company as may be designated by the President.
>
> 5. A small number of paddles and frames of extra size will be required for the Culvert locks, and will be furnished under this specification and proposal.[120]

The repair of the masonry locks was carried on throughout the winter of 1871–72. While repairs were made to the locks along the entire length of the canal, much of the effort was directed toward the locks below Seneca. Thirteen masonry locks on this section of the canal received extensive repairs. Much of the stone used for the work was "gray rock" from the Seneca quarries that had been intended for use on the dam at Great Falls. In addition to the masonry repairs, new paddles and frames were "put in at every Lock where needed" and many new heel and toe posts were "put on [the] Lock Gates."[121]

Engineer Thomas L. Patterson on June 2, 1873, informed the stockholders that a great number of repairs had been made to the canal the preceding winter. Concerning the locks, he said:

> All locks requiring it have been thoroughly overhauled, and the masonry put in good repair. In some cases a large portion of the lock has been rebuilt, as at the Mountain Lock [No. 37] above Harper's Ferry, &c. The lock-gates, throughout, have been examined, and where necessary new gates have been put in. The floors of several locks have been taken up, and the foundation timbers underpinned and secured by concrete; on the whole, the condition of the locks has been much improved.[122]

Despite the prosperity of the canal, President Gorman was not yet satisfied. He recommended the continuation of the general program of improvement and expansion designed to modernize the canal as a carrier and establish more firmly its future as a transportation line. In a long report made to the stockholders on June 7, 1875, he cited the reasons for his stand and the course he proposed to take. The report reviewed the changing position of the canal in the Cumberland coal trade and cited the critical need for undertaking a program of far-reaching improvements to strengthen its competitive position.

> It is well known when this work was constructed it was then of larger dimensions than any other Canal in this country; and the carrying capacity of the boats sufficient to make the cost of shipping coal, much less than by any of the then competing lines.
>
> Since then, but comparatively little attention has been paid to making improvements, so as to reduce the cost to a minimum. While on the other hand, *the best talent of the country has been employed in perfecting the system of railroad transportation and with wonderful results*.
>
> When this canal was completed in 1850, it was not supposed that a ton of coal could be profitably moved by rail for less than two (2) cents per ton per mile, whereas it is now transported from Cumberland to Baltimore for a fraction over one cent per ton per mile.

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[120] This specification was appended to a contract proposal by Calvin Page in August 1871. Although the canal company president was authorized to enter into a contract "for cast and wrought iron for Lock Gates," no documentation in the canal company records was found relative to the execution of a formal contract. Proceedings of the President and Board of Directors, L, pp. 420–421.

[121] Proceedings of the President and Board of Directors, L, pp. 533–534, 561–564. Also see Gorman to Maus, October 4, 1872 (Ltrs. Recd., C & O Co.).

[122] *Forty-Fifth Annual Report* (1873), C & O Co., p. 28.

> It is true, that during the same time, reductions have been made in tolls and wharf charges by the Canal, so that a proper difference has always been maintained in its favor. But further improvements are being rapidly pushed forward by other transportation Companies, which, when completed may, and probably will, require further reductions on our part.
>
> Up to this time the Baltimore and Ohio Railroad has been our only formidable competitor.
>
> The *able* and *comprehensive minds* who direct the affairs and shape the policy of that Company, have long since recognized the necessity for *greater reductions in the cost of transportation, and to that end,* have been for some years constructing its third track from Baltimore to Cumberland, *which, when completed, will enable it to reduce the cost of delivering a ton of coal from the mines on board vessels in the harbor of Baltimore to a minimum railroad rate,* which, together with the superior facilities of the port of Baltimore, as compared with Georgetown and Alexandria, for shipping to Northern Ports, will make it absolutely necessary that a corresponding reduction in cost and improved facilities shall be furnished by this Company.
>
> Within the past four years another competing line has been constructed in the coal fields, which is owned and controlled by the Pennsylvania Railroad Company; the very able and astute managers of which recognize the great value and importance of securing the transportation of a large portion of the products of the Maryland mines, and thus divert it from Baltimore and Georgetown to Philadelphia and Amboy.
>
> To this end they have constructed a railroad via. Broad Top, to the Maryland State Line, at which point they connect with the Cumberland and Pennsylvania Railroad which passes through our entire coal basin, thus affording an all-rail-route to Philadelphia, South Amboy and Jersey City.
>
> Up to this time the tonnage of that road has been insignificant, owing, possibly, to some extent to the want of rolling stock, but mainly because of the great length of haul; so that the Maryland lines have been the cheapest, and no serious competition could for any great length of time be maintained by this line as now operated.
>
> But the Pennsylvania Railroad Company owns and controls the Canal leading to the Juniata, and have for some years been making extensive improvements by enlarging them, and it is now proposed and recommended by their accomplished engineer to expand only one million dollars more, which could complete their enlarged Canal and slack water to a point within 180 miles of our mines.
>
> Then with the railroad of only 80 miles, and a Canal of sufficient capacity for section boats of 300 tons passing through to Philadelphia and New York, they claim that a large portion of the tonnage of this Canal, as well as of the Baltimore and Ohio Railroad must be diverted.
>
> Without admitting all the advantages that is claimed for that route when improved, it cannot be denied that unless greater improvements are made and the cost reduced by this Canal, a portion of the trade which properly belongs to this outfit, may be diverted to one which has less natural advantages, but where more enterprise has been displayed in its management.[123]

Among the general improvements Gorman recommended was the enlargement of the locks "so as to increase the capacity of the boats to two hundred and fifty (250) tons." Concerning this proposal, he further commented that

> the next improvement contemplated, is to lengthen the chamber of the locks by removing the breast walls and by using a drop-gate at the upper end of the lock, a boat ten feet longer than those now in use can be passed; thus increasing the carrying capacity over ten (10) tons each trip, and as a boat of that increased size and tonnage would not require an increase in power or labor over the smaller ones now in use, it would decrease the cost of transportation ten (10) per cent. Assuming the tonnage of the Canal at only 800,000 tons per annum, this reduction would amount to $100,000 per annum.

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[123] *Forty-Seventh Annual Report* (1875), C & O Co., pp. 14–16.

> While the cost of making an improvement which would produce such a result is roughly estimated at $81,200, if made, and only three cents a ton were added to the Canal charges, it would pay the entire cost in less than three years, while it would be a saving of more than $60,000 per annum to the Coal Companies or consumers.
>
> This improvement should be made during the suspension of navigation next winter, if the financial condition of the Treasury will warrant it.
>
> When the above named improvements are completed, a proper annual expenditure should be made each year looking to the lengthening of the locks so as to admit of section boats whose capacity will exceed 230 tons.
>
> This system has been inaugurated and successfully tried on the Pennsylvania Canal, with the most satisfactory results. The actual saving in cost of transportation being over *twenty-five per cent*.[124]

During the winter of 1875–76 work was commenced on lengthening Locks Nos. 5–7. The masonry on these structures was taken down and rebuilt in a lengthened form with granite, and new drop gates installed. A new shop office was built just below Lock No. 5 to accommodate this work as well as the other improvements to the canal in Georgetown.[125]

Just as the momentum for improving the canal was increasing, a decrease in trade and a reduction of tolls caused canal revenues and profits to fall. The decrease in trade, which was the result of the national economic depression and increasing competition from the railroads for the Cumberland coal trade, suspended most of the improvements, including the lengthening of the locks. A disastrous flood in November 1877 further burdened the canal company finances and postponed improvements to the waterway.[126]

At the annual meeting of the stockholders on June 7, 1880, president Gorman announced that the canal "from Cumberland to Georgetown is now unquestionably in better condition than it has been at any time since 1860." All the 1877 flood damage had "been thoroughly repaired and strengthened," and the navigation on the waterway was "now more reliable than it has been at any time since it was constructed." With the canal in good operating condition, Gorman repeated his earlier recommendation of doubling the locks. After the proposed change, the cost of transporting 250 tons of coal would be the same as that of transportation of 114 tons with the locks in their present condition.[127]

On May 20, 1881, the president and directors submitted a report to the stockholders entitled "Recommendations in Regard to Lengthening Locks of the Chesapeake and Ohio Canal Co." Casting aside as too costly two other suggestions for increasing the carrying capacity of the canal by deepening the waterway by one foot or by widening the locks from fifteen to seventeen feet, the report made the following recommendation:

> A third way is to lengthen the locks, one hundred feet, so that two boats may be passed through together, being coupled and directed at all times in their movements by a patented device which makes

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[124] *Ibid*., pp. 17–18.

[125] Gorman to Fletchall, December 7, 1875; Gorman to Smith, January 26, 1876; and Gorman to Latchford, March 12, 1876 (Ltrs. Sent, C & O Co.0; Fletchall to Gorman, June 2, 1876 (Ltrs. Recd., C & O Co.). According to the *Forty-Ninth Annual Report* (1877), C & O Co., p. 9, reconstructing and lengthening these locks cost $146,556.77.

[126] Sanderlin, *The Great national Project*, p. 240. Many locks were damaged by the flood. Canal company records indicate that Locks Nos. 5, 23 and 33 and several locks below South Branch were the most heavily damaged locks. Although the locks were all made serviceable for the next boating season, canal officials surveying the flood damage recommended the eventual reconstruction of these heavily damaged locks. Gorman to Board of Directors, December 12, 1878 (Ltrs. Recd., C & O Co.).

[127] *Fifty-Second Annual Report* (1880), C & O Co., pp. 10, 15.

> but a single displacement of the water necessary, the two boats carrying two hundred and forty tons, and both being propelled by a power which only exceeds by one-sixth that which is required to propel a single boat carrying not more than one hundred and twenty tons, and manned by the same crew required for a single boat. It is this improvement which is recommended, and which, when made, would place the canal in condition to meet successfully competition by any existing line of railway.

The report said this experiment in lengthening the locks had already been successfully attempted on the Pennsylvania Canals.

> The improvement, we now suggest, is not an untried experiment. It is one which has been thoroughly tried on the canals owned by the Pennsylvania Railroad Company, and its adaptability to our work has been tested by actual experiment made by us.
>
> It would extend this paper beyond the proper limits if we did more than call your attention to the necessity of that improvement. It is the improvement which other canal companies have found it necessary to make. It is an improvement we must make if our company expects to obtain in the future a fair share of the coal trade at paying rates.
>
> The Pennsylvania system of canals, extending from Wilkes-barre to Columbia, is owned and operated by the Pennsylvania Railroad Company.
>
> In 1867 these canal were four (4) feet deep with a width of bottom of only twenty-eight (28) feet and the locks seventeen by ninety feet. At that time and in that condition the actual cost of the movement of a gross ton of coal per mile, which included the boat service and motive power but excluded the maintenance of the canal, was ten (10) mills.
>
> From 1867 to 1875 these canals were increased to six and a quarter feet in depth, and thirty-four (34) feet wide of bottom, and the locks were lengthened so as to make them seventeen by one hundred and eighty feet. The carrying capacity of the boats in 1867 was eighty tons; in 1875 three hundred tons with but slightly increased cost for power, and absolutely no increased cost for labor in hauling the boats. Thus improved and enlarged, the cost of moving a gross ton of coal was reduced from ten (10) mills to four (4) mills per mile.
>
> This was the action of the Pennsylvania Railroad Company, with its magnificent lines of railway, splendidly equipped, passing through the same coal measures from which the canal draws its tonnage. That company, in solving the problem of economy of transportation, found it to be to *its interest* to widen and deepen its canals and enlarge the locks, so that two boats could pass, equipped with patent coupling and steering apparatus, for the purpose of delivering coal from their mines at tide water, and to successfully meet the competition of other coal fields.

Impressed by the results of the experiment on the Pennsylvania Canals, Gorman and the directors urged the stockholders:

> This is precisely what we recommend you to do with your work. As the original width and depth of your canal, however, was greater than that of the Pennsylvania Canals, it will not be necessary for you to do more, at this time, than to lengthen your locks between Cumberland and Georgetown to enable you to reduce the cost of transportation to such an extent that coal can be carried, with a profit to the boat owners, and also a return to the canal not less than fifty cents per gross ton for its tolls and wharfage, but reducing the whole cost to the public to 5/8 cents (6¼ mills) per ton per mile, or $1.15 for the whole distance. With such a reduction, it is safe to say that we could compete with any other line of transportation using the existing appliances. That this reduction would largely increase the output of the Cumberland region, and thus add largely to your gross tonnage, cannot be questioned. In our judgment, within five years after the improvement is made, the coal tonnage of your work would be doubled.

As we have already said, the improvement recommended is not an experiment. It has been thoroughly tested by other similar works. Inasmuch as the line of your work follows the many bends of the Potomac river, it was, at one time, thought that there might be some difficulty in navigating the canal with two boats, each ninety feet in length, coupled by the patent device used on the Pennsylvania canals. To test that question, we secured the right to use the steering apparatus of J. McCreery—purchased two boats and made a thorough test of its applicability to the navigation on your canal. We submit herewith the report made by Mr. E. Mulvaney, who was directed to make the experiment. It will be seen that there is not the slightest difficulty in applying the system to your canal, or in reaping its fullest advantages. It was found that the average time made on the levels with these double boats, loaded with two hundred and thirty (230) tons, drawn by four (4) mules, was two and a quarter (2¼) miles per hour. The same two boats, light, going up stream, were moved by four (4) mules at the rate of three (3) miles per hour.

The time of passage through the locks, the boats being then necessarily uncoupled, was twenty-five (25) minutes.

The average time with a single boat, one hundred and fifteen (115) tons, with three mules, is two and a half (2½) miles per hour; the time of the same boat, when empty, moving up the canal, drawn by three (3) mules, is three and a half (3½) miles per hour; the average time of lockage is eight (8) minutes.

The result of this test demonstrated that the system of towage would produce equally as good results on your work as on any other, provided the locks were lengthened.

As to the cost and advantage of lengthening the locks, the report stated:

To lengthen all the locks between Cumberland and Georgetown, seventy (70) in number, by making the composite locks, and having the timber creosoted, together with improved appliances for opening and closing the gates so as to save the labor of one man at each lock, would cost about $7,000 per lock—$490,000.

To derive the full benefit of this improvement, that is to say, to enable you to reduce the cost to a minimum, it will be necessary to enlarge the whole number.

It will be observed that when this improvement is made, five (5) cents per ton on a tonnage of six hundred thousand (600,000) tons would pay the interest upon the entire cost of the improvement. Knowing full well that in the present financial condition of your company, with the great amount of overdue interest on its preferred bonds, there might be some hesitancy in making so great an outlay at once, however necessary it might be, we have caused a careful examination to be made by the engineers to ascertain if it would be possible to select a certain number of the locks for enlargement, leaving the others in groups, so as to afford the greatest distance for the use of double boats with the fewest number of locks enlarged. That examination and report shows that by lengthening thirty-three (33) locks at a cost of $231,000, we can use double boats, coupled, on one hundred and (163) sixty-three miles of the one hundred and (184) eighty-four miles of your canal; and that the locks remaining unimproved can be left in groups. At such points it will be necessary for the company to maintain animal power to pass the boats through the single locks. An improvement to this extent would, in our judgment, make it possible for the boat owner to carry coal from Cumberland to Georgetown, with a fair profit at sixty-five (65) cents per gross ton. He would, of course, be compelled to have an extra steersman on his boats, and be subjected to delays in coupling and uncoupling his boats at all single locks, which would be equivalent to *not less than ten* (10) *cents per ton*; while the canal company, as herein before stated, would be compelled to furnish the extra power at the single locks for the passage of boats at these points at an average cost, as near as can be estimated, of five (5) cents on its tonnage. With this enlargement of thirty-three (33) locks the case would stand thus:

Cost $231,000; interest per annum on same $13,860, equivalent on a tonnage of six hundred thousand (600,000) tons to nearly two and one-third (2 1/3) cents per ton.

The whole cost to the trade of moving a gross ton of coal from Cumberland to Georgetown would be—

To boatman	65 cents
To canal for tolls and wharfage	55 cents
To the canal for animal power for passing boats through single locks	5 cents
Total per ton	$1.25

This improvement and consequent reduction of cost would therefore enable us to maintain our tolls at the present rate, notwithstanding the railroad lines should further reduce their charges thirty (30) cents a gross ton. Without this improvement it would be necessary to reduce your tolls to meet *any* reduction that the railroads may hereafter make.

It is proper, before closing this branch of the subject, to say, that while we have suggested that the lengthening of thirty-three (33) locks will suffice as a measure of temporary relief, we do not wish it to be understood that the work should stop with that improvement. It ought to be continued, at a later period, until every lock is lengthened. When thirty-three (33) locks are completed, we could devote a portion of the revenue of each year to the enlargement of the remainder of the locks.[128]

After a lengthy debate on the issue of lengthening the locks, the stockholders passed the following preamble and resolution on June 6, 1881:

Whereas,

The President & Directors of the Chesapeake & Ohio Canal Company, have in a special communication to the Stock and Bond-holders, incorporated in the Annual Report just submitted [53rd], show the absolute necessity of lengthening certain locks upon the canal, in order to maintain it as a means of interstate commerce, and to fulfill the purpose for which the canal was incorporated, and to keep it a living going concern,

Therefore be it

Resolved by the Stockholders in general meeting assembled, that the President & Directors of the Chesapeake & Ohio Canal Co. be and are hereby authorized to lengthen the locks of the Canal, in the manner and to the extent specified in their report this day submitted.

And that they be further authorized, either to dispose of the Repair Bonds issued under the Act of 1878, Chap. 58, to an amount, not exceeding $250,000, and to apply this proceeds to pay for such work, or to use the current revenue of the canal therefore, or to do both as in their judgment may best promote the interest of the Company.[129]

Six weeks later President Gorman submitted a report to the directors giving the details of the project to lengthen the locks.

The large quantity of lumber and other material required for the contemplated improvements made it necessary that immediate action be taken, so as to have the lumber delivered along the line of the Canal before the close of navigation in December.

As soon therefore, as the final revision of the estimated quantities could be made I contracted for a sufficient quantity of lumber to lengthen twenty-seven (27) locks. The number of feet, board measure, required for each lock is 132,514 feet, to lengthen thirty-three (33) would require 4,372,962 feet, exclusive of the amount required for the additional repair of lock gates at each lock.

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[128] *Recommendations in regard to Lengthening Locks of the Chesapeake and Ohio Canal Co.* (Annapolis, 1881), pp. 9–17.

[129] Proceedings of the President and Board of Directors, N, pp. 145–146.

> It was found to be almost beyond the capacity of the mills accessible to the Canal to have this amount of lumber sawed and delivered before December 1st. I however contracted with: Henry G. Davis to saw and deliver from 150,000 to 250,000 feet per month commencing with July, equivalent to furnishing lumber for ten (10) locks; P. Hein & Co. to deliver sufficient lumber for five (5) locks; and D. E. Offutt, sufficient to lengthen two (2) locks.
>
> The price paid for this lumber, delivered at [the] Canal at Cumberland, is twenty (20) dollars per M. payable in Repair Bonds of 1878, taken at their face value with coupon due January 1882 attached.
>
> For the lower end of the canal it was found impossible to purchase lumber for less than twenty two dollars and fifty cents ($22.50) per M. I therefore contracted E. E. Jackson & Co. for lumber sufficient for ten (10) locks at that price, to be paid for in canal Repair Bonds, it being understood and agreed with each of the firms and persons furnishing this lumber, that we receive for tolls ten (10) per cent of the Bonds held by them each year, beginning with the year 1882.
>
> The whole cost of the lumber contracted for, for twenty-seven (27) locks will be $74,870.41. It is possible we may be able to purchase a sufficient quantity for three (3) more locks at the same price.
>
> In addition to the lumber it will require 1,500 perch of stone, for filling, which will cost an average of one dollar per perch, which will be for twenty-seven locks 40,500 perches, equal to $40,500.
>
> Instructions have been given to the Superintendent to secure quarries conveniently located so that the stone can be quarried and delivered before the close of navigation. The quantity of spikes and bolts for each lock will be equal to 3,000 lbs. They have not yet been contracted for.
>
> The number of locks which, after inspection, I have determined to lengthen are, thirteen (13) on the first division, that is to say, thirteen (13) between the Great Falls and Dam No. 4 and from Dam No. 4 to Cumberland fourteen (14) selecting those locks which will give the greatest result in the number of miles to run; the remainder to be done during the coming year.
>
> Notwithstanding the immense labor of handling the material and building the locks during the winter, I believe, if the weather is at all favorable, the whole twenty-seven (27) can be completed by the opening of navigation on the 15th of April next.[130]

In January 1882 A. Leslie Duvall, a civil engineer, produced a set of drawings that were to be used in lengthening the locks. (See Drawings Nos. 8 through 15.) The drawings described the general plan and details for the extension of the locks, for the crib breast walls, and for the drop gates.[131]

Two months later (on March 21) President Gorman made a special report to a meeting of the stockholders concerning the progress made on lengthening the locks.

> After your action [the stockholder's approval of the May 20, 1881 recommendation] we purchased considerable material and made other arrangements for the lengthening of twenty Locks by the first of April. We found, however, that it was impossible to sell any considerable amount of the Bonds....We were therefore only able to lengthen fourteen of the Locks, which will be completed by the first of April and have on hand considerable material to be hereafter used.[132]

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130 Gorman to Board of Directors, July 19, 1881, in proceedings of the President and Board of Directors, N, pp. 146–147.

131 These drawings are on file in "Drawings and Other Records Concerning Construction" in the C & O Canal Company records at the National Archives, Washington, D.C.

132 Proceedings of the President and Board of Directors, N, pp. 174–175.

The stockholders were again informed in June 1882 that financial reverses resulting from a coal strike in western Maryland had halted repairs and improvements to the canal. Accordingly, only fourteen locks had been lengthened over the winter of 1881–1882 at a cost of $69,938.43.[133]

On June 4 of the following year President Lewis C. Smith informed the stockholders:

> Owing to the straightened [sic] financial condition of the Company, we were unable to prosecute with vigor the work of lengthening the Locks, and were obliged to content ourselves with an increase of two. . .
>
> Other extensive repairs have been made, the heaviest being the rebuilding of two of the Stone Locks, Nos. 40 and 49, which were in a very dilapidated condition, and the strengthening of the Basin Wharf at Cumberland.[134]

In June 1884 President Smith announced at the annual meeting that $28,362.84 had been spent for the extension of the locks. Only two locks had been lengthened during the preceding year because of the crippled finances of the canal company. As a total of only 16 locks had been lengthened, he feared that the railroad companies would drive the canal out of the business with their ruinous rates if sixteen more locks were not lengthened during the coming year.[135]

The financial plight of the canal company continued to worsen in 1884–85. In June of the latter year the stockholders were informed that $208.96 had been spent on lengthening the locks. While the locks generally were in fair condition, President L. Victor Baughman observed that the company's finances precluded the possibility of ever lengthening all the locks.[136]

Two major floods in late March and early April 1886 struck the canal, causing extensive damage to the canal prism and masonry structures. In June the stockholders were told that a number of locks had been heavily damaged by the freshets. Lock No. 21 had been undermined, endangering its walls, but it had been repaired with much labor. Repair required 125 barrels of cement. The slope walls of Locks Nos. 1–4 had been left in poor condition but also already had been repaired at considerable expense. In addition, masonry work was still needed on Lock Nos. 1–4, 6–7, and 24–25. Part of the chamber walls of Locks Nos. 56–57 had yielded and were cramping the boats. During the coming winter, these walls were to be rebuilt and set back. The lower towpath wing wall and hollow quoin of Lock No. 56, which had settled as a result of a heavy leak, would also have to be taken down and rebuilt.

Since the floods, considerable work had been done to the lock flumes and bottoms. Fourteen new lock gates had been made, ten had been repaired and twenty two had been installed in the locks. New gates had been put in Locks Nos. 42, 44, 49, 58, 60, 61, 66 and 75.[137]

President Baughman announced to the stockholders in June 1887 that the locks were in serviceable condition. However, many of the locks needed their joints of masonry pointed up with mortar where there were leaks. A number of locks also needed new floors.

During the previous winter many repairs had been made on the locks. The towpath side of Lock No. 2 had settled, thereby preventing boats from passing. The damaged side had been torn

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133 *Fifty-Fourth Annual Report* (1882), C & O Co., pp. 6, 9.

134 *Fifty-Fifth Annual Report* (1883), C & O Co., p. 8.

135 *Fifty-Sixth Annual Report* (1884), C & O Co., pp. 6, 13–14. More than $5,000 was spent during the year to build new lock gates. Canal company records do not indicate which locks were lengthened other than Locks Nos. 5–7. However, physical evidence indicates that locks lengthened were Nos. 25, 27, 29, 30, 31, 32, 33, 37, 38, 43 and 60. See USDI, NPS, "The Chesapeake and Ohio Canal: A Physical History," by Miele (1968), pp. 22–54.

136 *Fifty-Seventh Annual Report* (1885), C & O Co., pp. 10, 24.

137 *Fifty-Eighth Annual Report* (1886), C & O Co., pp. 15–17, 23–26.

down and rebuilt in the winter, and several lock flumes and bottoms had been reconstructed. In the coming winter, repairs were to be made on Locks Nos. 1–4 and the bottoms and drop gates of Locks Nos. 8–14.

[See drawings No. 8 thru No. 15, pages 141–145.]

Many repairs had also been made to the lock gates. Eighteen new gates had been made, twenty had been repaired and twenty-one had been installed. New lock gates were put on Locks No. 41, 53, 55, 61, 62, 64 2/3, 66 and 69, and Guard Lock No. 5, while new paddles and frames were placed in others.[138]

At the annual meeting of the stockholders on January 10, 1889, President Stephan Gambrill announced:

> We have maintained the canal in good condition throughout its entire length during the season, and will have only such repairs to make this winter as could not be made during navigation, the most of which is on Division No. 1 is rebuilding of wall and grouting of Lock No. 2, Georgetown; new machinery at Lock No. 6; renewing floor and part of wall at Lock No. 24; repair of culvert at White's Ferry; building of new trunk over creek below Edward's Ferry; building of two new flumes; stopping leaks and cleaning out. On Division No. 2, repair several bridges; building three new waste weirs; repair of several locks, and dredging basin at Cumberland.[139]

Between May 30 and June 1, 1889, a flood of titanic proportions left the canal a virtual wreck. The canal company was forced to go into a receivership, with the Baltimore and Ohio Railroad emerging as the majority owner of the company bonds.[140] Under the railroad's direction, trustees were appointed and the canal entered its last period of operation. In 1924, after the railroad had captured almost all of its carrying trade, the Chesapeake and Ohio Canal ceased to function. While documentary data in the canal company records for the period 1850–89 is sketchy, there is virtually no information dealing with these subjects for the years 1889–1924. However, secondary sources such as Sanderlin seem to indicate that the canal operated much as it had in pervious years, while under the railroad's guidance.

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138 *Fifty-Ninth Annual Report* (1887), C & O Co., pp. 15–19, 25–28.
139 *Sixty-First Annual Report* (1889), C & O Co., p. 8.
140 Proceedings of the President and Board of Directors, N, 329–331, 423.

CHAPTER IV
Rehabilitation of the Masonry Locks Between Georgetown and Seneca, 1938–1942

When the federal government acquired the Chesapeake and Ohio Canal in September 1938, the National Park Service promptly set about restoring the waterway as a scenic natural recreation area. As an experiment, it planned first to reconstruct the twenty-two miles between Georgetown and Dam No. 2 at Seneca. Several Civilian Conservation Corps camps were established on the canal to carry out this project.

Edmund B. Rogers, superintendent of Yellowstone National Park, was serving on a special assignment in Washington. Rogers reported in a memorandum to National Park Service Director Arno B. Cammerer that the major work of the CCC camps was:

> the rehabilitation of the canal which will involve the cleaning of the accumulated debris in the canal and along the towpath, the re-establishment of the grade of the floor of the canal, and reconstructing and re-enforcement of the canal dykes and towpath at some points and the reconstruction of the lock gates.[141]

One of the major CCC projects relative to the locks was the construction at Locks Nos. 15 and 16 of reinforced concrete spillways and wing walls faced with timber and rock cribbing. The contract for this work was let on September 8, 1939, to Corson and Gruman Co.[142]

In late 1939 and early 1940, this work on Locks Nos. 15 and 16 was completed. At Lock No. 15, the "large, stone-filled, wooden cribs on the berm side" were replaced by a thirty-foot concrete spillway, one foot below the top of the lock. The cribs were simulated on each side of the spillway to preserve the historic appearance. Much of the "upper extension wall, turns and wings" were replaced with concrete and partly "plastered over with a special mixture of sand and cement to simulate [the] red sandstone original atones."

