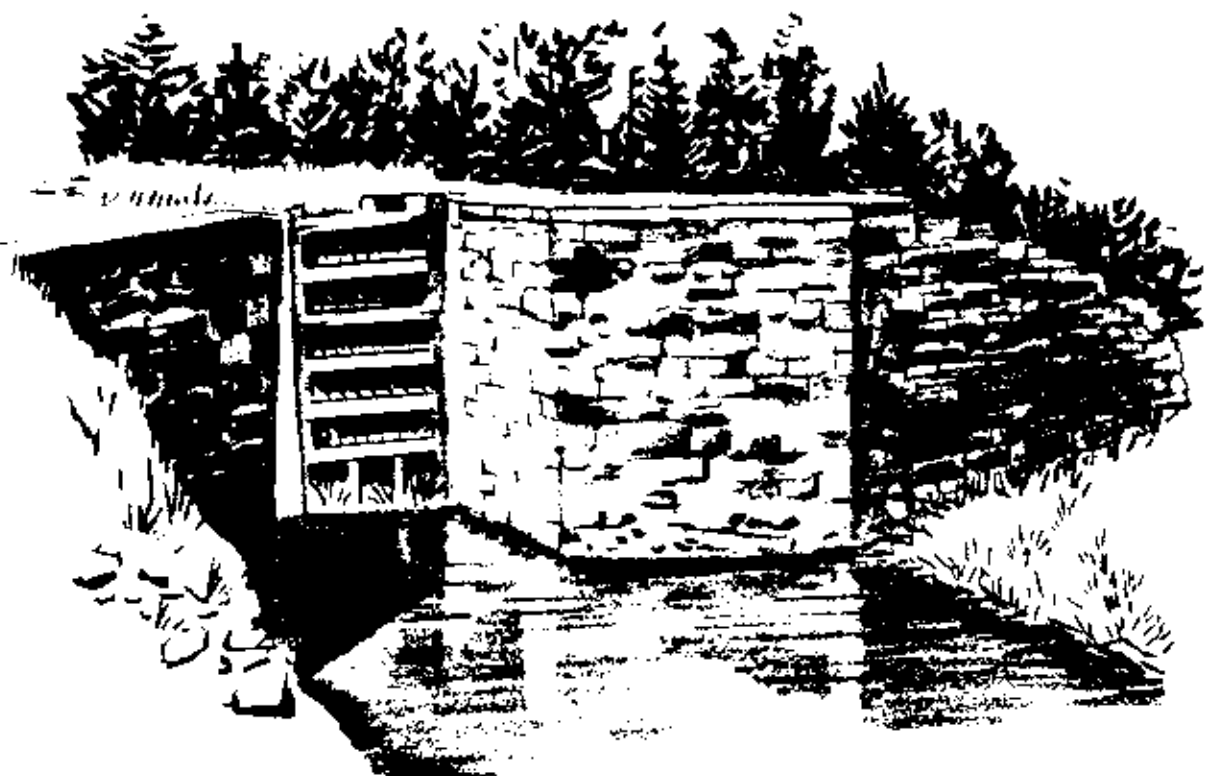


412/D-219

THE COMPOSITE LOCKS

CHESAPEAKE & OHIO CANAL NATIONAL MONUMENT

Historic Structures Report
Historical Data Section



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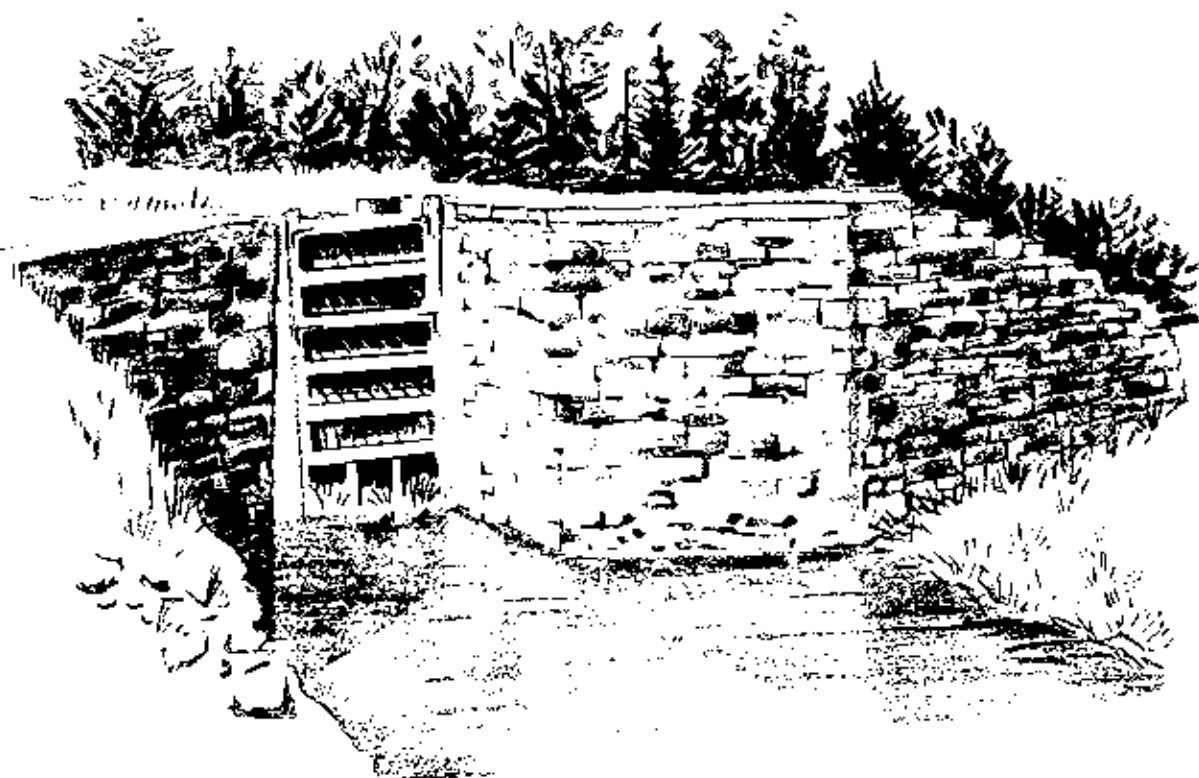


412/D-219

THE COMPOSITE LOCKS

CHESAPEAKE & OHIO CANAL NATIONAL MONUMENT

by
EDWIN C. BEARSS



DIVISION OF HISTORY
Office Of Archeology And Historic Preservation

March 31, 1968

National Park Service

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FOREWORD

This report has been prepared to satisfy in part the research needs as enumerated in RSP CHOH-H-12, Historic Structures Report, Parts I and II, Locks on the Chesapeake and Ohio Canal. As proposed by Acting Park Superintendent Robert W. Bell, this report was to be a thorough historic study of all lift locks along the C & O Canal to insure that there will be "an accurate and historic restoration" of those locks which it is administratively determined to restore.

When research for the subject RSP was undertaken, it was apparent that in the time allocated for the project it would be impossible to prepare a Historic Structures Report to encompass all the locks on the canal. It was therefore determined to focus this report on the Composite Locks, as Lock No.66, which is to be restored in Fiscal Year 1968, is of this type. RSP CHOH-H-12 accordingly deals exclusively with the Composite Locks. A Supplemental RSP will have to be prepared and scheduled for the Masonry Locks.

A number of persons have assisted in the preparation of this report. Particular thanks are due to Superintendent Dean McClanahan and Supervisory Ranger Robert Bell for their assistance at the site; to Architect Archie Franzen for sharing his knowledge of construction techniques on the canal; to Frank Sarles for reading the manuscript; and to Mrs. Lucy Pope Wheeler for her painstaking work at the typewriter, and editorial assistance.

E. C. B.

Washington, D. C.
March 21, 1968

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1. MICHAEL BYRNE FAILS TO BUILD THE TUNNEL HOLLOW LOCKS

By 1836 the Board of Directors of the Chesapeake and Ohio Canal Company was ready to take steps to secure capital with which to begin construction of the "50-mile section" between Dam No. 6 and Cumberland, Maryland. Bonds to a value of \$3,000,000 were issued in that year by the State of Maryland. This subscription, however, soon involved the Company in a tangled and increasingly precarious financial situation. Trouble was encountered in obtaining the bonds or proceeds from their sale; consequently the Company, although the surveys had been completed, had insufficient capital to call for bids for construction of the canal above Dam No. 6. Delays had occurred in implementing the law, while Maryland politics necessitated the postponement of the appointment of state commissioners to negotiate the sale of the bonds. By the end of March 1837, the Board of Directors had determined to purchase the bonds on behalf of the Company, if the state agents in Europe failed to market them. A provisional contract was drawn up.¹

Chief Engineer Charles B. Fisk on May 1, 1837, recommended to Commissioner George Bender (who in 1835 had been given the task of supervising construction of the Canal above Dam No. 5) that whenever the Board deemed it advisable, "to put more work under contract," he would

1. Walter S. Sanderlin, *The Great National Project, A History of the Chesapeake and Ohio Canal* (Baltimore, 1946), 129-130.

recommend the letting of the entire line from Dam No.6 to Cumberland. If the Board sanctioned his suggestion, Fisk would recommend that Assistant Engineer Ellwood Morris, with his rodman (A. H. Williams), be left in charge of the division from Licking Creek to Hancock. Moreover, it was intended that Morris have supervision of that section of the line east of the area over which Charles H. Randolph had jurisdiction. This section would include the Tunnel, over which he already had general superintendence through Assistant Engineer Henry H. Dungan. Fisk believed that Dungan ought to continue to oversee work at the Tunnel.

Randolph at the same time would be in charge of construction from Section No. 324 to Section No. 349. As heretofore he would oversee the work at the Oldtown Deep Cut, Section Nos. 333 and 334.²

The Board, on June 15, advised Bender that after studying Fisk's recommendations it had determined 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

2. Fisk to Bender, May 1, 1837 (Ltrs. Recd., C & O Co.). All manuscript source material referred to in this report are deposited in Record Group No.79, Department of the Interior files, National Archives and Records Center. Morris' crew included, besides himself and Dungan, Benjamin F. Brannan, Felton Henderson, James Thompson, Morgan Snively, and Thomas Snyder.

difficult sections (the cost of which had been estimated to exceed \$20,000 each), together with such less costly sections as Chief Engineer Fisk believed necessary in the construction of those costing over \$20,000, would also be put up for contract. Fisk had alerted the Board that 58 sections would be involved. Proposals at the same time would be invited for the remaining locks, culverts, and aqueducts.³

In view of the decision to award contracts for construction between Dam No.6 and Cumberland, as many of the "engineering corps" as could be spared from their other duties were turned to "revising the line and setting stakes, many of which had been displaced by accident or design."

On June 14, 1837, the Company inserted in the area's newspapers an announcement:

At the Office of the Commissioner of the Canal at Hancock until the 2d day of August, and at this Office until the 3d 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.

The work in question was located between Dam No.6 and Cumberland, and covered about 29 of the 50 miles between these points. The sections would be staked and the line ready for examination by July 1. It had been estimated by Company engineers that the "cost of the work . . .

3. Ingle to Bender, June 15, 1837 (Ltrs. Sent, C & O Co.); 9th Ann. Rpt., C & O Canal Co.

offered exceeds two million of dollars; and the general health of the country through which it is to pass" was believed to be as "good" as that of any other line of public works currently in progress.⁴

The Committee on Contracts reported on September 29, 1837, after opening and abstracting the bids, that James Cameron was low bidder for Lock No.56, James Wherry for Locks Nos.57 and 58, and Michael Byrne for Locks 59-66. The next day the Board of Directors wrote the successful bidders, informing them that their proposals had been accepted. But as the Company had not consummated its negotiations for the sale of the \$3,000,000 of 6 percent bonds of the State of Maryland (the proceeds of which were to fund the new work), no money could be disbursed to the contractors. Until the bonds were marketed, the Company would be unable to make payments on estimates, except through use of notes about to be issued.⁵

Nearly nine months passed before Byrne signed his contract. On May 30, 1838, Chief Engineer Fisk notified Assistant Engineer Morris of the Tunnel Residency that Byrne would build Locks Nos.59-60 "at prices with which you will be furnished, and which will without question carry him through, and with which he is satisfied." Byrne would be

4. Journal of Proceedings of the President & Directors, Advertisement No.58.

5. Proceedings of the President and Board of Directors, E, 318-319; Ingle to Pratt, Sept. 30, 1837 (Ltrs. Sent, C & G Co.).

paid as follows:

Ashler per superficial foot	\$ 1.10
1-foot coping per lineal foot	2.20
2-foot coping per lineal foot	3.30
Quoins per foot vein including &c the ashler upon them per foot vein	11.00
Backing per perch	2.20

Project Engineer Dungan would use these figures to calculate the money due Byrne on his contract and then draw up two estimates--one for Locks Nos. 59 to 66, and the other for roads, railroad cars, and tracks built to facilitate the construction of these eight locks. Three thousand dollars had been budgeted by the Board of Directors for construction of facilities to get the stone from the quarries to the lock sites in Tunnel Hollow and below.⁶

These locks were to be built in accordance with specifications formulated by Chief Engineer Fisk and his staff in 1837. A copy of the specifications is found in Appendix A.

As the stone for the locks in Tunnel Hollow would have to be hauled from the quarry in Twigg Hollow, above the Lock No. 61 site, Byrne turned a crew under James Lambie to building a railway on which horse cars would be employed. Work on the railway lagged, and it was February 28, 1839, before Lambie reported that \$2,206.12 1/2 had been expended on it. He broke down the costs into categories, which were

6. Fisk to Morris, Feb. 11 & May 30, 1838 (Ltrs. Recd., Morris).

as follows:

For Labor--grubbing, grading, and laying tract

926 1/2 days--labor, at \$1.25 per day, . . .	\$1,158.12 1/2
48 days--blacksmith, at \$1.75 per day, . . .	84.
2 1/2 months blacksmith at \$16 per month, . .	40.
65 days labor--superintendent at \$2 per day	130.
28 kegs of powder at \$3.75 per keg	105
	<u>\$1,517.12 1/2</u>

Timber--including cost of delivery

164 1/2 days--carpenter, at \$1.75 per day	\$287.87 1/2
141 3/4 days--labor, at \$1.25 per day	177.18 3/4
133 days--horses, at \$1.00 per day	133.
77 3/4 days--drivers at \$1.25 per day	70.93 3/4
	<u>\$689.00</u>

Meanwhile, Assistant Engineer Morris had been devoting much thought to the positioning of Byrne's locks, the amount of excavation required for the lock pits, and the type of foundations needed. On December 7, 1838, he forwarded to Fisk his estimate of the cost to the Company of the excavation and masonry of four locks, each of eight-foot lift, located in Tunnel Hollow. In obtaining this data he had made calculations siting the locks in three locations. He reported:

<u>Position</u>	<u>Excavation</u>	<u>Additional Masonry</u>
Position projected on survey of December 1, 1836	11,000 perches cost \$56,111.	3,601 perches
Each lock moved up 200 feet above position one	19,100 perches cost \$63,487.	3,167 perches

7. Lambie to Fisk, Feb. 28, 1839 (Ltrs. Recd, Morris).

Each lock moved up the length
of its pool above position one . . . 22,000 perches 1,943 perches
cost \$50,611

Excavation figured at x 1.50 per perch

Masonry calculated at x 11. per perch.⁸

Lock No.61 was nearest the quarry Byrne had opened at the head of Twigg Hollow. It was also the first lock site reached by the railway built under Lambie's supervision. Consequently, Byrne in assigning construction priorities gave it the highest, as with a tight money market the cost of transporting stone for this lock would be less than for the other seven he had contracted to build in the spring of 1838.

To enable Byrne's people to get started, Morris had one of his assistants, Benjamin F. Brannan, prepare figures as to the amount of earth that would have to be removed in excavating the pits for Locks Nos.60 and 61.⁹ (A copy of the computations and drawings by Brannan is found in Appendix B).

Morris, at the same time, prepared a "modified scale" for Lock No.61, computing it at \$10 per perch, and allowing \$1 per perch for the construction of the railway. According to this revised scale

8. Morris to Fisk, Dec. 7, 1838 (Ltrs. Recd., Chief Engineer).

9. "Brannan's Calculations of the Pits of Locks 60 & 61" (Ltrs. Sent, Morris).

Byrne was to be allowed:

<u>Material</u>	<u>Per Perch</u>		<u>No. of Perches</u>		<u>Amount</u>
Cement and sand x	\$ 1.00	x	1150	=	\$1,150
Laying all around	2.20		1150		2,530.50
Backing delivered	2.50		750		1,875
Cut stone (coping	18.00		40		720
(quoins	22.00		30		660
(ashler	14.00		330		4,620
					<u>11,555.50</u>
			1150 perches x \$10		<u>11,500.00</u>
					\$55.50

The cost of drywalling and paving was estimated at \$3.50 per perch. One dollar per perch could be charged against the cost of laying, which would make the charge for the stone delivered, \$2.50 per perch.¹⁰

In the autumn of 1838 Byrne put a crew to work in the quarry in Twigg Hollow cutting stone for Lock No.61.¹¹ He hoped that sufficient stone would be on hand when the pits for Lock Nos.60 and 61 were excavated to begin laying stone immediately. The pit for Lock No.61 had been dug and the foundation built by the carpenters and their helpers by early March 1839. Byrne's stone masons were now ready to move in. Before they commenced laying stone, Assistant Engineer Morris notified Byrne that he had "fixed upon the heights of the courses of lock No.61."

10. "Perch Scale of Lock 61" (Ltrs. Sent, Morris).

11. In November Byrne had 34 men and one horse working in the quarry, but in December this force was reduced to 12 men. At the same time, Lambie added to his crew working on the railway from the quarry to the lock site.

They would be :

<u>Towpath Wall</u>	<u>Berm Wall</u>
Coping = 12 inches	Coping = 12 inches
1 = 12 inches	11 = 12 inches
2 = 13 inches	12 = 13 inches
3 = 14 inches	13 = 14 inches
4 = 15 inches	14 = 15 inches
5 = 16 inches	15 = 16 inches
6 = 17 inches	16 = 18 inches
7 = 18 inches	17 = 19 inches
8 = 20 inches	18 = 20 inches
9 = 22 inches	19 = 21 inches
10 = 24 inches	20 = 23 inches
<hr/>	<hr/>
183 inches	183 inches
Joints - 2 inches	Joints - 2 inches
<hr/>	<hr/>
185 inches	185 inches

Thus, the height of the walls would be 15 5/12 feet or 185 inches. Consequently, it would be necessary for Byrne to have his stone cutters "cut the several courses to the exact heights named, as they will increase by the joints in settling so as to rise the altitude we want."

