REPORT ON THE PRESENT STATE OF THE CHESAPEAKE AND OHIO CANAL.

By

William Henry Swift

REPORT

ON THE PRESENT STATE OF THE

CHESAPEAKE AND OHIO CANAL:

THE ESTIMATED COST

OF COMPLETING IT TO CUMBERLAND,

AND

THE PROSPECTS OF INCOME TO BE DERIVED FROM THE TRANSPORTATION UPON IT OF THE COAL AND IRON OF THE MINES IN ALLEGHANY COUNTY;

WITH

ESTIMATES OF THE COMPARATIVE COST OF TRANSPORTING COAL BY THE CANAL, AND BY THE BALTIMORE AND OHIO RAIL-ROAD.

MADE AT THE REQUEST OF

THOMAS W. WARD, ESQ.,

Agent for Messrs. Baring, Brothers & Co.

BY WILLIAM H. SWIFT, AND NATHAN HALE.

WITH AN APPENDIX,

CONTAINING ANSWERS TO INTERROGATORIES ON THE SUBJECTS OF THE REPORT, BY CHARLES B. FISK, ESQ., CHIEF ENGINEER OF THE CANAL, AND OTHER EXPLANATORY DOCUMENTS.

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NOTE.

To save the expense and delay of furnishing manuscript copies of this report, and for the purpose of presenting it in a shape more convenient for use, we have caused it to be printed, with the exception of several rough plans, and some unimportant explanatory papers.

To avoid embarrassing the general description, in the report, of the work which remains to be done on the Canal, we have presented the more minute details, which are chiefly technical, or merely corroborative of the estimates, in a separate paper. The full and very valuable explanation of the Chief Engineer, which he has made more elaborate and thorough than we anticipated, together with a few other documents, are subjoined in an Appendix.

W. H. S.
N. H.

Boston, Feb. 25, 1846.

REPORT.

The undersigned, having been requested to inquire into the state of the Chesapeake and Ohio Canal, with a view of ascertaining the amount of work which remains to be done for its completion, and the prospect of its affording a certain and permanent income, having made such inquiries as they deemed necessary in the premises, present the following report of the result of their investigation.

The points to which their attention was particularly invited, and on which their opinion is requested, are embraced in the following questions :—

1st. Is the work of the Canal so far advanced that the portion which remains to be done, for completing it to Cumberland, in conformity with the plan proposed by the engineer, and decided on by the directors, can be finished at a cost not exceeding the amount of funds which the Canal Company is authorized to raise, by loan, under the Act of the last session of the Maryland Assembly ?

2d. Are the prospects of business upon the Canal when finished, such as to justify the expectation of a certain income from it, sufficient, in addition to defraying the expenses of management and repairs, to afford an adequate security for the interest and principal of the proposed loan ?

3d. Will the cost of transporting coal, and other heavy products of the mining region, by the Canal, to Georgetown and Alexandria, be so much lower than that of transportation by rail-road to Baltimore, that the business of the former will not be liable, under any circumstances, to be so far interfered with, by the competition of the latter, as to render doubtful and uncertain the promise of a sufficient income from it, for the objects above stated ?

The undersigned have made the inquiries which they deemed necessary, to enable them to give a satisfactory answer to these questions. On application to James M. Coale, Esq., the President of the Canal Company, we were promptly furnished by

him with every assistance in obtaining the necessary information, in aid of our purpose, and were supplied by him with copies of the reports of the directors, and other useful documents, with appropriate explanations. We have also received from G. B. Fiske, Esq., the engineer, under whose skilful direction and superintendence the work has been conducted from its commencement, the most thorough information in regard to every part of it, and to the estimates for completing it, in answer to inquiries both oral and in writing, accompanied with careful and elaborate statements and estimates, in elucidation of the various points of inquiry.

For the purpose of obtaining a more distinct and thorough knowledge of the condition of the work, we accepted the obliging invitation of the president, to accompany him, and a part of the directors and State agents, with the engineer, in an excursion over a great part of the Canal, from Georgetown to Cumberland, including the finished and unfinished parts of it, and also through a part of the mining region near Cumberland.

In the course of this excursion, our attention was given, with the assistance of the engineer and other officers, to such points of inquiry, as seemed to demand the aid of personal inspection.