At Lock No. 16, the lower berm wing wall, originally consisting of stone-filled wooden cribs, was replaced with a concrete wall to the height of the lock and a concrete spillway twenty-six feet wide and one foot below the top of the lock. The log cribs on each side of the spillway were simulated, as at Lock No. 15, to preserve their historic appearance.[143]

Aside from the restoration work done on Locks Nos. 15 and 16, CCC laborers also made repairs on a number of other locks. The general practice was followed of using concrete rather than replacing original stones in the upper parts of the locks, except for the upper two courses of

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[141] Rogers to Cammerer, December 10, 1938, National Park Service Central Classified Files, National Capital Parks, 1933–1949.

[142] The specification and drawings for this project are contained in Public Works Administration Federal Project No. 712, Contract No. I–28P–31, National Park Service Central Classified Files, National Capital Parks, 1933–1949.

[143] Thomas F. Hahn, *Towpath Guide to the Chesapeake and Ohio Canal* (Section one), Glen Echo, Maryland, 1974, pp. 38–39.

stone. Thus, the concrete substitution was below the waterline and did not show, so that the historical appearance of the watered locks was preserved at greatly reduced restoration prices.[144]

The dedication of the canal as a public park was celebrated on Washington's Birthday, 1939, with appropriate ceremonies featuring Mutt, a 38-year old canal mule. The canal was opened as far as Seneca in August 1940. When the restoration work was completed, Thomas C. Vint, Chief of Planning in the Branch of Plans and Design, issued a report on the architectural work that had been done.

> Naturally, the objective of recreational use has meant first restoration of the waterway itself. The masonry and gates of the locks were measured, repaired or replaced, all work being done in the character of the originals. The bed of the canal had to be cleared of accumulated silt, debris and vegetation. The feeders and dams and the towpath dyke itself had to be repaired and, in places where flood damage had been serious, rebuilt. Altogether, this work amounted to a substantial effort.
>
> The architectural work is concerned with restoring the structures necessary to the operation of the canal for use as a recreational waterway. As has been noted before, the guide in this work has been the determination to have nothing out of character with the originals, in so far as would be consistent with the new needs to be served.[145]

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[144] *Ibid*., p. 11. For a catalogue of the various CCC projects on the canal, see "Report of Civilian Conservation Corps Operations in the National Capital Parks, October 15, 1933–June 30, 1942," pp. 38–39. A copy of this report is on file at the C & O Canal NHP office at Great Falls.

[145] USDI, NPS, "Outline Report of Architectural Work on the Restoration of the Chesapeake and Ohio Canal for Recreational Use (Georgetown, D. C. to Seneca, MD.)," by Thomas C. Vint (ca. August 1940). This report is on file in National Park Service Central Classified Files, National Capital Parks, 1933–1949, RG 79, NA. It includes drawings of a typical lock, drop gates and swing gates.

APPENDIXES

APPENDIX A

Instructions for Constructing the Locks
Leckie to Purcell, July 3, 1829[146]

Your attention is particularly requested to the following details respecting the construction of the Locks—

Bottom Timbers and Puddling

The bottom timbers are to be laid solid and level and the spaces between them well filled with puddle that has been cut and treaded until it becomes a solid tenacious mass, that will adhere to the spade when stuck into it, so as to pull up several square feet several inches in endeavoring to extract the spade.

Sheet Pileing and Floors

The sheet pileing under the line of long gates to be let in, or driven at least three feet below the level of the floor; and to be cut off at the level of top of bottom timbers, so that the plank of the lower may be scribed down tight on it, and should be spiked to the side of the timbers, directly under the line of the gate; the plank for the sheet pileing should be 2½ inches thick; each plank being grooved on both edges; and having tongues made that will exactly fit the grooves, set in before driving home the sheet pileing at the upper and lower ends of the lock, to be let in to the same depth, and spiked to the timbers in the same manner, and to raise to the level of the surface of the first floor and to be carefully cut off, so that the plank of the second floor may be shut tight and close down on it, and in every case the sheet pileing should run several feet into the bank to prevent the water from working round the back of the walls; and from the sheet pileing at the head of the lock on the lower floor should extend across the whole line of the head of the lock, and be spiked to the timber that supports the floor in the forebay on the upper level, and continued across into the bank under the towing path and a puddle bed at least three feet thick should raise from the bottom of the first, or lower sheet pileing to the level of the forebay and continue for some distance into the bank on both sides, this precaution will afford additional security in preventing the water from working round, or, under the lock.

Floors of the Locks

The lower floor, on which the masonry is started should be laid closely and carefully so as to exclude the working of the water, and as the plank differs greatly in thickness they should be dubbed off on the under side where they rest on the bottom timbers, so that the upper surface will be a level uniform plane, and that the part under the cut stone faceing and culverts should be tongued and grooved to give additional security:

As the plank differ in thickness from ¼ to ¾ of an inch, it is very obvious, if they are laid down without being reduced to a thickness where they rest on the timber, so as to bring the upper surface level, that the upper floor, instead of resting on a smooth uniform surface; will rest on the

[146] Source: Ltrs. Recd., Letter Book of the Resident Engineer of the 1st Residency of the 1st Division.

thickest part of the planks of the lower floor, and there will be considerable longitudinal spaces running the whole length of the lock, where the water may work round between the floors.

Masonry of the Locks

All the cut stone faceing should be set with a hoisting machine, because the heavy stone will then be completely under control—the stone should have a lewis let in the upper bed, hoisted, and then let down dry on its bed, when an intelligent and experienced mason will directly see what sort of a bed is wanting to make the stone fir exactly; the stone should then be hoisted about 18 inches and the under bed as well as the place where it is to lay on made wet with a brush and water and the bed put on and the stone carefully laid down on it, and be settled down with a heavy wooden mallet, when, the mortar will come out all around, and the stone lay as solid as it did in the quarry.

When heavy stone are set without being hoisted, they are taken near the place with rollers (and pinch bars, generally used to the great injury of the stone). A bed is then put on at random and two pieces of plank put on, and the stone laid down on the plank, crowbars are then used, and the pieces of plank pulled out, and the stone let down on its bed in the mortar; from this statement it must be very obvious, that stone laid down on this manner must be very imperfectly laid indeed; as there is no previous trial to ascertain what sort of a bed will suit the stone, it is put on by chance, and pulling out the strips of plank would spoil it, even if it had been right at first, and the corners and face of the stone are generally much injured by the crowbars in let it down, and as the beds of the stone are generally cut slack to the square of the face stone “Batters” this is remedied by raising the back part with crowbars, and putting in some chips under the back part of the bed; and then when the stone set on the back part on these chips, and on the front part of the wall and the middle is all hollow, for it must be observed that lifting a heavy stone after being once laid as above described to remedy any defects in the bed is entirely out of the question, without the aid of a hoisting machine.

Filling in the middle of the lock wall with dry stone,
and trusting to grouting to make it solid.

This mode of masonry is in my opinion very objectionable indeed, and should never be trusted to for several reasons, among whom may be enumerated the necessity of having the grout very liquid that it may penetrate all the vacuities of the dry stone work; in this case it is very certain that when the aqueous or watery part of the grout evaporates, or settles away, that open spaces will be left in the masonry and that, where the surfaces of the stone touch each other, then no grout can get in, and that part of the wall is laid dry.

Grouting in my opinion ought to never to be trusted to, excepting to fill the vertical joints, and the small interstices caused by the irregularities of the materials; every stone should be laid in mortar and struck home to its bed until the mortar come out all around and the stone feels as solid as when it lay in its natural state in the quarry.

The first course of the cut stone in the lock should have the face cut fair and straight for at least six inches from the bottom to permit the upper flooring in the lock and culverts to fit up to it exactly and make it tight joint that will effectually exclude the water.

When the bottom is rock and no wooden floor put in, there are generally many irregularities in the surface, in this case the cut stone should be scribed down close in the irregular surface of

the rock in other words the under part of the cut stone should be cut away so as to fit down exactly on the irregularities of the rock, and the upper bed form a straight line, to receive the next course in a regular manner.

I am instructed by the president and Directors to say that they unanimously approve of the preceding modes of executing the masonry &c. of the locks, and to request that you will see them carried into effect by the lock contractors in your intendancy.

APPENDIX B

Regulations for Navigating The Chesapeake and Ohio Canal[147]

July 16, 1831

1st Every Boat or Float, navigating the Canal after the 15th day of August next, shall be propelled by a towing line drawn by men or horses, and shall be moreover furnished with strapping or snubbing lines for passing through the locks of the Canal without injury to the same.

2nd No Boat or Float shall, under any circumstances, use any iron shod or sharp pointed setting pole on the Canal.

3rd No Boat or Float shall forcibly strike, or violently rub against any other boat, or against the banks, locks, aqueducts, inside walls, or wastes, or bridges of the Canal.

4th No Boat or Float shall be permitted to pass along the Canal at night, unless with a conspicuous light on its bow; in case of rafts, gondolas, or scows, such light shall be at the forward end thereof.

5th No Boat or Float shall unnecessarily lie by, or be moored opposite to any waste, or within 150 yards of any Lock, or in any short basin or pool between two locks

6th When any owner, master, or other person having charge of any boat or float, designs to leave the same, for any time, in any other part of the Canal, he shall give notice of such intention to the Lock-keeper, in whose district the boat or float is to remain, and before he leaves his boat or float, he shall moor it along the berm, or side of the Canal opposite the towing path; and there, so secure it, as that it may, under no circumstances, lie across the Canal so as to obstruct, impede, or delay the passage of any other boat or float, along the same. And so, in like manner, when a boat or float, shall stop for the night, or lie by on account of high winds, or for any other transient or accidental cause, the owner, master, or other person having charge thereof, shall moor it securely against the berm of the Canal, or side opposite the towing path. Under no circumstances whatever, shall any boat or other floating thing, lie fastened to, or moored along the tow path of the Canal; nor shall the owner, master, or other person or persons, having charge thereof, encamp upon the towpath, or drive stakes into the top or slopes thereof, or place stones thereon, or kindle fires upon the same; or in any way or manner, obstruct or incommode the free and common use of the Canal by day or night.

7th Any boat or float left unmoored in the Canal, without any information thereof having been given by its owner or master, or other person having charge thereof, to the Lock-keeper of the District, in which such boat or float may be found, shall be considered as abandoned by the owner, master, or other person having had charge of the same; and if sunk in the Canal, or found floating loosely thereon, shall, by the Lock-keeper aforesaid, or some person duly authorized by him, be removed from the Canal as a nuisance, and the cost of removing the same, shall be chargeable to the owner of such boat or float; and in no case, shall the Lock-keeper be required to make sale thereof, or be held accountable for preserving the same, from farther injury by reason of the neglect of the owner.

8th No carcass, or dead animal, or putrid substance of any kind, be thrown into the Canal, or into any basin or feeder connected therewith.

9th Square headed or sharp covered boats, such as scows and gondolas, shall each have a semicircular platform, firmly fastened upon each end thereof, so as to save other boats or floats, and the banks and locks of the Canal, from injury by contact with either of the corners thereof; and no

[147] Source: Proceedings of the President and Board of Directors, B, pp. 410–419.

such boat, without such provision, shall, after the first day of October next, be allowed to enter the Canal, or to pass through any lock upon the same.

10th Every Boat or Float shall have its rudder so constructed, as not to catch, interfere with, or cut the tow-rope of a passing boat.

11th No raft or tow of timber passing on the Canal, shall consist of more than eight cribs, and when consisting of more than one, they shall be so united, as to conform readily to the curvatures of the Canal banks, and to glide by the same without rubbing against them.

12th All Boats or Floats descending the Canal, shall have a right to keep the towpath side thereof.

13th When any Boat or Float ascending the Canal, shall be about to meet another, it shall be the duty of the owner, master, or other person navigating or having charge thereof, to turn from the towing-path, so as to allow room for the descending boat to pass with ease; provided, however, that Packets or Boats, constructed exclusively for the conveyance of passengers, shall, until otherwise ordered, have the right to keep the towing-path side, both in ascending and descending the Canal. A boat authorized to carry the United States Mail, shall have preference of all others. All boats shall have preference to rafts.

14th When the owner, master, or other person having charge of any Boat or Float, shall perceive, or be told, or apprised by sounding a horn or by any other signal, that a packet boat, following him can, from its speed, pass him, and is desirous to do so, he shall turn his boat from the tow-path side of the Canal, and give way to the swifter moving boat to pass by, unless he be at such time within 150 yards of some Lock, in which case, if entitled to no preference, on any other score, the hinder shall wait, till the other shall pass the Lock: and all rafts shall, in like manner, give place to freight boats.

15th The passing of one boat by another, shall be effected by checking the boat bound by the preceding rules, to give way, as soon as she has opened a passage for the other, so as that the tow-line may sink to the bottom of the Canal, the boat entitled to pass shall float over the tow-line.

16th No Boat or Float, unless specially licensed to travel with greater speed, shall move on the Canal where its banks are not of rock on both sides, or not paved or walled on both sides, so as to guard them from abrasion, with a velocity exceeding four miles an hour.

17th In case of any breach or leak through the Canal banks, or of the apprehension of one, the several boats or floats, which may be near the place of danger, shall take such position in the Canal, as the Superintendent, or Officer, or Engineer, or Lock-keeper of the Company, or other person charged to repair or guard against such breach or leak may direct.

18th In all cases, boats engaged in repairing the Canal, shall have preference of all other boats, if their use at the time require it.

19th In approaching a Lock, the boat which first arrives within 150 yards thereof, not being in any lock shall have a preference, and if several boats arrive at or near the same time, within that distance of any lock, they shall have a right to pass in the order of their arrival within that distance; provided, that if two boats, at or very near the same moment, approach from above, and below, within such distance of any lock, the descending boat shall have the preference if the lock be at such time, full of water; if empty, the ascending boat; and one boat having passed from above through a lock, another boat from below shall have liberty to pass up, before another boat be admitted from above, and vice versa, except, that packet boats shall have preference of freight boats, and a boat carrying the United States Mail, of all others.

20th The preference granted to packet boats, by the preceding regulations, shall not extend to such as are less than 60 feet long.

21st All boats arriving within 150 yards of any lock, shall have preference of such parts of rafts as shall remain, after one or more cribs or parts of the same raft shall have already passed through any lock.

22nd Every owner, master, or other person having charge of any boat, in approaching a lock, by night, shall, for ten minutes, if necessary, give signal of his approach, by blowing a horn or knocking at the Lock-keeper's door, and if in that time, or after such knocking, the Lock-keeper shall not ap-

pear or answer, such owner, master, or other person, may proceed to let himself through the Lock, taking care to close the head-gates of the lock after passing, and to leave the paddle gates of the culverts as he found them: and no person, other than the Lock-keeper, or one acting under his authority, or with his consent shall open or shut any guard or lock gate, or handle or turn any paddle gate, but under the circumstances above stated; and at all times, for any damage to the Canal or its works, resulting from the violation of this rule, the offender shall be held personally responsible.

23rd Every Boat or Float which shall not avail itself of the first title it acquires to pass through any lock, shall lose its preference, thereat, till all the boats awaiting a passage through the same, in the same direction, shall have passed.

24th In approaching a Lock, the owner, master, or other person having charge of any boat or float, shall slacken his speed, at such distance therefrom as the Lock-tender or any person, acting by his authority, shall direct; and take care to enter the Lock without injury thereto.

25th In passing the Lock he shall fasten the bow and stern snubbing lines of his boat, to the strapping posts, on the proper side of the lock, until the lock is filled or emptied as the case may be, and in all other respects, he shall use his strapping ropes according to the instructions of the Lock-keeper, and tow his boat into or out of the lock, at such time, and in such manner as the Lock-keeper may direct. He shall especially make use of all possible diligence to go out of the lock, when the gates shall have been opened for his departure, so as to occasion no unnecessary delay to other boats, waiting to pass the same lock, or any other lock in charge of the same Lock-keeper.

26th Every breach or violation of any of the preceding regulations, by the owner, master, or other person having charge of any Boat or Float, shall be reported by the Lock-keeper, or any other person having cognizance thereof, to the Register at Rushville, or to the Collector at or near Georgetown, or to the Superintendent of the Canal, or to some other Officer of the Company, together with the number of the Boat, and the name of the owner, master, or person having charge of the same for the time being; and from the occurrence of such breach or violation of any of the said Rules, such boat shall be excluded from the navigation of the Canal, until it otherwise be adjudged and ordered by the President and Directors of the Chesapeake and Ohio Canal Company.

27th No Boat shall be used as a Packet Boat on said Canal, unless specially licensed therefore, which license shall give to the said Boat the privilege of carrying passengers to and from any point on said Canal, between the Basin at Georgetown and Rushville: and the owner or master of said Packet Boat shall pay for every trip up or down between said Basin and Rushville: or any intermediate points, the sum of one dollar and fifty cents, which sum shall be paid weekly to such Collector as may be authorized to receive the same, and on any failure to pay the said sum, or fraudulent return by the owner, master, or other person having charge of the said Boat, of the number of voyages made in the week by said Boat, its license shall be forfeited.

28th The tolls upon laden boats shall remain as heretofore, until otherwise ordered.

29th After the lst day of August next, there shall be charged, for every empty freight boat, passing the Guard lock at Rushville, with a view of descending the Canal, the sum of one dollar, and, the same for every empty boat entering the Canal at the old locks below the Little Falls, or passing by the same up the new Canal. The same sum shall be paid for every boat having cargo, the toll upon which shall not amount to one dollar.

30th There shall be a book kept by the Register at Rushville, in which shall be entered the number, owner's name, and place of abode, length, breadth, and draft of water, of every Boat or Float navigating the Canal, except such Boat or Float as shall enter the Canal from above Seneca, without designing to return.

31st Preparatory to numbering the boats, a classification of them shall be made under the following denominations: Packet Boats, or Boats designed for passengers exclusively, Freight boats, Boats for passage and freight, Scows and Gondolas. The boats of each class or denomination, shall be numbered as they arrive at the Guard Lock, from 1 upwards.

32nd The number of each boat shall correspond with the number by which it is entered in the Register, and be inscribed on both sides of the boat, in figures not less than three inches long, near the stern thereof, so high above water that, as the boat navigates the Canal, the number may at all times be plainly discerned from either bank.

33rd On numbering and entering each boat, the Register shall issue, according to such printed form as may be prescribed, to the owner, master, or other person having charge thereof, a certificate, to be called the Boat's Register, which shall contain the number and description of the boat, and shall correspond with the entry thereof.

34th After the 15th day of August next, no Boat required to be numbered by the preceding regulations, shall be permitted to enter the Canal, or to pass through any Lock thereof, which has not been duly numbered and registered, or of which the owner, master, or other person having charge thereof, shall refuse to show the Boat's Register to any District Lock-keeper who may demand sight thereof: Provided, That any boat ascending the Canal for the first time, need not be so numbered until it shall have reached Rushville; but in lieu of a register, such boat shall be provided with a certificate from the Collector at or near Georgetown, or from the first District Lock-keeper, by whose lock it may pass, that it is on its first voyage up or down the Canal.

35th No owner, master, or other person shall alter the number of any boat, without the express permission in writing of the Register; and, on the sale or transfer of any boat from one owner to another, notice thereof shall be given when the boat next enters the Guard Lock at Rushville, to the Register, by whom a Record of such sale or transfer shall be made in the Register opposite to the number and description of the boat.

36th On the destruction or accidental loss of any Boat which has been numbered and registered, the number of such boat may be given to any boat not hitherto numbered and registered, and a new certificate issued to the owner thereof, if requested.

37th On satisfactory proof to the Register, that the certificate of any boat's register has been unintentionally destroyed, or accidentally lost, he shall renew the name, on application of the owner, master, or other person having charge of such boat.

38th Every Boat or Float duly registered, which, in descending the Potomac to Rushville, is not provided with wooden pointed setting poles, shall be entitled to receive of the Register, in exchange for its iron shod poles, an equal number of wooden pointed setting poles, for its voyage down and up the Canal, and shall have its iron shod poles returned, on delivering up those which it had received in exchange therefore; and for any poles so supplied, and which may have been lost, the Register shall demand and receive the cost thereof. No Boat or Float shall be permitted to enter the Canal, until she shall have delivered up all iron shod poles which she may have on board.

APPENDIX C

By-Laws, Rules, and Regulations For Navigating the Chesapeake and Ohio Canal

February 18, 1835

1st Every boat or float navigating the Canal, and not specially licensed to move by paddle wheels, shall be propelled by a towing line, drawn by men or horses, and all boats and floats shall be moreover, furnished with strapping or snubbing lines for passing through the locks of the Canal, without injury to the same.

2nd No boat or float shall, under any circumstance, use any iron-shod or sharp pointed settling pole on the Canal; nor shall they be allowed to pass any lock till all such have been deposited with the lock keeper, whose duty it shall be safely to keep the same, and return them to the master of such boat upon her return.

3rd Square headed or sharp cornered boats, such as scows and gondolas, shall each have a semicircular platform, firmly fastened upon each end thereof, so as to save other boats or floats, and the banks and locks of the Canal, from injury by contact with either of the corners thereof; and every boat or float shall have its rudder so constructed as not to catch, interfere with, or cut the tow-rope of a passing boat.

All boats or floats not conforming to these three rules, shall be proceeded against as provided for by the act of Maryland, hereto annexed. (Appended act–Extract from an act of the General Assembly of Maryland, entitled "An act further to amend the act incorporating the Chesapeake and Ohio Canal Company," passed at the December session, 1831.)

4th Every boat, gondola, and scow, navigating the Canal, must be named or numbered, and such name or number must be inscribed, by the direction and at the expense of those who are interested in her, with oil paint, in letters or figures, not less than three inches long, on both sides of such boat, gondola, or scow, and on some permanent part thereof, so high above water that it may be plainly seen from either bank of the Canal; and such name, together with the description of boat, (i.e. whether packet boat, freight boat, gondola, or scow,) must be inserted in her register, or license, and way-bills, or permit, and be entered in the records and returns of the collectors: provided, however that, in the first voyage down, if the owners or master shall have found it inconvenient to have had such name inscribed, the boat may be permitted to pass, designating her in her way-bill, &c. as a new boat; but after arriving at her destination, she shall not be permitted to return until her name has been inscribed as above directed; and provided, also, that, where the same name or number shall have been given to two or more boats of the same description, the one which has been most recently so named or brought on to the Canal shall be required to have the name so altered, or a number added thereto, as to easily distinguish it from the previous one.

5th No raft or tow of timber passing on the Canal shall consist of more than eight cribs, and when consisting of more than one, they shall be so united as to conform readily to the curvatures of the Canal banks, and to glide by the same without rubbing against them.

6th No boat or float shall forcibly strike or violently rub against any other boat, or against the banks, locks, aqueducts, inside walls, or wastes, or bridges of the Canal.

7th No boat or float shall be permitted to pass along the Canal at night, unless with a conspicuous light on its bow; in case of rafts, gondolas, or scows, such lights shall be at the forward end thereof.

8th No boat or float shall unnecessarily lie by or be moored opposite to any waste, or within one hundred and fifty yards of any lock, or in any short basin or pool between two locks.

9th When any owner, master, or other person having charge of any boat or float, designs to leave the same for any time in any other part of the Canal, he shall give notice of such intention to the

nearest lock-keeper; and, before he leaves his boat or float, he shall moor it along the berm or side of the Canal opposite the towing-path, and there so secure it that no part of it shall be more than one-third of the width of the Canal from the berm-bank; and, in like manner, when a boat or float shall stop for the night, or lie by on account of high winds, or for any other transient or accidental cause, the owner, master, or other person having charge thereof, shall moor it securely along the berm side of the Canal.

10th Under no circumstances whatever shall any boat, or other floating thing, lie fastened to or moored along the tow-path of the Canal; nor shall the owner, master, or other person or persons having charge thereof, encamp upon the tow-path, or drive stakes into the top or slopes thereof, or place stones thereon, or kindle fires upon the same, or in any way or manner obstruct or incommode the free and common use of the Canal by day or night

11th No carcass, or dead animal, or putrid substance of any kind, shall be thrown into the Canal, or into any basin or feeder connected therewith, or be put upon or left on either bank of the Canal, or upon any part of the Canal property, so as to be offensive to travelers or others; and in the event of such being left, it shall be the duty of the lock-keeper nearest thereto to have it forthwith removed, and to endeavor to obtain such evidence as may lead to the conviction of the offender.

12th Whenever any superintendent or lock-keeper shall find any boat or float moored or fastened in any manner to the tow-path side of the Canal, or so moored or fastened in the Canal, or to the berm side thereof, that any part of such boat or float shall be more than one-third of the width of the then water surface of the Canal from the berm-bank, he shall forthwith direct the person or persons in charge of it to prevent its continuing so to lie. And if the person or persons in charge of such boat or float shall refuse or neglect to remove the same, he or they shall be proceeded against according to law; but if no person be found on board, or near at hand, in charge of such boat or float, the superintendent or lock-keeper shall cause it to be removed, and secured as near to the nearest lock-house as conveniently may be; and when the person claiming to be the master or owner thereof, or to be acting in behalf of the master or owner, shall apply for the repossession of it, it shall be delivered to him; but if he do not at the same time pay the expense of so removing and securing it, a prosecution shall ensue for the violation of these by-laws.

13th Whenever a superintendent or lock-keeper shall find any boat, float, or other substance, floating loose upon, or sunk in the Canal, or any of its basins, ponds, or feeders, the owner of which is unknown, or, if known, neglects or refuses, after reasonable notice, to remove the same, such superintendent or lock-keeper shall cause it to be broken up and removed from the Canal.

14th All boats and floats descending the Canal shall have the right to keep the tow-path side thereof; and when any ascending boat or float is about to meet a descending one, it shall be the duty of the owner, master, or other person navigating or having charge thereof, to turn from the towing-path, so as to allow room for the descending boat to pass with ease; provided, however, that licensed packet boats shall, until otherwise ordered, have the right to keep the towing-path side, both in ascending and descending the Canal, with this exception: that when two such licensed packet boats meet, the ascending one shall lose its right to the towing-path side for the time occupied in passing such other packet boat.

15th Rafts shall, in all cases, give place for boats of all descriptions to pass between them and the towing-path; and in like manner all boats moved by steam power, or any other means than by a towing line, whether they be packet boats or not, shall in all cases give place for boats or floats moved by a towing line to pass between them and the tow-path

16th When the owner, master, or other person having charge of any boat or float, shall perceive, or be told, or apprized by sounding a horn, or by any other signal, that a packet or other boat following him can, from its speed, pass him, and is desirous to do so, he shall turn his boat from the tow-path side of the Canal, and give way to the swifter moving boat to pass by, unless at the time of such signal he be within three hundred yards of the next lock ahead of him.

17th The passing of one boat by another shall be effected by checking the boat bound by the preceding rules to give way, as soon as she has opened a passage for the other, so as that the tow-line may sink to the bottom of the Canal, and boat entitled to pass may float over it.

18th In case of any breach or leak through the Canal banks, or of the apprehension of one, the several boats or floats, which may be near the place of danger, shall take such position in the Canal, as the superintendent, or officer, or engineer, or lock-keeper of the company, or other person charged to repair or guard against such breach or leak, may direct.

19th In all cases, boats engaged in repairing the Canal shall have preference of all other boats, if their use at the time require it.

20th If several boats are approaching a lock at the same time, from the same direction, the one which first arrives within one hundred and fifty yards thereof shall be entitled to pass through it first, and the others in the order of their arrival, within said distance of one hundred and fifty yards; provided, however, that if there be one or more packet boats among them, such packet boars shall be passed in preference to all others, except the one that may be in the lock at the time when such packet or packets arrive within the one hundred and fifty yards; and after such packet or packets shall have passed, the others will resume the order of their passing as before. In like manner, freight boats, gondolas, and scows, shall have a preference over rafts, and such parts of rafts, as remain after one or more cribs of the same raft shall have passed.

21st In all the short levels, to wit, between locks 1 and 4, between locks 9 and 14, between locks 15 and 20, between locks 35 and 36, and between locks 41 and 43, all freight boats, gondolas, scows, or rafts, passing in the same direction with a packet boat or boats, shall give way for such packet or packets to enter the lock at the end of such level, except the freight boat or other craft that may be in such lock at the time when the gates of the lock at the other end of the level are opening to pass such packet out; in which case such freight boat or other craft shall be passed through the lock it may have so entered, and wait in the next level (if it be one of the short ones above referred to) till such packet or packets shall have passed her.