Byrne would also see that in each of the gate recesses, a small sub-recess (four inches deep, six feet in height, and of the same length as the main recess) was built. The under side of this sub-recess would be at "the bed of the mitre sill both at the upper and lower gates." At the tail of the lock, the four-inch recess would be formed on the towpath side by a six-inch check along the lower bed of Course No.7 for the length of the main recess, and on the berm side by an eight-inch check along the lower bed of Course No.17, the length of the main recess. At the head of the lock the four-inch recess

would be formed on the towpath side by a 12-inch check along the upper bed of Course No.10. The top of the recess would be formed by projecting Course No.6.

On the berm side there would be an 11 inch check, four inches deep, along the upper bed of Course No.20. This would be the bottom of the recess. The top of the recess would be formed by a one-inch check, four inches deep, along the lower bed of Course No.16. (See Appendix C for a copy of Morris' plan for the sub-recesses.)

The hollow quoins were to be cut to fit "the four-inch recess by checking hack, square with Recess face, 4 in. deep at the intersection of the strap of the Hollow Quoin with the face of the Recess."¹²

By the winter of 1838-39, it was apparent to Byrne that he could not complete the locks as scheduled, so he wrote the Board asking that he be granted an extension from November 1, 1839, until November 1, 1840. Fisk, when asked to comment on Byrne's request, reported to the Board that he felt Byrne was justified in his plea, as he was unwilling to bind himself to accomplish the impossible. He requested that the Board authorize the Commissioner to make the change, "as Byrne had already been at very great expense in preparing for work, for which as yet he had received no estimate." The Board was agreeable.¹³

12. Morris to Byrne, March 1, 1839 (Ltrs. Sent, Morris).

13. Proceedings of the President & Board of Directors, P,22.

Byrne, like the other contractors on the "50-mile section," had found himself caught up in the inflationary spiral. Wages and prices had risen rapidly in the months since he had formulated his bid. In April, before his masons had done an appreciable amount of work on Lock No.60, he complained to Morris that unless he were allowed more than \$10 per perch for his work, he would be compelled to abandon his contract. Morris accordingly recommended that Byrne be paid \$11 per perch, which would increase the cost to the Company of Lock No.61 from \$11,555 to \$12,617.¹⁴

The Board of Directors, realizing that Michael Byrne was one of their most industrious and successful contractors, voted to increase his allowance for Lock No.61.

Another problem now arose to haunt the Company. As the weeks passed, it became apparent to Morris' engineering detail that quarries in the Paw Paw Bends area would not provide a sufficient quantity of suitable building stone for the locks contracted to Byrne, if they were built in accordance with the specifications adopted in 1837.

Fisk, on June 8, 1839, reported that a failure of the quarries relied on for facestone for the first eight locks below the Tunnel made necessary a change in the plan of construction.

14. Perch Scale for Lock No.61, May 1, 1839 (Ltrs. Sent, Morris).

If the immediate construction of Dam No.7 should be agreed upon, the present plan might be executed for all but two or three of these locks. The ashler and coping could then be prepared at the quarries near Hancock and boated up the canal upon the completion of Dam No.7. Only a short time would be needed to put up the locks, after all the materials had been prepared. If, however, the decision was to dispense with the building of Dam No.7, the Company would either have to build rubble locks or temporary wooden locks.¹⁵

As an alternative to his chief's proposal, Morris on August 18 notified Fisk that in constructing Locks Nos.60 to 66 the Company should adhere to the plan prepared in 1835, when the difficulties of securing suitable stone for them was foreseen. He accordingly advanced a proposal to build these locks of rubble masonry, with the quoins and coping of cut limestone. The rubble masonry could be secured in the vicinity of the locks, and the cutstone could be purchased from Hantz's quarry, near Hancock, taking advantage of periods when the Potomac was navigable for barges to transport the stone upstream.

The bond in these rubble locks, from front and rear, "to be headers and stretchers alternately and to be suitably broken by each necessary

15. Fisk to Board, June 8, 1839 (Ltrs.Recd., C & O Co.).

course." The "entire work was to be laid in full beds of Pure cement mortar and grouted with Pure Cement Grout, course by course."

Morris was satisfied by the recent experiments undertaken by Colonel Pasley that "pure cement when set was equal in strength to building stones which from descriptions must be quite as strong as sandstone." If this were true, a lock constructed in this manner would soon "become as solid as the stone itself . . . and endure for ages." The use of "Pure cement mortar," Morris estimated, would probably increase the cost of cement per lock to \$1.75 per perch.

Should rubble locks be adopted as he advocated, he would recommend that the thickness of the walls beneath the coping be increased to five feet, provided the dimensions of the base was held at seven.¹⁶

Chief Engineer Fisk did not agree with Morris' proposal to substitute locks built of rubble masonry for those Byrne had contracted to construct of cutstone. Morris' letter, however, caused him to undertake an investigation to determine if there might not be another solution to the lack of suitable building stone in the region of the Paw Paw Bends. Before making any recommendations to the Board, Fisk asked Superintendent of Masonry, A. B. MacFarland, to examine and report on the local quarries.

16. Morris to Fisk, Aug. 18, 1839 (Ltrs. Recd., Chief Engineer).

On checking distances, MacFarland found it was a little over three miles from a point on the Virginia shore, opposite Tunnel Hollow, to Quarry No.1 atop Purslane Mountain. There was a road to within one-half mile of the quarry. MacFarland believed the one-half mile of road could be opened by the contractor at a small cost. As there might not be enough stone in Quarry No.1 to provide cutstone for all the locks in question, MacFarland pinpointed another quarry on Sideling Hill, four miles by road from the mouth of Tunnel Hollow. This second quarry was in "the heart of the stone region . . . where there are stone enough for 50 Locks, if needed, and of a quality . . . equal to the best granite."

MacFarland was satisfied that Byrne, if he used these quarries, would encounter less difficulty in hauling the stone than Mr. Childs had experienced in reaching the quarry from which he secured stone for Aqueduct No.9.¹⁷

Fisk, after reviewing MacFarland's paper and discussing the situation with Byrne concluded that Byrne would be compelled to abandon his contract if the Company insisted on building the locks of cutstone. He, however, could not sanction in its entirety Morris' recommendation to construct the locks of rubble masonry.

17. MacFarland to Fisk, Sept. 11, 1839 (Ltrs. Recd., Chief Engineer.

Writing the Board on September 25, 1839, he advised the members to make a change in the plans and specifications of the locks under contract to Byrne along with those not currently under contract. He recommended the adoption of a plan for Composite Locks similar to those found on New York's Chenango Canal. Reports regarding these locks were favorable.

If the Board went along with his suggestion, he would see that dry walls were used "for all the lock from a point seven feet below the upper gates down to the tail of the lock." These dry walls were to be faced with timbers and planks, "so arranged as to be water tight, and so secured to the dry walling as to be easily and readily removed and replaced in the winter whenever required." This woodwork to prolong its utility should be kyanized.

Fisk would also recommend "a heavy stone coping (instead of wood as on the Chenango Canal)." This stone could be secured at Hantz's Hancock quarry and boated up to the locks, where it was to be laid after the "50-mile section" had been opened to navigation.

The saving to the Company by the adoption of this proposal would not be less than \$750 per foot lift. For example, on the eight locks (Nos. 59 to 66) under contract to Byrne, and on the five locks (Nos. 67-71) not under contract, the saving would total not less than \$78,000.

Byrne, he reported, for the past several months had been "working to great disadvantage & loss in consequence of the uncertainty there is in regard to his work." To relieve the contractor, he suggested

the Board appoint a committee to inquire into the propriety of a change in plan to the one he had recommended. If the committee favored the new plan, he urged that an arrangement be made with Bryne to permit him to build the locks upon "the new plan and upon what terms."¹⁸

Harassed by mounting financial difficulties, the Board at this time took no action on Fisk's proposal to substitute composite for cutstone locks in the Paw Paw Bend area.

Meanwhile, Morris on September 2, 1839, had urged Fisk to change the site of Lock No.62 to permit the feeder from Dam No.7 to enter the waterway "fairly upon the bottom land without being forced out either into the river or into a dangerous proximity to it as must now be the case."

Should the locks in Tunnel Hollow be planned to receive a feeder from Dam No.7, Lock No.62 would have to be repositioned. He trusted Fisk would approve it being sited on a "tangent at the head of the curve leading out of Tunnel Hollow, which would place it in the ravine about 500 feet below Lock No.63 and making four locks in the hollow-- Nos.63-66.

To place Lock No.62 at the point of the hill, as he had originally suggested, would be objectionable, because it would be on a sharp curve of 120 degrees.

18. Fisk to Board of Directors, Sept. 25, 1839 (Ltrs. Recd., C & O Co.). The kyanizing process consisted of dipping the timbers in a "corrosive sublimate" to prevent early decay.

With Lock No.62 sited as now recommended, the waste and waste weir combined on the rocky point would operate as a waste "both to the feeder & to the main line . . . & would have as its outlet" a ten- or 12-foot culvert, which would be built in the feeder near where Sandy Flat Hollow debouches into Tunnel Hollow.¹⁹

Fisk and the Board refused to go along with Morris' suggestion at this time, as the Company had much more vexing problems with its liquid assets all but exhausted. Within the next three months, the Company, as well as Byrne, was broke. On December 7, 1839, Byrne advised the Board that he wished to abandon his contract for Locks Nos.59-66. The Board was agreeable, and as a severance charge it agreed to pay Byrne \$6,000 "in full satisfaction for all his claims against . . . [it] on account of said locks, he is to surrender to the Company." In addition, Byrne would turn over to Morris, as representative of the Chesapeake and Ohio Canal Company, all "the materials got out by him for the locks," his railway, railway cars, cranes and shanties. Byrne, after securing the property to be surrendered, would in cooperation with Morris prepare an inventory of the same. One of the men residing in the shanties was to be employed as a guard.²⁰

19. Morris to Fisk, Sept. 2, 1839 (Ltrs. Recd., Chief Engineer). This correspondence demonstrates that at this time the Company still planned to build Dam No.7 and four locks in Tunnel Hollow. As an economy measure, Dam No.7 was eliminated, and the locks in Tunnel Hollow were reduced from four to three.

20. Fisk to Morris, Dec.7, 1839 (Ltrs. Recd., Morris); Proceedings of the President and Board of Directors, F, 126.

In the 19 months that Byrne had held the contract for Locks Nos.59-66, work had progressed at a snail-like pace. A Company official reported on June 30, 1840, that Byrne's people had done very little at the eight locks. Of the \$210,607 dollars programmed for these "works of art" only \$14,775 had been paid to Byrne on the estimates forwarded by the project engineers. On December 28, 1839, the cost of these locks had been estimated at: Lock No.59, \$24,635; Lock No.60 \$25,846; Lock No.61 \$25,296; Lock No.62 \$26,165; Lock No.63 \$30,860; Lock No.64 \$30,860; Lock No.65 \$30,860; and Lock No.66 \$30,860.²¹

The Board of Directors at this time advised the stockholders of the Chesapeake and Ohio Canal Company that on the "50-mile section" work on the masonry had lagged. There were between Dam No.6 and Cumberland 22 lift-locks with a total lift of 182 feet, 4 aqueducts, 30 culverts, one dam, and one guard lock. Of the locks, five (Nos.55, 57, 73, 74, and 75) were finished, or nearly so. Materials had been prepared for five more, while the remaining 12 locks could be "regarded as not being commenced."

21. Byrne to Fisk, June 30, 1840 (Ltrs., Recd., Chief Engineer). In the period, May 20--December 7, 1839, \$2,410 had been disbursed to Byrne under the Lock No.60 account; \$5,453.33 in the Lock No.61 account; \$4,725.92 in the Lock Nos.62-66 account; and \$1,797.46 for the railway. Ledger Book B, pp.725, 739, 765.

Most of the "works of art" on the ten miles above Dam No.6 and on the sections between Cumberland and the Narrows had been finished. Along the intermediate 30 miles very little masonry work had been built. The reason: the difficulty in securing at a reasonable cost suitable building stone. Chief Engineer Fisk had suggested that structures of kyanized wood "may be resorted to as a temporary, if not permanent, substitute for some of the works of masonry where this scarcity of stone exists." But because of the shortage of working capital, the Board had continued to drag its feet. The members were understandably more concerned with meeting the financial crisis which had engulfed the Company.²²

22. 12th Annual Report . . . (Washington, 1840), 14-15.

I. BUELL & WATT BUILD THE TUNNEL HOLLOW COMPOSITE LOCKS

After construction was stopped, following the exhaustion of the Company's immediate resources, the State of Maryland paused in its promotion of the project to review the condition of the canal. By 1839 the waterway had been completed as far as Dam No.6, a distance of 135 miles from Georgetown. Work done thus far had been accomplished under the most trying circumstances. A succession of obstacles had marred construction, delayed the completion, and increased the cost of the undertaking far beyond all expectations. Disputes over the right-of-way, cholera epidemics, continual labor, financial and engineering problems, and political machinations all contributed their share. By 1842 over \$10,000,000 had been disbursed for the building of the canal and incidental expenses. In supplying the major share of this sum, the State of Maryland had acquired control and direction of the Company's affairs from the Federal Government and the cities of the District.¹

The section of the line from Dam No.6 to Cumberland, which had not yet been completed, was referred to as "the 50-mile section." While the region through which it passed included some of the most beautiful and rugged country in the Potomac Valley, it lacked good building stone. Thus, both excavation and masonry work were expensive.

1. 13th Annual Report, 28; Sanderlin, *History of the C & O Canal*, 138. About \$2,000,000 more had gone into interest and losses.

Although all but 18 1/2 miles of the "50-mile section" had been completed, the unfinished parts were dispersed over the entire 50 miles and included most of the heaviest work--the Paw Paw Tunnel, the Deep Cut, three aqueducts, and 17 locks. Great difficulty would be faced in acquiring the funds and recruiting the necessary laboring force.²

By 1842 the financial condition of the Company was deplorable, if not hopeless. Company officials publicly acknowledged debts of \$1,196,400 above all means. Many of the Company's resources were tied up in the few remaining five percent bonds it owned.³

Farther progress by the canal was impossible without additional help, but in the straitened financial circumstances of the State of Maryland, additional aid from that source was problematical. Many State leaders were hostile toward the Company for the way it had disposed of the bonds authorized by the Act of 1836, and with the completion of the Baltimore & Ohio Railroad to Cumberland in 1842 many legislators saw little need to extend the canal.⁴ In 1836 Maryland had endeavored to put all internal improvement companies in the State

2. Fisk to President & Directors, Dec. 1, 1842; 16th *Annual Report* (1844); Sanderlin, *History of the C & O Canal*, 139.

3. Sanderlin, *History of the C & O Canal*, 139.

4. *Niles Register*, 68, No.1 (March 8, 1845), 16; *Ibid.*, No.2 (March 15, 1845), 23-24; Sanderlin, *A Study of the History of the Potomac River Valley*, (Washington 1949), 78.

on a firm financial footing through an appropriation of \$8,000,000 of which the Baltimore & Ohio Railroad and Chesapeake & Ohio Canal each received \$3,000,000. Because of the tightness of the international money market in 1837 and the years immediately following, the Companies were unable to dispose of the state bonds (the form Maryland assistance invariably took) at the premium required by law or even at par. Thus the large subscription was not fully effective and did not prevent the rise of a new crisis in railroad and canal finances. The Baltimore & Ohio being in a stronger position financially and having the advantage of full use of its line as far as completed was not as seriously affected as the Canal Company. The Canal Company had hypothecated the bonds at levels well below par, in return for bank loans, incurring the wrath of state leaders for so doing. Thus three years were to pass before means were provided to resume work on the waterway. Meanwhile, the Baltimore & Ohio, being in a stronger economic position, was able to continue with the construction of its line toward the Ohio River.

Early in May 1843 the Board of Directors of the Chesapeake and Ohio Canal Company established ground rules under which a contract for the completion of the ditch could be negotiated.⁵

5. Proceedings of the President and Board of Directors, G, 38-40.

The contractor was to receive Canal Company bonds maturing in 20 years, bearing six percent interest payable semi-annually. Work was to begin in 60 days and the canal should be completed in two years. The maximum cost at which the contract would be negotiated was Chief Engineer Fisk's estimate of 1842. As security for the repayment of the bonds, the Company offered a pledge of all revenue, subject to existing mortgages. The latter phrase constituted a stumbling block, because the State of Maryland refused to waive its sizeable prior liens.⁶

The Board of Directors in 1843 and 1844 devoted considerable attention to a campaign designed to secure legislative approval of a waiver by the state. Since 1844 was both a national and state election year, there was considerable excitement. Two big issues in the local campaign were the related subjects of the state credit and the condition of the canal. In some instances friends of the canal were defeated, but on the whole the results were favorable to both issues. Governor-elect Thomas G. Pratt and many members of the new Assembly proved friendly to the canal.⁷

6. Sanderlin, *History of the C & O Canal*, 148.

7. Mandeville to Price, Oct. 5, 1844; *A Short History of the Public Debt of Maryland*, 49; Sanderlin, *History of the C & O Canal*, 152.

Following the established procedure, proponents of the canal introduced a bill in the new legislature to provide for the waiver of the state lien. This time after a stiff fight it met with success. Both the canal bill and a stamp act to provide effective means of meeting the interest on the state debt, after being defeated, were reconsidered and passed in the crucial House of Delegates by one vote, 38 to 37. The canal bill provided that the Chesapeake & Ohio Canal Company could issue \$1,700,000 of preferred construction bonds on the mortgage of its revenue, when it received guarantees from interested parties for 196,000 tons of trade annually for five years.⁸

The Canal Company and its friends promptly moved to secure the guarantees required and to receive the full benefits of the act. President James M. Coale traveled to Boston and New York to confer with officials of the Cumberland coal companies.⁹

There he found evidence of interference by the Baltimore & Ohio interests. "I am induced to believe," he wrote the president of the Maryland Mining Company, "that the Baltimore & Ohio Road interest, as their last throw of the die are endeavoring to prevent the fulfilment of the guaranties."¹⁰

8. *Niles' Register*, 68, No.1 (March 8, 1845); Sanderlin, *History of the C & O Canal*, 152.

9. Proceedings of the President and Board of Directors, G, 228; *Niles' Register*, 68, No.6 (April 12, 1845), 85.

10. Coale to Allen, May 8, Ltr. Bk. G, 258.

An article reputedly inspired from Baltimore was published in the New York *Herald* casting doubts on the value of the canal. It exaggerated the duration of enforced suspension during the winter months. It emphasized the more frequent handling and trans-shipment of coal via the canal route and the greater damage to the product. President Coale refuted these assertions, but the effect of their publication among financial interests in New York was felt.¹¹

All the while, the Board conducted an extensive correspondence in its efforts to assure the guarantees. Friends of the canal were active along the Potomac. Public meetings were held in the "upper counties, and spirited addresses" were made to "enlist confidence in the completion of the work." An ordinance was passed by the city of Alexandria to indemnify any of its citizens who might sign the bonds of guarantee.¹²

Twenty-eight instruments, including both personal and corporate, were eventually signed and delivered for 225,000 tons of trade. Governor Pratt formally accepted the guarantees and certified his approval in August 1845.¹³

11. Coale to Allen, May 13, 1845, Ltr. Bk. G., 263-264.

12. *Niles' Register*, 68, No.6 (April 12, 1845), 85.