The Chesapeake and Ohio Canal, as regarded for the purposes of the present inquiry, is not, as its name implies, a work extending across the Alleghany range of mountains, and uniting with the waters of the Ohio River. The present designs of its proprietors are limited, to the completion of it within the valley of the Potomac, and they leave to the future, the extension of the original design, whenever the exigencies of the country may demand it.

The Canal commences at the port of Georgetown, about three miles distant from the capitol in Washington, and extends to Cumberland, on the easterly margin of the Alleghany ridge. From the basin at Georgetown, it communicates, by means of a branch Canal, with Tyber creek, at a point near the centre of the city of Washington. It is also connected by means of an independent Canal, with the port of Alexandria, at a lower point of the river, where it is navigable by vessels of a large class. It will terminate when completed, at Cumberland, in a capacious basin, from which it may be hereafter extended by additional works. It will then be connected with rail-roads, leading to various parts of the extensive mining region in the vicinity.

The improvement of the Potomac River, for the purposes of navigation, from tide water above Georgetown, D. C., to Cumberland, Maryland, and even beyond that point, was considered an object of great importance, at quite an early day. In the year 1784, the subject attracted the attention of General Washington, and, at a meeting of commissioners, appointed on the

part of the States of Virginia and Maryland, held for the purpose of extending the "navigation of Potomac river from tide water to the highest place practicable on the north branch," he presided, and laid, at that time, the foundation of the old "Potomac Company." During a period of forty years, that company expended some $700,000 or $800,000 in improving the river at certain points, and in constructing Canals around the more important falls and rapids.

In the year 1820, the project of uniting the waters of the Potomac with those of the Ohio, was discussed by the board of public works of Virginia, and their engineer, Thomas Moore, pointed out the route, and the mode of effecting the communication.

In the years 1824 and 1825, the general government caused surveys to be made, of the county between tide water above Georgetown, D. C., and the Ohio River at Pittsburg, for the purpose of ascertaining the practicability and the cost of a Canal, uniting the waters of Chesapeake Bay with those of the Ohio River. These surveys were made principally by officers of the topographical engineers, under the instructions of a board of distinguished officers, called the "Board of Internal Improvement."

In the year 1826, this board made an elaborate report to the War Department, embracing the results of all the surveys made in 1824 and 1825, and in December of the same year, the report and plans were communicated to Congress by the President of the United States.

The route recommended for the proposed Canal, commenced at Georgetown, thence it pursued the valley of the Potomac river to Cumberland, situated at the mouth of Wills Creek, thence north by the valley of that creek to its source, thence west across the ridge or mountain, which separates the waters flowing west, from those which flow east, to Casselman's River, thence by the valley of that stream to its confluence with the Youghioghaney, thence by that stream to its junction with the Monongahela River, and thence by that river to its union with the Alleghany at Pittsburg.

The proposed Canal was divided by the board into three sections. The first or eastern division extended from Georgetown to Cumberland, a distance, by the line surveyed, of 186 miles, with an aggregate rise of over 600 feet, and estimated to cost $8,177,000.

The second or middle division embraced the distance between Cumberland and the mouth of Casselman's River, (a confluent of the Ohio,) 70⅔ miles. It included a tunnel of 4 miles in length, passing under a ridge or mountain of 856 feet above the line of Canal, and included an aggregate rise and fall of 1,961 feet. The estimated cost of this section was $10,028,000.

The third or western section, was to extend from the mouth of Casselman's River to Pittsburg, 85¾ miles, with a descent of 619 feet, at a cost by the estimate of $4,170,000, making a total length of 341¾ miles, an aggregate ascent and descent of 3,158 feet, a tunnel of 4 miles, and estimated to cost $22,375,000.

The middle or mountain section, proved to be so very expensive, (upwards of $143,000 per mile,) that the board suggested, as an alternative, the substitution of a rail-way for that portion of the route.