22nd The preference granted to packet boats by any of the preceding rules shall not extend to such as are less than sixty feet long; and no boat shall be deemed to be a packet, within the meaning of these rules, until she shall have obtained a license as such, signed by the President and Clerk of the Company, nor after such license shall have been annulled by a vote of the President and Directors, at some legal meeting of the Board.

23rd If two or more licensed packets approach a lock at the same time, from the same direction, the one which first arrives within one hundred and fifty yards of the same shall pass first, and the other or others in the order of their arrival within that distance. And in this and the three preceding rules, no distinction shall be made whether the boats be moved by a towing line, steam power, or other means.

24th If boats or other craft are approaching a lock from above and below at the same time, the descending one, which, by the foregoing rules, would have the right to pass, were they all bound in the same direction, shall be passed first, whatever may be the distance at which she is first discovered, if the lock be full of water, and it is the opinion of the lock-keeper, judging from her speed, that the water cannot be drawn off before she will have reached the lock, and, in like manner, the ascending one shall be passed first, if the lock be empty, and it is the opinion of the lock-keeper that it cannot be filled before such ascending one will have reached it.

25th No boat or float shall pass in any degree the walls of a lock, above or below its gates, until directed by the lock-keeper so to do; nor shall it take or keep a position, contrary to the orders of the lock-keeper, so as to prevent another from freely passing out or in. The Seneca aqueduct must be considered as forming part of the walls of the lock with which its connected, so far as relates to this rule.

26th In all questions as to a boat or float being in a lock, it shall be held that if any part of it shall have passed the extreme end of the walls of such lock, in its regular turn, and with the consent of the lock-keeper, then it is in the lock, within the meaning of the foregoing rules, but not otherwise. In

like manner, a boat or float shall be considered as within one hundred and fifty yards of a lock, if the bow of it shall have passed the mark indicating that distance, but not otherwise.

27th In all cases when there are several boats, or other craft, waiting near a lock to pass in both directions, so soon as one of them shall have been passed down, agreeable to the foregoing rules, the ascending one, entitled to enter, shall be passed up, if ready, and if not, then the next in order that is ready, before another from above shall be passed down; and in like manner, if an ascending boat, or other craft, shall have passed first, a descending one, if ready, shall be passed down before another shall pass up.

28th Every boat or float which shall not avail itself of the first title it acquires to pass through any lock, shall lose its preference thereat, till all those have passed which were, at the time of such neglect, awaiting a passage through the same, in the same direction.

29th It is made the duty of every lock-keeper to remove into his lock-house before going to bed, the cranks, or handles, by which the paddle gates of every lock in his charge are turned, so that no person but himself, or one acting under his authority, can turn any such gates. And it is further hereby made the duty of every lock-keeper, at any hour of the night, upon being apprized of the wish of any boat or boats to pass, either by the blowing of a horn, knocking at his door, or other signal, to rise and pass such boat or boats, or have it done by some one acting under his authority.

30th Every owner, master, or other person having charge of any boat or float which may offer to pass any lock, by night or by day, may be required by the lock-keeper or his assistant to produce the boat's register and way-bill or permit; and if such owner, master, or other person having charge, shall refuse either to show to the lock-keeper demanding sight thereof his register, bill of lading, or permit, or, being without either, to state from whence he began his voyage, or took in or increased his cargo, he shall be refused a passage through the lock at which such demand is made.

31st In approaching a lock, the owner, master, or other person having charge of any boat or float, shall slacken his speed, at such distance therefrom as the lock-keeper, or any person acting by his authority, shall direct; and take care to enter the lock without injury thereto.

32nd In passing the lock he shall fasten the bow and stern snubbing lines of his boat, to the strapping posts, on the proper side of the lock, until the lock is filled or emptied, as the case may be; and in all other respects he shall use his strapping ropes according to the instructions of the lock-keeper, and tow his boat into or out of the lock, at such time, and in such manner, as the lock-keeper may direct. He shall especially make use of all possible diligence to go out of the lock, when the gates shall have been opened for his departure, so as to occasion no unnecessary delay to other boats waiting to pass the same lock, or any other lock in charge of the same lock-keeper.

33rd No cart, wagon, or wheel carriage of any description, shall travel upon, or be permitted to use, the towpath bank, or berm-bank of the Canal, except in crossing them, in the shortest convenient direction, at some authorized ferry.

34th It is hereby made the duty of every lock-keeper to note, or bear in mind, every breach or violation of any of the preceding rules, so as to be able to give testimony in the case, whenever legally required to do so; and also to report all such breaches and violations to the superintendent.

35th All rules and regulations heretofore made, so far as they conflict with the foregoing rules, regulations, or by-laws, are hereby repealed.

Enacted by the President and Directors of the Chesapeake and Ohio Canal Company, at a meeting of the Board, this 18th day of February 1835.

John P. Ingle
Clerk Ches. And Ohio Canal Company.

APPENDIX D

Description of Masonry Work And Sources of Stone for Locks Nos. 1–45.[148]

Tide lock at the mouth of Rock Creek, Lift Lock No.	Location.				Lift in feet	Total lockage	Description of work	Stone used for the face work, where obtained, &c.
	Distance from lock to lock		Distance from tide lock at the mouth of Rock Creek					
	Miles	Yds.	Miles	Yds.				
							Cut work	Aquia creek free stone
1		661		661	8	8	ditto	
2		81.5		742.5	8	16	ditto	
3		100.5		843	8	24	ditto	
4		98		941	8	32	ditto	
5	4	909	5	90	8	40	The lower six feet of these two locks are of stone, hammer-dressed, the remainder cut work	The *hammer dressed stone* is from a quarry less than a mile distant. The *cut stone* is from Aquia creek.
6		637	5	727	8	48		
7	1	1075	7	42	8	56	Cut work	Granite, except the coping, which is of Aquia creek free stone. The granite is obtained from a quarry within an eighth of a mile.
8	1	594	8	636	8	64	Ditto	Red sand stone, boated down from the quarries at Seneca, 14½ miles.

[148] Source: *House Report 414*, pp. 158-161.

Lift Lock No.	Location.				Lift in feet	Total lockage	Description of work	Stone used for the face work, where obtained, &c.
	Distance from lock to lock		Distance from tide lock at the mouth of Rock Creek					
	Miles	Yds.	Miles	Yds.				
9		604	3	1240	8	72	Cut work	Built of granite, except the coping, which is of Aquia creek free stone, and a few feet of ashlar, which are of red sand stone, from Seneca. The granite is from the quarry near Lock No. 7; distance of transportation 1.75 miles by land.
10		153	8	1393	8	80	Ditto	Entirely granite. One-half from the quarry near Lock No. 7, the other half from a quarry four miles in the country. The transportation comes by land.
11		319	8	1712	8	88	Ditto	Red sand stone, boated down from Seneca, 14 miles.
12		545	9	497	8	96	Ditto	Granite, from the quarry near Lock No. 7; transported by land 2½ miles.
13		148	9	645	8	104	Ditto	Granite, from the quarry in the country, mentioned at Lock No. 10; transportation by land 4 1/3 miles with the exception of the coping and the hollow quoins, which are from Seneca.
14		148	9	793	8	112	Ditto	Granite, one-half from the quarry in the country referred to at Lock No. 10, the other half was boated down from a quarry 5 miles distant.

Lift Lock No.	Location.				Lift in feet	Total lockage	Descrip-tion of work	Stone used for the face work, where obtained, &c.
	Distance from lock to lock		Distance from tide lock at the mouth of Rock Creek					
	Miles	Yds.	Mi.	Yds.				
15	3	1740	13	773	8	120	Cut work	Red sand stone, boated down from Seneca, 9 miles.
16		311	13	1084	8	128	Ditto	
17		618	13	1702	8	136	Ditto	
18		178	14	120	8	144	Ditto	
19		134	14	254	9	153	Ditto	
20		198	14	452	8	161	Ditto	
21	2	623	16	1075	8	169	Ditto	Red sand stone, boated down from Seneca, 6½ miles.
22	2	1544	19	859	7	176	Ditto	Red sand stone, from Seneca, in part boated 3¼ miles.
23	2	856	21	1715	8½	184½	Ditto	Red sand stone, from Seneca, one mile.
24		1174	22	1129	8½	193	Ditto	Red sand stone, from Seneca, less than 1/2 mile. The masonry of the upper end of this lock is connected to the masonry of the lower abutment of Seneca Aqueduct.
25	8	23	30	1152	8	201	Ditto	Red sand stone, from Seneca, boated 8½ miles
26	8	1137	39	529	8	209	Ditto	Red sand stone, from Seneca, 17 miles, boated 16 2/3 miles; land transportation 1/3 mile.
27	2	20	41	549	8	217	Ditto	Red sand stone, boated down 5 mi. from quarry near the river, 2 ½ miles below Pt of Rocks, with the exception of the coping, which is from Lee's quarry near Seneca, &c., a few feet of ashlar, obtained by land, 2 ½ miles from the same quarry, whence stone were obtained for the Monocacy Aqueduct.
	Location.				Lift	Total	Descrip-	Stone used for the face work,

Lift Lock No.	Distance from lock to lock		Distance from tide lock at the mouth of Rock Creek		in feet	lockage	tion of work	where obtained, &c.
	Miles	Yds.	Mil es	Yds.				
28[149]	7	906	48	1415	6	223	Cut work	One-seventh of the stone was brought 46 miles on the B&O RR (at 6 cents per ton per mile) from the granite quarries of the Patapsco, to the Point of Rocks, and was thence wagoned nearly one mile to the lock. The other six-seventh of the stone was transported in wagons from a quarry of hard white flint stone in Virginia, 4 miles.
29	1	1597	50	1292	7	230	Ditto	*Two-thirds* of the stone were obtained from the granite quarries of the Patapsco, in the same manner as for the last lock. The distance of land transportation from the Point of Rocks to the lock was 2 2/3 miles; the other third of the face stone was obtained from the quarry in Virginia, referred to at the last lock.
30	4	143	54	1435	8	238	Ditto	*One-seventh* of the stone of the Patapsco granite, *one-seventh* of stone found scattered through the neighborhood; *five-seventh* of red sand stone boated 32 ½ miles from Seneca.

[149] To Monocacy Aqueduct 1156 yards, length of Monocacy Aqueduct 172 yards. From Aqueduct to pivot bridge at Point of Rocks, 6 miles, 1 yard. Thence to Lock No. 28, 1337 yards.

Lift Lock No.	Location.				Lift in feet	Total lockage	Descrip-tion of work	Stone used for the face work, where obtained, &c.
	Distance from lock to lock		Distance from tide lock at the mouth of Rock Creek					
	Mi.	Yds.	Mi.	Yds.				
31	3	121	57	1556	8	246	Cut work	Built of stone from different quarries; a part from the hard white flint stone quarry in Virginia, mentioned at Locks Nos. 28 and 29; a part was obtained within ½ mile, and a part from a granite quarry in Virginia; the land transportation was 1 mi., and water transportation 1½ mi.
32	2	332	60	128	8	254	Ditto	*One-fifth* of the stone from the granite quarry referred to at the last lock; the transportation from which was in wagons, distance 2 mi., crossing two rivers: Shenandoah and Potomac. *Four-fifths* of the stone were from different lime stone quarries up the Potomac, varying in distance from 2–12 miles, the last mile of which was land transportation, the rest water transportation.
33[150]		760	60	888	8	262	Ditto	Built mostly of stone from the granite quarry in Virginia, last referred to; transportation in wagons 1½ mile, crossing the Shenandoah and Potomac; a small portion of the stone is from Maryland, 1 mile distant.
34		1556	61	684	8	270	Ditto	Built of limestone from a quarry in Virginia, on Potomac shore; water transportation 5 miles, land transportation ¾ mi.

[150] The foot of this lock is connected with the abutment of the bridge over the Potomac at Harpers Ferry.

Lift Lock No.	Location. Distance from lock to lock		Distance from tide lock at the mouth of Rock Creek		Lift in feet	Total lockage	Description of work	Stone used for the face work, where obtained, &c.
	Miles	Yds.	Miles	Yds.				
35		1267	62	191	8	278	Cut work	Lime stone from quarry last referred to; transportation 5 miles by water.
36		173	62	364	8	286	Ditto	Lime stone from quarry last referred to; nearly 5 miles by water.
37	4	909	66	1273	9	295	Ditto	Lime stone from a quarry in Maryland distance ½ a mile.
38	5	1426	72	939	5	300	Ditto	Lime stone from quarry directly opposite on Va shore of the Potomac.
39	1	287	73	1226	6	306	Ditto	Lime stone from quarry in Va. 1 mile distant.
40	5	1027	79	493	9	315	Ditto	Lime stone from quarry ½ mile distant

	Location. Distance from lock to lock		Distance from tide lock at the mouth of Rock Creek		Lift in feet	Total lockage	Description of work	Stone used for the face work, where obtained, &c.
	Mi.	Yds.	Mi.	Yds.				
To Guard Lock No.3	6	447	85	940			Rubble masonry	Lime stone from a quarry 3 miles distant; land transportation
Slack-water & towpath to Lock No. 41	6	1710	92	920	10	325	Hammered stone Cut work	
42		2000	92	1120	9	334		
43		2000	92	1320	9	343		
44	6	1020	99	580	10	353	Cut work	Lime stone from quarry 3 mi. distant; land transportation.
To Guard	7	1420	107	240			Rubble	

Lock No. 4							Masonry	
Thence to the entrance of the canal into the Potomac[151]		320	107	560				

[151] Dam No. 5 backs up the Potomac about ten miles. The length of slack water navigation, above Dam No. 4, is given as it was previous to the change. The length of the level between Locks Nos. 42 and 43 is now nearly four miles greater than that given above, and, of course, the slack water is much less.

APPENDIX E

SOURCES OF STONE FOR LOCKS NOS. 46–75[152]

LOCKS NOS. 46–50 — These five locks were built of Conococheague limestone from a quarry within 200 feet of the pool behind Dam No. 5. It was known as Prathers Neck Quarry. The stone was taken by wagon to the individual construction sites, all of which were within a distance of two miles from the quarry.

LOCKS NOS. 51–52 — The two locks were built of limestone obtained from Hart's Quarry on the Little Tonoloway "in the rear of Hancock," about two miles from Aqueduct No. 7. The stone was transported most of the distance over the Cumberland Road (National Road).

LOCK NO. 53 — The lock was built of sandstone taken from quarries about three miles distant and transported overland by wagon.

LOCKS NOS. 54–57 — The four locks were constructed of limestone, some of which was probably obtained from a Virginia quarry within one mile of Dam No. 6, and some from Hart's Quarry on the Little Tonoloway near Hancock.

LOCKS NOS. 58–66 — Stone for these composite locks was quarried in at least four different locations. The cut stone was quarried at Hart's Quarry on the Little Tonoloway near Hancock and boated up the Potomac over distances ranging between 19½ and 30½ miles. The remainder of the stone for the locks was quarried at (1) Twigg Hollow just above Lock No. 61; (2) Purslane Mountain about three miles from a point on the Virginia shore opposite Tunnel Hollow; and (3) Sideling Hill, some four miles from the mouth of Tunnel Hollow.

LOCKS NOS. 67–68 — The two locks were built principally of limestone from quarries on Town Hill on the Virginia side of the Potomac opposite Aqueduct No. 10 and from Hatch's Quarry at the mouth of South Branch.

LOCKS NOS. 69–71 — The three composite locks were built of limestone from the quarries on Warrior Mountain near the banks of the Potomac on the Virginia side of the river. Located just below and opposite to Oldtown, the quarries were about 1½ miles distant from Alum Hill.

LOCKS NOS. 72–75 — The four locks were built of limestone obtained principally from a quarry located some 1½ miles up Evitts Creek from Aqueduct No. 11. The stone was brought from the quarry to the aqueduct by a temporary railroad and was taken by wagon from the aqueduct to the four locks below, all of which were between five and six miles distant.

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[152] Source: Fisk to Board of Directors, June 16, 1835 and September 25, 1839, and Purcell to Ingle, May 26, 1835; Ltrs. Recd., C & O Co.; Lambie to Fisk, February 28, 1839, Ltrs. Recd., Prin. Asst. Eng.; Fisk to President and Directors, May 27, 1839, Ltrs. Sent, Chief Engineer; McFarland to Fisk, September 112, 21, 1839, Ltrs. Recd., Chief Engineer; and *Report of the General Committee of the Stockholders of the Chesapeake and Ohio Canal Company* (Washington, 1839), pp. 9–13, 19–20.

APPENDIX F

Construction Costs of Lift Locks, So Far as They Were Paid or Estimated as of March 31, 1834.

SECTION	LOCK	COST
A	1,2,3,4	$34,052.08
1	5,6	18,985.67
4	7	9,493.43
7	8	9,043.14
8	9, 10, 11	32,575.35
9	12, 13, 14	29,905.10
17	15, 16	20,932.47
18	17, 18, 19, 20	42,618.70
23	21	8,327.76
29	22	7,969.28
34	23	8,912.80
35	24	8,886.88
51	25	11,191.64
68	26	10,376.30
72	27	11,323.75
87	28	9,734.55
90	29	9,457.05
98	30	11,694.51
	(Flume)	1,134.10
104	31	16,085.49
108	32	11,298.85
	(Flume)	
109	33	20,728.05
111	34	10,282.66
	(Flume)	1,132.00
111	35	9,448.00
112	36	7,944.70
122	37	11,453.13
133	38	7,725.85
135	39	8,332.40
146	40	8,920.00
166	41	7,531.35
167	42	5,973.17
173	43	8,895.60
187	44	10,738.62
202	45	5,659.55

SUMMARY

Section Nos.	1–35	$270,319.66
Section Nos.	36–84	32,891.69
Section Nos.	85–112	129,774.91
Section Nos.	113–156	53,371.13
Section Nos.	157–202	48,024.79
		$534,382.18

APPENDIX G

General Summary of Alfred A. Cruger's Estimates of the Cost Of Constructing the Canal between Dams Nos. 5 and 6, March 20, 1834[153]

SECTION	LOCK	LIFT	PRICE	COST	FLUMES AND WALLING
203	45	8	To Complete	$5,000	$1,000
205	46	8	$1,185	9,480	$1,000
207	47	8	$1,185	9,480	$1,000
207	48	8	$1,185	9,480	$1,000
207	49	8	$1,185	9,480	$1,000
221	50	8	$1,185	9,480	$1,000
234	51	8	$1,185	9,480	$1,000
241	52	8	$1,185	9,480	$1,000
248	53	8	$1,185	9,480	$1,000
				$80,840	$9,000

[153] Source: *House Report 414*, pp. 216–217.

APPENDIX H

Specifications for the Gates of a Lock of 8 Feet Lift, Ca. 1836.[154]

All of the timber and planking shall be of heart white oak, except only the planking on the upper side of the gate which shall be of heart yellow pine.

The rectangle out of which the keel post is formed shall be 12 by 14 inches, and in like manner for the toe post; 11 by 11 inches shall be the square. There shall be 7 arms in each leaf, the upper one measuring vertically 6 inches—the 2nd, 4 inches—the 3rd, 4 inches—the 4th, 5 inches—the 5th, 6 inches—the 6th, 8 inches—the 7th, and lower arm 8 inches.

Two vertical pieces between the two lower arms, rendered necessary by the two valves, will be 6 inches each, measured in the direction of the balance beam.

The balance beam will be 24 feet long, 18 inches square at the larger end and 10 inches vertically by 11 inches at the smaller end.

The spaces between the arms will be between the two upper ones 17 inches—the two next 20 inches—the 3rd space 21 inches—the 4th [space] 22 inches—the 5th [space] 18 inches and the 6th [space] 28 inches. These spaces added together in addition to the several arms as given above will make 13 feet 11 inches for the height of the gate from the bottom of the lower arm to the top of the upper arm (the latter point being on a level with the water surface in the upper level, and the former being one inch above canal bottom on the lower level, the lower arm shutting 3 inches above the mitre sill). From the level of the top of the upper arm to the bottom of the balance beam, at that point in the toe post, which is directly over the vertex of the mitre sill (when the gate is shut), will be 6 inches and the balance beam throughout its length on the under side from the small towards the large end shall have an accent of 1½ inch to the foot. There shall be a strap over the balance beam to connect it to the toe post of 2 inches by 5/8ths iron. This strap shall extend down the toe post on each side 18 inches below the middle of the upper arm and will brankle out 18 inches along each side of the upper arm—5 5/8” bolts will be required to secure this ‘strap and L’s’, the screws used upon the bolts will be 5/8ths iron.

There shall be a set of T’s at the angle formed by the upper arm with the heel post—its length from the angle upwards shall be 12 inches and, as before, will be required for this T. The heel also the toe post will each extend down 2 inches below the bottom of the lower arm, and around each will be a 2 inch by 5/8 iron band.

The thickness of the gate measured at right angles to the lower side through the centre of the curve of the heel post shall be 12 inches—measuring in like manner it shall be 11 inches at the toe post (at the point above referred to as corresponding to the vertex of the mitre sill).

The heel post and toe post shall be so framed together as to suit the hollow quoin curve of the masonry and the angle of the mitre sill.

They shall also, together with the arms, be so framed that the latter shall be two inches longer on their upper than on their lower side (one inch at each end), this shall be done by boxing into the two posts.

The dimensions of the arms horizontally of the gate shall be such as will allow of the putting in the 2 inch plank on the upper and lower side of the gate in the manner hereinafter provided—the whole gate, including the plank on the lower as well as on the upper side, being left with a

[154] Source: "Contract Proposal of Thornton C. Bradley, February 4, 1836," Drawings and Other Records Concerning Construction, C & O Company, Records of the National Park Service, Record Group 79, National Archives, Washington, D.C.

full and fair surface on each side 12 inches thick at the heel and 11 inches at the toe post as before stated. The upper planking will be 2 inches in thickness, and shall run diagonally of the gate in a direction parallel to a line drawn between the two inner angular points, the first formed by the upper arm and the toe post, and the second being the intersection of the lower arm by one with the heel post—The face of this planking being flush with the heel and with the toe post, with the upper and lower arms, as well also as the valve uprights next to the toe post, and that portion of the lower arm but one that is over the two valves shall be let into each of these by a rebate of two inches.

The lower planking shall be placed vertically of the gates with 2 inches left between adjoining planks. For this lower planking in like manner as for the upper shall a rebate of 2 inches be cut into the heel and toe posts, upper and lower arms &c. The joints for the upper planking shall be thus formed; for the ½ inch next the arm, at right angles to its surface; but for the remaining 1½ inches, they shall be beveled of 1/8 of an inch from the square so that the joint immediately upon the work being furnished shall show upon the surface an opening of ¼ of an inch. All of the timber and planking shall be cut as nearly as practicable in the month of February.

The spikes used shall be 5½ inches long, of 5 to the lb.—wrought spikes.

The irons and spikes immediately upon being made, must be heated to a blue heat and be immersed, when thus heated, in linseed oil. In addition to the irons already mentioned, there shall be L's on each of the lower angles of the gates, each by measuring 18 inches—each set of L's shall be secured by 5 bolts the diameters of which also of the screws and of the L's themselves shall be the same as those of the irons put on the upper angles of the Gate—The horizontal part of these L's will run along the middle of the lower arm, & from their angular points shall run down a bank connecting respectively with the bands around the bottom of the heel post and the bottom of the toe post—

The upper Gates will be about one foot less in height than the lower ones—The only difference this will occasion will be to divide the posts equally among the five upper spaces between the arms, which spaces as given above refer to the lower Gates diminishing them that much, the number and dimensions of the arms remaining the same N B and the planking on the lower side of the Gate will be required over the whole surface of the upper ones—but on the lower ones it will not be required higher than to the 3rd arm from the top—Into this arm therefore a rabbit of two inches shall be cut, and the arms left naked will come out flush with the mitre and heel posts.

All the materials of every kind must be of the best quality—the workmanship also shall be the very best.

APPENDIX I

Specification for Locks on the Chesapeake and Ohio Canal, 1837[155]

The thicknesses of walls, lengths of timbers, &c., given below, are for a lock of eight feet lift. For a lock of greater, or less lift, these dimensions will be varied as in the judgment of the Engineer may be thought necessary.

FOUNDATION

1. If a rock foundation cannot be had, the lock shall be placed on a bottom, formed of one-foot square white oak timbers, laid transversely of the lock and closely fitted together. These timbers shall be hewn so as to present a smooth surface on top and bottom, and to make tight joints on the sides.

2. Their several lengths will be as follows, beginning at the head of the lock:

No. of pieces	Length on the towpath side of the center of the lock	Length on the berm side of the center	Total length
6	23 ½ feet	27 ½ feet	51
1	22	27 ½	49 ½
1	20 ½	27 ½	48
1	19	27 ½	46 ½
1	17 ½	27 ½	45
1	16	27 ½	43 ½
16	16	16	32
83	14 ½	14 ½	29
17	16	16	32
4	14 ½	14 ½	29
1	16	16	32
1	17 ½	17 ½	35
1	19	19	38
1	20 ½	20 ½	41
1	22	22	44
7	23 ½	23 ½	47
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3. The twenty-third and the one hundred and twenty-third timbers shall be respectively directly under upper and the lower main sills.

4. All of the above timbers shall be neatly fitted upon two rows of timbers of similar dimensions running longitudinally of the lock, and which shall be placed so that they shall be, one directly under the front face of the lock walls, the whole breadth of timber being under the mason-

[155] Source: "1837 Specification for Locks on the Chesapeake and Ohio Canal," Drawings and Other Records Concerning Construction, C & O Company, Records of the National Park Service, Record Group 79, National Archives, Washington, D. C.

ry. These longitudinal timbers should be as great length as can reasonably be procured; and where their ends fit against each other there shall be placed a shorter piece of the same dimensions, twelve feet in length, parallel and close to them under the wall. Note that of all the timbers used in the foundations shall be squared. The top of the transverse timbers shall be 12 inches below the bottom of the canal.

5. There shall be four rows of sheet piling, of well-jointed three-inch yellow pine plank, extending at least *4* feet below the bottom of the transverse timbers, and running across the whole breadth of the foundation of the lock, which shall be driven, secured, and arranged, as may be directed by the Engineer. These four rows of sheet piling shall be fitted respectively against the upper side of the first, of the 23rd, of the 123rd, and of the last of the above-mentioned transverse timbers.

6. When the masonry is completed, there shall be a course of plank of first rate heart pine, two inches thick, well jointed and squared, and laid as nearly water tight as possible, over the whole space between the two main walls of the lock, from the breast of the lock to the lower end of the masonry. There shall be two spikes, not less than eight inches long, at each end of each plank, and at least ten tree-nails, of one and a quarter inch square and nine inches long, in each plank, to secure it well to the timbers below.

7. Should the lock be placed on rock, and the foundation of timber be dispensed with, either in whole or in part, the Engineer shall adjudge the difference in cost between the timber foundation dispensed with, and the extra masonry necessary for the foundation as high up as the floor of the lock, which difference shall be deducted from or added to the estimate of the lock, as the case may be.

EXCAVATION OF THE PIT

8. The excavation of the pit for the lock shall be of such length, width, and depth, and with such slope as shall, in the opinion of the Engineer, be considered necessary, as well for the security of the work by puddling after it shall have been finished, as for space sufficient for the work during construction. After the excavating of the pit, the bottom shall be prepared in such manner as the Engineer may direct, so that the timber may be properly bedded.

9. Any stone excavated from the lock pit, if approved of by the Engineer, may be used in the lock without charge. All other material, whether of rock or of earth, shall be deposited at any place the Engineer may direct, not exceeding two hundred feet from the pit; and if placed in the embankments of the canal, in the manner required by the Section specifications, the extra labor caused thereby shall be paid for at the estimate of the Engineer.

10. The Company reserves the right of causing the Contractor for any of the neighboring embankments to excavate the pit, with a view to the material being used in that embankment. They also reserve the right of making a contract with any person at any time during the construction of the lock, for the puddling up and embanking around the masonry, or they may do this with hands hired and paid by the Company. Unless the Company seeks to exercise this reserved right, and until they shall do so, the Contractor shall carry on the puddling and embankment as directed by

the Engineer, so that at no time shall any portion of it be nearer than two feet to the level of the lowest part of masonry that may at such time be laid and grouted.