13. Special Report, 17th Annual Meeting (July 22, 1845); Sanderlin, *History of the C & O Canal*, 154.

After the guarantees were approved, the Board of Directors proceeded to the letting of the contract. It rejected the first proposals of prospective contractors in August 1845 and granted a ten-day delay for the submission of new offers.¹⁴

On September 23, 1845, the Board accepted the proposal of Walter Gwynn, William Thompson, James Hunter, and Walter Cunningham. Agents of the state gave their approval, and the contract was reduced to writing and executed. The additional mortgage to the State of Maryland, required by the legislature, was signed on January 5, 1846.¹⁵

By terms of their contract, Messrs. Gwynn & Co. agreed to provide materials of the required quality according to the specifications laid down by Chief Engineer Fisk; to begin work within 30 days; to complete the canal by November 1, 1847; to raise \$100,000 for the use of the Company (to pay its contingent expenses); and to cash the bonds of the Canal Company at par, paying the interest on them until January 1, 1848. The price to be paid Messrs. Gwynn & Co. for the work was fixed at \$1,625,000 in canal bonds.¹⁶

14. *18th Annual Report*, (1846), 6-7.

15. *Proceedings of President and Board of Directors*, G, 317-318, 320-321, 322-323, 353-354.

16. *18th Annual Report* (1846), 8-9.

Ellwood Morris had resigned, and Assistant Engineer Henry M. Dungan had succeeded him as assistant engineer in charge of the Tunnel Division. Dungan in 1845 maintained his office at his home on the Virginia side, near Baker's Store, which was about one-half mile above the Baltimore & Ohio's Paw Paw Tunnel. With the contract with Gwynn & Co. about to be signed, Chief Engineer Fisk laid plans to beef up his corps of engineers. A number of former employees, who had been laid off and were interested in returning to work, were recalled.¹⁷

On October 12 Dungan notified Fisk that he had encountered no difficulty in recruiting hands for his engineering force at 75¢ per day. By spring, however, he doubted whether he could have "suitable hands . . . for less than \$1 per working day."¹⁸

After studying the data forwarded by his assistant engineers, Fisk found that the Company had on its payroll three Engineering Parties, a Superintendent of Masonry, and one Superintendent of Sections. The number of axemen and chainmen per party varied. Each party was headed by an assistant engineer, whose salary was \$1,100 per year. The men holding these positions were the following: John A. Byers, H. M. Dungan, and T. L. Patterson; Joseph Knode was Superintendent of Sections, and A. B. MacFarland was Superintendent of Masonry. MacFarland's pay was the same as the Assistant Engineers, while Knode was paid \$33.33 per

17. Fisk to Turner, Oct. 6, 1845, and Fisk to Patterson, Sept. 29, 1845 (Ltrs. Sent, Chief Engineer).

18. Dungan to Fisk, Oct. 12, 1845 (Ltrs. Recd., Chief Engineer).

month. Rodmen were W. H. Bryan and T. Gore each at a salary of \$540 per annum. Axemen were paid 75¢ a day.¹⁹

Gwynn & Co. subcontracted a number of projects along the "50-mile section," but many of the subcontractors were slow to get their forces organized. They had signed a contract with Marcellus Ritner & Co. for the construction of Lock Nos. 59-66. When Superintendent of Masonry MacFarland visited the Tunnel in early April 1846 he found that Ritner & Co. had a few hands quarrying stone on the ridge crossed by Montgomery's road leading to the Oldtown road. This quarry was a continuation of the one opened by Byrne. MacFarland praised the stone, but he saw that it would run out before enough had been removed to complete the locks. The distance to the quarry from Lock No. 62, via Sandy Flat Hollow, was less than two miles. This distance could be reduced by one-half by opening a new road, costing about \$300.

MacFarland, in recommending that this cost be allowed the contractor, observed that the road would be needed long before the Tunnel Hollow locks were completed. This road would give the Company "perfect command of the east slope of Town Hill, and enable us . . . to obtain many important stone for cutting purposes about the Tunnel."²⁰

19. Fisk to Board, Nov. 13, 1845 (Ltrs. Recd., C & O Co.).

20. MacFarland to Fisk, April 13, 1846 (Ltrs. Recd., Chief Engineer).

The small force employed by Ritner & Co. at the quarry soon dispersed and drifted off to other jobs. On April 27, 1846, Dungan complained to Fisk that all work on his division had been suspended since the 24th, except on Section 324. He urged Fisk to "insist upon an adequate force being immediately put upon the work in general, the Tunnel in particular, to insure its completion in the time specified by the contract."²¹

In accordance with Dungan's suggestion, Fisk notified Gwynn & Co. on May 19 that their attention "must be mainly directed to the Tunnel, the Town Creek Aqueduct, Dam No.8 and guard lock, the locks and masonry in general."²²

The stockholders learned in June 1846 that work on the "50-mile section" had been resumed in November. From the spirit manifested by the subcontractors, high hopes were engendered that the work would be prosecuted with "vigor and energy." The Board of Directors' expectations were quickly shattered. While there was no way of "ascertaining the actual expenditure," as of May 1 only \$55,384 had been paid out on estimates submitted by Chief Engineer Fisk. Of this sum less than \$4,000 had been disbursed for work on the Tunnel and masonry.

21. Dungan to Fisk, April 27, 1846 (Ltrs. Recd., Chief Engineer). Thompson, the subcontractor on Section No. 324, had three hands and two carts at work.

22. Fisk to Gwynn & Co., May 19, 1846 (Ltrs. Sent, Chief Engineer).

Along the "50-mile section," the number of employees from November until April had not exceeded 300 laborers and mechanics and 100 carts. Since then the force had steadily declined, and by the fourth week of May it was down to 40.

On May 19 Fisk ordered the contractors, in writing, to have 500 laborers and mechanics on the line by May 31; 1,000 by June 30; 1,500 by July 31; and 2,000 by August 31, along with the necessary number of wagons and teams to keep the men "fully and properly employed." This force for the time being would be mainly engaged at the tunnel and in the "prosecution of such works of masonry as require the longest time for construction."²³

Gwynn & Co. were unable to meet these deadlines. By June 1, 1846, the subcontractors had ceased work, and Dungan, after measuring the tunnel, discharged two of his engineering party. Shortly thereafter, the Board declared that Gwynn & Co. had abandoned its contract.²⁴

Negotiations for the sale of the bonds had been underway since before the formal signing of the contract with Gwynn & Co. Efforts by Senator Daniel Webster and the Company itself to effect a loan in Great Britain failed, when the House of Baring declined to take any part of it.²⁵

23. *18th Annual Report*, (1846), 45.

24. Dungan to Fisk, July 20, 1846 (Ltrs. Recd., Chief Engineer); *19th Annual Report*, June 7, 1847, (Proceedings of the President & Board of Directors, C & O Co.).

25. Proceedings of Board of Directors, G, 311.

Subsequent attempts to complete the necessary arrangements appeared to be making progress in May and June 1846. These hopes were dashed, when efforts failed to interest merchants of London, England. The contractors next turned to local capitalists for assistance. Here conversations reached the point of assigning quotas to be subscribed by interested bankers. This plan likewise failed.²⁶

Another year passed before negotiations again reached a stage which gave some promise of success. Several events by this time had improved the prospects affecting the sale of the bonds. The State of Maryland had finally provided for the payment of the arrears on its debt and for the prompt payment of the semi-annual interest in the future. This measure helped the credit of both the state and the Chesapeake & Ohio Canal Company. The Virginia Assembly now authorized the state treasurer to guarantee \$300,000 of canal bonds. The corporations of Georgetown and Washington had authorized the loan of \$25,000 and \$50,000 respectively to the contractors in exchange for canal bonds, while the citizens of Alexandria took up a private subscription for \$25,000. The activities of these three cities in April 1847 guaranteed \$100,000 of the bonds.²⁷

26. *18th Annual Report* (1846), 11; Cox to Coale, July 19, 1846 (Ltrs. Recd., C & O Co.).

27. *18th Annual Report* (1847), 4-5; *Niles Register*, 68, No. 12 (May 22, 1847), 179.

These arrangements were threatened by the withdrawal of the Barings, because of the tightness of the international money market, but it was anticipated that local capitalists could be persuaded to step into the breach. Three men (Allen B. Davis, Nathan Hale, and Horatio Allen), acting as agents for the contractors, were able to carry the negotiations to a successful conclusion.²⁸

The Board in the fall of 1847 drew up and executed a mortgage of the Company's revenue. Phineas Janney of Alexandria, W. W. Corcoran of Washington, David Henshaw and George Morcy of Boston, and Horatio Allen of New York were named by the Board as representatives of the 28 New York, Boston, and Washington capitalists who had undertaken the sale of the bonds. By the terms of the final agreement, the financiers agreed to take \$500,000 of the bonds and the subcontractors \$200,000, in addition to the \$400,000 already pledged by the State of Virginia and the District cities.²⁹

Work was resumed on November 18, 1847, under a modified contract. The old company was reorganized and a new one succeeded to its contract with the Canal Board. Gwynn and Cunningham retired, but the re-

28. *Niles' Register*, 68, No. 19 (July 10, 1847), 293; Proceedings of the President and Board of Directors, H, 92-95; *20th Annual Report* (1848), 3-4.

29. Proceedings of the President and Board of Directors, K, 94-96; *20th Annual Report* (1848), 5-6.

maining partners, Hunter and Thompson, continued with the addition of a third partner, Thomas Harris.³⁰

The Board of Directors now authorized various economy measures to facilitate the early completion of the canal. It was determined to adopt the proposal submitted by Chief Engineer Fisk in 1839 to substitute kyanized wood for cutstone in a number of the locks. The construction of lock-keepers' quarters and the arching of the Paw Paw Tunnel were to be deferred till after the canal was formally opened to Cumberland.³¹ All efforts were now to be concentrated on the single object of completing the canal to Cumberland in some manner at the earliest possible date.³²

Cement for masonry along the "50-mile section" would be supplied by Hunter, Harris & Co. A contract was signed with George Shafer, who ran a mill below Dam No.6, "to burn, grind, and deliver at the mill 120,000 bushels [of cement] at the rate of 12,000 bushels per month, if required." A second contract was negotiated with Charles Locker of Cumberland for 60,000 bushels at the rate of 6,000 bushels per month.³³

30. *20th Annual Report*(1848), 7-8.

31. *Proceedings of the President and Board of Directors*, G, 285.

32. Sanderlin, *History of the C & O Canal*, 157-158.

33. *20th Annual Report* (1848), 20.

Of the 17 locks to be constructed, most would be built on the composite plan. These locks were subcontracted by Hunter, Harris & Co. as follows: Locks 54 and 56 to Moyle, Randal & Jones; Locks 59 and 61 to Ritner & Co.; Locks 62-66 to Buell & Watt; Lock 67 to W. P. Steritt; and Locks 68 and 71 to Fallan & Ambrose. Nearly all the stone for Locks 54 and 56 had been cut and delivered, while the stone for Lock No. 58 had been cut but not delivered.³⁴ Locks Nos. 59-66 and 67-71 would be built on the composite plan. Before work was resumed, Chief Engineer Fisk prevailed on the Board to eliminate one of the four locks scheduled for construction in Tunnel Hollow. This decision having been made, the locks to be built in Tunnel Hollow by Buell & Watt would be designated Locks Nos. 63 1/3, 64 2/3 and 66.

The crews turned to by Buell & Watt to excavate the pits and build the foundations for the Tunnel Hollow locks were not overly energetic, although subscribers to the *Cumberland Semi-Weekly Civilian* read on May 19, 1848, that work was "progressing under such circumstances as render it certain" that the canal will be completed by autumn. Wages on the ditch for unskilled hands had risen to \$1 per day. In response to the "high pay", workers were migrating to the area.³⁵

34. Ibid., 18.

35. *Cumberland, Semi-Weekly Civilian*, May 19, 1848.

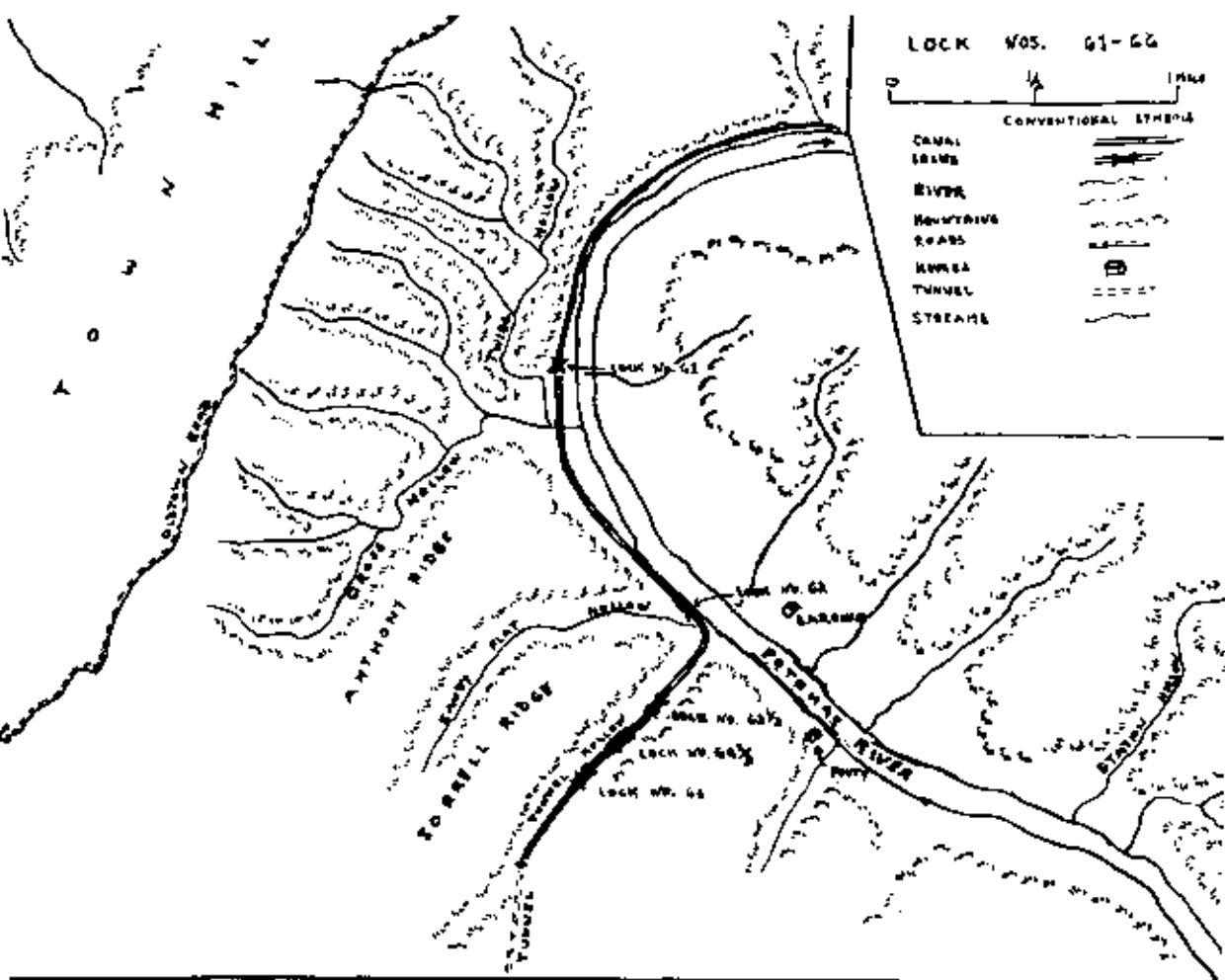


PLATE I
 Location Map for Lock Nos. 61-66, C & O Canal

Fisk two weeks later was able to notify the Board that there were upwards of 700 laborers employed on the "50-mile section," and men were reporting in such numbers as to justify him in concluding that there is "a reasonable probability of the canal being finished within the contract time."³⁶

The contractors to whom the Composite Locks had been sublet by Hunter, Harris & Co. seemingly dragged their feet. In Mid-August they were slowed by heavy rains. Buell & Watt's puddle ditch at the Tunnel Hollow locks at that time was down to bedrock and partially excavated. Steritt at Lock No.67 had salvaged some of Ritner's plank, which had been washed into a drift by the flood of 1846. Dungan caused an uproar when he had refused to accept these timbers as flooring or sheeting. A compromise was effected when Dungan told him he would receive the heart.³⁷

Scant progress was made in September by Buell & Watt. When they learned of this situation from Chief Engineer Fisk, the Trustees scolded the contractors for the Tunnel Hollow Composite Locks. Buell, in reply, complained on October 7 that "sickness has both disabled my force during the past 6 weeks or 2 months, and rendered an increase

36. Fisk to Coale, June 2, 1848 (Ltrs. Recd., C & O Co.).

37. Dungan to Fisk, Aug. 14, 1848 (Ltrs. Recd., Chief Engineer).

impossible." He expected by the end of the week to complete the railway running from his quarries into Tunnel Hollow. As soon as the "sickly season" was over, he would increase his force. Meanwhile, he had completed "arrangements for timber, plank & stone" to insure the completion of the locks by the time stipulated--October 1849.³⁸

A visit to Tunnel Hollow in November by the Trustees was discouraging. While the excavations for the lock pits had been completed, none of the foundations had been finished. They therefore ordered Buell to have the foundation of Lock No. 64 2/3 in by January 1, 1849; Lock No.66 by February 1; and Lock No.62 by April 1. Dungan, however, argued that Lock No.66 should be given priority over No. 64 2/3, because of the problem that would develop in the disposition of the spoil. Fisk agreed, and Buell & Watt were directed to see that work on the Lock No.66 foundation was expedited.³⁹

It was the end of May 1849 before Buell & Watt completed the foundation of Locks Nos.62-66.⁴⁰

With the foundations for Locks Nos.62-66 nearing completion, Chief Engineer Fisk became concerned about the care with which the

38. Trustees to Board, Oct. 7, 1848 (Ltrs. Recd., C & O Co.). Contracts had been signed by Buell & Watt and Ritner & Co. with W. Young of Cumberland for yellow pine planking for their locks. Young to Fisk, Sept. 28, 1848 (Ltrs. Recd., Chief Engineer).

39. Trustees to Buell, Nov. 1848 (Ltrs. Recd., Chief Engineer).

40. Dungan to Fisk, June 7, 1849 (Ltrs. Recd., Chief Engineer).

contractors were raising the walls of the Composite Locks. On December 2, 1848, he had ordered Assistant Superintendent of Masonry Rhind to proceed to Lock No.67 as project engineer. Rhind, while he was in the area, would give his attention to the Buell & Watt locks. Through this action Fisk hoped "to secure uniformity in the construction of our Composite Locks."