The route thus briefly described, had the preference in the minds of the board, over a route which had been previously examined, to wit: Instead of leaving the Potomac River at Cumberland, to continue by the valley of that stream to the mouth of Savage river, (near the middle of the great coal field,) and thence by one of the tributaries of that stream to its source, thence by a tunnel through the dividing ridge to Deep Creek, a branch of the Youghioghaney, and thence by that stream and the Monongahela to Pittsburg. The distance by the Deep Creek route, was 18 miles greater than by Casselman's River, the supply of water nearly the same, the lockage 873 feet greater, and the cost, by the estimates, $537,000 greater, and hence the decision in favor of the route by Casselman's.

If, hereafter, the centre of the coal field at the mouth of Savage River be approached, either by a slack water improvement of the North branch of the Potomac, or by an independent Canal, the substitution of a rail-way for the Canal across the mountain, might possibly lead to different conclusions in regard to the route between Cumberland and Pittsburg.

We have thought it necessary to describe, in this brief manner, the entire project of the Chesapeake and Ohio Canal, lest it might be supposed that the coal and iron of the Cumberland district, constituted *all* the resources upon which the Canal depended for support. If the whole project should be carried out hereafter, it will readily be perceived that the business of the Canal will embrace much besides that which may be derived from the coal and iron of Alleghany county.

The particular portion of this great work which we are about to consider, constitutes, even now, something more than one half of the entire distance between Georgetown and Pittsburg on the Ohio. If to the distance to Cumberland, we add the slack water improvement of the Monongahela River, (designed for the navigation of steamboats of a large class,) from Brownsville to Pittsburg, a distance of 55 miles, and now in successful operation, we shall have (with the Canal completed to Cumberland,) 241 miles of water communication, or nearly three-fourths of the entire line between Georgetown and Pittsburg finished.

We do not propose to pursue the history of the Canal through

its various stages, from its commencement to the period when the works upon it were suspended. It will answer our purpose to state generally, that the work was commenced in 1828, and that it was completed to a point (dam No. 6,) 134½ miles above Georgetown, in the year 1839. Between dam No. 6 and Cumberland, a distance of about 50 miles, the work was prosecuted simultaneously with work below, until the year 1839, when, for the want of the necessary means to carry it on to completion, operations were suspended entirely, leaving locks, dams and aqueducts partially finished, banks partly formed, and the whole exposed to dilapidation and ruin.

We shall, in this portion of our report, confine ourselves to a brief description of the Canal, from tide water to Cumberland, with its various accessory works, and to the enumeration of others with which it is connected at Cumberland, for the supply of coal and iron, leaving various collateral questions to be treated elsewhere.

From the basin at Rock Creek, in Georgetown, the Canal has been extended along the margin of the Potomac to the mouth of Tiber Creek in Washington city, a distance of about 1¼ miles, connecting itself with the Tiber, by a tide lock near the point of junction.

From the Tiber, a Canal has been opened through the city of Washington, to the eastern branch of the Potomac River, near the navy yard. But it can be used only at high water, for the passage of boats; it receives the sewerage of a part of the city, and, as a consequence, it has become much obstructed, by the accumulated deposits of several years.

From a point about a mile west of the Rock Creek basin, the Alexandria Canal, seven miles long, diverges from the Chesapeake and Ohio Canal, and crosses the Potomac River by a stupendous aqueduct 1,600 feet long, elevated some 38 feet above low water in the river. This level is maintained until the Canal reaches the Potomac at Alexandria, and there connects with the river by means of 4 locks of 9½ feet lift each.

The line of Canal between Georgetown and the town of Cumberland, lies entirely on the north or Maryland side of the Potomac; this is a decided advantage, inasmuch as the Canal is exposed to the rays of the sun in winter, for a much longer period each day, than it would be if it were located on the Virginia side. The Canal pursues the immediate valley of the river, throughout its whole extent, except at a point called Pawpaw Bend. To avoid a circuit at that place of some seven miles, which the river makes in this part of its course, the Canal has been taken across the gorge, by means of a tunnel three-fifths of a mile in extent, by which about six miles in distance have been saved. The course of the Canal, for nearly its whole