MASONRY

11. The entire length of the masonry measured in the continuation of the lock-walls, from end-to-end of the wings, shall be one hundred and forty-three feet, viz; twenty-two feet above the upper side of the upper main sill, one hundred feet between the upper sides of the two main sills, and twenty-one feet below the upper side of the lower sill. The wings shall splay twelve feet each in eight feet, measured in the direction of the lock, and shall be connected with the main walls without any curvature.

12. The main walls of the lock will rise to the height of one foot above the water surface of the upper lock. The top of the towpath lower wing shall descend one foot in its length; the descent commencing three feet back from the angular point. The towpath upper wing in like manner descends six inches. The berm upper wing runs out level and curves around, as is represented on the plan that has been exhibited, into a straight line parallel with the lock, and ends twelve feet below the upper point of the lock masonry, measuring in the direction of the canal. This round corner forms the upper entrance to the flume, and is formed and carried on with, and is considered a part of, the lock masonry. The lower berm wing runs out level the same length as the corresponding towpath wing, and then connects with a straight wall running out at right angles to the lock: this wall will be built for the purposes of a

FLUME

13. The length of this flume-wall shall be as great as in the judgment of the Engineer may be considered necessary. Its foundation will be of timber of the same dimensions as that used in the lock foundation. First, there will be placed lengthwise of the wall, and directly under its face, a foot square white oak timber, on the upper side of which will be a row of sheet piling, similar to that for the lock. Upon this timber, at right angles to it, will be placed other timbers of the same kind, ten feet in length, and projecting out two feet below the lower timber; upon this foundation, which shall be one foot lower than the lock foundation, will be built the flume-wall connecting with the wing-wall of the lock; with which it shall be carried on of masonry similar in every respect to the lock-masonry, the width and depth of which will be greater or less in proportion to the length of the level above, and the quantity of water to be passed through, as shall be determined by the Engineer. The top of this wall will rise to the full height of the lock wall, with an opening or notch left through it. On the upper side of this opening there will be left a recess, for the purpose of receiving a frame of wood work. The bottom of this opening will be coped with stone placed on edge, and extending four feet into the wall and two feet deep.

14. The width of the lock will be fifteen feet at the bottom, with perpendicular walls on the face, except that between the gates there will be a batter of one hundredth of a foot to the foot rise on each wall in the middle of the chamber; this batter lessening, as the Engineer may direct, to nothing at the gates. The walls of the lock, including the flume-wall, will be seven feet thick at the bottom and four feet thick on a level with the bottom of the coping, except that for seventeen feet in length against the lower gates, measuring upwards from a point five feet below the upper side of the main sill, and also from a point the same distance below the upper side of the upper main sill, and extending up to the intersection with the upper wings, the back of the main walls at bottom will be eight and a half feet from the front line of the wall in the chamber, and at the top un-

der the coping it shall be six feet, measured from the same line. These thicknesses, however, may be increased or diminished, as local circumstances may require or justify. In raising the walls, they shall be diminished in thickness be a half inch batter, and by three offsets so arranged as to make precisely the same amount of masonry as though it were to batter uniformly from the bottom to the top thickness.

15. In each of the four recesses for the gates, for six feet of their height and for their whole length, there shall be a small recess of four inches in depth; and the hollow quoins and other work shall be made to conform thereto.

FACE STONE

16 The stone shall be of a quality to endure the frost and sun, and such as shall be approved of by the Engineer or Superintendent of Masonry.

17. All of the face stone, except the hollow quoins and coping, shall be well scabbled in their face, in their beds, and in their joints, so that, by taking off of each of the scabbled surfaces one-half inch, a perfect and complete cut stone in every respect might be had. In other words, the beds, the joints, and the face, shall fill the square, and shall be as complete as the beds, joints, and face of cut stone in every respect, except the surfaces being scabbled instead of cut.

18. There shall, on an average, be a header or bond stone for every ten feet in length on each course, measuring from center to center of the header. And, in laying the work, these headers shall be placed as near to this average as the intermediate stretchers will allow of. The headers of any course shall divide, as nearly as practicable, the spaces between the headers below.

19. Two and a half inches of the bottom of the face of the lower course of stone shall be cut so as to allow of the two-inch course of planking being fitted against it.

20. No course shall be less than one foot in thickness, and no stretcher shall have less than eighteen inches bed. And where the thickness of the course is greater than eighteen inches, then the stretcher shall have as much bed as face.

21. The stretchers shall not be less than two feet nine inches long, and their ends shall not make an even and full joint of less than nine inches in from the face of the wall. In no case shall the stretcher, at the distance back from its face, of its required width of bed be more than one foot less in length than the face; and whenever any such dimension shall be made from the front length, then as much additional bed shall be given in the width of the stone as shall make it in bulk the same as though it retained its full length throughout its whole required bed.

22. The headers shall not be in width on the face less than the height of the course, and in no case shall this width be less than twenty inches. All of the headers shall extend into the wall not less than forty inches, and at the distance back from the face of the wall the header shall in no case be less than eighteen inches wide, and the joints shall be full and even as far back as they touch the adjoining face stone.

23. The face stone, whether header or stretcher, shall have parallel beds throughout, and they shall be so scabbled as to lie as firm upon each other throughout their whole width as they do in front.

24. In the monthly estimate of work done and materials prepared, the face measurement of the headers and of the stretchers shall be stated separately, and against the face measurement of the headers shall be mentioned their *average*; and in no case will any money be paid upon such portion of the stretchers as shall exceed the proportion of ten feet *linear* of face for each header.

25. The hollow quoins shall be closely cut throughout their face, their beds, and their joints. What is normally called the "whole hollow" shall be the header, and the "half hollow" the stretcher, so that they shall be alternately headers and stretchers. The straight part of the "whole hollow" in the recess shall not be less than the height of the course, neither shall the straight part in the chamber be less; and the "half hollow" shall break over that which be taken as equal to its own thickness. The "half hollow" shall be in width such that in no place, measuring in at right angles to its face, whether in the curve or in the straight part of it, shall it be less than eighteen inches, neither shall the joints be less, and the "whole hollow," when laid in its place, shall not be less than forty inches, measuring in from any part of the face at right angles to the lock.

26. The coping shall be twelve inches thick and three feet wide, and be so laid as to present a nearly uniform width on top. The angle formed by the top of the coping and the inner side of the lock-wall shall be fairly and handsomely cut to a radius of three inches, as shall also be the remaining nine inches of the inner edge of the coping. The end joints shall be cut full and even throughout the three feet. The top and the bottom beds shall be well scabbled and parallel. No piece of coping shall be less than three feet in length. From the recess above the upper gates, out to the end of the wings, the coping shall be two feet in thickness; in every other respect, as to workmanship and dimensions, it shall be the same as the rest of the coping. The towpath wing at the end, is six inches less in height than at the recess, corresponding to this the thickness of coping may be diminished from two feet to eighteen inches. The coping around the gates, and from the gates to the upper and lower ends of the lock, shall be connected by iron clamps and bolts as may be directed.

27. At the head and at the tail of the lock along the towpath and berm wings there shall be bolted one-foot square white oak timber, the top of which shall be one foot below water line. There shall be three screw bolts of 1 ½ inch square iron properly secured to the masonry in each of the four pieces of timber.

28. All of the face stone shall be laid in full beds of mortar. Every stone must be completely prepared before it is laid, so that no trimming will afterwards be necessary. Each course shall be laid entirely around the lock before a stone shall be laid in the second course above. The pointing shall follow on immediately after the laying but so that it shall always be one course below it.

BACKING

29. The stone for the backing or dead work shall be of such size and quality as shall make the best of durable and solid wall. The backing shall be so laid as to bind well with the headers of the face stone, and so also as to fill in with a suitable bond stone the angular place that may be left in consequence of the front

stone being less in length in the rear than in their face, as is allowed within certain limits by the specifications. The back wall shall be so laid as to present a fair and even surface in the rear. The laying of the backing shall follow on directly after the laying of the face stone, and it shall be well grouted at each course in height, and in no case shall any face stone be laid while any of the courses below it within fifty feet has not been fully and thoroughly grouted.

BREAST-WALL

30. The breast of the lock shall be of masonry similar to that prescribed for the lock-walls—its thickness will be six feet at bottom and four at top. It shall be coped with stone four feet wide. The top of it will be one foot below the bottom of the upper level. The front of this breast wall will be ten feet from and parallel with the upper side of the upper main sill, and will be in a line with the upper end of the recesses.

31. In the main wall over this breast-wall, and rising to within three feet of the top of the coping, shall be cut a recess for stop-plank of such dimensions and form as may be required.

32. Dry walls will be built at each end of the lock, and there shall be a paving below the lock—the dimensions of these dry walls and of the paving shall be such as in the judgment of the Engineer may be necessary.

33. The plan of all parts of the masonry, and of the foundations, shall be furnished each Contractor, and all necessary explanations shall be given by the Engineer or the Superintendent of Masonry.

34. Where stone may be required for the construction of the lock, and the contractor cannot agree with the owner thereof for the same on reasonable terms, the President and Directors will, upon application, cause the same to be condemned according to the charter of the Company, the Contractor paying the expense of the condemnation, as well as the sum awarded by the jury for the stone.

CEMENT AND STONE

35. The cement shall be furnished by the Canal Company, and shall be drawn by the Contractor for the lock from some one of the deposits of cement, which shall be established by the Canal Company, upon the written orders which he shall from time to time receive from the Engineer for the same; and the Engineer shall be the sole judge as to which deposit it shall be drawn from, and shall express the same in said orders; and said Contractor shall be charged at the rate of twenty-five cents per bushel of seventy pounds weight for every bushel of cement delivered under said orders; which shall be deducted from his estimates as they become due. And the said Contractor shall transport the cement so received to said lock in good tight barrels or casks, to be provided by him at his own cost, and shall keep it therein secure from the weather until used, in a suitable cement house; but the Canal Company shall repay the Contractor, upon completion of the lock, the amount he shall actually have paid for such transportation, (exclusive of the cost of casks,) provided it be the fair and customary price at the time, and cheapest route, whether by land or by water, which could then have been used; and if, from any cause, the Engineer shall permit the cement, or any portion of it, to be transported otherwise than in good tight casks, a deduction shall be made from the estimate, at the rate of five cents per bushel, for the quantity so allowed to be transported.

36. It is expressly stipulated that though the Canal Company agree to furnish the cement for this lock, yet that if from any cause the said Company shall not be able to supply it as required, that they shall not be responsible for any damages arising to the Contractor from the want of it.

37. The sand must be clean and sharp, and if deemed necessary it must be washed—a sufficiently large screen shall be had through which to pass the sand, the longitudinal wires of which shall not be more three eighths of an inch apart.

38. The mortar shall be made of two parts of cement to one of sand, properly worked upon an approved bed formed of plank, and the length of time between the first wetting of the cement and its being placed in the wall shall never exceed one half hour. The grout shall be formed of equal parts of cement and sand, and no longer time shall pass between the wetting of the cement and its use than in the case of mortar, viz; one half hour. The grout box shall not contain, when full, more than twenty-four cubic feet.

THE MITRE SILLS

39. Shall be of first rate white oak timber—they shall be nine inches thick, planed, jointed, and framed, in the *best of work* the lower mitre sill shall be placed immediately upon the transverse timbers of the foundation, which, *so far as the mitre* sill and the platform for the upper mitre sill touch upon them, shall be well planed upon their upper surface and in their joints. The upper sill shall be placed on a platform of well-jointed white oak timbers, one foot thick, laid close together upon the lower timbers, for the whole breadth of the lock and of the recesses. These timbers will be six feet in length parallel with the lock—their lower end on top shall be fair with the lower side of the mitre sill, and with their ends two inches longer on the lower than on the upper side, they shall fit tightly against a fourteen-inch white oak timber that will extend under each of the main walls one foot, and will rise closely two inches upon the main sill. These mitre sills and platforms to be secured by tree-nails and by iron bolts, of a size and quantity to be directed by the Engineer of the Company. The braces of the mitre sills will be omitted and the triangular space will be filled up even with the top of the sill as may be directed. In laying down the mitre sill and the platform, pitched paper shall be used between the timbers.

40. All of the timber required in the lock, whether used in the foundation, mitre sills, or elsewhere, shall be cut at such season of the year as the Engineer may require, so as not, however, to delay the prosecution of the work.

LOCK GATES

41. The lock gates will be made under a separate contract with some other person, but especial care will be required that the hollow quoins be truly cut, so that no trimming will be necessary for the gate Contractor. A reasonable and suitable place not far from the site of the lock will be required for the placing of the timber and for the framing of the gates.

APPENDIX J

Calculations for a Lock of 8 Feet Lift, August 1, 1838

Calculations made by C B Fiske Chief Engr give exclusive only of the Flume Wall beyond a line perp to end of 12 ft wing.—

Tow Path Masonry = 510·5139 Perches
Berm do = 548·7055 do
Breast Wall = 21·9524 do

Total = 1081·1718 Perches

Of the 1081·1718 Perches

There are { Of Backing = 692·5030
of Cut Work = 388·6688 } Perches
1081·1718

Lengths of Face Work

measuring all that shows and following every indentation & curve.— & excluding the Flume Wall beyond a vertical Plane hanged perp to the end of a 12 ft Wing Berm side tail of lock.—

Length of face Tow Path side = 159·5776 ft
ditto Berm do = 176·8343
Total = 336·4119 ft run

Mr Fiske makes the cut work item by item as over

				Cubic feet
$61\frac{2}{3}$ ft rise H.W.S.	× 10 cft per foot rise	=		$616 \cdot \underline{6666}$
$272 \cdot \underline{3112}$ ft run 1 ft Coping	× 3 per foot run	=		$816 \cdot \underline{9336}$
$56 \cdot \underline{0671}$ do 2 ft Coping	× 6 do	=		$336 \cdot \underline{4026}$
$17\frac{2}{3}$ do Breast Coping	× 4 do	=		$70 \cdot \underline{6666}$
$339 \cdot \underline{7267}$ sq ft of Rounds	× $1\frac{8}{10}$ per sq ft	=		$611 \cdot \underline{5081}$
$4035 \cdot \underline{8564}$ do of Ashlar	× $1\frac{8}{10}$ do	=		$7264 \cdot \underline{5415}$
			25)	$9716 \cdot \underline{7190}$
			Perches =	$388 \cdot \underline{6688}$

Mr Fiske makes the Scale Quantities thus

693 Perches of Backing
$61\frac{2}{3}$ ft rise of Quoins

272 ft run of One ft Coping viz { 264 ft straight, 8 do Curved

56 ft run of Two ft Coping viz { 35 ft straight, 21 do Curved

18 ft run of Breast Coping
340 sqd feet of Rounds
4036 do of Ashlar

{ Cement, Sand & Laying for 1081 Perches

The above excludes the Flume Wall which in making a Scale for any particular Lock must be estimated and added, in due proportion. —

Note { The depth of the Recesses is measured in with the Coping & also with the Ashlar. —

Fisk to Morris, August 1, 1838 [These calculations are an exact duplicate of the original manuscript. Historical Architect Thomas N. Crellin has stated that the figures are inaccurate. Hence the calculations should not be accepted without question and revision.]

APPENDIX K

Calculation of Masonry Lock No. 73 of Nine Feet Lift, September 1840*

This lock is calculated for a width at the foundation of the masonry of 8 feet, a width of 4 feet under the coping (as is usual).

	Cubic Feet	Perches
2.639 x 15.5 x 6.0 2.639 x 93	245.427	9.817
$\frac{10.141}{2}$ x 8.32 x 3.22 x2	271.721	10.869
6.141 x 7.18 x 3.22 x 2	283.955	11.358
1.859 x 7.18 x 3.22 x 2	85.959	3.438
39.492 x 15.5 -- $\frac{4.8 \times 8.32 \times 2}{3}$	585.502	23.428
$\frac{2.129 + 4.995}{2}$ x 15.5 x 4.0	220.844	8.834
$\frac{4.995 + 4.995 + 2.868 \times 4.0 \times 15.5}{6}$	398.598	15.944
15 x 4.0 x 8.5	510.000	20.400
$\frac{15 + 15 + 24 \times 8.5 \times 3.0}{6}$	229.500	9.180
$\frac{7.211 + 9.877}{2}$ x 4.0 x 15.5	529.728	21.189
(9.877 + 8.346) x 15.5 x 4.0	290.367	11.615
$\frac{23 + 19}{2}$ x 6 x 15.5 x 2.0	3,906.000	156.240
$\frac{(18.193 + 18.193 + 15.724) \times 15.5 \times 3.5}{6}$ x 2	942.323	37.693
83 x 93 x 2.0	15,438.000	617.520
17.0 x 7.75 x 15.5	4,082.250	163.290
3.72 x 93.0 x 2.0	691.920	27.677
$\frac{4.2 + 2.14}{2}$ x 15.5 x 4.0 x 4.0	796.080	31.843
$\frac{2.14 + 15.5 \times 4.0}{6}$ x 4.0 x 4.0	88.453	3.538
10.14 x 93.0	943.020	37.721
7.72 x 93.0	717.960	28.718
$\frac{1.21 + 2.42}{2}$ x 4.0 x 15.5	112.530	4.501
$\frac{1.21 \times 15.5 \times 2.0}{3}$	12.503	0.500

* Calculations made by Engineer Fenton M. Henderson in September 1840.

	Cubic Feet	Perches
$\frac{3.63}{2}$ x 4.0 x 16.5	119.790	4.792
$\frac{1.21 \times 16.5 \times 2.0}{3}$	13.310	0.532
23.58 x 16.5 x 4.0	1,556.280	62.251
$\frac{18.58 + 18.58 + 15.08 \times 16.5}{6}$ x 4.0	574.640	22.968
16.5 x 3.5 x 1.5	86.625	3.465
16.5 x 4.0 x 3.0	198.000	7.920
$\frac{(3.0 + 3.0 + 7.0) \times 16.5 \times 2.0}{6}$	143.000	5.720
Projec. of flume coping 12 x 2 x .25	6.000	0.240
Add the coping	------	42.900
		1,406.101

Recesses for gates	33.067	
Recess at flume opening	0.621	
Subrecesses at gates	3.200	
Flume water way	2.880	39.768
		1,366.333

APPENDIX L

Chronology of the Construction of the Individual Lift Locks

Locks Nos. 1–4 — Section A
December 10, 1828 — Contract was let to Dibble, Beaumont & McCord.
June–July, 1829 — Work was commenced on locks.
April 1831 — Work was completed on locks.
Cost: $34,052.08

Locks Nos. 5–6 — Section No. 1
October 25, 1828 — Contract was let to Bennett & Brackett.
March 14, 1829 — Contract was relet to Abram Knapp & Co.
May 1829 — work was commenced on locks.
September 1830 — Work was completed on locks.
Cost: $18,985.67

Lock No. 7 — Section No. 4
October 25, 1828 — Contract was let to Brackett & Hovey.
January 1829 — Work was commenced on lock.
February 1829 — Contract was abandoned.
March 14, 1829 — Contract was relet to Fenlon & Bosteder,
April 1829 — Work was resumed on lock.
September 1829 — Work was completed on lock.
Cost: $9,493.43

Lock No. 8 — Section No. 7
October 25, 1828 — Contract was let to Brackett & Hovey.
March 14, 1829 — Contract was relet to Abram Knapp & Co.
April 1829 — Work was commenced on lock.
July 1830 — Work was completed on lock.
Cost: $9,043.14

Lock No. 9 — Section No. 8
October 25, 1828 — Contract was let to W. W. Fenlon & Co.
February 1829 — Work was commenced on lock.
September 1830 — Work was completed on lock.
Cost: 9,540.98

Lock No. 10 — Section No. 8
October 25, 1828 — Contract was let to Kavenaugh, Knox, Hale & Nichols.
January 1829 — Work was commenced on lock.
March 3, 1830 — Contract was abandoned.
March 1830 — Contract was relet to Douglas & Small.
March 1830 — Work on lock was begun again.
August-September 1830 — Work was completed on lock.
Cost: $9,729.22

Lock No. 11 — Section No. 8
October 25, 1828 — Contract was let to Kavenaugh, Knox, Hale & Nichols.
January 1829 — Work was commenced on lock.
July 1830 — Work was completed on lock.
Cost: $10,089.18

Lock No. 12 — Section No. 9
October 25, 1828 — Contract was let to J & J Maynard.
January 1829 — Work was commenced on lock.
February 1829 — Contract was abandoned.
March 14, 1829 — Contract was relet to Fenlon & Bosteder.
March 1829 — Work was resumed on lock.
August 1830 — Work was completed on lock.
Cost: $10,650.31

Lock No. 13 — Section No. 9
October 25, 1828 — Contract was let to Patrick Donnelly.
December 1829 — Contract was relet to Charles Moury.
December 1829 — Work was commenced on lock.
September 1830 — Work was completed on lock.
Cost: $9,300.81

Lock No. 14 — Section No. 9
October 25, 1828 — Contract was let to Patrick Donnelly.
June 1829 — Contract was relet to Wood & Kendall.
June 1829 — Work was commenced on lock.
September 1830 — Work was completed on lock.
Cost: $9,673.87

Lock No. 15 — Section No. 17
October 25, 1828 — Contract was let to J & J Maynard.
January 1829 — Work was commenced on lock.
February 1829 — Contract was abandoned.
March 14, 1829 — Contract was relet to Abram Knapp & Co.
April 1829 — Work was begun on lock again.
July 1829 — Work was completed on lock.
Cost: $10,349.83

Lock No. 16 — Section No. 17
October 25, 1828 — Contract was let to J & J Maynard.
January 1829 — Work was commenced on lock.
February 1829 — Contract was abandoned.
March 14, 1829 — Contract was relet to Abram Knapp & Co.
April 1829 — Work on lock was begun again.
July 1829 — Work was completed on lock.
Cost: $10,001.78

Lock No. 17 — Section No. 18
October 25, 1828 — Contract was let to Henry & Roberts.
March 14, 1829 — Contract was relet to Abram Knapp & Co.
April 1829 — Work was commenced on lock.
July 1830 — Work was completed on lock.
Cost: $10,941.81

Lock No. 18 — Section No. 18
October 25, 1828 — Contract was let to J & J Maynard.
January 1829 — Work was commenced on lock.
February 1829 — Contract was abandoned.
March 14, 1829 — Contract was relet to Abram Knapp & Co.
April 1829 — Work on lock was begun again.
July 1830 — Work was completed on lock.]
Cost: $9,383.61

Lock No. 19 — Section No. 18
October 25, 1828 — Contract was let to J & J Maynard.
January 1829 — Work commenced on lock.
February 1829 — Contract was abandoned.
March 14, 1829 — Contract was relet to Fenlon & Bosteder.
November 1829 — Work was begun again on lock.
October-November 1830 — Work was completed on lock.
Cost: $10,139.11

Lock No. 20 — Section No. 18
October 25, 1828 — Contract was let to J & J Maynard.
January 1829 — Work was commenced on lock.
February 1829 — Contract was abandoned.
March 14, 1829 — Contract was relet to Abram Knapp & Co.
April 1829 — Work on lock was begun again.
July 1830 — Work was completed on lock.
Cost: $9,355.52

Lock No. 21 — Section No. 23
October 25, 1828 — Contract was let to Holdsworth & Isherwood.
July 1829 — Work was commenced on lock.
October 12, 1829 — Contract was relinquished.
October 21, 1829 — Contract was relet to Richard Gorsline.
October 1830 — Work was completed on lock.
Cost: $8,327.76

Lock No. 22 — Section No. 29
October 25, 1828 — Contract was let to Kenney & Roberts.
March 14, 1829 — Contract was relet to F. C. Clopper.
April 1829 — Work was commenced on lock.

May 1831 — Work was completed on lock.
Cost: $7,969.28

Lock No. 23 — Section No. 34
October 25, 1828 — Contract was let to Kenney & Roberts.
March 14, 1829 — Contract was relet to Holdsworth & Isherwood.
June 1829 — Work was commenced on lock.
January 1831 — Work was completed on lock.
Cost: $8,912.80

Lock No. 24 — Section No. 35
October 25, 1828 — Contract was let to aHoldsworth & Isherwood.
March 1829 — Work was commenced on lock.
May 5, 1830 — Contract was assigned to Richard Holdsworth.
March 1832 — Work was completed on lock.
Cost: $8,886.88

Lock No. 25 — Section No. 51
October 25, 1828 — Contract was let to Lafferty & Boland.
July 1829 — Work was commenced on lock.
January-February 1830 — Contract was abandoned.
April 21, 1830 — Contract was relet to James Stewart.
June 1830 — Work on lock was begun again.
October 1831 — Work was completed on lock.
Cost: $11,191.64

Lock No. 26 — Section No. 68
October 25, 1828 — Contract was let to Amos Johnson.
March 14, 1829 — Contract was relet to Abram Knapp & Co.; firm subcontracted lock to Stewart & Douglas
January 1831 — Work was commenced on lock.
July-August 1832 — Work was completed on lock.
Cost: $10,376.30

Lock No. 27 — Section No. 72
October 25, 1828 — Contract was let to Lafferty & Boland.
January 1829 — Work commenced on lock.
February 1830 — Contract was abandoned.
February 12, 1830 — Contract was relet to D. Canfield.
November 26, 1830 — Contract was relet to Andrew Small.
March 1831 — Work on lock was begun again.
June 1832 — Work was completed on lock.
Cost: $11,323.75

Lock No. 28 — Section No. 87
March 24, 1832 — Contract was let to J. B. & D. K. Cahoon.

May 1832 — Work was commenced on lock.
July 1832 — Work was completed on lock.
Cost: $9,734.55

Lock No. 29 — Section No. 90
March 17, 1832 — Contract was let to J. B. & D. K. Cahoon.
May 1832 — Work was commenced on lock.
August 18, 1832 — Contract was abandoned.
August 25, 1832 — Contract was relet to Littlejohn and Thompson.
November 1833 — Contract was abandoned. Work was begun again by canal company.
April 1834 — Work was completed on lock.
Cost: $9,457.05

Lock No. 30 — Section No. 98
March 14, 1832 — Contract was let to Obadiah Gordon
June 1832 — Work commenced on lock.
July 1832 — Contract was abandoned.
August — September 1832 — Contract was relet to Andrew Small.
October 1832 — Work was begun again on lock.
October 1833 — Work was completed on lock.
Cost: $11,694.51

Lock No. 31 — Section No. 104
March 17, 1832 — Contract was let to Obadiah Gordon.
May 1832 — Work was commenced on lock.
December 31, 1832 — Contract was abandoned.
January 1833 — Contract was relet to John M. Moore.
January 1833 — Work was begun again on lock.
September 1833 — Work was completed on lock.
Cost: $16,085.49

Lock No. 32 — Section No. 108
March 17, 1832 — Contract was let to Lewis Wernwag.
September 1832 — Contract was assigned to John Hay.
September 1832 — Work was commenced on lock.
January 18, 1833 — Contract was abandoned and construction assigned to Charles B. Fisk, with John Hay as principal builder.
February 1833 — Contract was relet to Gibson & Co.; firm subcontracted lock to Littlejohn & Co.
February 1833 — Work on lock was begun again.
July 1833 — Work was completed on lock.
Cost: $11,298.85

Lock No. 33 — Section No. 109
March 17, 1832 — Contract was let to James O'Brien.
April — May 1832 — Contract was relet to Lewis Wernwag.

June 1832 — Work was commenced on lock.
September 1832 — Contract was abandoned.
September 1832 — Contract was relet to Littlejohn & Co.
September 1832 — Work on lock was begun again.
September 1833 — Work was completed on lock.
Cost: $20,728.05

Lock No. 34 — Section No. 111
March 17, 1832 — Contract was let to Henry Smith.
April 21, 1832 — Contract was relet to Fries & McDonnell.
May 1832 — Work was commenced on lock.
November 1833 — Work was completed on lock.
Cost: $10,282.66

Lock No. 35 — Section No. 112
March 17, 1832 — Contract was let to Henry Smith.
April 21, 1832 — Contract was relet to Fries & McDonnell.
June 1832 — Work was commenced on lock.
October 1834 — Work was completed on lock.
Cost: $10,809.19

Lock No. 36 — Section No. 112
June 2, 1832 — Contract was let to Fries & McDonnell.
July 1833 — Work was commenced on lock.
November 1834 — Work was completed on lock.
Cost: $9,659.80

Lock No. 37 — Section No. 122
June 7, 1832 — Contract was let to Gilson, Noonan, Midler & Fresh & Co.
September 1832 — Work was commenced on lock.
August 1833 — Work was completed on lock.
Cost: $11,453.13

Lock No. 38 — Section No. 133
June 7, 1832 — Contract was let to Gilson, Noonan, Midler & Fresh & Co.
September 1832 — Work was commenced on lock.
September 1833 — Work was completed on lock.
Cost: $7,725.85

Lock No. 39 — Section No. 135
June 2, 1832 — Contract was let to Wilson and Bryan.
July 17, 1832 — Contract was abandoned.
August 25, 1832 — Contract was relet to Gilson, Noonan and Fresh.
January 1833 — Work was commenced on lock.
April 1833 — Contract was abandoned.
June 17, 1833 — Contract was relet to Jacob and Alexander Provest.