In reviewing the specifications for the Composite Locks, Rhind found that the

mortared masonry is to be of the character of that of the aqueduct and culvert rubble masonry recently constructed upon this canal as nearly as in the opinion of the Chief Engineer and neighboring quarries of durable building stone will admit of; and the dry masonry is also in like manner to be as nearly as practicable of the character of that recently constructed upon the canal under the lock contracts, care being taken that the front of the chamber walls shall allow the upright posts to bear firmly against them.

As for the masonry, the Company was most interested in its "strength," and this must be insisted upon. So far, the masonry had not measured up to standards. In regard to the work already done, the Company would have "to make the most of it, correcting manifest imperfections, where it can be done without much difficulty." But in the future, Fisk had cautioned his subordinates, "the specifications must be taken as the guide."

Hereafter, no section of the lock masonry would be raised higher than eight feet "until it is all raised to that height, including the dry walls below the lock."⁴¹

Dungan on April 28, 1849, reported that Buell & Watt had commenced hauling stone for their locks the previous October 30. Since then they had hauled: in November, 24 loads; in December, 36; in January, 31 1/2; in February, 21; in March, 33; and in April, 73. The stone averaged two perches to the load, so that by the end of April 457 perches of stone had been quarried and hauled for the Tunnel Hollow locks.

To insure the completion of those locks by the deadline, Dungan urged the contractors to increase deliveries. By employing three cars instead of two, they should be able to haul 288 perches per month; using six cars, 576 perches for the same period, and using 12 cars, 1,152 perches. In six months 12 cars would be able to shuttle 6,912 perches from the quarry to the construction sites. According to his calculations, 6,800 perches of stone were required for the four locks.⁴²

Buell & Watt promised to do what they could to expedite deliveries. A number of stone cutters and masons were added to the payroll.

41. Fisk to Dungan, Dec. 2, 1848 (Ltrs. Recd., C & O Co.)

42. Dungan to Board, April 28, 1849 (Ltrs. Recd., C & O Co.).

Once a month, on pay day, the workers along the "50-mile section" crowded into Cumberland. On March 15, 1849, the editor of the *Civilian* learned from the workers, who thronged the town, that manpower was abundant on the canal, and that the contractors planned to press the work hard, "now that the season had opened." Unless there were some unforeseen developments, he predicted, the "50-mile section" would be ready for navigation by October 1. This news caused a number of boatyards to be opened. A leading Cumberland businessman was said to have signed a contract with the coal companies to boat 100,000 tons of coal to the District cities in 1850.⁴³

The *Cumberland Civilian* carried an announcement on June 1 that the editor had been checking into the reports that water would be admitted into the "50-mile section" by October 1. On doing so, he was delighted to see that over 1,200 men were at work. He had learned from project superintendents that the "two cut-stone locks, between Dam No.6 and Cumberland, would be completed by July 1." As for the 13 Composite Locks, three would be finished by late August. Timber for the lock gates was now being delivered. It seems, he assured his readers, that nothing "connected with the completion of the line has been neglected."⁴⁴

43. *Cumberland Civilian*, March 15, 1849.

44. *Ibid.*, June 1, 1849.

The previous month, Chief Engineer Fisk had taken action which he hoped would insure that the "50-mile section" would be opened for navigation by the deadline--October 1, 1849. He notified Hunter, Harris & Co. that they were to see that the subcontractors had employed on Locks Nos. 59 and 60, Culverts 206-208, and Sections 283-289, by May 15, 10 stone masons, with the requisite number of helpers, quarrymen, and laborers. Similar orders were issued in reference to Locks Nos. 62, 63 1/3, 64 2/3, and 66, where Buell & Watt were to have 16 masons with the necessary number of helpers, quarrymen, and tenders. They were to keep these people hustling to get out and make delivery on all the stone needed for these four Composite Locks. Buell & Watt failed to comply with this directive, and on May 17 Fisk notified the Trustees of their failure.⁴⁵

Fisk, on June 1, reported to the stockholders that there were employed on the unfinished sections of the canal: 77 bosses, 39 blacksmiths, 54 carpenters, 75 drillers and blasters, 107 quarrymen, 59 stonecutters, 73 masons, 122 mason tenders, 6 brick moulders, 50 others engaged in making bricks, 16 bricklayers, 19 bricklayer tenders, and 760 laborers; totaling 1,447 mechanics and laborers. In addition there were 233 drivers, 562 horses, 26 mules, and 6 oxen employed in driving

45. Fisk to Hunter, Harris & Co., May 1 and May 17, 1849 (Ltrs. Sent, Chief Engineer.)

and pulling 285 carts, 20 scoops, 13 ploughs, 11 two-horse wagons, 3 three-horse wagons, 28 four-horse wagons, 1 six-horse wagon, 5 one-horse railway cars, 14 two-horse railway cars, 10 three-horse railway cars, 14 drays, 4 brick-making machines, and several cranes.

The railway cars were being employed to remove rock and transport bricks and other materials at the tunnel; in the transportation of stone from quarries to Lock No.58, the locks in Tunnel Hollow, the Oldtown Locks, and the Town Creek Aqueduct. The total length of these temporary railways was nearly nine miles. They were of great assistance, as they expedited the work by reducing the number of horses and enabling the contractors to carry on their work more economically than if they hauled in wagons over the public road network.

As of June 1, Fisk estimated there remained to be done on the locks:

<u>Work</u>	<u>Work Done</u>	<u>Work to be Done</u>	<u>Total</u>
Locks	\$74,308	\$153,523	\$287,831 ⁴⁶

On June 30 Fisk visited the Tunnel and saw that the recent hot, humid weather had slowed work by keeping many of the men "in-doors." More alarming, however, was the discovery that large numbers of laborers had walked off their jobs and had gone to work for the Baltimore & Ohio Railroad, which was pushing construction west of Cumberland toward the Tygart River Valley. As the railroad paid 87 1/2 cents

46. *21st Annual Report (1849)*, 25.

per day, while the canal contractors paid \$1, he was inclined to believe that most would be back. Others had left the waterway to return to their homes to assist with the harvest.⁴⁷

By July most of those who had left to go to work for the railroad had returned on discovering the wage differential.⁴⁸

Fisk, on July 30, called to the attention of Hunter, Harris & Co. that work continued to lag on the four Composite Locks subcontracted to Buell & Watt. He was now compelled to order: (a) that as large a force as could be economically employed be turned to excavating and preparing the masonry and foundation of Lock No.66; (b) that the dry walling and paving of Locks Nos.63 1/3 and 64 2/3 (as well as the masonry, puddling, and embankment) should be forthwith completed; and (c) that until a sufficiency of stone was on hand for Locks Nos. 63 1/3 - 66, no stone should be delivered by the railway from the Town Hill quarries to Lock No.62.⁴⁹

As had happened so often, expectations that the "50-mile section" would be opened for navigation by October 1, 1849, were dashed. At a meeting held at Barnum's Hotel in Cumberland attended by the Board of Directors, the State Agents, and the Trustees, it was determined to

47. Fisk to Coale, June 30, 1849, (Ltrs. Recd., C & O Co.).

48. Harris to Coale, July 10, 1849 (Ltrs. Recd., C & O Co.).

49. Fisk to Hunter, Harris & Co., July 30, 1849 (Ltrs. Recd., C & O Co.).

extend the deadline for completion of the "50-mile section" by Hunter, Harris & Co. to December 26, 1849.

On October 1, Chief Engineer Fisk notified Hunter, Harris & Co. that if water were to be admitted to the "50-mile section" by Christmas, they would have to see that the subcontractors increased their force to:

<u>Contractor</u>	<u>Work</u>	<u>Masons Required</u>	<u>Bricklayers Required</u>	<u>Workers 9/25/49</u>
Ritner & Co.	Lock Nos. 59 & 60 Culverts 206-208	16	6	9
Buell & Watt	Lock Nos. 62-66	22		6

To build the lock gates and the wooden waste weirs, install the wooden frames in the masonry waste weirs, do the wood work on the bridges, and position the wood linings in the locks, would require 25 carpenters on the projects east of the Tunnel. On September 25 the number at work was considerably less.

If the new completion date were to be met, 50,000 bushels of cement would be required. Deliveries should be scheduled as follows:

October 1 to 15	12,000 bushels
October 16 to 31	13,000 bushels
November 1 to 15	15,000 bushels
November 16 to 30	5,000 bushels
December 1 to 15	5,000 bushels
	<u>50,000 bushels</u>

The three mills currently supplying cement to the contractors could be counted on daily for: Lynn's, 510 bushels; Shafer's,

270 bushels; and the Potomac Mill, 150 bushels. By October 21, Lynn's fourth kiln with a capacity of 120 bushels would be in production.⁵⁰

Hunter, Harris & Co. now encountered great difficulty in raising capital. Work accordingly continued to drag, and in December they were compelled to ask the Board for another extension. The Board, meeting in Baltimore, extended the time limit of Hunter, Harris & Co. for completing the "50-mile section" from December 26 to April 1. In granting this extension the Board agreed to defer the "laying of the stone coping of the locks, and other pieces of work, not necessary for the commencement of navigation . . . until after the admission of water, to facilitate" their transportation. These deferred projects, it was held by Chief Engineer Fisk, could always be undertaken at a season of the year not calculated to interfere with navigation on the waterway.⁵¹

Work done by Hunter, Harris & Co. as of January 1, 1849, totaled \$583,202, while work to a value of \$382,927 had been accomplished during 1849. Thus the value of work completed as of January 1, 1850, was \$966,036.

To complete the "50-mile section", using the 1845 estimates, would cost \$235,528. Fisk informed the Board at this time that \$163,138

50. Fisk to Board, Oct. 1, 1849 (Ltrs Sent, Chief Engineer); *Cumberland Civilian*, Oct. 12, 1849.

51. *Cumberland Civilian*, Feb. 22, 1850.

had been paid out for the construction of the locks (Composite and Masonry), while work to a value of \$45,456 had to be done on these "works of art."⁵²

The winter of 1849-1850 was very severe in the mountains of western Maryland. On January 7, Fisk warned President Coale that the cold weather was unfavorable for earthwork, but it should not interfere materially with the construction of the dry masonry and wood work of the locks.⁵³

Assistant Engineer Dungan was also having his problems. On the day after Christmas he checked with Fisk as to whether a second flooring of 2-inch plank should cover the platform and extend down and rest against the lower mitre sills in the Tunnel Hollow locks. Personally, he was at a loss as to what should be done with the 8 1/2-foot 12 x 12s, squared on both sides, that had been allowed for cribbing.⁵⁴ Either Fisk gave his subordinate verbal instructions on the subject, or his reply to Dungan's inquiry had been lost.

On February 18 Dungan forwarded to Fisk figures as to the quantity of stone used in the "face work" for the four locks being built by Buell & Watt. These estimates were for all "the walls laid in cement above and below the gates, and the dry masonry above the mortared masonry below the lock gates." His estimates were outlined below.

52. Fisk to Coale, undated, January, 1850 (Ltrs. Recd., C & O Co.).

53. Fisk to Board of Directors, Jan. 7, 1850 (Ltrs. Recd., C & O Co.).

54. Dungan to Fisk, Dec. 24, 1849 (Ltrs. Recd., Chief Engineer).

<u>Lock No. 62</u>	<u>Perches</u>
Below the lower gates mortared masonry	31.36
Below the lower gates dry masonry	5.61
Below the upper gates mortared masonry	31.14
Above the upper gates mortared masonry	38.06
Breast wall mortared masonry	16.46
Above level of breast wall	10.80
Head of lock	59.10
Flume walls	13.96
	<u>206.49</u>

<u>Lock No. 63 1/3</u>	<u>Perches</u>
Below lower gates mortared masonry	31.44
Below lower gates dry masonry	24.74
Below upper gates mortared masonry	37.80
Above upper gates mortared masonry	46.20
Breast wall mortared masonry	16.46
Above level of breast wall	12.00
Head of Lock	39.90
Towpath & flume walls	144.88
	<u>353.62</u>

<u>Lock No. 64 2/3</u>	<u>Perches</u>
Below lower gates mortared masonry	31.44
Below lower gates dry masonry	25.52
Below upper gates mortared masonry	37.80
Above upper gates mortared masonry	46.20
Breast wall mortared masonry	16.46
Above level of breast wall	12.00
Head of lock	39.90
Towpath & flume wall	203.61
	<u>412.93</u>

<u>Lock No.66</u>	<u>Perches</u>
Below lower gates mortared masonry	31.44
Below lower gates dry masonry	5.30
Below upper gates mortared masonry	29.84
Above upper gates mortared masonry	36.48
Breast wall	16.68

Above level of breast wall	8.00
Head of lock	34.39
Towpath & flume wall	33.06
	<hr/> 197.19

So far the subcontractors had laid 1,170.30 perches of stone for the locks, three feet in from the face.⁵⁵ At this time Dungan had forwarded to Fisk a report of the work accomplished by Buell & Watt as of November 21, 1849, on Locks Nos.62-66. A copy of this work appears in Appendix D.⁵⁶

Hunter, Harris & Co. finally came to the end of their resources in early March. Pay day came and there was no money for the artisans and laborers. On the 9th they assigned their contract to the Trustees to enable them to complete the "50-mile section." Before the Trustees took over, Fisk had notified them that the "failure of Hunter, Harris & Co. to carry through the work to completion in their own name has occasioned delay, thereby postponing the time when the navigation can be opened to Cumberland." Fisk now estimated that water could be let into the upper ten miles of the canal by May 15, into an additional 18 miles by June 1, and into the entire 50 miles by June 15.⁵⁷

55. Dungan to Fisk, Feb.18, 1850(Ltrs. Recd., Chief Engineer).

56. Dungan to Fisk, Feb. 2, 1850 (Ltrs. Recd., Chief Engineer).

57. Fisk to Trustees, April 15, 1850 (Proceedings of the President & Board of Directors, C & O Canal).

Before work could be resumed, however, the Trustees would have to get the men, who had struck when they were not paid, back to work. Trustee Hale and Assistant Engineer Dungan spent March 12 at Oldtown and the next day at the Tunnel Hollow locks. At both places the men were on strike, and they encountered resistance when they sought to persuade them to return to work, without making any promises beyond their means. At Oldtown, the men agreed to resume work after dinner, provided: (a) the Trustees would pay for all work done since the 11th on a weekly basis on Saturday nights; (b) that they would be paid one-half the February estimate on Saturday of next week; and (c) that they would be paid one-half the amount due them for the first eight days of March on the following Saturday, and the other half of these sums "if the work goes to completion."⁵⁸

Their appeals to the men working on the Tunnel Hollow locks had been less successful. They made no commitments about returning to their jobs. But as they seemed well disposed, Hale felt that upon reflection they would be satisfied that the proposition offered was the best the Trustees could make under the circumstances, and after discussing it among themselves they would vote to accept it.⁵⁹

58. Hale to Coale, March 13, 1850 (Itrs. Recd., C & O Co.).

59. Ibid., March 17, 1850 (Itrs. Recd., C & O Co.).

By the evening of March 14 all the men on the "50-mile section," except those at Cumberland and those at the Tunnel Hollow locks, were back on the job. Hale was confident, however, that the strike at those two points would soon be over. He was correct, as the men were back at work on the morning of the 17th.⁶⁰

There was labor unrest again in April, as the Trustees failed to meet their obligations. On the 9th the men working on the Oldtown locks struck, and came marching down the towpath from Lock No.68 with a flag. A letter was handed to one of Dungan's men that evening, notifying him that all hands from Cumberland to Town Creek had ceased to work and were determined to "prevent the completion of the canal till" they received their back pay for the period, January through March. The people at the Tunnel and the locks below were asked to join in the demonstration.

A storm kept the strikers in their shanties on the 10th, so there was no trouble. Dungan, concluding that the strikers would use the day to recruit, wrote Fisk urging steps be taken to prevent another march by the disgruntled workers, before the strike spread to the men employed on the Tunnel and at Locks Nos.62-66.⁶¹

On the 12th the "rioters" were out in force, and they marched from Oldtown to Section 325, where they halted all work, and their

60. Fisk to Coale, March 14, 1850 (Ltrs. Recd., C & O Co.).

61. Dungan to Fisk, April 10, 1850 (Ltrs. Recd., Chief Engineer).

leaders threatened to push on to the Tunnel. On April 22, Dungan warned Fisk that if the men were not paid by the 30th, there would be a general strike that would put a stop to all work on his division.⁶²

On April 23, and again on the 24th, the men at the Tunnel had struck and had marched down the towpath to Lock No.61, stopping all hands still at work. Dungan was told by Haines and Murray that Upton, who was one of the leaders, had endeavored to secure a gallon of brandy to treat the men after they had stopped work in Tunnel Hollow. The strikers appeared to be acting under the influence of the contractors' creditors, who expected the bondholders to pay the arrears to insure completion of the canal. The strikers, it seemed, planned to hold peaceable possession and voiced no threats. Several men, satisfied that the projects would be shut down for some time, took their bundles and left the canal.

Piper, one of the foremen, promised to get the men back to work on Monday the 28th. Dungan, however, feared that Piper would be unable to make good on his promise. If the strikers did not return to their jobs in the near future, it was feared that the rest of the hands would walk off.⁶³ Apparently, Piper knew his people better than Dungan, because most of them were back on the job at the Composite Locks and the Tunnel on April 28.

62. Dungan to Fisk, April 13 and 22, 1850(Ltrs. Recd., Chief Engineer).

63. Dungan to Fisk, April 25, 1850(Ltrs. Recd., Chief Engineer).

By the late winter of 1850, the stonework at Lock Nos.62-66 had been nearly finished. A large force of carpenters was now needed to line the walls of the lock chambers with "kyanized" planking. This would be accomplished by securing five and one-fourth inch square vertical studs to the stone surface at 30-inch intervals. The stud fastenings were four-foot long, one-inch round iron rods driven into the masonry joints and threaded at the exposed end to receive square nuts. There were two rods per stud. The studs ran from a six-inch wide by three and one-half inch deep sill at the bottom to the underside of the coping. A layer of horizontal planking was nailed over the studs and another layer of vertical planking was laid over the horizontal planking for strength.⁶⁴

Dungan on March 1 had voiced the opinion that if they were to be completed as scheduled there should be at least 25 carpenters assigned to Locks Nos.61 to 66. He feared that work on the gates was lagging. With the exception of the gates and coping for the locks, his latest estimates had included nothing that had not been delivered.

As to be expected, the labor difficulties caused a significant reduction in the carpenter force. By April 4 there were only 15 at work on the 5 locks. Seven carpenters had left for North Carolina with Watt. As yet, the crib timbers had not been delivered, while

64. Archie W. Franzen, "Historic Structures Report--Survey Report for Lock No.66 Complex," (Files, NPS), pp. 1-2.

there had been threats to attach the planks stacked at the railroad siding to satisfy claims against Hunter, Harris & Co. by Groves for stringers used for the railway to the quarry.⁶⁵

Additional carpenters were recruited by Buell, and by mid-April they were hard at work on the coping. Assistant Engineer John Byers on April 17 forwarded to Fisk plans he had prepared for the wooden coping in the upper and lower recesses of the Composite Locks. He wished to know which should be adopted. Sketch No. 1 of the upper and No. 2 of the lower recess were drawn for a single line of joist timbers. The other sketches had been drawn with the thought of adding strength to the "points liable to be struck by the boats" in passing through the locks, and "to avoid short pieces."

At the upper recess, he would cut off the post (A) at the height of the 6 x 6 cross ties, and pass the 10 1/2-inch x 6-inch timbers over it, thus protecting the end from the weather, and bringing the top crib log against the end of the 10 1/2 x 6 and also against the post.⁶⁶ Copies of these plans accompany this report.

Fisk, on the 22d, notified Byers that the plan he proposed for providing additional strength to the wooden coping at the upper and lower recess should be adopted.⁶⁷

65. Dungan to Fisk, March 1 and April 5, 1850 (Ltrs. Recd., Chief Engineer).

66. Byers to Fisk, April 17, (Ltrs. Recd., Chief Engineer).

67. Fisk to Byers, April 22, 1850 (Ltrs. Sent, Chief Engineer).

On April 23 Byers forwarded to Fisk a bill of "timber and plank" for the coping of the Composite Locks. He believed that the coping for the locks would present "a good appearance and possess all the strength that can be given to it at the exposed points." He would see that the lower wings were covered entirely, as rough coping was currently unavailable.⁶⁸ (A copy of the bill of timber and plank for the coping of a Composite Lock accompanies this report.)

Haines, in addition to himself, on June 1, had 32 carpenters at work between Dam No.6 and the Tunnel. Trustee Hale, on June 2, contracted with Voorman, who had a reputation as an efficient carpenter, for the coping for the Composite Locks.⁶⁹

There was a brief delay in early June, when it was discovered that the Buell & Watt foreman at Lock No.62 had blundered. Dungan had noticed that a section of the lock chamber was discolored. He ordered Clarke to open up the wall. Although the wall was taken down to a depth of five feet no "sign of mortar or grout in the heart of the wall" was found. Both men were satisfied from the dark color of the pointing that the rest of the wall had been grouted. The pointing in the section of wall that had been condemned was "quite dry and white" as was the "facing of the dry masonry which was laid in mortar by

68. Byers to Fisk, April 23, 1850 (Ltrs. Recd., Chief Engineer).

69. Hale to Fisk, June 2, 1850 (Ltrs. Recd., Chief Engineer).

Mr. Moore's orders to save bedding the stone." When questioned by Dungan as to how this had occurred, Clarke expressed the opinion that some one must have misdirected the mortar bar and had run the grout into the dry masonry. Dungan did not believe him, but he decided not to press the subject.⁷⁰

Meanwhile, it was discovered that not enough timber for coping had been stockpiled at Lock No.66. On taking inventory, Dungan discovered that the only coping was for the flume opening at the tail. He felt that it would be wise to substitute timber to cover the 13 1/3-foot opening.⁷¹

This situation had been corrected by mid-July. On the 17th Dungan found that there was sufficient timber and planking on hand for Buell & Watt to accomplish all the woodwork at Locks Nos.62-66, except the coping and stop plank for the flumes. The lining plank for the gates had been unloaded at Water Station No.12. Dungan had asked Mr. House, the keeper of the station, to alert him should anyone disturb the planking or attempt to attach it. It would be wise to have it hauled over to Tunnel Hollow and stacked. The lock gates and casting for three of the locks had also been delivered and were stored at the shop on the Virginia side, opposite Tunnel Hollow.

70. Dungan to Fisk, June 12, 1850(Ltrs. Recd., Chief Engineer).

71. Ibid.

Threats had been voiced in local grog shops against the canal by disgruntled laborers, who believed Hale would not pay them for their last week's work. Dungan, however, did not foresee any immediate danger.⁷²

These fresh labor troubles had been precipitated by the failure of the Trustees to see the project through to completion. Bad weather (a succession of snow, sleet, and rain storms), along with the labor difficulties, frustrated Fisk's rosy prediction that the "50-mile section" would be opened to navigation by June 15. On June 3 the stockholders of the Chesapeake and Ohio Canal Company were notified that if the labor force was doubled all work necessary for admission of water to the entire waterway could be accomplished by July 1.⁷³

This proved impossible. Meanwhile, the time limit for the completion of the canal had been extended to July 1 and then to August 1. It was in vain, however, for in July the Trustees' resources had been exhausted and work again stopped. The Board promptly declared the contract abandoned and negotiated a new one with Michael Byrne of Frederick County, who 12 years before had contracted to build Lock Nos. 59-66, providing for the completion of the canal for \$3,000 in cash and \$21,000 in bonds. Reporting this development, the Cumberland

72. Dungan to Fisk, July 17, 1850 (Ltrs. Recd., Chief Engineer).

73. *22nd Annual Report* (1850), 13-15.

Civilian commented, "As Byrne is an old and experienced contractor and possessed of ample means, there can be little doubt that the work will be finished at the time designated."⁷⁴

By August 25, work on the Tunnel Division had progressed to the point where Dungan reported that, until this moment, "I have been unable to name a date when I would be able to admit water to Lock No.66." But Haines had now informed him that he would have the stop plank up by the next evening. If this were correct, he would then be ready to receive water on the Tunnel Level.⁷⁵

A little before 11 a.m. on August 31, Dungan had the upper gate at Lock No.67 opened. By 12:30 the water had reached Lock No.66. The only leak reported was a slight one at the Tunnel.⁷⁶

The only "works of art" not now completed on the "50-mile section" were those in Seven-mile Bottom. They were Locks Nos.59-60, and the waste weirs on Sections 282 and 283. Lock No.60 was finished and ready for water on Tuesday, the 24th, while Lock No.59 would be ready the next evening. By the 24th all that remained to be done at Lock No.58 was to hang the gates, and Haines and an eight-man crew had been detailed to raise them. Haines, however, was delayed by the discovery that he was short 30 bolts.

74. *Cumberland Civilian*, Aug. 2, 1850.

75. Dungan to Fisk, Aug. 25, 1850(Ltrs. Recd., Chief Engineer).

76. Dungan to Fisk, Sept. 1, 1850(Ltrs. Recd., Chief Engineer).

As the balance beams on the Tunnel Hollow locks checked rapidly, metal straps would have to be slipped over the posts. But this could be attended to after the waterway was opened for navigation to Cumberland.⁷⁷

It was October 8 before water was let into the Seven-mile Bottom sections.⁷⁸ The eastern portion of the Chesapeake and Ohio Canal, the only part to be completed, was formally opened to trade at Cumberland, Thursday, October 10, 1850.

77. Bender to Fisk, Sept. 25, 1850(Ltrs. Recd., Chief Engineer).

78. Bender to Fisk, Oct. 8, 1850(Ltrs. Recd., Chief Engineer).

III. LOCK FOUNDATIONS

Assistant Engineer Morris on December 15, 1838, mailed to Michael Byrne, the contractor for Locks Nos. 59-66, the specifications for Locks 60 and 61 upon a "common foundation" and Locks 64-66 on a rock foundation. The bill for the timber for Locks 64-66 was:

<u>White Oak Timbers, one foot square</u>	<u>Running Feet</u>
69 pieces 12 x 12 & 20-foot long =	1,380
168 pieces 12 x 12 & 17-foot long =	2,856
3 pieces 12 x 12 & 18-foot long =	54
3 pieces 12 x 12 & 21-foot long =	63
3 pieces 12 x 12 & 25-foot long =	75
3 pieces 12 x 12 & 29-foot long =	87
3 pieces 12 x 12 & 32-foot long =	96
	<hr/>
	4,611 lineal feet

<u>Planking for Locks Nos. 64-66</u>	<u>Feet B.M.</u>
Sheet piling 2 feet deep = 2,760 square feet of 3-inch plank or	8,200
Flooring = 7,200 square feet of 2-inch plank or	14,400
	<hr/>
	22,680

All the planking was to be heart of yellow pine and no plank was to be over 8 in. in width. The bill of timber for Locks Nos. 60 & 61 was to be:

<u>White Oak Timbers, one foot square</u>	
Main traverse timbers of the lock:	<u>Running Feet</u>
12 pieces of 12 x 12 & 51 feet long =	612
2 pieces of 12 x 12 & 49 1/2 feet long =	99
2 pieces of 12 x 12 & 48 1/2 feet long =	97
2 pieces of 12 x 12 & 46 1/2 feet long =	93
2 pieces of 12 x 12 & 45 feet long =	90
4 pieces of 12 x 12 & 43 1/2 feet long =	174

66 pieces of 12 x 12 & 32 feet long =	2,112
174 pieces of 12 x 12 & 29 feet long =	5,046
2 pieces of 12 x 12 & 35 feet long =	70
2 pieces of 12 x 12 & 38 feet long =	76
2 pieces of 12 x 12 & 41 feet long =	82
2 pieces of 12 x 12 & 44 feet long =	88
14 pieces of 12 x 12 & 47 feet long =	658
2)286 = 143 sticks each lock	

Flume Timbers

2 pieces of 12 x 12 & 15 feet long =	30
30 pieces of 12 x 12 & 10 feet long =	300

Longitudinal Timbers

16 pieces of 12 x 12 & 37 feet long =	592
12 pieces of 12 x 12 & 12 feet long =	144
Total for 2 locks	<u>10,363 lineal feet</u>

Planking for Locks Nos. 60 and 61

Flooring 4,808 square feet of 2-inch plank or 9,616 feet B.M.
 Sheet piling 7,722 square feet of 3-inch plank in lengths of
 7-foot or 23,166 B.M.

Mitre Sills and Upper Platforms for Locks 60-61 and 64-66:

<u>White Oak Timbers</u>	<u>Running Feet</u>
Platforms 90 pieces 12 x 12 and 6 1/2 feet long =	585
5 pieces 14 x 14 and 17 feet long =	85
Mitre Sills 20 pieces 9 x 9 and 9 feet long =	180
10 pieces 9 x 9 and 17 feet long =	170 ¹

1. Morris to Byrne, Dec. 15, 1838 (Ltrs. Sent, Morris).

Two months later, in February 1839, Morris, in response to an inquiry from Byrne, advised the contractor that he could subcontract the Lock No.62 foundations. If he should do so, Byrne was to bear in mind that the "timbers &c" were to be similar to those called for in the foundations of Lock Nos.60 and 61 except: (a) all the 29-foot sticks were to be 31 feet in length; (b) all the 32-foot sticks to be of 34-foot lengths; and (c) the remaining timbers to be increased in length one foot each, i.e., the 51's becoming 52, the 49 1/2's to be 50 1/2, etc. Longitudinal timbers beneath the front of the lock wall were to be of the usual length.

Because of the changes in length of the foundation timbers, Byrne was to see that sheet piling of six-foot lineal length was used in the lock, besides the 42 square feet of 2-inch plank used for sheeting in Locks Nos.60 and 61.

He would also contract for the lumber for the mitre sills and platforms; the specifications to be similar to those enumerated on December 15 for the five locks.

Timber for Lock No.62, as well as that for the other locks in the series Nos.60-66, was to be delivered by early summer.

In contracting for the floor planking, Byrne was to be certain that no planks exceeded eight inches in width and that all were free of sap.

The lineal feet of timber in the foundation of Lock No.62 above a lock with a "common" foundation was to be:

Head of Lock	12 sticks	increased 1 foot	12-foot running
Recess timbers	15 sticks	increased 2 foot	30-foot running
Chamber timbers	83 sticks	increased 2 foot	166-foot running
Recess timbers	17 sticks	increased 2 foot	34-foot running
Tail of Lock	16 sticks	increased 1 foot	16-foot running
	<u>143</u>		<u>258</u>

A "common lock bill" for 12 x 12-inch timber was 5,181 1/2 running feet; adding 258 feet, would make the bill for Lock No.62 in the amount of 5,439 1/2 feet.²

The decision to eliminate one lock in Tunnel Hollow compelled Chief Engineer Fisk in January 1848 to prepare a new "bill of timbers" for the foundations of Locks Nos.63 1/3, 64 2/3, and 66. For each of the three locks there would be required:

	<u>Linear Feet</u>	<u>Cubic Feet</u>
22 pieces of 1-foot square white oak timber	25	550
60 Pieces of 1-foot square white oak timber	22	1,320
6 pieces of 1-foot square white oak timber	47	282
		<u>2,152</u>

There would be in the three foundations 6,456 cubic feet of white oak timbers. These timbers would be positioned:

In the first 15 feet below the breast	10 pcs	25 feet long
Next 81 feet below the breast	54 pcs	22 feet long
Next 18 feet below the breast	12 pcs	22 feet long
Next 9 feet below the breast	6 pcs	22 feet long
Next 8 feet below the breast	6 pcs	22 feet long ³
Next 8 feet below the breast	6 pcs	47 feet long ³
Total of 131 feet	<u>88 pcs</u>	

2. Morris to Byrne, Feb 9, 1839 (Ltrs. Sent, Morris).

3. Fisk to Dungan, Jan. 8, 1848 (Ltrs. Recd., C & O Co.).

By the end of May 1849 Buell & Watt had finished the foundations for the four composite locks subcontracted to them by Hunter, Harris & Co. When he checked their work, Dungan found:

Timbers used for foundations in the four locks	13,600 cu. ft.
Planking used in the locks...	88,000 superficial ft.
Lining timbers	6,734 cu. ft.
Planking timbers	53,700 superficial ft.
or all together	141,700 superficial feet of planking and 20,334 cubic feet of timbers.

No timber had been included in this estimate for cribbing, part of which had been delivered. Buell needed six timbers 49 feet long for Lock No.62. If he had submitted all his bills, the Company could allow him about \$1,200 for timber and planking, and \$400 for 800 superficial feet of scabbled stone at the quarry.⁴

Dungan, in June 1849, in accordance with instructions from Fisk, had added several items to his estimates for Locks Nos.63 1/3 and 64 2/3. Buell& Watt would be paid for the "cement filling" between and around the foundation timbers at a rate of \$3.50 per perch.⁵

4. Dungan to Fisk, June 7, 1849(Ltrs. Recd., Chief Engineer).

5. Ibid.

IV. EXCAVATIONS AND EMBANKMENT FOR LOCKS NOS.62-66

In January 1848 Assistant Engineer Dungan forwarded to Chief Engineer Fisk calculations of the excavation and embankment needed for Locks Nos.62-66. Dungan, in making his estimates, had assumed the bottom for lock pits "63 1/3, 64 2/3, & 66 is 2.41 and for 62, 1.141." The levels of rock at each lock were:

Levels of Rock at Each Lock

Lock No. 63 1/3

Tail, level of rock = 2.3 or 127.3B rock base.
 Lock, level of rock 89 ft. up 0.4 or 125.4B rock base.
 Head, level of rock 89 ft. up 0.7 or 124.38 assumed.

Lock No.64 2/3

Tail, level of rock = 0.9 or 115.9B assumed by drill, about a ft.
 below the bed of drain.

Head, level of rock = 2.1 or 112.9B assumed by drill.

Lock No.66

Tail, level of rock = 1.4 or 103.6B rock base.
 Head, level of rock = 5.3 or 99.7B rock base.

Lock Excavation & Embankment

<u>Lock No.62</u>	<u>Embankment</u> <u>cubic yards</u>	<u>Excavation</u>			<u>Total</u> <u>Cu. Yds.</u>
		<u>Cu. Yds.</u> <u>Rock</u>	<u>Cu. Yds.</u> <u>Loose Slate</u>	<u>Cu.Yds.</u> <u>Earth</u>	
Earth Excavation (to be done)			300	300	
Earth Embankment (to be done)	8,500				

Lock No.63 1/3

Excavation of pit		293.9	2,209.9	1,212.3	3,716.1
Excavation of towpath		7.9	792		799.9
Embankment at head of towpath	684.3				
Excavation at berm		122.2	601.5	622.2	1,345.9
Embankment, earth & slate	1,945.0				
Embankment Proper:					
(Embkt. of slate against berm wall)	2,288				
(Embkt. of slate against towpath wall)	1,374.4				
<u>Total</u>	<u>6,292.6</u>	<u>424</u>	<u>3,603.4</u>	<u>1,834.5</u>	<u>5,861.9</u>

Lock No.64 2/3

Excavation of pit		555.6	74.2	1,119.6	1,749.4
Excavation at head of towpath		42.5	1,117.5		1,160
Embankment at head of towpath	960				
Excavation connection at berm		122.6	195.2	282	599.8
Embkt. connection	1,306.5	(at berm, earth and slate)			
Embankment Proper:					
(Embkt. of slate against berm wall)	2,288				
(Embkt. of slate against towpath wall)	1,640.3				
<u>Total</u>	<u>6,194.8</u>	<u>720.7</u>	<u>1,386.9</u>	<u>1,401.6</u>	<u>3,501.2</u>

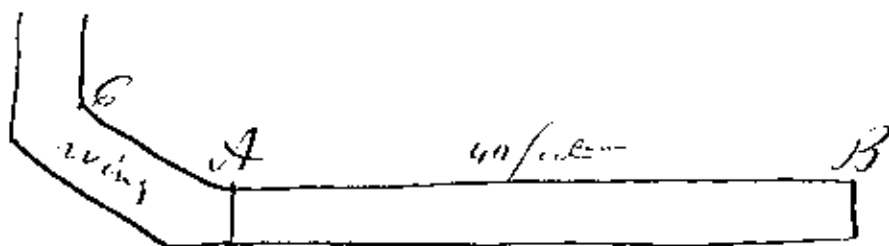
Lock No.66

Excavation of pit		2,253.1	2,015.2	1,676.8	5,945.1
Excavation at head of towpath for connection		46.8	212.5		259.3

Excavation at connection with berm	118.8		375.0	489.8
Excavation for lining 350 ft. towpath		1,000		1,000
Embkt. connection at head of berm	1,059.8			
Embkt. connection,, towpath	164.3			
Embkt. lining, towpath, 350 ft.	1,408.7			
Embankment Proper (Embkt. of slate against berm wall)	2,288.0			
(Embkt. of slate against towpath)	1,182.1			
Totals	6,102.9	2,414.7	3,227.7	7,694.2

Dungan felt that a towpath lining, extending from the wall at the head of Lock No.66 for 350 Feet up the canal, would be "the best mode of making a watertight connection." The slate embankment against the lock wall had been calculated at "15 wide at top of wall and a 1 to 1 slope down to Rock."¹

Fisk on December 2, 1849, forwarded instructions and a plan to Dungan as a guide in positioning the embankment and puddling at the Tunnel Hill locks. On the berm side below the lock this plan would be followed:



1. Dungan to Fisk, Jan. 3 and 6, 1848(Ltrs. Recd., Chief Engineer).

The foundation of the wall (A-B) would be as low as that on the towpath side. Its thickness would be equal to that of the wing wall (C-A). The two walls (A-B) and (C-A) were to be connected at A, just as if they were "one and the same wall."