September 1833 — Work on lock was begun again.
September 1834 — Work was completed on lock.
Cost: $9,265.00

Lock No. 40 — Section No. 146
August 25, 1832 — Contract was let to Gibson, Noonan and Fresh.
January 1833 — Work was commenced on lock.
June-July 1834 — Work was completed on lock.
Cost: $10,202.00

Lock No. 41. — Section No. 166
August 25, 1832 — Contract was let to Michael Byrne & Co.
January 1833 — Work was commenced on lock.
November-December 1834 — Work was completed on lock.
Cost: $10,930.66

Lock No. 42 — Section No. 167
August 25, 1832 — Contract was let to Michael Byrne & Co,
February 1833 — Work was commenced on lock.
November-December 1834 — Work was completed on lock.
Cost: $8,349.96

Lock No. 43 — Section No. 173
August 25, 1832 — Contract was let to Michael Byrne & Co.
February 1833 — Work was commenced on lock.
January 1835 — Work was completed on lock.
Cost: $9,634.40

Lock No. 44 — Section No. 187
August 25, 1832 — Contract was let to Michael Byrne & Co.
September 1832 — Work commenced on lock.
November 1834 — Work was completed on lock.
Cost: $10,485.82

Lock No. 45 — Section No. 202
April 20, 1833 — Contract was let to Byrne, Lathrop and Provest to construct lock below water line.
June 1833 — Work was commenced on lock.
November 1834 — Work was completed under contract.
July 3, 1835 — Contract was let to W. Morrow to complete lock.
February 2, 1836 — Contract was abandoned.
June 20, 1836 — Contract was relet to Michael Byrne & Co.
August 1836 — Work was begun again on lock.
November 1836 — Work was completed on lock.
Cost: $12,488.81

Lock No. 46 — Section No. 203
July 3, 1835 — Contract was let to John C. Lissig.
February 2, 1836 — Contract was abandoned.
June 20, 1836 — Contract was relet to Michael Byrne & Co.
November 1836 — Work was commenced on lock.
May 1838 — Work was completed on lock.
Cost: $12,964.00

Lock No. 47 — Section No. 206
July 3, 1835 — Contract was let to Daniel K. Cahoon.
January 1836 — Work was commenced on lock.
November 1837 — Work was completed on lock.
Cost: $10,546.05

Lock No. 48 — Section No. 208
July 3, 1835 — Contract was let to Daniel K. Cahoon
December 9, 1835 — Contract was abandoned.
June 20, 1836 — Contract was relet to Michael Byrne & Co.
January 1837 — Work was commenced on lock.
May 1838 — Work was completed on lock.
Cost: $13,232.82

Lock No. 49 — Section No. 208
July 3, 1835 — Contract was let to Daniel K. Cahoon.
December 9, 1835 — Contract was abandoned.
June 20, 1836 — Contract was relet to Michael Byrne & Co.
January 1837 — Work was commenced on lock.
May 1838 — Work was completed on lock.
Cost: $17,365.28

Lock No. 50 — Section No. 208
July 3, 1835 — Contract was let to Daniel K. Cahoon.
December 9, 1835 — Contract was abandoned.
June 20, 1836 — Contract was relet to Michael Byrne & Co.
April 1837 — Work was commenced on lock.
May 1838 — Work was completed on lock.
Cost: $13,783.30

Lock No. 51 — Section No. 234
July 3, 1835 — Contract was let to Robert Brown.
January 1836 — Work was commenced on lock.
August 9, 1837 — Contract was abandoned.
December 6, 1837 — Contract was relet to William Storey.
December 1837 — Work on lock was begun again
April 1838 — Work was completed on lock.
Cost: $16,257.24

Lock No. 52 — Section No. 234
July 3, 1835 — Contract was let to Robert Brown.
January 1836 — Work was commenced on lock.
August 9, 1837 — Contract was abandoned.
August 23, 1837 — Modified contract was relet to Robert Brown.
November 1837 — Work was begun again on lock.
April 1839 — Work was completed on lock.
Cost: $15,191.61

Lock No. 53 — Section No. 249
July 3, 1835 — Contract was let to Patrick McGinley.
September 1835 — Work was commenced on lock.
January 1836 — Work was stopped on lock.
March 15, 1836 — Contract was assigned to Thomas Fealey.
March 1836 — Work was begun on lock again.
January 1837 — Work was completed on lock.
Cost: $11,387.62

Lock No. 54 — Section No. 258
January 16, 1836 — Contract was let to Henry Smith.
May 1836 — Work was commenced on lock.
December 28, 1839 — Contract was abandoned.
No further work was done on this lock until work was resumed on the canal in November 1847. At the time of its abandonment, the lock was 40 percent completed at a cost of $6,066.43. When work resumed in 1847, Hunter, Harris & Co. subcontracted this lock to Moyle, Randal & Jones for its completion.
1848-49 — Work was completed on lock.

Lock No. 55 — Section No. 258
January 16, 1836 — Contract was let to Henry Smith.
November 1836 — Work commenced on lock.
October 1840 — Work was completed on lock.
Cost: $13,621.54

Lock No. 56 — Section No. 262
September 29, 1837 — Contract was let to John Cameron.
March 1838 — Work was commenced on lock.
December 28, 1839 — Contract was abandoned.
No further work was done on this lock until work was resumed on the canal in November 1847. At the time of its abandonment, the lock had been 50 percent completed at a cost of $9,475.09. When work resumed in 1847, Hunter, Harris & Co. subcontracted this lock to Moyle, Randal & Jones for its completion.
1848-49 — Work was completed on lock.

Lock No. 57 — Section No. 267
September 29, 1837 — Contract was let to W. C. Steedman.

May 24, 1838 — Contract was relet to James Wherry.
August 1838 — Work was commenced on lock.
March 1840 — Work was completed on lock.
Cost: $17,774.39

Lock No. 58 — Section No. 276 (Composite Lock)
September 29, 1837 — Contract was let to W. C. Steedman.
May 24, 1838 — Contract was relet to James Wherry.
August 1838 — Work was commenced on lock.
December 28, 1839 — Contract was abandoned.
No further work was done on this lock until work was resumed on the canal in November 1847. At the time of its abandonment, the lock was 40 percent completed at a cost of $8,922.16. When work resumed in 1847, Hunter, Harris & Co. subcontracted this lock to an unnamed firm (according to available canal company records) for its completion.
1848-50 — Work was completed on lock.

Locks Nos. 59–66 — Sections Nos. 282-299 (Composite Locks)
September 29, 1837 — Contract for Lock No. 59 was let to Edward H. Fielding.
September 29, 1837 — Contract for Locks Nos. 60-66 was let to Michael Byrne & Co.
November 1838 — Work was commenced on locks.
December 28, 1839 — Work was suspended on locks.
September 1845 — Contract was let to Gwinn & Co.; subcontracted to Marcellus Ritner & Co.
April 1846 — Work was begun again on locks.
April-May 1846 — Contract was abandoned.
November 1847 — Contract was let to Hunter, Harris & Co.; Locks Nos. 59-61 were subcontracted to Ritner & Co.; and Locks Nos. 62-66 were subcontracted to Buell & Watt.
November 1847 — Work on locks was begun again.
June-July 1850 — Contract was abandoned.
July 1850 — Contract was relet to Michael Byrne & Co.
July 1850 — Work on lock was begun again.
August 1850 — Work was completed on Locks No. 61-66.
September 1850 — Work was completed on Locks Nos. 59-60.

Lock No. 67 — Section No. 322 (Composite Lock)
May 24, 1838 — Contract was let to Joshua Lobdell.
August 1838 — Work was commenced on lock.
November 28, 1838 — Contract was abandoned.
No further work was done on this lock until work was resumed on the canal in November 1847. At the time of its abandonment, the lock was barely begun; only $740.56 worth of work had been done on it. When work resumed in 1847, Hunter, Harris & Co. subcontracted this lock to William P. Sterritt for its completion.
1848-50 — Work was completed on the lock.

Lock No. 68 — Section No. 329 (Composite Lock)
September 27, 1837 — Contract was let to Robert McCoy.
May 16, 1838 — Contract was assigned to J. Noble Nisbet.

November 14, 1838 — Contract was abandoned.
No work had done on this lock at the time of its abandonment, and nothing was done on it until work was resumed on the canal in November 1847. At that time, Hunter, Harris & Co. subcontracted this lock to Fallan & Ambrose for its completion.
1849-50 — Work was completed on lock.

Lock No. 69 — Section No. 331 (Composite Lock)
September 29, 1837 — Contract was let to William Pratt.
April 1838 — Work was commenced on lock.
July 18, 1838 — Contract was abandoned.
No further work was done on this lock until work was resumed on the canal in November 1847. At the time of its abandonment, only $759.12 worth of work had been done on the lock. When work resumed in 1847, Hunter, Harris & Co. subcontracted this lock to Fallan & Ambrose for its completion.
1849-50 — Work was completed on lock.

Lock No. 70 — Section No. 332 (Composite Lock)
September 29, 1837 — Contract was let to William Pratt.
July 18, 1838 — Contract was abandoned.
No work had done on this lock at the time of abandonment of the contract, and nothing was done on it until work was resumed on the canal in November 1847. At that time, Hunter, Harris & Co. subcontracted this lock to Fallan & Ambrose for its completion.
1849-50 — Work was completed on the lock.

Lock No. 71 — Section No. 332 (Composite Lock)
September 29, 1837 — Contract was let to William Pratt.
July 18, 1838 — Contract was abandoned.
No work had done on this lock at the time of abandonment of the contract, and nothing was done on it until work was resumed on the canal in November 1847. At that time, Hunter, Harris & Co. subcontracted this lock to Fallan & Ambrose for its completion.
1849-50 — Work was completed on lock.

Lock No. 72 — Section No. 347
September 29, 1837 — Contract was let to G. W. Henry.
September 7, 1838 — Contract was relet to Thomas M. MacCubbin.
February 1839 — Work was commenced on lock.
December 28, 1839 — Contract was abandoned.
January 22, 1840 — Modified contract was relet to Thomas M. MacCubbin.
November 1841 — Work was completed on lock.
Cost: $20,853.85

Lock No. 73 — Section No. 350
September 27, 1837 — Contract was let to George G. Johnson.
August 1838 — Work was commenced on lock.
December 28, 1839 — Contract was abandoned.
January 23, 1840 — Modified contract was relet to George G. Johnson.

December 1840 — Work was completed on lock.
Cost: $18,209.04

Lock No. 74 — Section No. 350
September 27, 1837 — Contract was let to George G. Johnson.
April 1838 — Work was commenced on lock.
December 28, 1839 — Contract was abandoned.
January 23, 1840 — Modified contract was relet to George G. Johnson.
March 1841 — Work was completed on lock.
Cost: $20,547.35

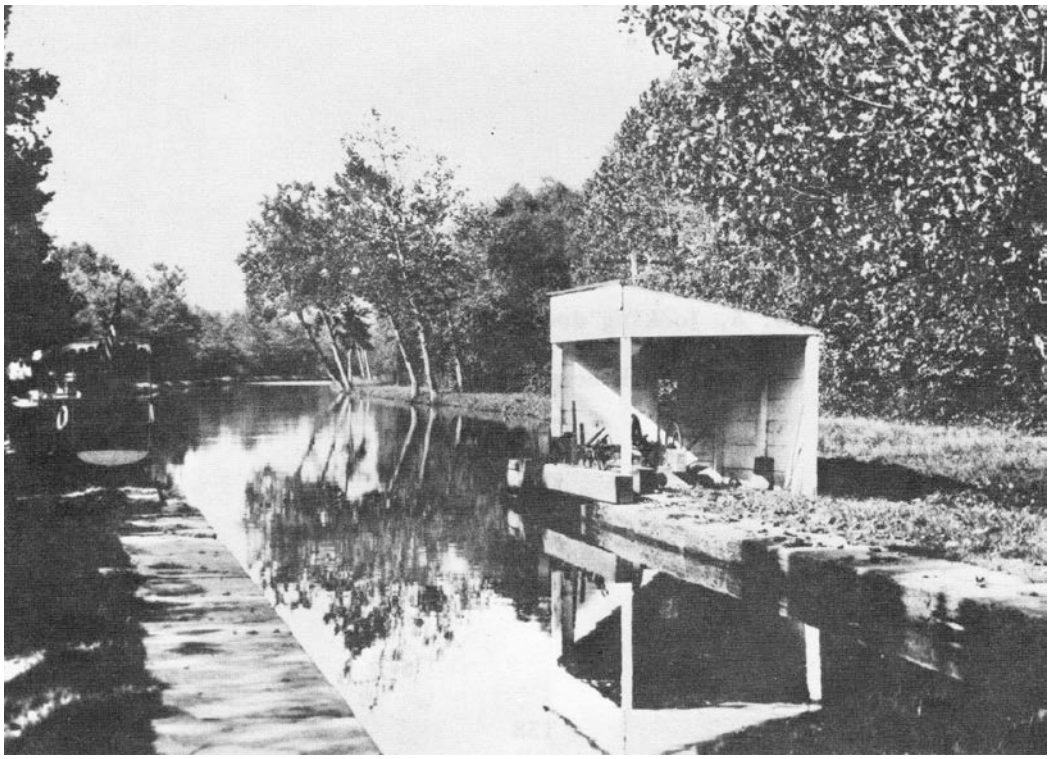
Lock No. 75 — Section No. 350
September 27, 1837 — Contract was let to George G. Johnson.
March 1838 — Work was commenced on lock.
August 1840 — Work was completed on lock.
Cost: $18,007.50

ILLUSTRATIONS

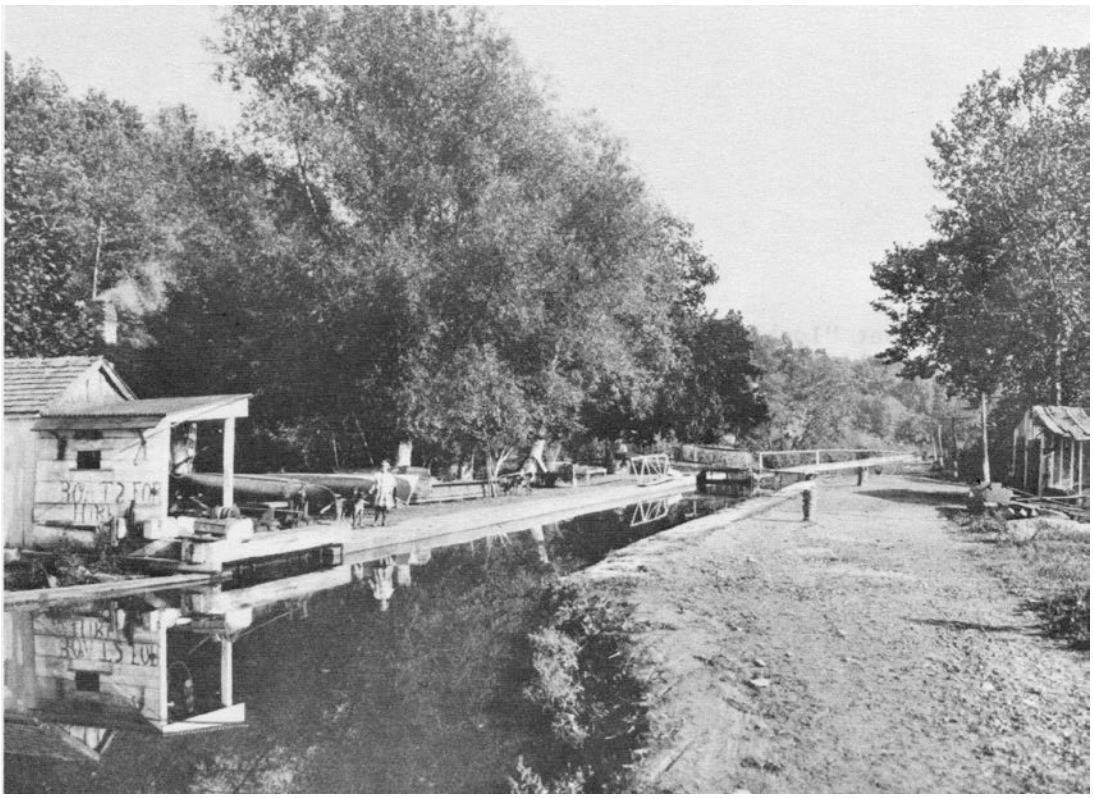
1: Boat passing through unidentified lock [Lock No. 42 or 46], ca. 1900.
From National Park Service (NPS) files, National Archives (NA)

2: Boat “locking through” unidentified lock, ca. 1897. From Library of Congress.

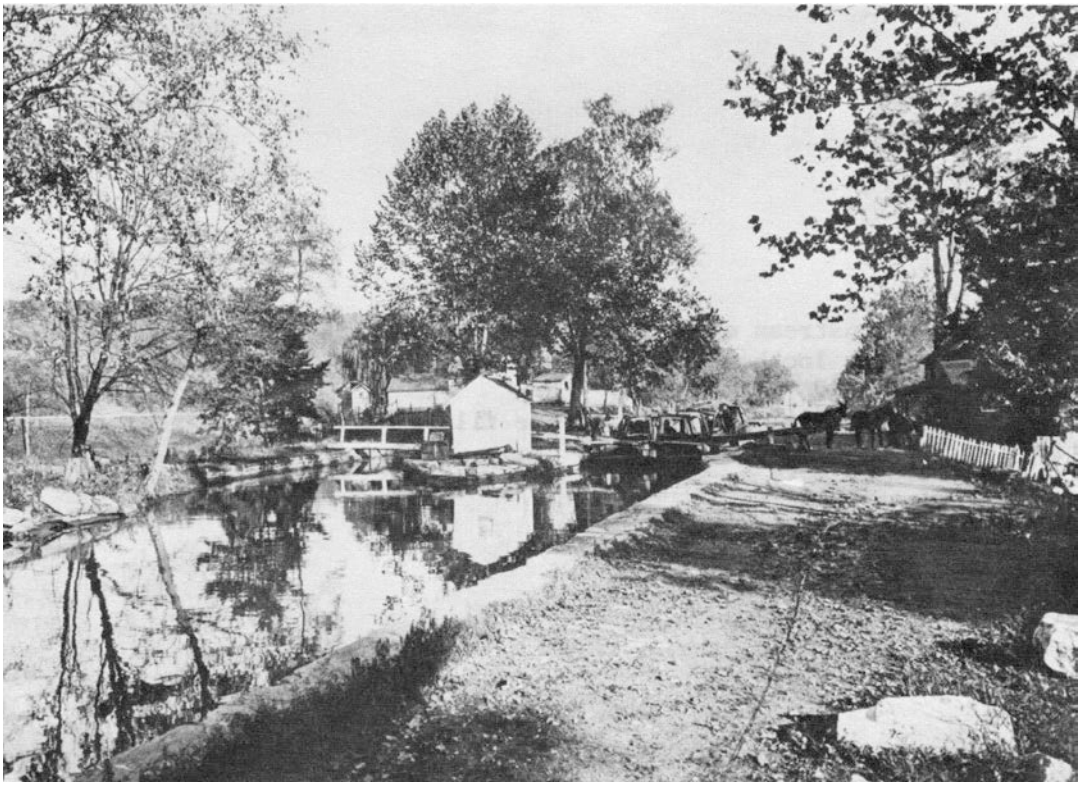
3: Horse-drawn boat approaching upstream end of Lock No. 5, ca. 1900.
Note the snubbing post in foreground and the upstream drop gate.
From E. B. Thompson collection, Department of the Interior.



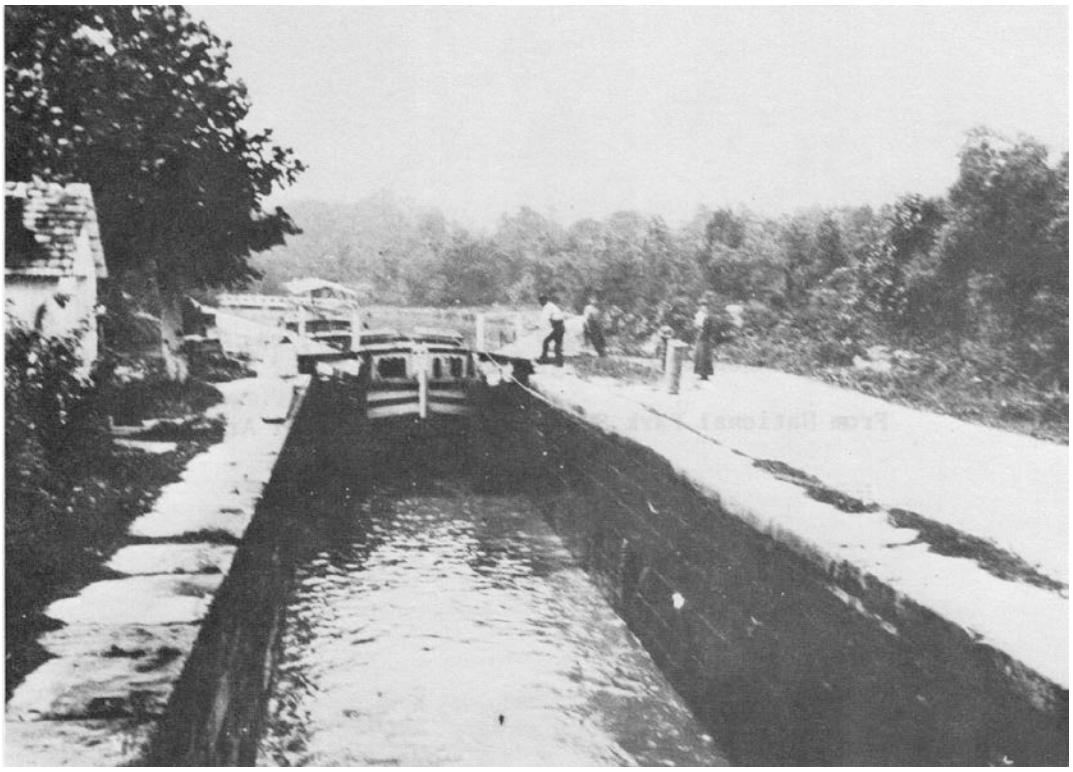
4: Upstream drop gate and winch of Lock No. 5, ca. 1920.
From Consolidation Coal Company collection,
C & O Canal National Historical Park (NHP).



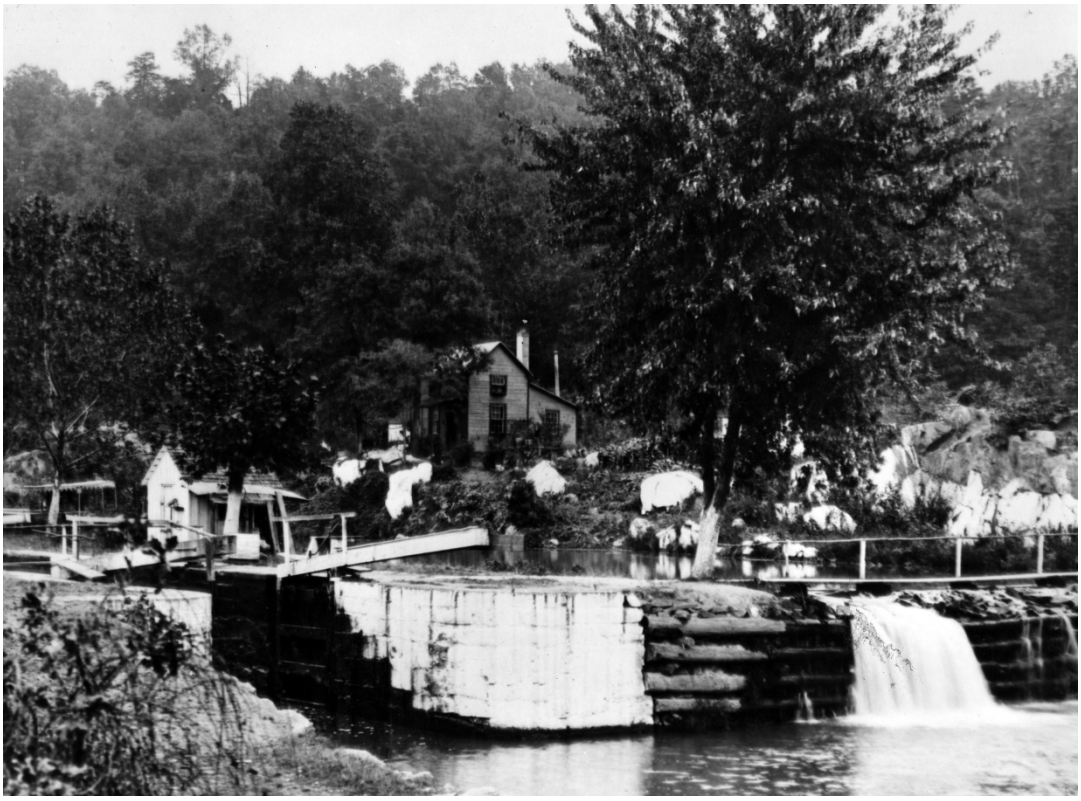
5: Upstream drop gate and winch, looking toward downstream gates of Lock No. 5, ca 1920. From Consolidation Coal Company collection, C&O Canal NHP.



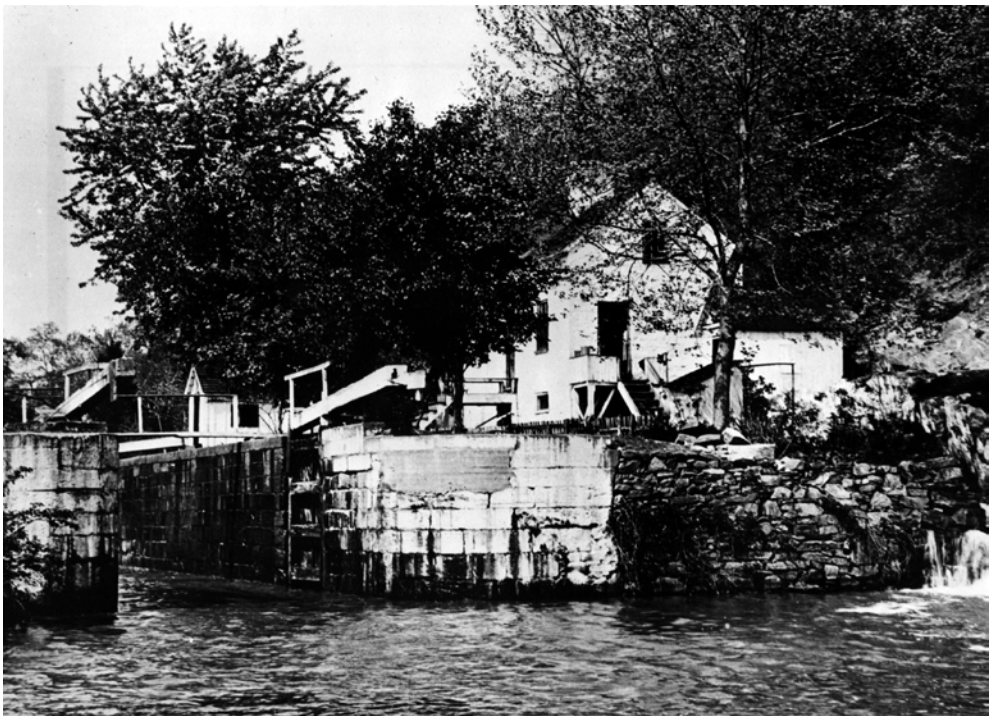
6: Lock No. 8, looking downstream, ca. 1900. From NPS file, NA.



7: Boat “locking through” Lock No. 15, ca. 1900.
From E. B. Thompson collection, Department of the Interior



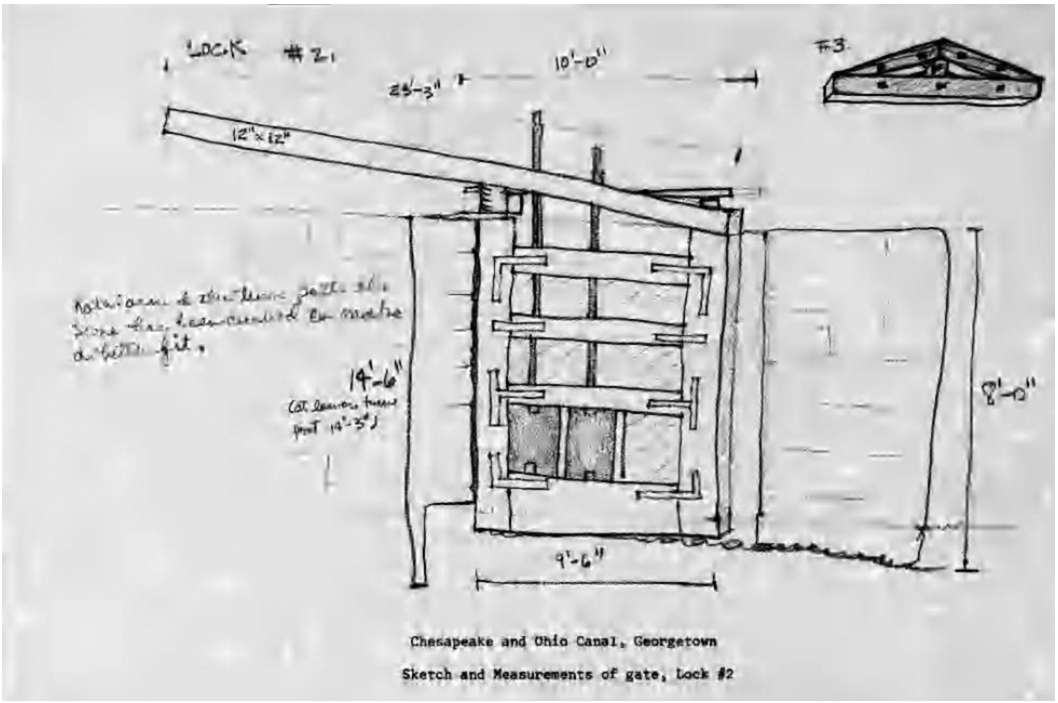
8: Downstream end and flume of Lock No. 15, ca. 1900. From NPS files, NA.



9: Downstream end and flume of Lock No. 18, ca. 1900.
Note lockhouse in background. From NPS files, NA.

10: Lock No. 33 complex, looking west, ca. 1900. Note lockhouse on towpath side of lock, bypass flume with warehouse above it on berm side, and the stone house (erroneously designated the Salty Dog Saloon in many sources) on extreme right. From NPS files, NA.

11: Lock-keeper's shanty and drop gate at Lock No. 74, ca. 1910.
Note snubbing post in foreground. From NPS files, NA.



12: Sketch and measurements of gate, Lock No. 2, made in 1967.
From HABS file, Library of Congress.

13: Lock No. 1, looking west toward 29th Street bridge, 1935.
Note Lock No. 2 in background. Photo by Albert Burns, from HABS file, Library of Congress.

14: Lock No. 3, 1967. Photo by George Eisenman, from HABS file, Library of Congress

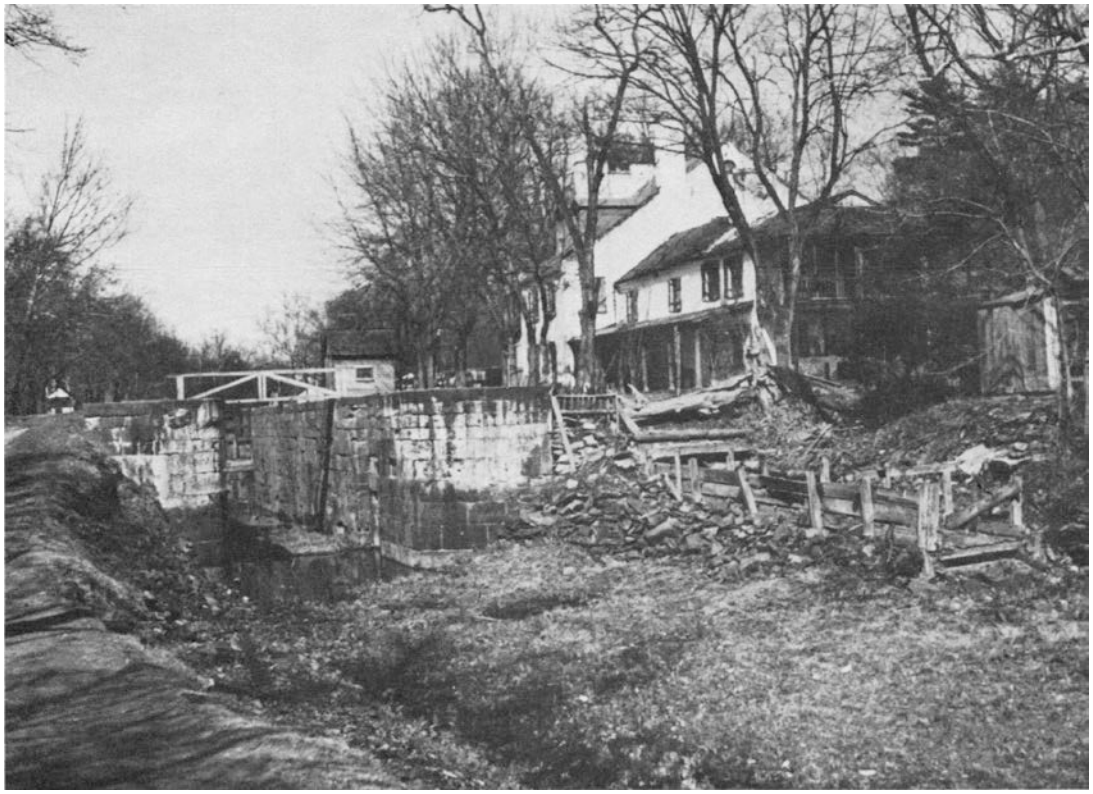
15: Upstream gates and A-frame gate stop on the floor of Lock No. 3, 1967.
Photo by George Eisenman, from HABS file, Library of Congress.

16: Lock No. 3, looking west, 1967.
Photo by George Eisenman, from HABS file, Library of Congress

17: Upstream gates of Lock No. 3, 1967.
Photo by George Eisenman, from HABS file, Library of Congress

18: Walled well and culvert in side wall of Lock No. 3, 1967.
Photo by George Eisenman, from HABS file, Library of Congress

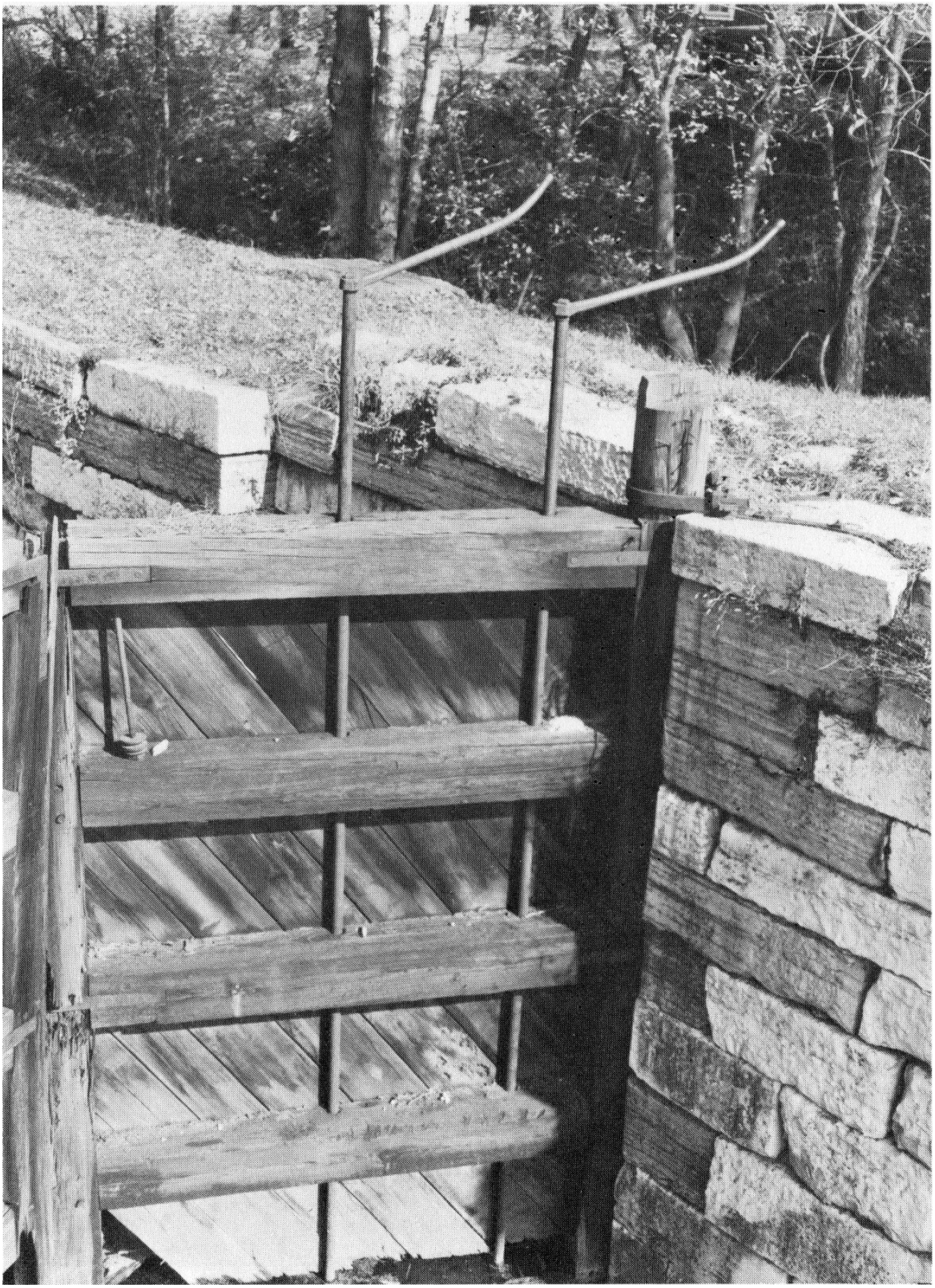
19: Drop gate and winch at Lock No. 13, ca. 1936. From C & O Canal NHP files.



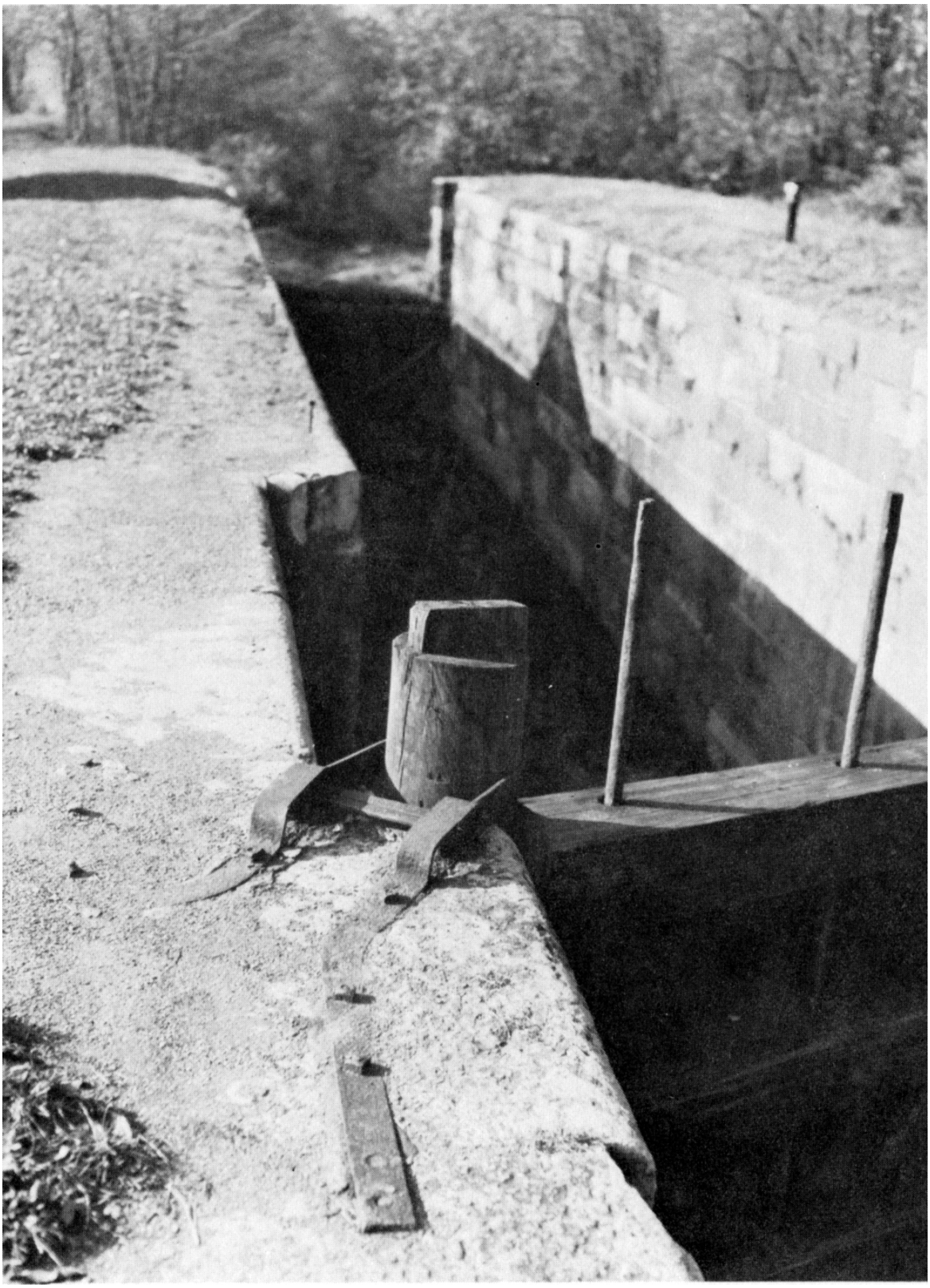
20: Lower end of Lock No. 20, ca. 1936.
Note Great Falls Tavern in background. From NPS files, NA.

21: Lower end of Lock No. 44, 1959.
Photo by Jack E. Boucher, from HABS file, Library of Congress.

22: Ironwork for gates at lower end of Lock No. 44, 1959.
Note gate collar, lock, and curving goosenecks bolted into the coping stone.
Photo by Jack E. Boucher, from HABS file, Library of Congress.



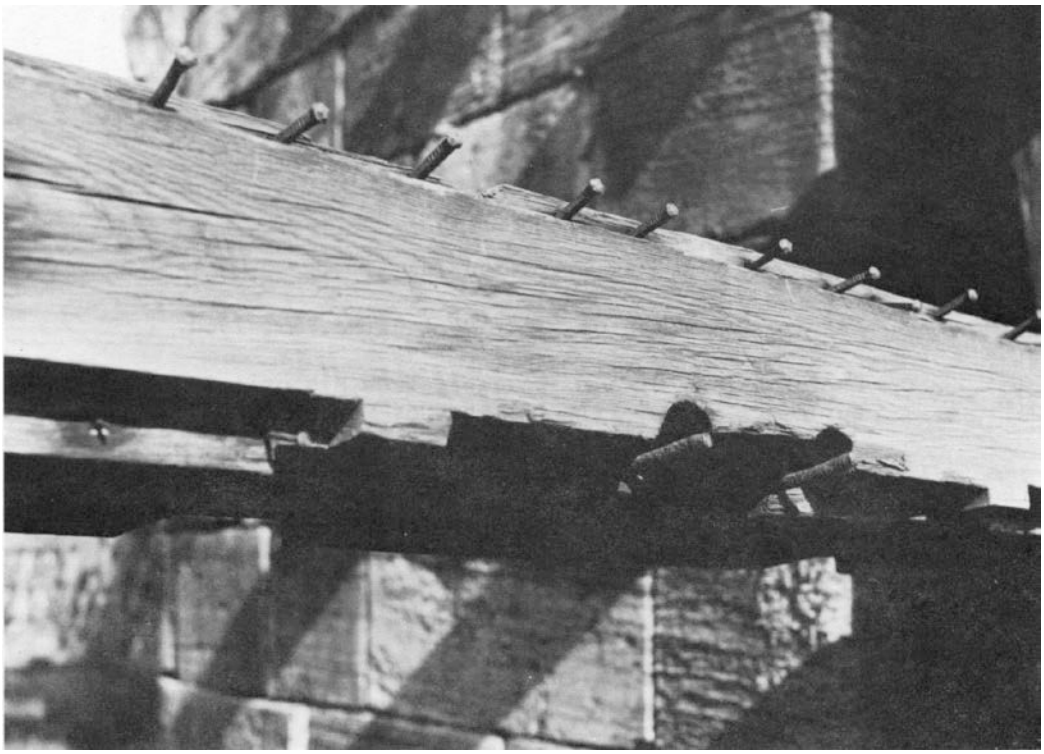
23: Detail of gate at Lock No. 44, 1967.
Note iron rods for opening and closing sluice valves at the bottom of the gate.
Photo by Hugo Skrastins, from NPS files, Department of the Interior.



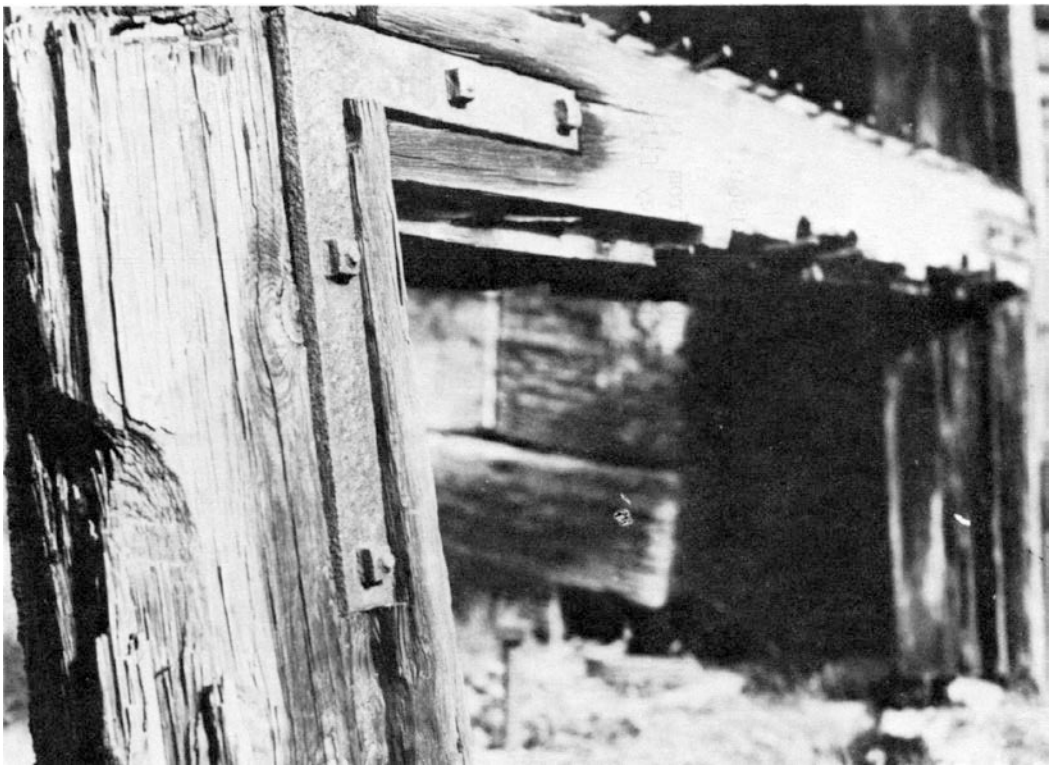
24: Ironwork for gate at Lock No. 44, 1967.
Note gate collar around heal post, gate lock, and goose necks.
Photo by Hugo Skrastins, from NPS files, Department of the Interior.

25: Ironwork for gate at Lock No. 44, 1967.
Closeup of gate collar around heal post, lock, and goose necks.
Photo by Hugo Skrastins, from NPS files, Department of the Interior.

26: Ironwork for gate at Lock No. 44, 1967.
Photo by Hugo Skrastins, from NPS files, Department of the Interior.



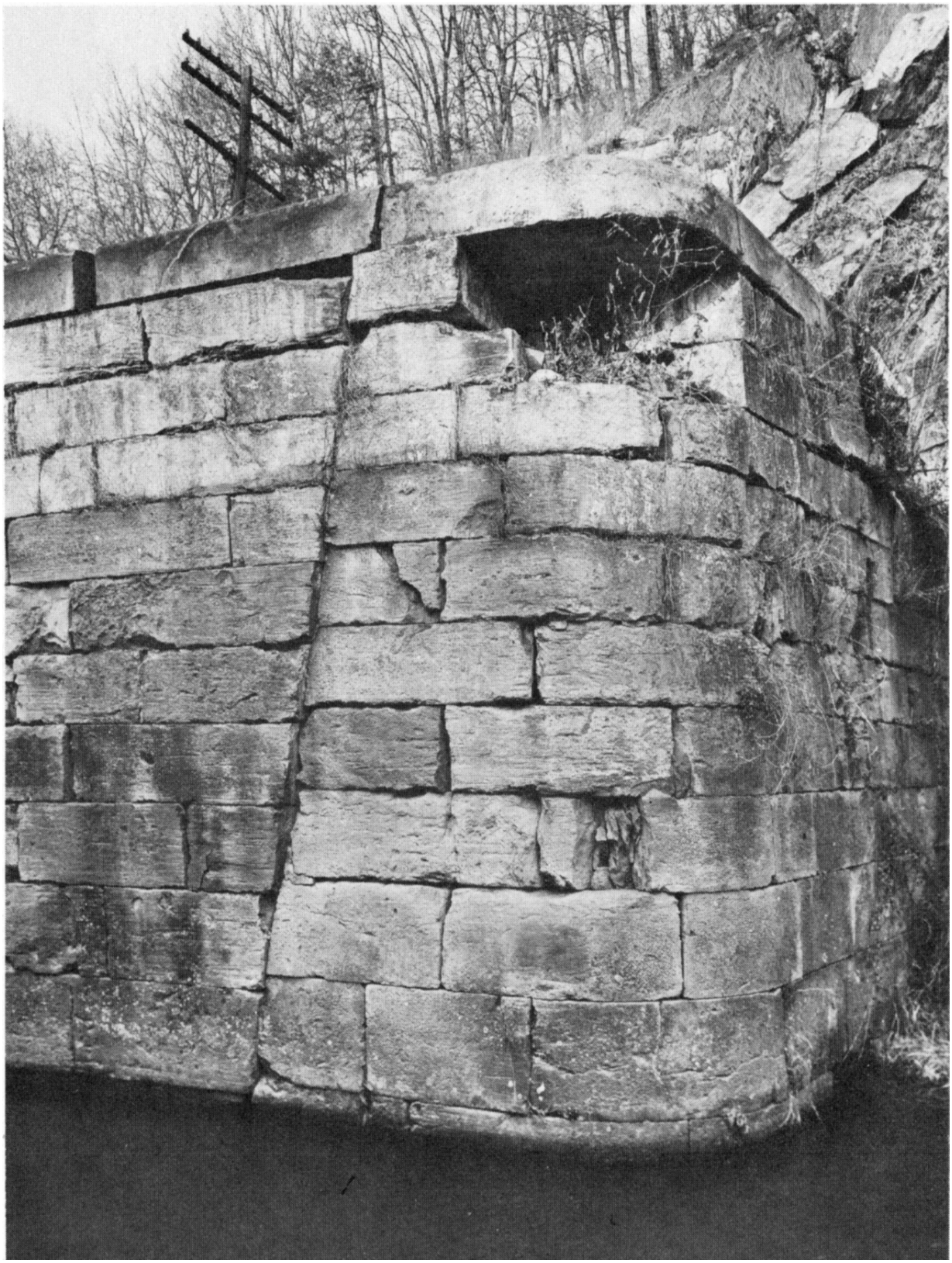
27: Nails in gate of Lock No. 44, 1967.
Photo by Hugo Skrastins, from NPS files, Department of the Interior.



28: Angle iron in gates of Lock No. 44, 1967.
Photo by Hugo Skrastins, from NPS files, Department of the Interior.

29: A-frame gate stop (AKA miter sill) on floor of Lock No. 55, 1960.
Photo by Jack E. Boucher, from HABS files, Library of Congress.

30: Berm side of Lock No. 55, 1960.
Photo by Jack E. Boucher, from HABS files, Library of Congress.



31: Berm wing wall of Lock No. 55, 1960.
Photo by Jack E. Boucher, from HABS files, Library of Congress

32: Holding irons (AKA cramps) in masonry of Lock No. 55, 1967.
Photo by Hugo Skrastins, from NPS files, Department of the Interior.

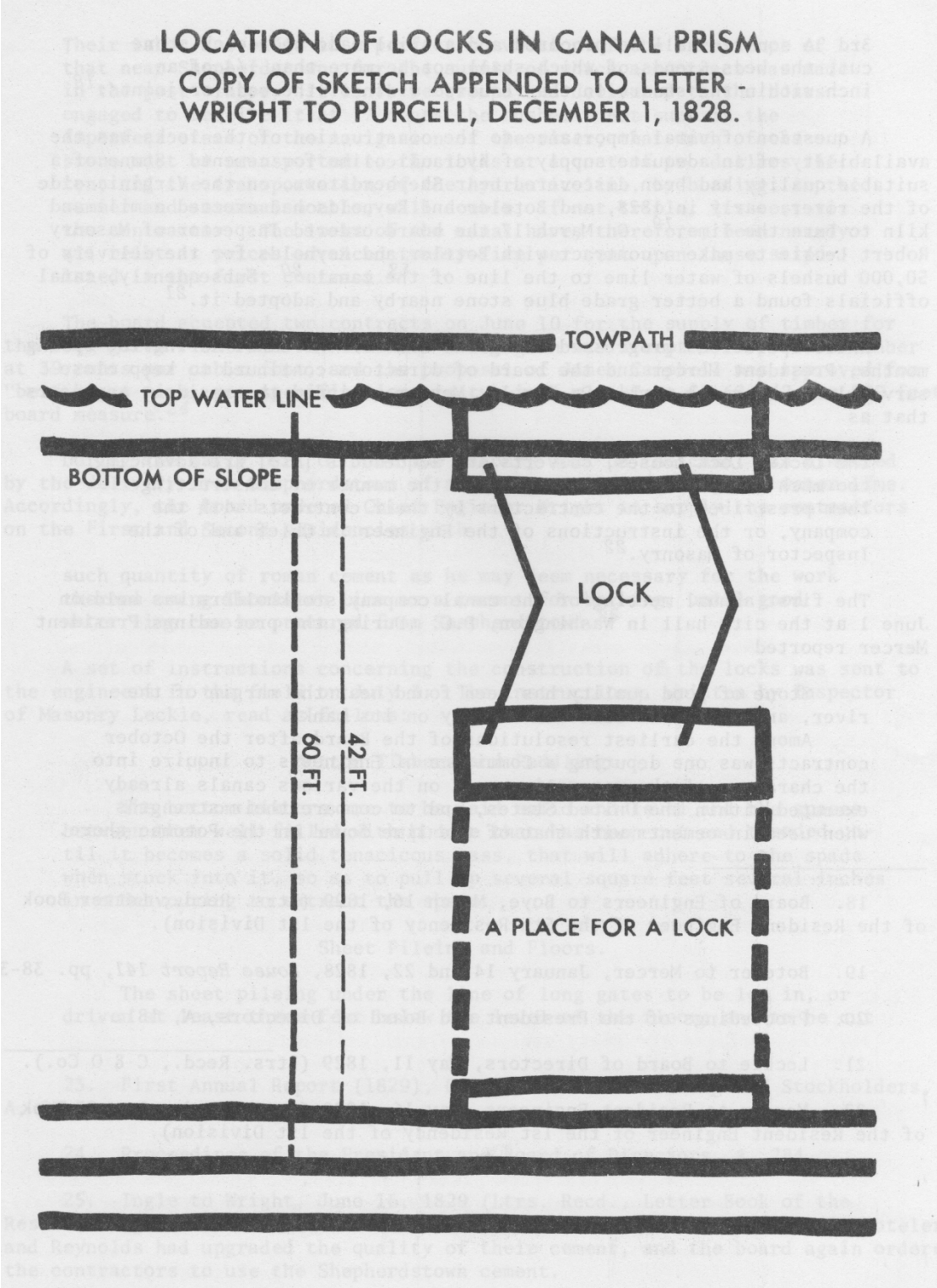
33: Wing walls and gate at upstream end of Lock No. 72, 1959.
Photo by Jack E. Boucher, from HABS files, Library of Congress.