As for the embankment and puddling, Rhind and Dungan were to be especially watchful. Along the mortared masonry at the head of the lock and above the breast, puddling would be put in "with all the care observed in constructing masonry locks."

From the termination of the mortared masonry at the head of the lock to point (A) coarse gravel, to a width of three feet, would be used for the entire height of the walls. Of this distance that part "in the rear of the mortared masonry, below the lower gates, should have for three feet in height in place of gravel" stone of six inches in diameter. This stone should be positioned to keep the earth from obstructing the flow of water through "the drain," should any escape from the lock chamber. Construction on the towpath side would be similar.

From (A) to (B) "a fine gravel" three feet in width would be preferred. With the above exceptions all the embankment about the lock would be made of watertight material carefully put together.

Until the receipt of additional instructions, no embankment would be raised to a height above seven feet. No puddling at the head of the locks would be put in before spring. In addition, the paving below the locks would not be put in until the dry walls had been raised.²

2. Fisk to Dungan, Dec. 2, 1848 (Ltrs. Sent, Chief Engineer).

V. CRIB WORK AT HEAD OF THE LOCKS

On May 12, 1849, Assistant Engineer Dungan reported that he had been unable to secure the necessary information from Assistant Engineer Byers on the "position & arrangement of the crib work" at the head of the Composite Locks. As the heads were straight, he wished to know if the angles were to be rounded or would "the crib work set flush to prevent about stocking."¹ It has been impossible to determine Fisk's views on this subject, as he either replied verbally or by a letter which has been lost.

1. Dungan to Fisk, May 12, 1849(Ltrs. Recd., Chief Engineer).

VI. FRAMES AND LININGS OF LOCK FLUMES

Buell & Watt had posts sawed for the linings of the flumes. Assistant Engineer Dungan, on discovering this, reported that where the masonry had been put up, it would facilitate the work if the posts could be framed in after the longitudinal sills had been secured. To shift the entire frame backward and forward until each post would have "a full bearing was no trifling job, but if the sills were fixed each post might be readily fitted to its bearing and we would have a fixed base to work from."

The contractors' current practice presented no difficulty, when the timbers were put up before the masonry was started. To expedite the framing, he suggested that the post be framed into "the longitudinal sills plumb and the batter given by bevelling the beds of the sills."¹

In February 1850 Dungan asked Fisk for additional instructions as to how Buell & Watt were to position the side planking of the flumes, if it were to be flush with the 12-inch posts. He would also like to know how the 12-inch posts were to be "set upon the longitudinal sills, whether to project 2 inches in or out, & if set in whether the 10-inch posts should also be set inch out to bring the side plank flush to a 3 inch rabbet in the 12-inch posts."² (See attached plan for side plank-

1. Dungan to Fisk, May 12, 1849(Ltrs. Recd., Chief Engineer). The carpenters preferred to arrange the framing by "tenon & mortice," but by so doing the rabbet of two inches in the longitudinal if cut plumb was not on the same plane as the face of the post.

2. Dungan to Fisk, Feb. 14, 1850(Ltrs. Recd., Chief Engineer).

ing and longitudinal sills for lock flumes.) Verbal instructions on this matter, or his memorandum on the subject has been lost, because a diligent search of Record Group 79 has failed to turn up Fisk's reply to Dungan's letter of February 14.

Dungan was instructed by Fisk on May 2, 1850, that if the work in the flumeway at Lock No.62 was "firm and close the paving could [be] dispensed with, except for a distance of . . . 20 feet at the upper end." If, however, it would not hold water, it would have to be paved and grouted. Fisk was of the opinion that for the time being the greater part of the paving could be dispensed with.³ A test showed, as Fisk had anticipated, that the paving could be dispensed with.

3. Fisk to Dungan, May 2, 1850(Ltrs. Recd., C & O Co.).

VII. LOCK GATES

Information on modifications of the lock gates made in the period immediately before the gates were installed in the Tunnel Hollow locks is found in the correspondence of the Division Superintendents with Chief Engineer Fisk. It is probable that these modifications were incorporated in the gates for Lock Nos. 62-66.

Superintendent Stone of the Hancock Division, on March 21, 1846, reported that the 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 would prevent the breaking of the tenons of the arms.¹

Superintendent Elgin of the Harpers Ferry Division reported on April 26, 1848, that he had taken measurements of the shoe for the lock gates. The diameter of the shoe was six inches, with a 3 1/2-inch recess with a depth of 2 inches for the pivot to work in. The weight of those in use was 24 pounds. The pivots had flanges with a diameter of 6 inches. He would prefer them to have an 8-inch diameter, with 4 houses for bolts with sunken heads. It took about 130 spikes to each gate or 520 to a set of gates. There were about eight 5-inch spikes to a pound. The collar to the cast iron valve weighed 9 pounds.²

1. Stone to Fisk, March 21, 1846 (Ltrs. Recd., Chief Engineer).

2. Elgin to Fisk, April 26, 1848 (Ltrs. Recd., Chief Engineer).

Fisk reported that the thickness of the lock gates at the rub post was 12 inches, and at the toe post ten inches.

The breast wall of Locks Nos.1-25 were directly under the upper mitre sill, and rose 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 of these locks were therefore shorter.

The breast wall of the remainder of the locks was entirely above the upper gates. The upper gates of these locks were consequently the longer ones.³

3. Fisk to Pickrell, Jan. 10, 1850(Ltrs. Sent, Chief Engineer).

VIII. WICKETS (PADDLES) FOR LOCK GATES

Chief Engineer Wright in 1829 made a detailed study of John F. King's patent of a Wicket Gate for canal locks. What he saw convinced him that King's model was the best he had yet seen of a paddle or wicket gate, and he advised the Board of Directors to adopt it. (A copy of a King's Patent accompanies this report).

King had told Wright that he was unwilling to enter into agreements with the lock contractors separately, but he would contract with the Board "direct at 8 cents per lb." A wicket or paddle gate 2 foot square, King reported, with all its fixtures would weigh 190 to 200 pounds.

As Wright had planned the gates, there would be two paddles in each of the lower gates of two feet by 18 inches, and they would weigh 160 to 180 pounds each making four wicket gates to a lock. Wright was of the opinion that it would be of benefit to the contractors if the company compelled them to use cast iron wicket gates instead of wooden ones. He trusted the Board would follow his recommendation and bargain with King.¹

The Board on August 30 agreed to use King's cast-iron wicket gates, provided the contractors would pay the cost thereof.²

1. Wright to Board of Directors, July 30, 1829(Ltrs. Recd., C & O Co.).

2. Proceedings of the President & Board of Directors, A, 315.

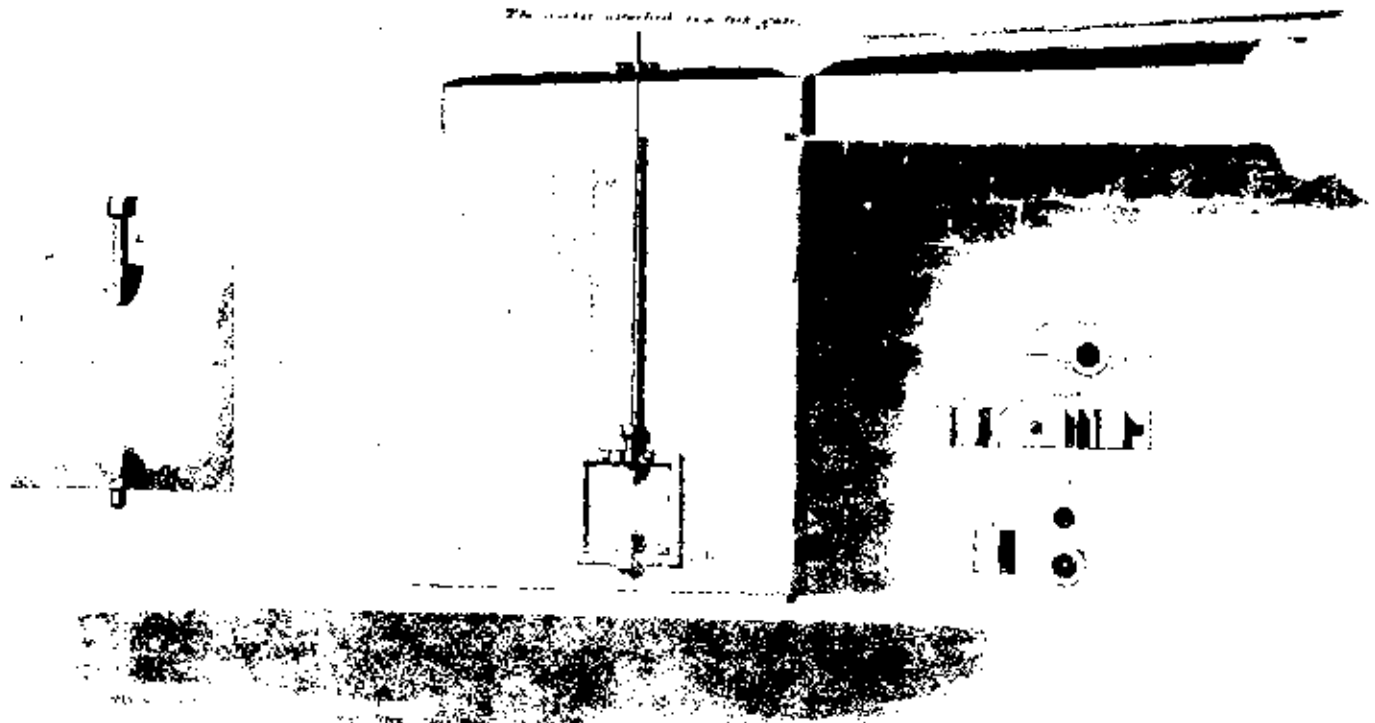
CLASSIFICATION
5288X
DIVISION

Nickel Gate.

Patented November 29, 1911.

FIG. 1
FIG. 2
FIG. 3

The motor attached to the gate.



Figures.

- 1. part of the gate
- 2. motor through the pulley
- 3. the pulley
- 4. the gate
- 5. motor on the top pulley
- 6. projection on the part of the gate
- 7. the motor through the pulley
- 8. smooth part of the gate
- 9. the gate on the lower pulley
- 10. the gate

W. H. ...
...

W. H. ...

On August 7, 1831, King agreed to deduct from the contract price for the wicket gates made from his patent

what ever 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 1 1/2 rod which is to be used for the Iron gates. Provided . . . that the Iron gates be made of sutch [sic] dimensions as only to pass the same quantity of water in a given time that wooden gates would pass.³

When they had delivered the wicket (paddle) gates for Locks Nos. 5-25, King and his partner, Livingston, had warrented them for one year with good usage. These gates had been cast at the furnace of A. & J. Ellicott at Oak Ridge Landing, Maryland. The wicket gate at Lock No.17 broke on April 18, 1831, and the Superintendent of the Georgetown Division believed the difficulty was in the iron box, which held the foot of the gate, being improperly fitted into the wooden frame. A letter was accordingly addressed to King requesting that he have the foundry cast a replacement. If, however, they dragged their feet, it would be possible to take the pattern and have one cast at the little foundry near the Tyber.⁴

3. King's Proposal (C & O Co. Mss. Correspondence).

4. Williams to Boyd, April 18 and Wright to Ingle, April 19, 1831(Ltrs. Recd., C & O Co.).

King and Livingston, when advised of the difficulty, suggested that it was possible that the wicket (paddle) gate was not strong enough and that therefore the Company should have A. & J. Ellicott add to its thickness.⁵

In 1832 King and Livingston agreed to cut their price for the wicket (paddle) gates. Writing President Mercer on June 5, 1832, Livingston announced that they would now supply the Company with their patent cast iron paddle or wicket gate for five and one-half cents per pound. If the Company should introduce the horizontal paddle, they would have them cast accordingly.

In the past, they admitted, four or five of the 3 1/2-foot wicket gates had been broken. This had been caused, they 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.⁶

King and Livingston on August 25, 1832, notified the Board that if it had not accepted their June 5 quotation for wicket (paddle) gates, they wished to withdraw it. Because of a recent price rise of cast-iron, they found that they could not afford to make deliveries at the price quoted.⁷

5. King to Ingle, April 21, 1831(Ltrs. Recd., C & O Co.).

6. Livingston to Mercer, June 5, 1832(Ltrs. Recd., C & O Co.).

7. King & Livingston to Board, Aug. 25, 1832 (Ltrs. Recd., C & O Co.).

By the summer of 1834, the Company had contracted for and received 132 of King's wicket gates. Since then the Company had had other gates cast for which King had not received any money. 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.⁸

A compromise was reached, and the Company agreed to reimburse King for infringing on his patent.

8. Dibble to President C & O Canal Co., June 13, 1834(Ltrs. Recd., C & O Co.).

IX. PAINING FOR LOCK GATES

The lock gates were to be painted and treated with linseed oil. There is no information as to the color the gates were to be painted at this time.¹

1. Van Slyke to Board, Sept. 20 and 30, 1830(Ltrs. Recd., C & O Co.).

X. DATA TO BE PAINTED ON LOCKS AND GATES

The Board on July 1, 1831, ordered that the distance between the locks be measured and marked on the lower ends of the locks.¹

The Board on August 17, 1836, ordered the number of each lock to be painted upon the balance beam of the lower gate, and also the height above tidewater.²

1. Proceedings of the President and Board of Directors, S, 399.

2. Ibid., E, 122.

XI. WORK DONE TO THE COMPOSITE LOCKS IN THE YEARS 1851-1852:
CRIBS AND FENDERS

On December 18, 1850, Superintendent Dungan forwarded to Chief Engineer Fisk a bill of timbers for a crib under the lock flumes. Included for each lock were to be:

16, 9 x 9s of 9 feet in length) = 164 cubic feet x 10¢ = \$16.40
13, 9 x 9s of 12 feet in length)

These timbers were to be of oak, and 12 cribs would be required at and above Lock No.60. In addition, 25 perches of stone were needed.

To improve the fenders at each lock would require:

2 pieces 14 1/2 feet long 12 x 12s = 29 cubic feet
2 pieces 10 1/2 feet long 12 x 15s = 26 1/4 uprights
2 pieces 12 1/2 feet long 9 x 9s = 14 bearing pieces
44 pieces 6 feet long 6 x 6s = 66

Total of 135 1/4 cubic feet x 10¢ =	\$13.53
Workmanship	10.00
For each lock	23.53
Lock Nos.60-75	<u>\$352.95</u>
Cost of 16 locks	<u>\$376.48</u>

Dungan soon thereafter forwarded to Fisk a plan of the fenders, drawn by J. C. Stuck. A copy of Stuck's plan accompanies this report.²

On January 20, 1851, Dungan reported that he had contracted for the timber for the cribs and fenders for the 16 locks in his division.

1. Dungan to Fisk, Dec. 18, 1850(Ltrs. Recd., Chief Engineer). Upon the completion of the Canal to Cumberland, Dungan had been named Superintendent of the Cumberland Division.

2. Dungan to Fisk, Dec. 19, 1850(Ltrs. Recd., Chief Engineer).

The cost of the timber for Locks Nos.62-66, which required no cribs, would be \$21 a lock. Timber for Locks Nos.61-66 would be received at Fair Play and be delivered to the sites by scow.

Byers at this time agreed to finish Lock No.60, the timber for which would cost \$500 delivered.

The ironwork (bolts and spikes) for the cribs and fenders would be forged by Mr. Stiles at his shop near Lock No.62.³

George W. Merchant proposed to build the cribs for Locks Nos.60 and 61 for \$25 each, and the fenders for Locks Nos.60-66 for \$35 each, all the materials and a boat to be provided by the Canal Company.⁴ His price was considered too high and was rejected. Fisk now directed Dungan to carry out this project with day labor. Carpenters who would do the work for what the Company would pay were scarce. On February 8 Dungan, observing that the carpenters scheduled to work on the pivot bridge had not arrived, inquired, "Would it be possible to send enough up from Washington also to put up the cribs and fenders?" By the end of the week, he added, all the timbers, except those for Lock No. 60, would be on hand.⁵ The carpenters soon arrived, and on March 3, Treasurer Ringgold forwarded Dungan a draft to pay for their services and for the timber and ironwork.⁶

3. Dungan to Fisk, Jan. 20, 1851(Ltrs. Recd., Chief Engineer).

4. Merchant to Fisk, Jan. 23, 1851(Ltrs. Recd., Chief Engineer).

5. Dungan to Fisk, Feb. 8, 1851(Ltrs. Recd., Chief Engineer).

6. Ibid., March 3, (Ltrs. Recd., Chief Engineer).

XII. MAINTENANCE OF THE COMPOSITE LOCKS, 1857-1919

In June of 1857 Lock Nos. 56 through 75 were measured. All were found to be 100 feet in length, but their width varied from 15 feet to 15 feet seven inches measured at the narrowest point. The distance between the masonry of the sidewalls of the 13 Composite Locks averaged 16 feet eight inches. The addition of the wooden linings resulted in a nominal width of 15 feet. At the same time, a second engineer, Charles Clark, had measured Lock Nos. 27-40, and he reported that they varied in width from 14 feet seven inches to 14 feet ten inches.¹

Engineer W. R. Hunton 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."

Reporting on the condition of the Composite Locks, he wrote that they were in a serviceable state, though the wood was "old and worn." He indicated that they had been relined when necessary, and the lining and sheeting secured with longer spikes. Several could not last much longer, he thought, as the wing walls, being of dry masonry, had been badly damaged by passing boats bumping into them.

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

Hunton recommended that preparations be made to rebuild two or three of the Composite Locks during the winter of 1870-71 in "some cheap, but more durable style, of good rubble masonry . . . laid in cement mortar, with fender posts of wood and hollow quoins of cast iron. The walls of the locks to be rebuilt were to have a slight batter on the face."²

During the winter of 1873-1874 the Composite Locks in need of repair were rebuilt.³

In the period 1886-1888 considerable work was done on the Composite Locks during the winter months. The upkeep consisted of installing new sheeting and lining.⁴

Because of the configuration of the gate pockets and headwalls, it would have been impractical to attempt to line their masonry surfaces with wood. To protect these surfaces from abrasions and strain cement was applied in 1910, if not earlier.⁵

2. *42nd Annual Report*(1870), 30-32.

3. *48th Annual Report* (1874), 11.

4. *58th Annual Report* (1886), 24; *59th Annual Report* (1887), 27; *60th Annual Report* (1888), 29.

5. Franzen, "Historic Structures Report--Survey Report for Lock #66 Complex," p.2; John R. Miele, "The Chesapeake and Ohio Canal, A Physical History," January 2, 1964, 25.

XIII. CARPENTER'S SHOP

A diligent search of Record Group 79, Papers Chesapeake and Ohio Canal Company, at the National Archives has failed to turn up any documents containing data on the Lock No.66 Carpenter's Shop. Archie Franzen, in his Historic Structures Report, "Survey Report for Lock #66 Complex," December 1967, discusses the background of the Carpenter's Shop, describes its present condition, and gives its dimensions.