34: Inside and upstream gates of Lock No. 72, 1959.
Photo by Jack E. Boucher, from HABS files, Library of Congress.

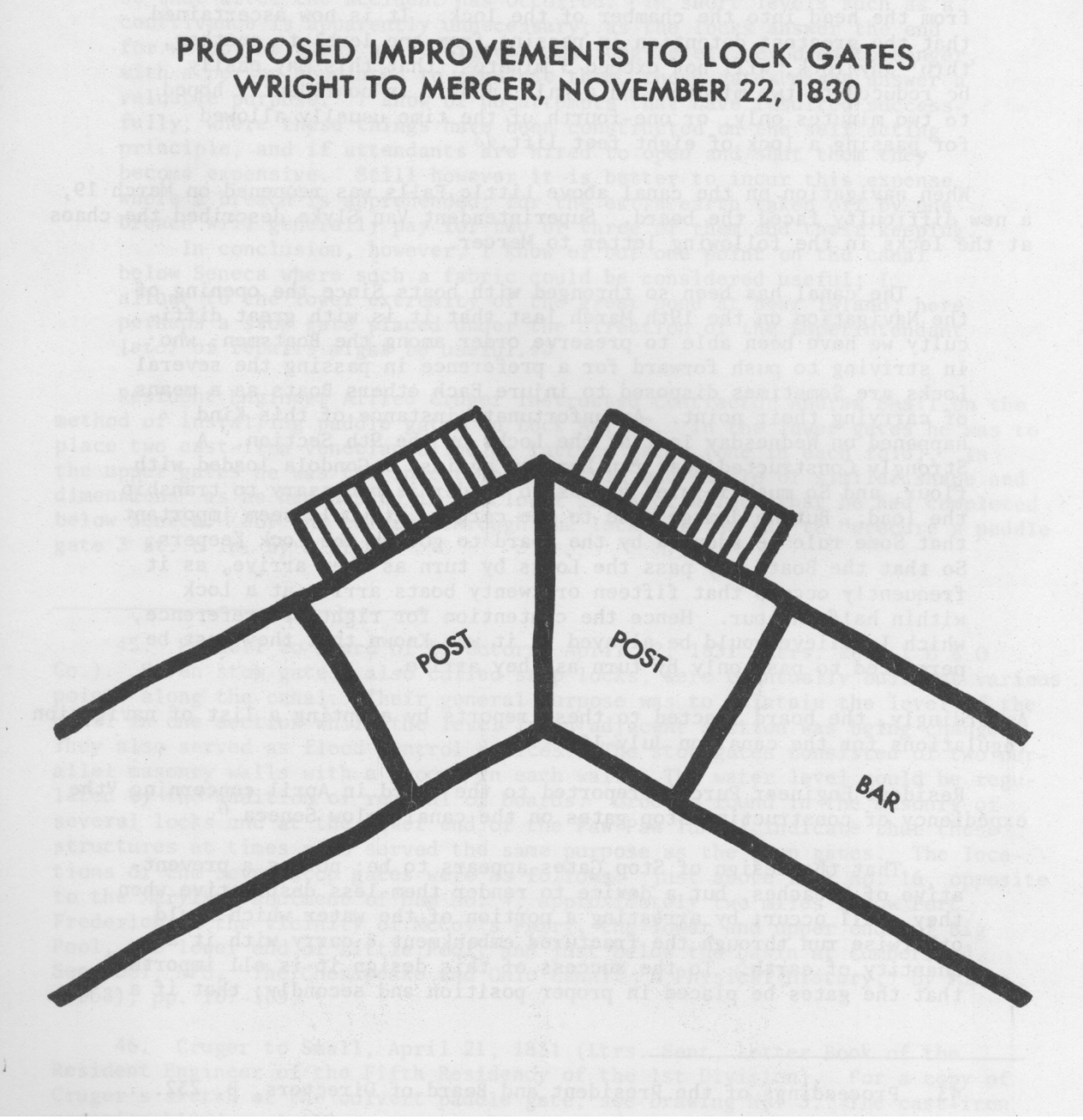
35: Lock No. 74, ca. 1936. Note lock-keeper's shanty and drop gate.
From NPS files, NA.

36: Typical snubbing post, 1967.
Photo by Hugo Skrastins, from NPS files, Department of the Interior.

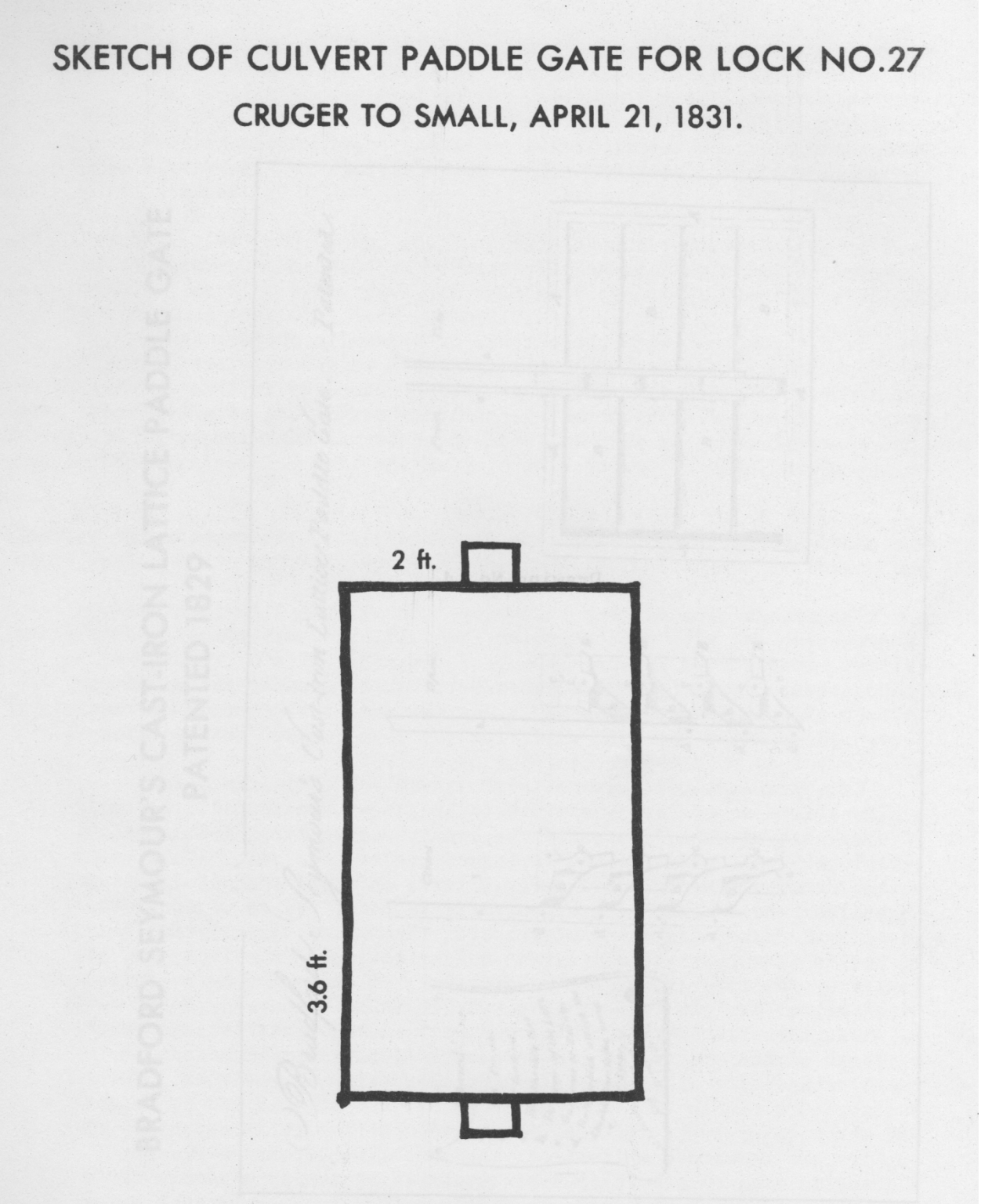
DRAWINGS



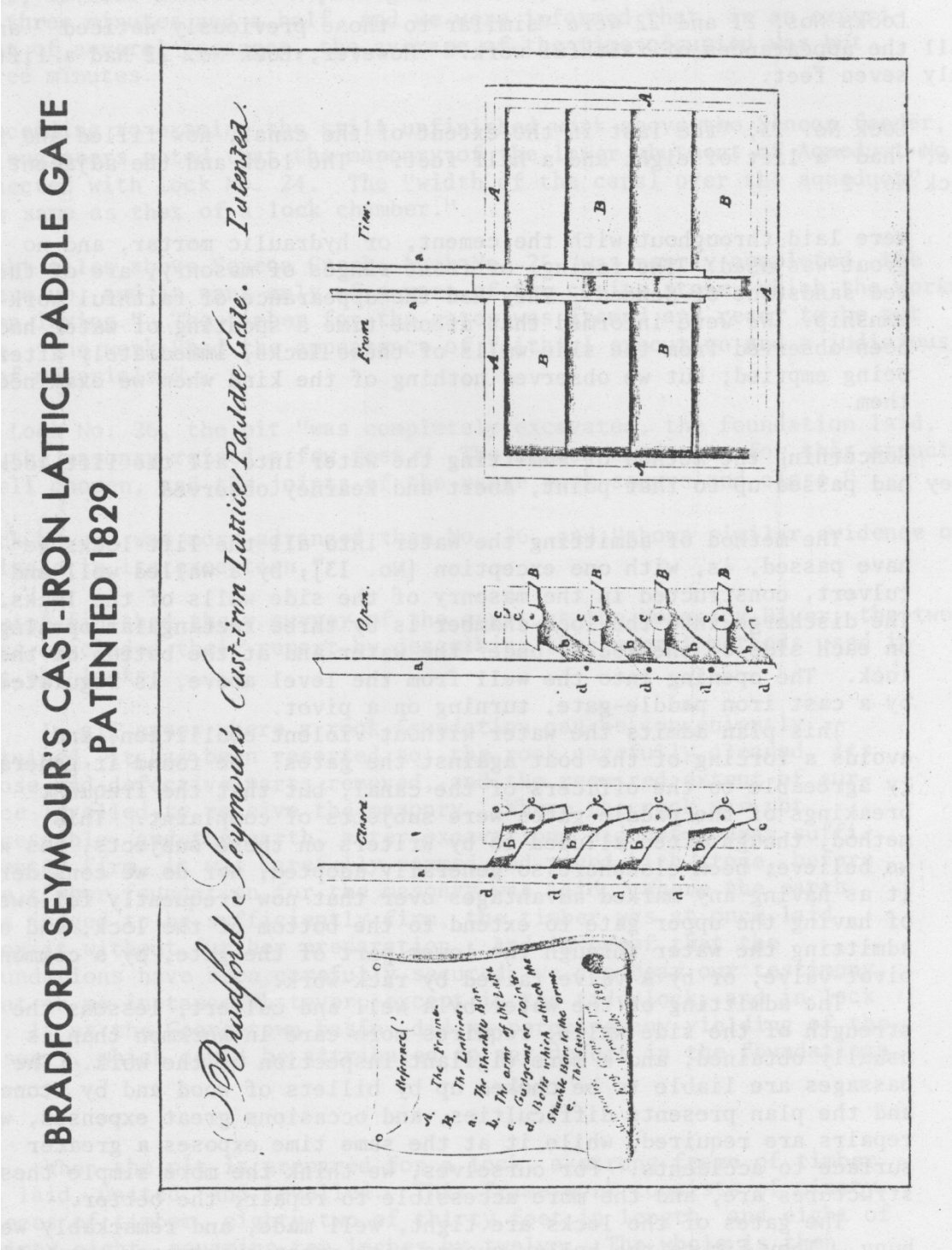
1. Location of Locks in Canal Prism.
Note that initial design allowed for the eventual construction of a second lock beside the first, which would have made it possible for two boats to be locked through simultaneously.



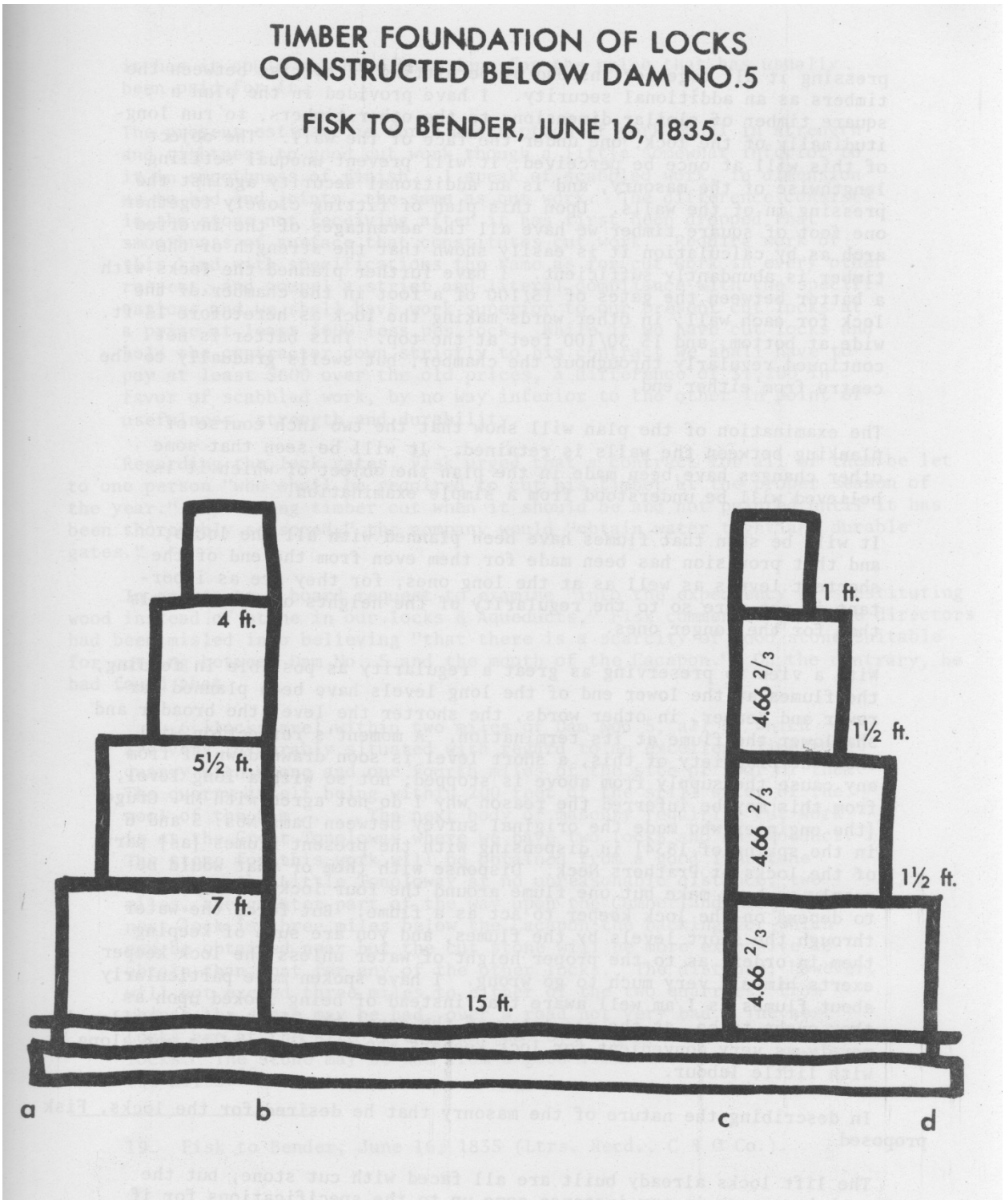
2. Proposed Improvements to Lock Gates.



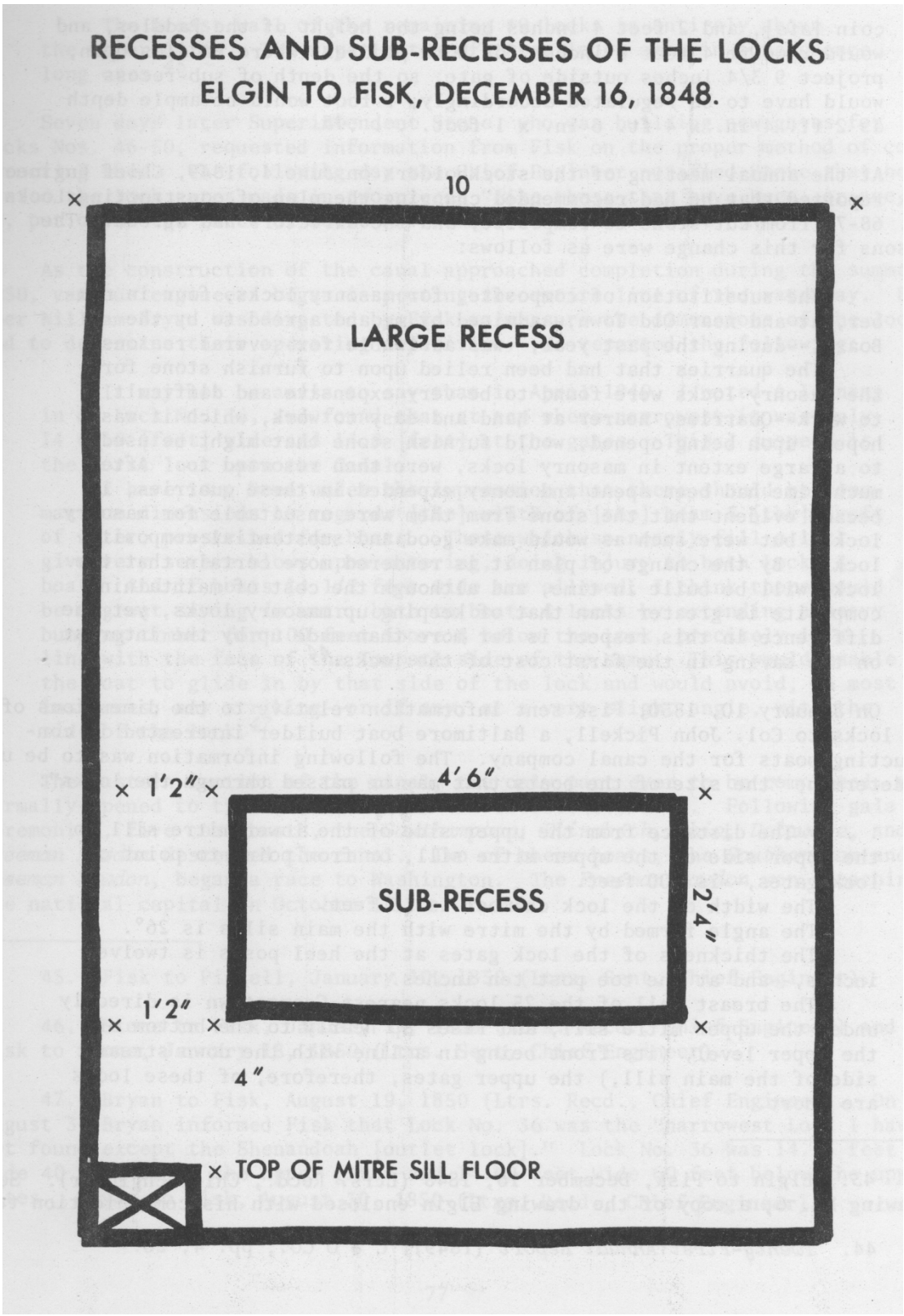
3. Sketch of Culvert Paddle Gate for Lock No. 27.



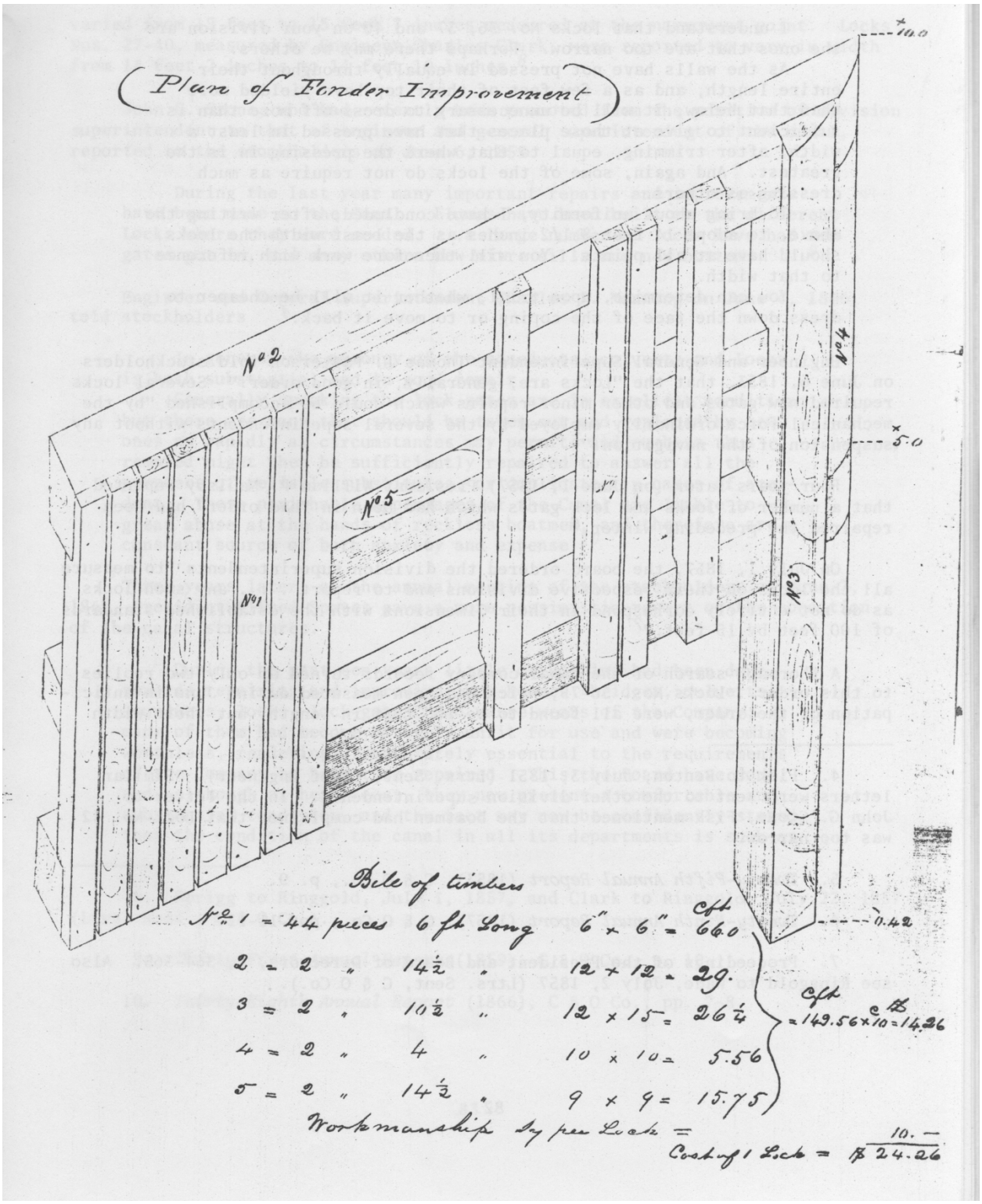
4. Bradford Seymour's Cast-Iron Lattice Paddle Gate, Patented 1829.



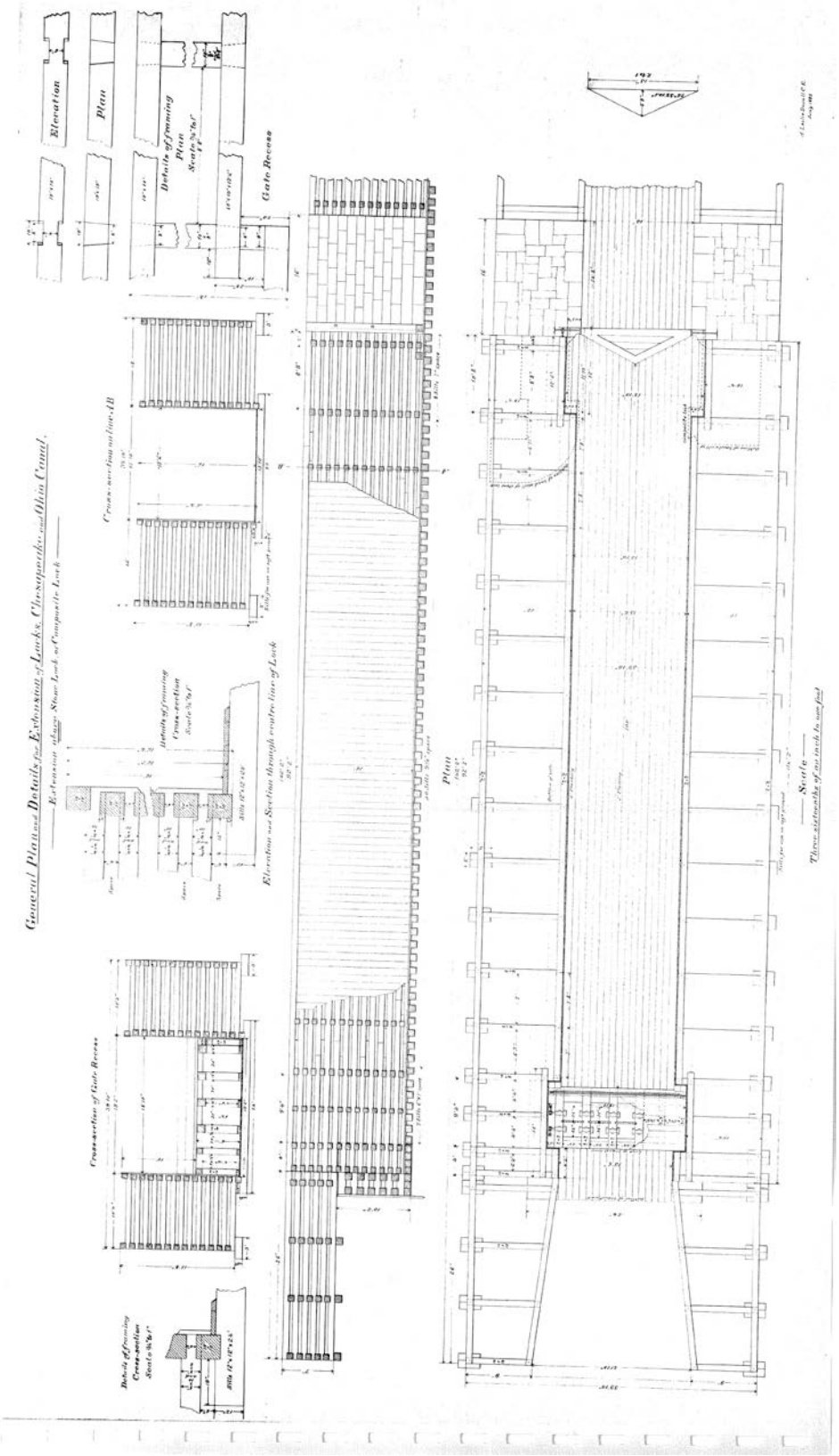
5. Timber Foundation of Locks Constructed Below Dam No. 5.



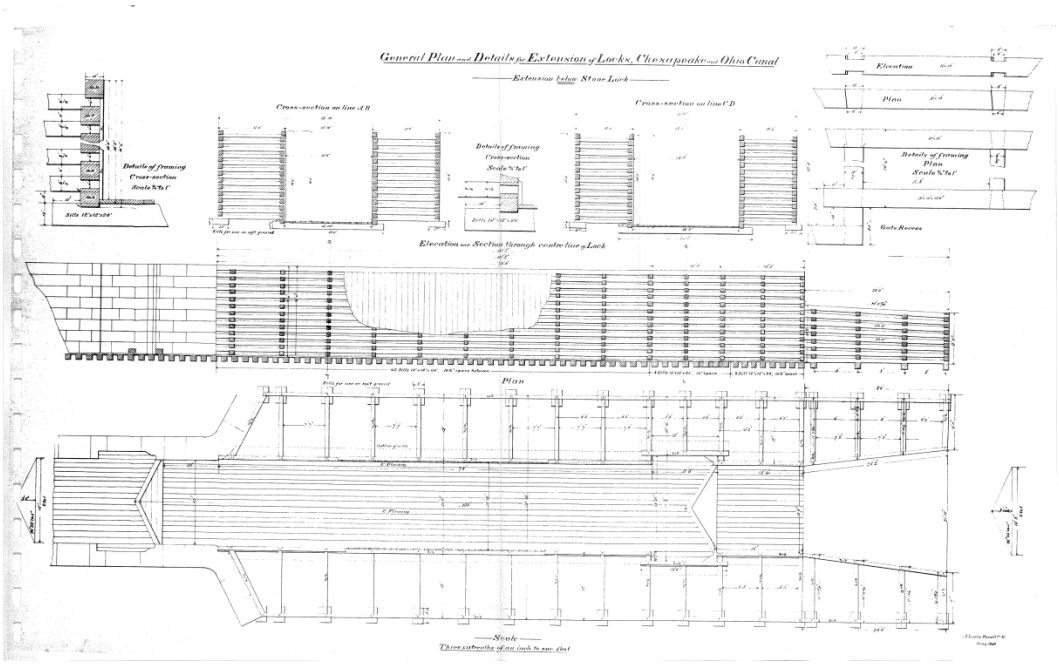
6. Recesses and Sub-recesses of the Locks.



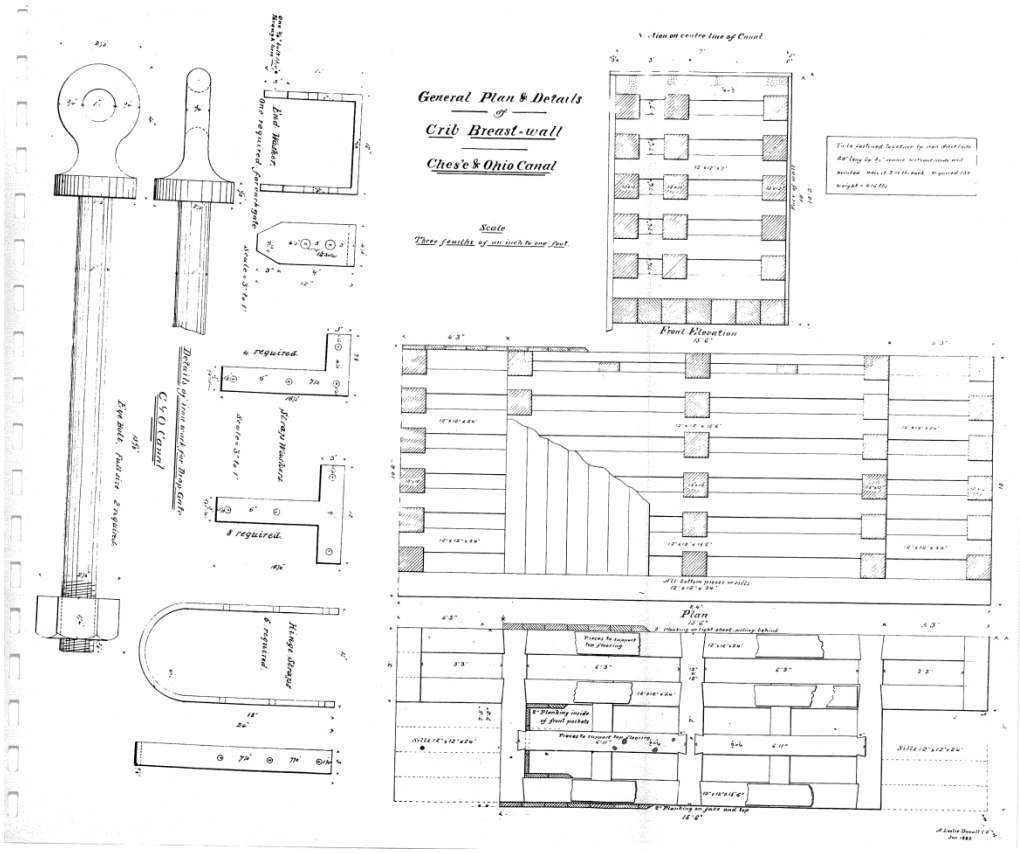
7. Plan of Fender Improvement.



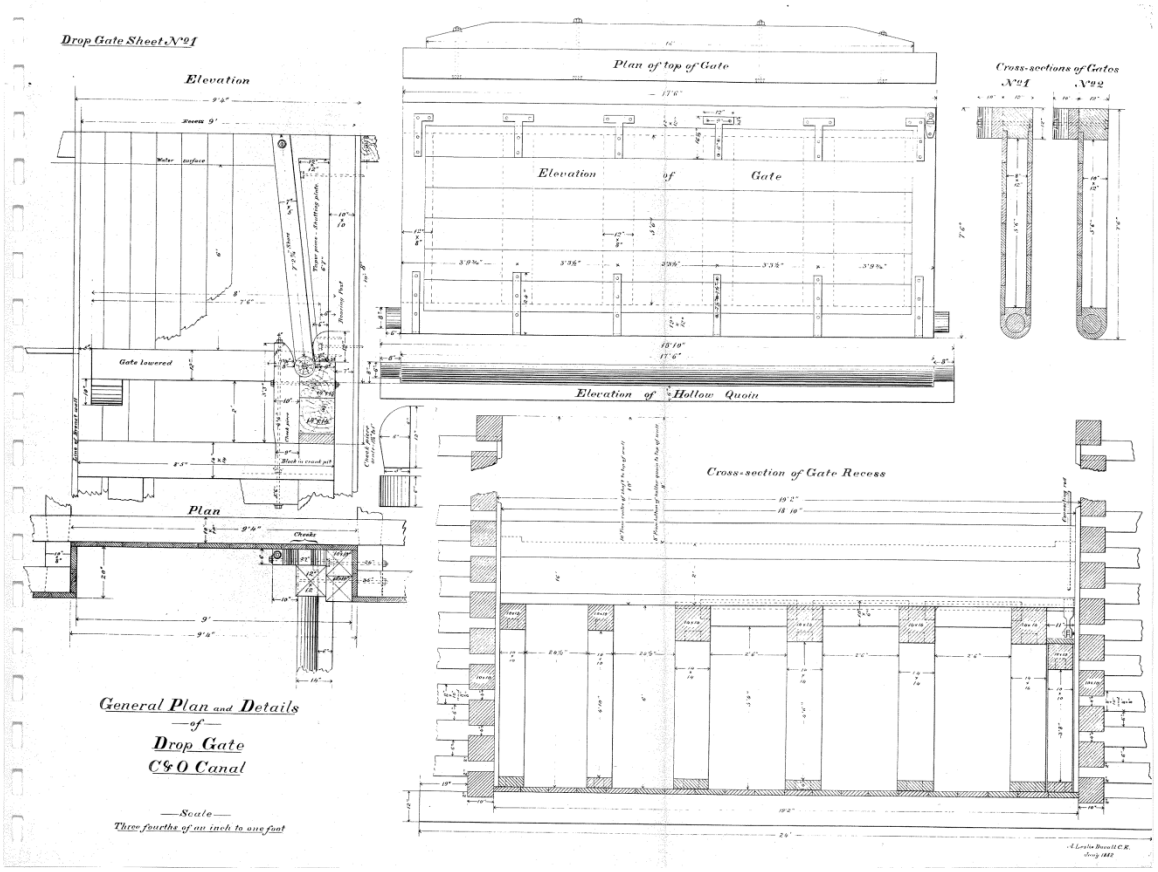
8. General Plan and Details for Extension of Locks, Chesapeake and Ohio Canal; Extension above Stone Lock, or Composite Lock.



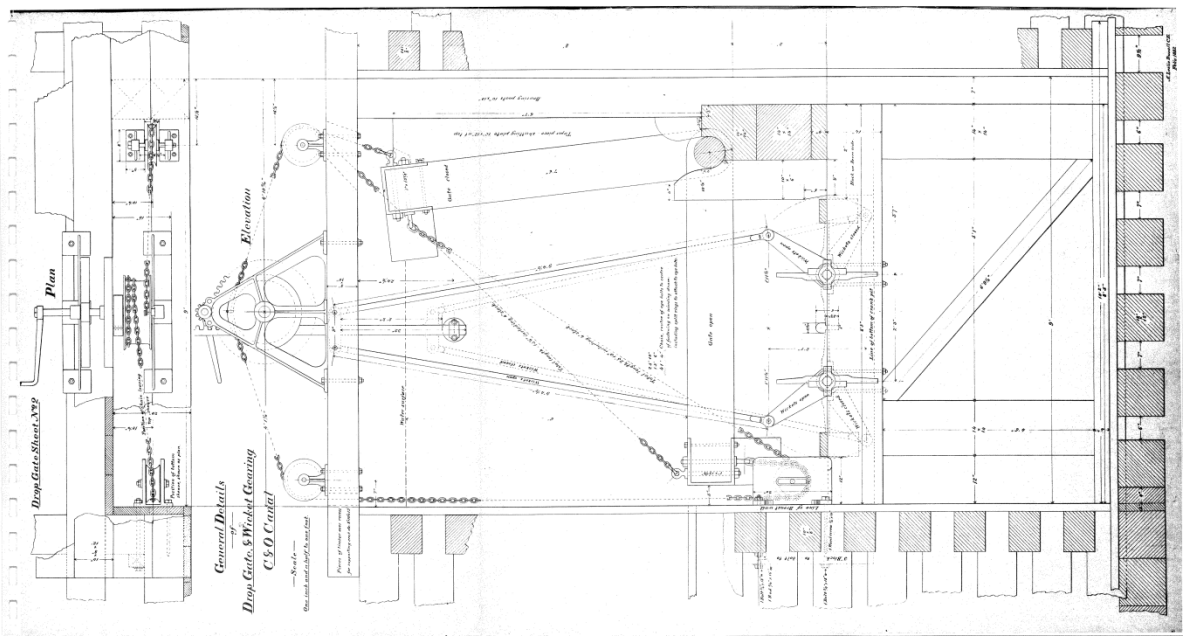
9. General Plan and Details for Extension of Locks, Chesapeake and Ohio Canal; Extension below Stone Lock.



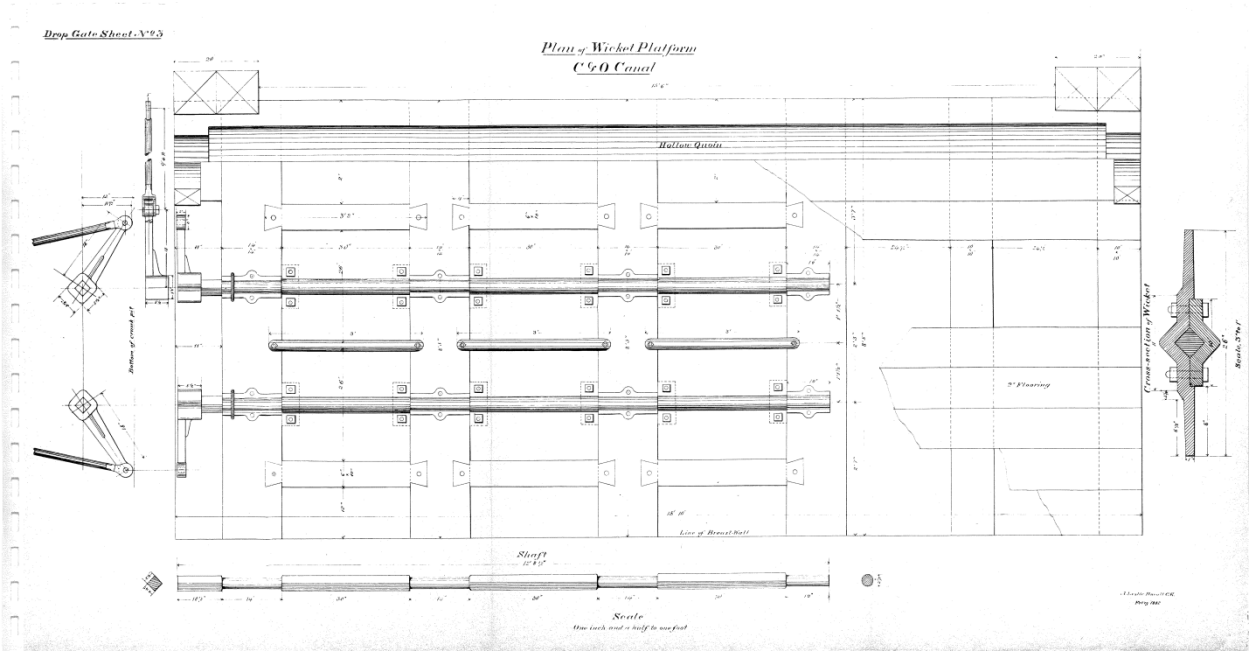
10. General Plan and Details of Crib Breast-Wall, Chesapeake & Ohio Canal.



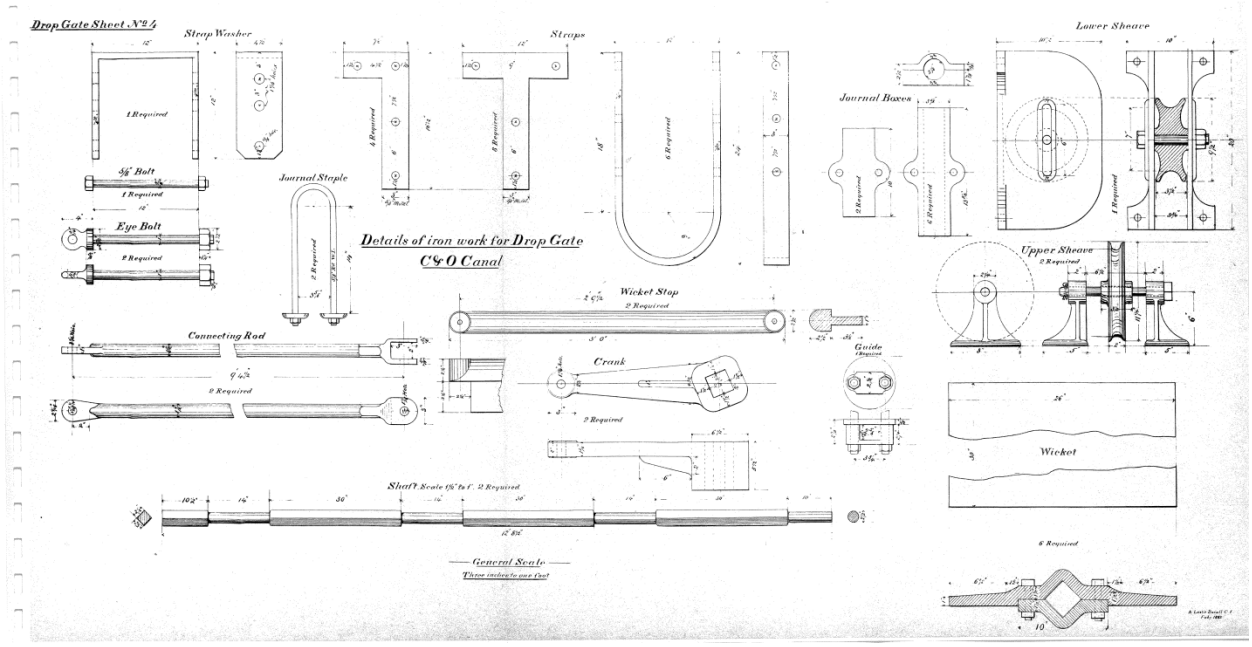
11. General Plan and Details of Drop Gate, C & O Canal.



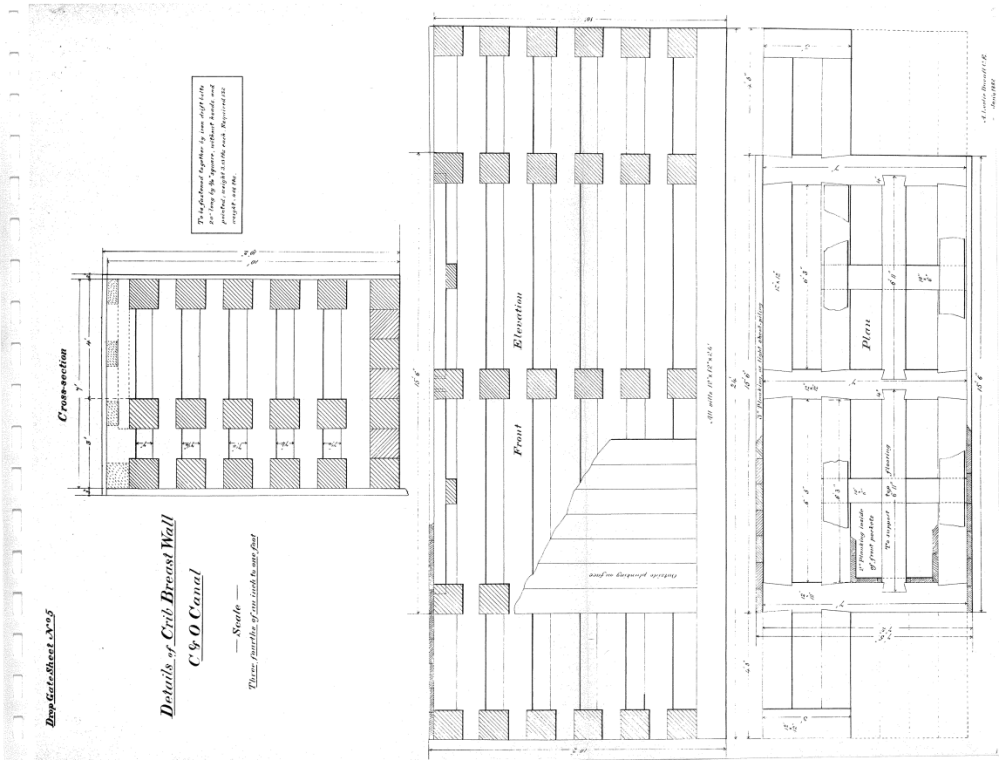
12. General Details of Drop Gate and Wicket Gearing, C & O Canal.



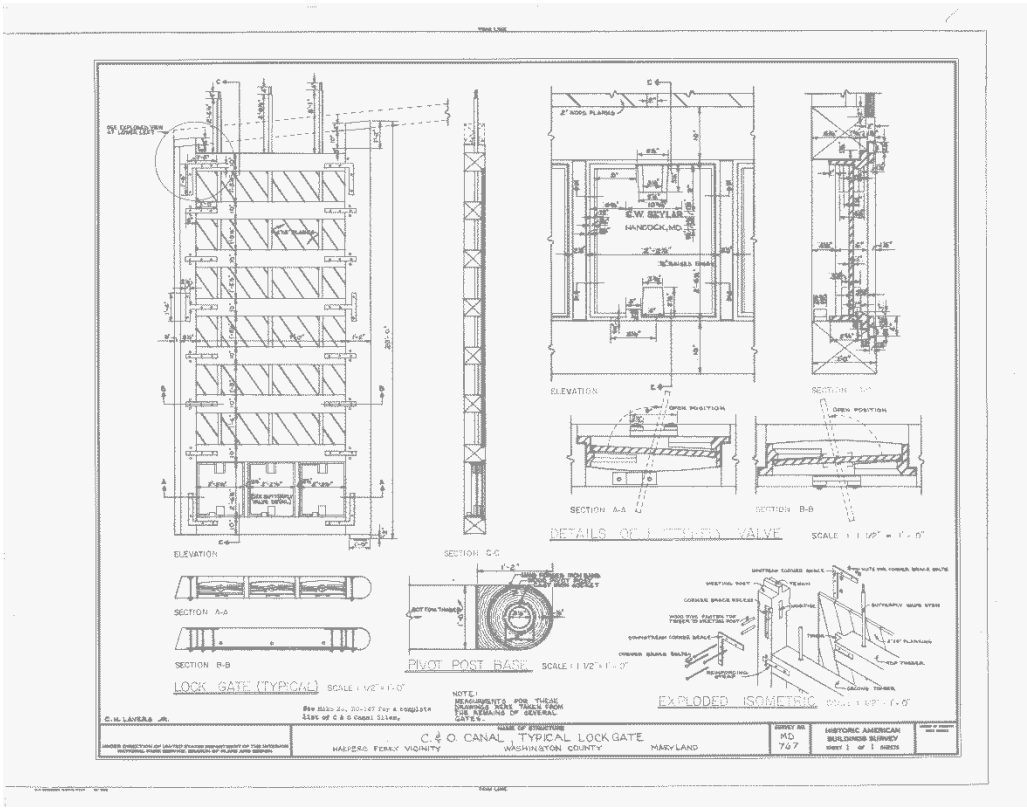
13. Plan of Wicket Platform, C & O Canal.



14. Details of Iron Work for Drop Gate, C & O Canal.



15. Details of Crib Breast Wall, C & O Canal.



16. Typical Lock Gate, C & O Canal.

BIBLIOGRAPHY

PRIMARY SOURCES

Manuscript Materials

The following documents are to be found in National Archives and Records Administration, Records of the National Park Service, Record Group 79.
See: www.archives.gov/dc-metro/college-park/

Assessment Book of the 5th Residency of the 1st Division, C & O Canal Company, 1829–33, 1 Vol.
Correspondence of Office of Trustees, 1913–38
Drafts of Letters Sent by the Chief Engineer, 1836–38, 46–52.
Drafts of Letters Sent by the Commissioner of the Chesapeake and Ohio Canal, 1835–40.
Drawings and Other Records Concerning Construction, 1828–37.
Index to Correspondence, 1913–38.
Index to Proceedings of Stockholders, C & O Canal Company, 1828–83, 1 Vol.
Indexes to Proceedings of the president and Board of Directors, C&O Canal Company, 1828–90, 2 Vol.
Ledgers, 1828–90, 5 Vols.
Letter Book of the Resident Engineer of the 1st Residency of the 1st Division, C & O Canal Company, 1828–32, 1 Vol.
Letter Book of the Resident Engineer of the 5th Residency of the 1st Division, C & O Canal Company, 1828–31, 1 Vol.
Letter Books of the Commissioner of the Chesapeake and Ohio Canal, 1835–42, 3 Vol.
Letters Received by the Chief Engineer, 1834–52.
Letters Received by the Commissioner of the Chesapeake and Ohio Canal, 1835–42.
Letters Received by the Office of the President and Board of Directors, C & O Canal Company, 1828–89.
Letters Received by the Office of the President and Board of Directors, C & O Canal Company, 1873–80.
Letters Received by Thomas L. Patterson, Assistant Engineer, 1841–42.
Letters Sent by the Chief Engineer, 1838–39, 1 Vol.
Letters Sent by the Office of the President and Board of Directors, C & O Canal Company, 1828–70, 12 Vols.
Letters Sent by the Office of the President and Board of Directors, C & O Canal Company, 1879–81, 1 Vol.
Letters Sent from the Engineer's Office at Cumberland, 1835–39, 1 Vol.
National Park Service Central Classified Files, National Capital Parks, 1933–49.
Printed Materials, 1816–1907.
Proceedings of the President and Board of Directors, C & O Canal Company, 1828–90, 13 Vols.

Proceedings of the Stockholders, C & O Canal Company, 1828–89, 5 Vols.
Records Concerning Proposed Extension of the Canal, ca. 1874.
Records of Ellwood Morris, Principal Assistant Engineer, 1838–40.
Records of William A. Pratt, Assistant Engineer, 1838.
Register of Letters Received by the Chief Engineer, 1835–40, 1 Vol.
Register of Letters Received by the Office of the President and Board of Directors, C & O Canal Company, 1828–70, 1 Vol.
Schedules of Bids for Locks 54–75, 1836, 1 Vol.

Published Documents

Annual Reports, C & O Canal Company, 1828–89.
Proceedings of the President and Directors of the Chesapeake and Ohio Canal Company and of the Corporations of Washington, Georgetown, and Alexandria, in Relation to the Location of the Eastern Termination of the Chesapeake and Ohio Canal. Washington, 1828.
Recommendations in Regard to Lengthening Locks of the Chesapeake and Ohio Canal Company. Annapolis, 1881.
Report of the General Committee of the Stockholders of the Chesapeake and Ohio Canal Company. Washington, 1839
Report to the Stockholders on the Completion of the Chesapeake & Ohio Canal to Cumberland, with a Sketch of the Potomac Company, and a General Outline of the History of the Chesapeake & Ohio Canal Co., from its Origin to February, 1851. Frederick, Maryland, 1851.
U.S. Congress. House. Committee on Public Lands. *Chesapeake and Ohio Canal Report*. H. Doc. 687, 81st Congress, 2nd Session, 1950.
U.S. Congress. House. Committee on Roads and Canals. *Chesapeake and Ohio Canal*. H. Report 141, 20th Congress, 1st Session, 1828.
U.S. Congress. House. Committee on Roads and Canals. *Chesapeake and Ohio Canal*. H. Report 414 to accompany H. R. 94, 23rd Congress, 1st Session, 1834.

SECONDARY SOURCES

Books

Dunbar, Seymour. *History of Travel in America*. New York, 1937.
Hahn, Thomas F. *Towpath Guide to the C & O Canal*, 4 Vols. Glen Echo, Maryland, 1971.
Harlow, Alvin F. *Old Towpaths*. New York, 1927.
Hulbert, Archer B. *The Great American Canals*. Cleveland, 1904.
Sanderlin, Walter S. *The Great National Project*. Baltimore, 1946.
Scharf, J. Thomas. *History of Western Maryland*, 2 Vols. Philadelphia, 1882.
Ward, George Washington. *The Early Development of the Chesapeake and Ohio Canal Project*. Baltimore, 1899.

Periodicals

Bearss, Edwin C. “1862 Brings Hard Times to the Chesapeake and Ohio Canal.” *West Virginia History*, January 1969.

Bearss, Edwin C. "War Comes to the Chesapeake and Ohio Canal." *West Virginia History*, April 1968.

Lee, Ronald F. "Chesapeake and Ohio Canal." *Columbia Historical Society Bulletin*, Fall 1939.

National Intelligencer (Washington), 1828–30.

Sanderlin, Walter S. "The Vicissitudes of the Chesapeake and Ohio Canal During the Civil War." *Journal of Southern History*, February 1945.

Technical Studies

U. S. Department of the Interior. National Park Service. "The Chesapeake and Ohio Canal: A Physical History," by John R. Miele. 1968. National Park Service MS on file at C & O Canal National Historical Park, Sharpsburg, Maryland.

U. S. Department of the Interior. National Park Service. "Historic Structure Report: The Composite Locks," by Edwin C. Bearss. 1968. On file at C & O Canal National Historical Park,

U. S. Department of the Interior. National Park Service. "Historic Structure Report: Lock No. 40," by John R. Miele. 1964. On file at C & O Canal National Historical Park,

U. S. Department of the Interior. National Park Service. "Historic Structure Report: Lock No. 36," by John F. Luzader. 1963. On file at C & O Canal National Historical Park,

U. S. Department of the Interior. National Park Service. "Outline Report on the Restoration of the Chesapeake and Ohio Canal for Recreational Use (Georgetown, D.C. to Seneca, MD)," by Thomas C. Vint. Ca. August 1940. Report in National Park Service Classified Files, National Capital Parks, 1933–49, Record Group 79, Records of the National Park Service, National Archives.

U. S. Department of the Interior. National Park Service. "Preliminary Historical Memorandum on the General Dimensions and Construction of the Chesapeake and Ohio canal from Rock Creek to Seneca Creek," by Rogers W. Young. January 1939. On file at C & O Canal National Historical Park Archives, Interior Building, Washington, D.C.

U. S. Department of the Interior. National Park Service. "A Preliminary Historical Study on the Area Along the Maryland Shore of the Potomac at Great Falls During the Heyday of the Chesapeake and Ohio Canal, 1858–80," by Rogers W. Young. June 1939. On file at C & O Canal National Historical Park Archives, Interior Building, Washington, D.C.

U.S. Department of the Interior, National Park Service. "A Survey of Historic and Prehistoric Archeological Sites Along the Chesapeake and Ohio Canal National Monument, 1961–1962," by Edward McMillan Larrabee. 1961. National Park Service MS on file at C & O Canal National Historical Park.