We concur in Architect Franzen's recommendation that as "so little is known of the operation of the carpenter's shop, it might be best to remove the existing fabric remains and stabilize the masonry foundation rather than reconstruct it."

#

SPECIFICATION

For Locks on the Chesapeake and Ohio Canal.

The thickness of walls, length of timbers, &c., given below, are for a lock of eight feet lift. For a lock of more 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 tow-path side of the centre of the lock.	Length on the berm side of the centre.	Total length.
0	23½ feet	27½ feet	51 feet.
1	23	27½	50½
1	20½	27½	48
1	19	27½	46½
1	17½	27½	45
1	16	27½	43½
10	16	16	32
83	14½	14½	29
17	16	16	32
4	14½	14½	29
1	16	16	32
1	17½	17½	35
1	19	19	38
1	20½	20½	41
1	22	22	44
7	23½	23½	47

144

3. The twenty-third and the one hundred and twenty-third timbers shall be respectively directly under the head and the lower main sills.

4. As the above timbers shall be neatly fitted upon two rows of timbers of similar dimensions laid longitudinally of the lock, and which shall be placed so that they shall be, one directly under the head and one under the lock walls, the whole breadth of the timber being under the masonry. These longitudinal timbers may be as great length as can reasonably be procured; and where their ends fit against each other there shall be space between them of the same dimensions, twelve feet in length, parallel and close to them under the wall. The ends of all of the timbers used in the foundation shall be squared. The top of the transverse timbers shall be finished 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 six feet below the bottom of the transverse timbers, and running across the whole breadth of the foundation of the lock, which shall be driven, fitted, 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 third, of the twenty-third, and of the one hundred and twenty-third of the above-mentioned transverse timbers.

6. When the masonry is completed, there shall be a course of plank of first rate white 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 cross-boards, 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 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 on 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 as for the pit to be finished, as for space sufficient for the work during the construction. After the excavation of the pit, the bottom shall be prepared in such manner as the Engineer may direct, so that the timber may be properly laid.

9. Any stone excavated from the lock pit, if approved of by the Engineer, may be used in the lock walls or elsewhere. All other material, whether of rock or of earth, shall be deposited at any place the Engineer may direct, not more than two hundred feet from the pit; and if placed in the embankments of the canal, in the manner required by the above specification, the extra labor caused thereby shall be paid for at the estimate of the Engineer.

10. The Company reserve 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 causing a contract with any person at any time during the construction of the lock, for the puddling up and embankment around the masonry, or they may do this with hands hired and paid by the Company. Unless the Contractor can be shown 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 no stone shall any portion of it be nearer than two feet to the bottom of the lowest part of the 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 level. The top of the tow-path lower wing shall descend one foot in its length, the descent commencing three feet back from the angular point. The tow-path upper wing in like manner descends six inches. The lower 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 lower wing runs out level the same length as the corresponding tow-path 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 commencing 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 up.

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 from a point the same distance below the upper side of the upper main sill, and extending up to the interior join 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 under 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 by a half inch, batter, and by three eighths 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 beds, 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 all be square, and shall be as complete as the beds, joints, and face of cut stone in every respect, except the surface, 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 centre to centre 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 deviate, 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 plank being neatly fitted against it.

20. No course shall be less than one foot in thickness, and no stretcher shall have less than a seven 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 up more and full four or 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 diminution 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 this 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 reach the adjoining face stone.

23. The face stone, whether header or stretcher, shall have parallel beds through out, 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 estimates 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 number, and in no case will any money be paid upon such portion of the stretchers as shall exceed the proportion of one foot and a half of face for each header.

25. The hollow quoins shall all be closely cut throughout their face, their beds, and their joints. What is called a half hollow shall be cut to the header, and the half hollow the stretcher, so that they shall be alike in the hollows of the headers and stretchers. The straight part of the whole hollow in the recess shall not be less than the height of

Appendix A (cont'd)

the coping, as the straight part in the chamber be less; and the 'half hollow' shall break over the 'whole hollow' at the top to its own thickness. The 'half hollow' shall be in width such that in no place, nor ending in a curve, shall be to its face, whether in the curve or in the straight part of it, shall it be less than eight inches; and the joints be less; and the 'whole hollow' when laid in its place, shall not be less than forty inches, and remain the same from any part of the face at right angles to the lock.

22. The coping shall be twelve inches thick and three feet wide, and be so built as to present a nearly uniform width on the top. The angle formed by the top of the coping and the inner side of the lock-wall shall be fairly and broadly be 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 bedded 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 tow-path 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 cramps and bolts as may be directed.

23. At the head and at the tail of the lock along the tow-path and beam wings there shall be balked one foot square white oak timber, the top of which shall be one foot below water line. There shall be three sets of bolts of 1½ inch square iron properly secured to the masonry in each of the four pieces of timber.

24. 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.

25. 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 borders of the face stone, and so also as to fill in with a suitable hard stone the angular place that may be left in consequence of the front stone being less in length in the rear than 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 course below it within fifty feet has not been fully and thoroughly grouted.

BREAST-WALL.

26. 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 steps 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.

27. 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.

28. 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.

29. 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 the masonry.

30. 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 concluded 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 SAND.

31. 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; and the Canal Company shall repay the Contractor, upon the 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.

32. It is expressly stipulated that although 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.

33. 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 than three eighths of an inch apart.

34. 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 so long time shall pass between the wetting of the cement and its use than in the case of mortar, viz: one half hour. The joint box shall not contain when full more than twenty-four cubic feet.

THE MITRE SILLS.

39. Sills of first rate white oak timber—they shall be nine inches thick, planed, jointed, and framed, in the lower end. The lower mitre sill shall be placed immediately upon the transverse timbers of the foundation, which, to be in place under the 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 upon 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 quality to be directed by the Engineer of the Company. The braces of the mitre sills will be octagonal 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 all of 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.

PROPOSAL.

I propose to furnish all necessary materials and to construct Lock No. *18-70* Section No. *19* of the Chesapeake and Ohio Canal, and do the necessary excavation, embankment, and puddling, in conformity to the foregoing specification, for the annexed prices:

1. For masonry of the lock and flume, including the cutting of the hollow quoins and of the coping, and the scabbling of all the rest of the work as described in the foregoing specification, including also clamps, bolts, cement, the four timbers bolted on the angles of the lock, and all other materials laid in the lock, per perch of twenty-five cubic feet,	\$	<i>12.00</i>
2. For foundation of timber, if required, for the lock and flume, including sheet piling, puddling for the bedding of the timbers and for the sheet piling, iron work, laying, and other materials required, a gross sum of	\$	<i>1,503.20</i>
3. For the mitre sills and for the platform for the upper gates,	\$	<i>140.00</i>
4. For any walking above and below the lock, per perch of twenty-five cubic feet,	\$	<i>3.75</i>
5. For paving below the lock,	\$	<i>3.75</i>

Excavation of the lock-pit, embankment and puddling around the masonry, for the whole required for the lock, or so much of it as the Company may permit the Contractor for the lock to do, viz:

6. Excavation of rock quarried or blasted, per cubic yard,	\$	<i>1.50</i>
7. Do. of slate,	\$	<i>.75</i>
8. Do. of all other materials, including stone equal in size to one cubic foot, per cubic yard,	\$	<i>.60</i>
9. Embankment excavated from the lock-pit and moved back into the bank, per cubic yard,	\$	<i>.20</i>
10. Do. not excavated from the pit,	\$	<i>.25</i>
11. For puddling, per cubic yard, in addition to the embankment price,	\$	<i>.35</i>

The above prices include all pumping or bailing of water, both during the excavation of the pit and the construction of the lock.

For an addition of *25 cents* per perch, I will lay, if required, the front stone of the masonry with a brick.

Signed by me, this *25th*

day of *August* 18 *58*

Wm. M. Moser

Note.—A strict compliance with the terms of this proposal will be required in every instance.

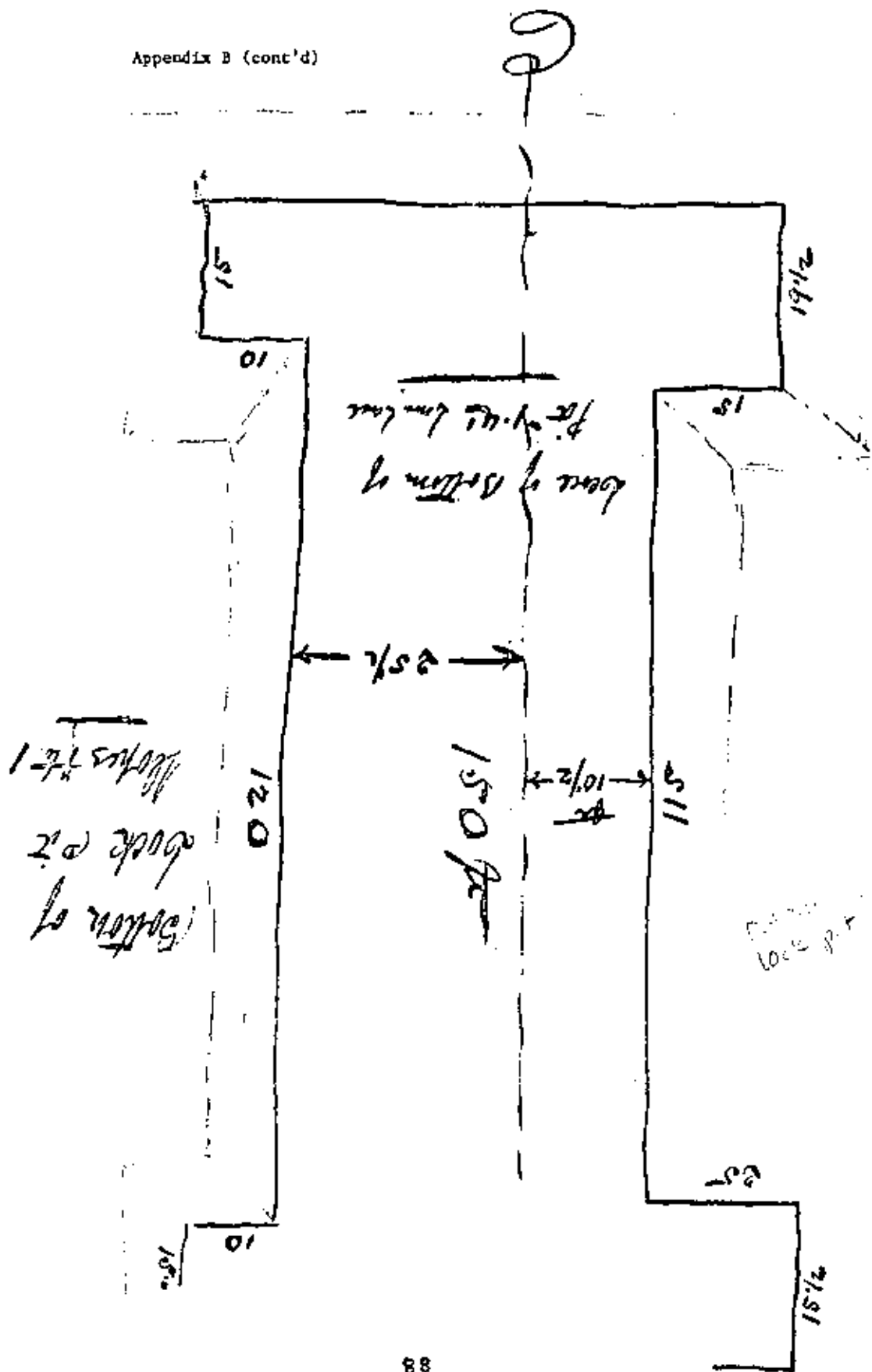
No contract will be made with more than one person.

(203)

Nov 18th 1838

W. Braam's calculation
of the Pits of Coetz

60 & 61



Coast 50

Bottom Section

(1050)

$$\begin{array}{r}
 3.25 \times 2000 = 6500.0 \\
 27.1 \times 15.5 = 420.05 \\
 15.1 \times 13.1 = 197.81 \\
 15.1 \times 10.1 = 152.51 \\
 19.5 \times 15.1 = 294.45 \\
 \hline
 3 \times 6380.0 \\
 9 \times 2126.66 \\
 \hline
 236.3 = \text{cyls Bottom Section}
 \end{array}$$

Content of Pit 5 = 3893.1 cys

$$\begin{array}{r}
 073.6 \times 5.6 = 412.16 \\
 6380.0 \\
 \hline
 3 \times 21392.2 \\
 9 \times 4130.7 \\
 \hline
 458.9 \text{ cys } \times \text{operation}
 \end{array}$$

$$\begin{array}{r}
 236.3 \\
 458.9 \\
 \hline
 695.2 \\
 156 \\
 \hline
 851.2 \\
 347.60 \\
 \hline
 3893.1 \text{ cys}
 \end{array}$$

Area Coast Pit = 3893.1 cys

Coast Pit 6D

Bottom Section

(1061)

$$\begin{array}{r}
 150. \times 36 = 5400.0 \\
 25.0 \times 15.5 = 387.5 \\
 15.1 \times 10.1 = 152.51 \\
 15.1 \times 10 = 150.0 \\
 19.5 \times 15 = 292.5 \\
 \hline
 3 \times 6380.0 \\
 9 \times 2126.67 \\
 \hline
 236.3 \text{ cys } \times \text{Doll } (see)
 \end{array}$$

Content of Pit 6 = 3131.2 cys

$$\begin{array}{r}
 5.30 \times 9.5 = 5035.5 \\
 6380.0 \\
 \hline
 3 \times 11415.5 \\
 9 \times 3505.5 \\
 \hline
 450.8 \text{ cys } \times \text{operation}
 \end{array}$$

$$\begin{array}{r}
 236.3 \\
 450.8 \\
 \hline
 687.1 \\
 327.6 \\
 156 \\
 \hline
 1170.7 \\
 3131.2 \text{ cys}
 \end{array}$$

APPENDIX C

Manual Resistance to 2000 ft
Mar 1st 1887

Mr. Michael Byrnes
Contractor for dock 6180

Dear Sir

I have fixed upon the heights of the Courses of
Dock No 61
As Below

	Down Pock Mill		Down Wall	
	Coping = 12 ins		Coping = 12 ins	
10 Courses	1 = 12	}	11 = 12	10 Courses
	2 = 13		12 = 13	
	3 = 14		13 = 14	
	4 = 15		14 = 15	
	5 = 16		15 = 16	
	6 = 17		16 = 17	
	7 = 18		17 = 19	
	8 = 20		18 = 20	
	9 = 22		19 = 21	
	10 = 24		20 = 23	
	183		183	
	Allowance for joints = 21		Joints = 21	
	185 Inches		185 Inches	

10 courses sides or 20 courses in all:

The whole height of
Mull will be on each side 185 or 185 Inches

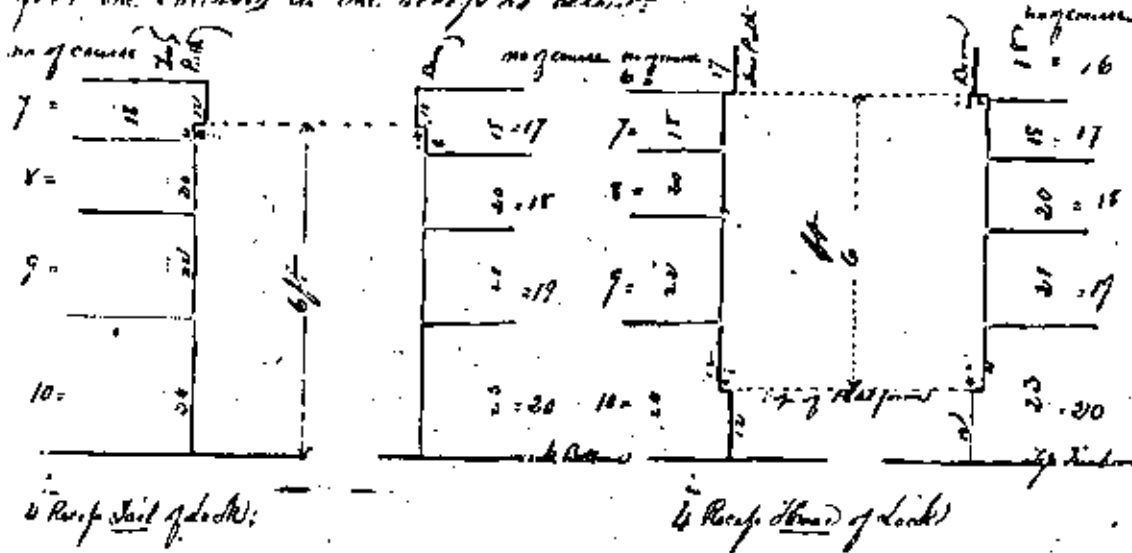
Adding up this

10 Courses (courses heights)	=	183
Allowance for joints at the rate of about 2 1/2 per joint	=	21
		185

So that it will be necessary to cut the second courses to the exact heights named, as they will increase by the joints in setting, so as to rise the altitude we want.

In case of the Recept for the Gates there is to be made a small recess 6' deep & 6' high of the same length as the main recess:

The under side of this side recess will be at the bed of the main sill both at the upper & lower gates & will of feet the courses in the recess as follows:



Thus it will be seen that at the Tail of the Lock the 4 recess will be formed by
 on the Tow Path side { a 6 inch check along the lower bed of course
 on 7 for length of main recess
 11 inches deep }
 on the { an 8 inch check along the lower bed of course
 on 7 for length of main recess
 11 inches deep }
 Bottom

And at the Head of the Lock the 4 recess will be formed by
 on Tow Path side { a 12 inch check along the upper bed of the 10th course 6' deep from the bottom of the Recess; the top of it being formed by projecting course No 6
 16 for the length of Recess }
 on Bottom side { an 11 inch check 6' deep along the upper bed of the 20th course for the bottom of the recess; the top of it being formed by a 1 inch check 6' deep along the lower bed of course No 16 for the length of the recess. }
 Side

In planning the above no account has been taken of size of details. The Hollow Joins will be cut to suit the 4 Recess by collecting back, square with Recess face, 4' deep at the intersection of the slope of the Hollow Joins with the face of the Recess;

Shows your Locks shall be more fully opened & will an-
swer the Chances of the other Locks, which I must prefer to have
in heavier cases if it would suit the Livery as well.

I am Sir Respectfully
your obed^t Serv^t

(signed)

Edmond Morris

Paris, France, Eng^d

APPENDIX D

Work accomplished by Buell & Watt as of November 21, 1849, under their contract of November 20, 1947, with Hunter, Harris & Co.:

Lock No.62

4,457.62 perches mortared masonry	
662.58 perches dry masonry	
3,529 cubic feet timber in foundations	
18,670 superficial feet of planking in foundations	
624 cubic feet timber in lining	
2,238 cubic yards earth, excavation	
395 cubic yards rock, excavation	
1,000 cubic yards embankment from pit	
800 cubic yards embankment not from pit	
450 cubic yards puddling	
679 cubic feet timber delivered x 20¢	\$135.80
15,889 superficial feet plank delivered x \$17.50/w	\$278.06
9 perches stone delivered x \$2.00	18.00
4,304 iron anchors	

Locks Nos.63 1/3, 64 2/3, and 66

1,852.76 perches mortared masonry	
2,690.83 perches dry masonry	
193.49 perches dry walling	
6,479 cubic feet timber in foundations	
27,418 superficial feet planking in foundations	
1,403 cubic feet timber in lining	
1,801 superficial feet plank in lining	
8,783 iron anchors	
150 perches concrete masonry x \$2.50	\$375
350 cubic yards puddling	
2,072 cubic feet timber delivered x 20¢	\$414.40
37,136 superficial feet plank delivered x \$17.50/w	649.88
50 perches stone delivered x \$2.00	100.00
8,000 oak pins, 1 1/2 inch	\$8.50 68.00
5,500 locket plus 3/4 inch	\$7.00 38.50
On account of railroad	\$1,1597.93

Buell & Watt had accomplished several items not covered in Dungan's estimates. They were: (a) 26,452 superficial feet of plank jointed at 50¢ per hundred; (b) 31 lineal feet of longitudinal sills and the recess frames for Lock No.62; and (c) one quoin post for Lock No.63 2/3.¹

-
1. Dungan to Fisk, Feb. 2, 1850(Ltrs. Recd., Chief Engineer).

SEMI-MONTHLY RETURN OF THE FORCE EMPLOYED ON THE 50-MILE SECTION, MARCH 10, 1850.

Locks Nos.	Blacksmiths	Carpenters	Quarry Men	Stone Cutters	Masons	Mason Tenders	Brakemen	Laborers	Bosses	Totals	Horses	Drivers	4-horse wagons	Drays	2-horse cars	3-horse cars
59					2	2				4	4	1	1			
60		2	3		2			7	1	15	5			1		
61		7			4	6				17	2	3		1		
62-66	2	20	32	6	8	6	7		4	95	35	15	1	3	2	7
3 carts, as well.																

SEMI-MONTHLY RETURN OF THE FORCE EMPLOYED ON THE 50-MILE SECTION, March 25, 1850.

Locks Nos.																
59		6								6						
60		6						5		16	4	4	1			
61		9			4	6		8		27	2	2				
62-63	2	6	23	5	7	17										

SEMI-MONTHLY RETURN OF THE FORCE EMPLOYED ON THE 50-MILE SECTION, APRIL 10, 1850

Locks Nos.	WORK had been suspended in MARCH on the 11-15.																			
	59	60	61	63-66	1	9		3	6	14	2	3	1	39	10	4		2		
	Blacksmiths	Carpenters	Quarry Men	Stone Cutters	Mason	Mason-Tenders	Boatmen	Laborers	Bosses	Total	Horses	Drivers	4-horse wagons	Drays	3-horse cars	2-horse cars				

SEMI-MONTHLY RETURN OF THE FORCE EMPLOYED ON THE 50-MILE SECTION, APRIL 27, 1850

Locks Nos.	59	60	61	63-66	1	6		2	2	10	3	4	1	9	2	1	1			
	Blacksmiths	Carpenters	Quarry Men	Stone Cutters	Mason	Mason-Tenders	Boatmen	Laborers	Bosses	Total	Horses	Drivers	4-horse wagons	Drays	3-horse cars	2-horse cars				

Apt. Engr's office (Litho) Released Apr 25 1930

Charles B. Hyde Esq.
Chief, Engr. Sec.

I herewith enclose you a bill of lumber and plan's for the casing of the Champion Locks on this division, made out from a full plan, and which I shall be pleased to have meet your approbation, as I think it will show a good appearance, and I hope all the strength that can be given to it at the proposed points.

I have plans to cover the lower wing, entirely, as I find rough coping cannot now be made.

I gave the bill to Mr. Lowe last week asking him to delay such parts as I wished to consult you in regard to, and which are nearly correctly shown in the sketches I sent you some days since. I was anxious to prepare this sooner but was prevented by being compelled to remain several days, on account of a sick child, but I see but little activity in getting the bills they already have.

Respectfully
Yours etc.
John A. Hayes
Apt. Engrs

PLATE III
Byrne's Transmittal Letter etc.

Bill of lumber and planing in the Company of a Composite

Below the upper gates

No. of pieces	Length	Size	Sub. per foot	total feet
2	7 ft 9 in	6 in x 6 in	92.00	
3	6 "	6 " x 6 "	36.50	
4	5 "	10 " x 6 "	105.00	
2	11 "	7 " x 6 "	97.00	406.83
2	11 "	11 " x 4 "	29.33	
2	11 "	6 " x 11 "	41.00	
2	11 "	6 " x 11 "	41.00	

When used exclusively of lower receipts

22	6 ft	6 in x 6 in	396.00		
2	28 "	9 " x 6 "	256.50		
2	32 "	9 " x 6 "	288.00		
2	26 "	9 " x 6 "	234.00		
2	16 "	4 " x 4 "	44.00		
2	5 "	4 " x 4 "	14.66		
8	16 "	4 " x 4 "	170.66	2499.07	
2	21 "	6 " x 4 "	86.50		
4	24 "	6 " x 4 "	192.00		
2	16 "	6 " x 12 "	66.00		
2	6 "	9 " x 6 "	54.00		
18	7 "	3 "	9 " x 6 "	587.25	208.25
2	7 "	8 "	9 " x 6 "	69.00	
2	12 "	6 "	9 " x 6 "	40.50	
2	7 "	8 "	9 " x 6 "	69.00	

Lower Receipts

2	8 feet	12 in x 6 in	96.00	
2	6 "	6 " x 6 "	36.00	
2	6 "	6 in x 6 in	97.50	
2	7 "	4 " x 4 "	17.67	371.67
2	7 "	4 " x 6 "	42.00	
2	5 "	15 " x 6 "	82.50	
2	5 "	15 " x 6 "	82.50	

Below side below the lower gates and round to the flange

5	4 ft 7 in	6 in x 6 in	71.25		
1	5 "	6 " x 6 "	16.50		
1	5 "	6 " x 6 "	15.00		
1	7 "	6 "	9 " x 6 "	33.75	
1	15 "	6 "	9 " x 6 "	67.75	
1	23 "	6 "	9 " x 6 "	105.75	
1	7 "	11 " x 6 "	9.33		
1	14 "	4 " x 4 "	18.67	595.17	
1	23 "	4 " x 4 "	30.67		
1	5 "	4 " x 6 "	10.00		
1	11 "	4 " x 6 "	22.50		
1	21 "	7 "	4 " x 6 "	43.50	
3	6 "	7 "	9 " x 6 "	51.13	
3	7 "	3 "	9 " x 6 "	97.87	

Carried forward 3872.74 323.72

Instead of 3 of these pieces on each side of the flange
 and one piece where these 2 would be commoned species
 only to facilitate the getting of them, these
 2 pieces on the upper gates 46 feet long } these as shown in
 2 " " " " " " " " " " " " " " } the table will meet
 1 " " " " " " " " " " " " " " } the distance between the
 " " " " " " " " " " " " " " } " " " "

Sheet forwarded

Sheet # 387274
 Cont. page 32 272

Hourly work done below the lower gate

	No. of pieces	Length	Depth	Height	Sup. ft.	
	3 pieces	4 ft - 9 in	6 in x 6 in		12.75	} 317.50
7.6	1 "	5 " - 6 "	6 " x 6 "		10.50	
16.	1 "	7 " - 6 "	7 " x 6 "		33.75	
	1 "	16 " -	7 " x 6 "		72.10	
	1 "	7 " -	11 " x 11 "		7.32	
	1 "	14 " -	14 " x 11 "		18.67	
	1 "	5 " -	6 " x 11 "		10.00	
7.	1 "	13 " -	6 " x 6 "		24.00	
12	1 "	7 " -	9 " x 6 "		31.50	
143.6	1 "	13 " -	7 " x 6 "		58.50	
					<u>4187.70</u>	317.50
						<u>349.11</u>

Blanking

Above the upper gate	22 ft x 5 ft 3 in x 2 in	231.00
Columns	15 ft 6 in x 5 ft 3 in x 3 "	} 1748.40
"	10 ft 6 " x 4 ft 6 in x 2 "	
Lower Blanking	14 ft x 5 ft 3 in x 2 "	117.00
Bound side, below lower gate	41 ft x 3 ft 9 in x 2 "	307.50
Low path	19 ft 6 in x 3 ft 9 in x 2 "	146.00
		<u>2579.96</u>

Part of timber for coping
 29th April 1880
 J. G. Army

Total of sup. ft in coping 4767.70 feet

Bills for the Hourly Day work

I propose to put timber on in 5 lengths, viz 2 pieces on the grade of 40 ft. and 3 pieces on the 60 feet levels
 To finish with the coping I propose to make the piece
 next the piece next the end of the last being 12 in x 12 in
 at 20 feet 9 in x 6 in, and then to the end of the wall, 9 in x 6 in
 thus 1 piece 31 feet long 12 in x 12 in at one end & 9 in x 6 at the other end
 " " 31 " " 9 in x 6 in, making 2416 ft sup. ft

I think these can be better done on such walls as we have them larger ones.

PLATE V
 Bills of Timber and Blank. . in Coping, etc.

Fort Vancouver Office, 9th July 1850

To Colonel W. W. M. Esq.

Chief, Engineers

Sir

I have here enclosed sketches of plans for the wooden coping in the upper canal lower reaches of the composite locks. I expressly wish that you will direct me which shall be used.

Sketch No 1 of the upper, and No 2 of the lower respective designs for a single line of great timbers as your general instructions indicated. The other sketches I have appended to give additional strength to points liable to be struck by the boats, and to avoid short pieces.

At the upper reach I propose to cut off the post (A) at the height of the 6x6 copes, and pass the 10x6 in timber over it, fastening the end from the car water, and bringing the top end up against the end of the 10x6 and also against the post. I believe the plan will suffice the best. The increase of timber as you will see, is about 150. If you please send a letter to me in the Messing at Bismarck I shall receive it in the course of the day, which I should like to do in order to complete my bills

Respectfully
Yours
John W. Byrnes

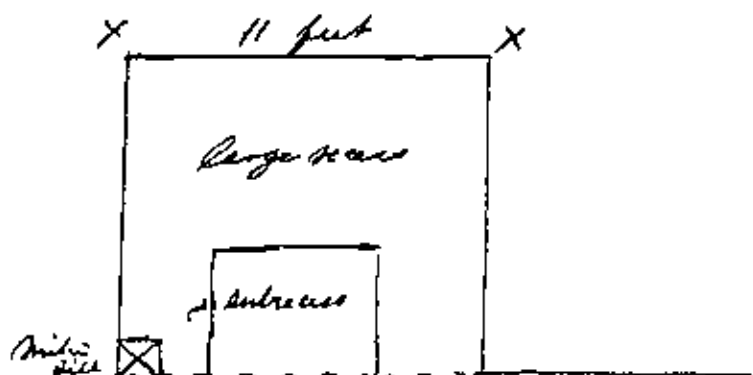
PLATE VI

Byrne's Transmittal Letter, with Sketch of Plan, etc.

Chief Engr's Office U.S. Canal
Sant Fe, 12th Dec, 1878

Dear Sir,

I am arranging some little matters of detail about our composite locks, — among others that of the dimensions of the Subrecess, — (in the larger recess) — It is desirable to have three dimensions of the recess, — depth, height and length, then is necessary to receive the lock valves, — remaining open, when the lock gate is fully opened — These dimensions, I know, admit of being accurately calculated, but I would prefer to have the results of accurate measurements at locks with valves and frames such as are now put in upon this Canal. —



Please give the exact position, as well as the dimensions of the Subrecess —

W. D. Elgin, Esq.

Sept. 26. H. S. P. Frimley

Yours Very respectfully
to have by Dr. Fish
to Chief Engr.

PLATE IX
Fish's Letter with Dimensions of Recesses and Subrecesses.

Cum gratia Dec. 19th 1859

Charles B. Fiske Esq.

Chief Eng. Ches. & Ohio C^o

Sir

I transmit you the plan of fenders drawn by J. C. Stuck which shows distinctly every thing I wished to convey except that No 5 is reduced to 6x9 jagged into No 2 and terminates in a dove tail, upon which No 4 is fitted and makes the round full & complete between from 2.0 A. to 7.0 to the foot of No 5 can be secured by 3 short braces pinned to the foundation timbers in the manner of those let into the Mitre sill & a ring up to brace the gwin parts.

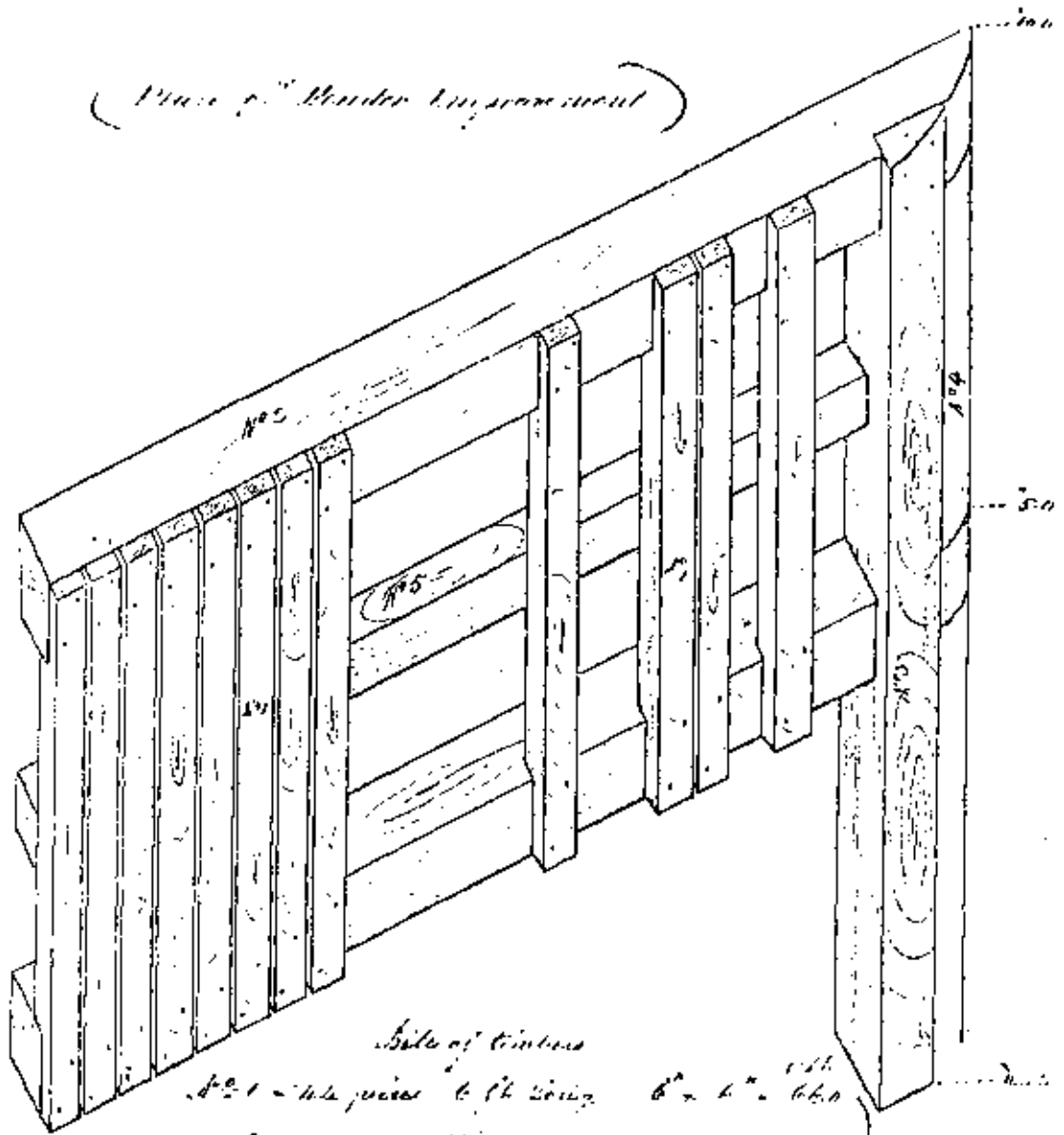
You will perceive I put nothing down to pay ballies Doyle should be paid for half of No 2 on Eng. of C and from that time to Jan 9th as a help No 3 Frank from the 8th of Dec. & No 4 Shaker from the 12th of Nov. and prior to that time as a man under Mr Cunningham - please inform me what wages are to be allowed the Ballies whether forty per No deducting board board or otherwise, please request Mr. Ringgold to forward me some Subscribers & I hope the money will be forth coming by Monday at farthest to enable me to pay off the men, do not forget the cross section books.

PLATE X

H. M. Dungan's Transmittal Letter with Plan by J. E. Stuck for Fender Improvement.

Very Respectfully
Your obt. Serv. H. M. Dungan

(Plan of "Fender Improvement")



Bill of timbers

4-2-1 = 14 1/2 pieces	6 ft long	6" x 6"	66.0	116
2 = 2	14 1/2 "	12 x 12	29	116
3 = 2	14 1/2 "	12 x 15	26.4	102.50 10 1/2
10 = 2	4 "	10 x 10	5.56	}
5 = 2	14 1/2 "	9 x 9	15.75	
Front horizontal rail			By per Lead =	10
			Over left side =	17.20

PLATE XI
Stuck's Plan of Fender Improvement.

Law Paw Dept. Wa
July 14th 1880

Charles D. Fish Esq:

Chief Eng^r C. S. & G.

Sir

enclosed I send

you the return of price for the 11th inst.

I will try to have the returns in earlier in
future. — I paid Mr. Arney my self for one
month and for the last month gave him a
check bill for fifty dollars which I understood
Major Harris had promised to cash. —

If Major Harris is in Cumberland please take
it up for me and charge you with the
amount. If the side planking of the flume
is to be flush with the face of the 12 inch posts
(being 8 inch planks) I cannot clearly understand by
Mr. Meyer's plan how the 12 in posts are set upon the
large (undrilled) dills whether to project 2 in. in or out of
if ^{set in} ~~out~~ whether the 10 inch posts should also be set in
to bring the side plank flush by a 2 in setback in
the 12 inch posts

I am lost —

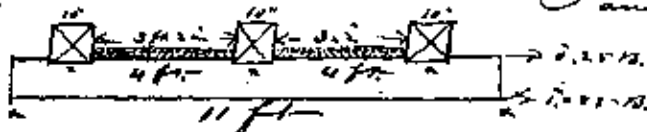


PLATE XII
Dungen's Transmittal Letters and Plan of Flume Side
Planking.

Very Respectfully

J. M. Dungen
A. C.