length, is through an uncultivated and very thinly inhabited tract of country. It occupies the narrow space between the rocky bank of the river, and the precipitous mountain ridge, which encloses it on the north. The only towns of any consequence through which it passes, are Harper's Ferry, Williamsport and Hancock, and these have but a limited population. The fertile valley, which lies between the Blue Ridge and north mountain, embracing the counties of Washington in Maryland, and Jefferson and Berkeley in Virginia, form a striking exception to the general unproductiveness of the country, bordering on the line of the Canal. These tracts of country are occupied almost exclusively by an agricultural population, and, notwithstanding their fertility, are but thinly inhabited. A large portion of the Canal is excavated through the rocky projections of the mountain, and at frequent intervals it is supported on the river side by extensive artificial works. The material obtained from the excavation, on a large portion of the route, where required for the bank and tow path, forms a solid bank, and a hard and durable path, and the nature of the soil, in general, along the line, is such as to give the character of solidity and permanency, to all the earth work of the Canal.

The entire length of the Canal, from the basin at Rock Creek in Georgetown, to the basin in Cumberland, is 184½ miles, and the total rise from one basin to the other is 609½ feet. The ascent is overcome by means of 74 lift locks. By means of one lift and guard lock combined, Rock Creek basin is connected with the Potomac River. In addition to the locks enumerated, there are six guard locks, and one guard gate, at the points at which the feeders are taken from the river, and there are three outlet locks, which connect the Canal with the river, for the accommodation of the Virginia trade.

The depth of the Canal is intended to be 6 feet throughout—from Georgetown to Harper's Ferry, 60 miles—it is 60 feet wide at the surface, and 42 feet at the bottom. From Harper's Ferry to dam No. 5, 47 miles; the width at the surface is 50 feet, and at the bottom 32 feet. From dam No. 5 to Cumberland, 77½ miles, the surface width is 54 feet, and the bottom 30 feet.

The locks average 8 feet lift. They are 100 feet long, by 15 feet in width, in the clear, and are capable of passing boats carrying 100 tons of *coal*, although 80 tons may be considered the load which will usually be transported of general merchandise.

There are 11 aqueducts, built entirely of stone, between Georgetown and Cumberland—of these, 7 are below dam No. 6. The width of water-way in them is from 15 to 21 feet. They are of various lengths, being, from face to face of abutment, from 62 feet the least, to 438 feet the greatest, and composed of from one to seven arches, in spans of 20 to 90 feet

each. The copings are elevated from 18 to 36 feet above low water in the river. Above dam No. 6, there are to be four—two of which (Sideling Hill and Evitt's Creek,) are completed, or very nearly completed. They are all of a single span, varying from 50 to 70 feet, and they rise from 24 to 29 feet above low water in the river. The width of water-way is 21 feet in all. These last are built of sandstone and limestone.

The supply of water for the Canal is drawn entirely from the Potomac. For this purpose, dams are now constructed across the river, at seven different points, and ultimately there may be 8, and perhaps more.

Dam No. 1, at the Little Falls of the Potomac, is of stone, and it supplies 5 miles of the Canal proper, the extension to the Tiber 1¼ miles, and branch to Alexandria 7 miles—total, 13 miles. No. 2, 22 miles above Georgetown, of stone, 2,500 feet long, is at Seneca Falls; it supplies water for 17 miles of Canal. No. 3, is the property of the United States, and is built at the head of the Falls at Harper's Ferry, 62½ miles from Georgetown, for the supply of water for the Amory at that place. It also furnishes water to the Canal from this point to Seneca, 40⅓ miles. No. 4, 84½ miles above Georgetown, feeds 26½ miles. No. 5, 8 miles above Williamsport, and 107 above Georgetown, feeds 18½ miles.

Dam No. 6, 134½ miles above Georgetown, supplies 27 miles nearly. No. 7, proposed to be erected hereafter, if it should be found necessary, will be placed below the South Branch of the Potomac. Besides feeding the Canal for 20½ miles to dam No. 6, it will give 12 miles of slack water navigation to that river. No. 8, unfinished, is at Cumberland, 184½ miles above Georgetown. It will feed the 50 miles of Canal which are yet unfinished, or 29½, in case No. 7 should be erected.

The material used in the construction of the locks and aqueducts, upon the line of the Canal, is generally good, much of it of superior quality. The first six locks, reaching from Rock Creek basin, are constructed wholly, or in part, of the Aquia Creek freestone, the same material of which the Capitol and the Treasury in Washington, are built. It has not sufficient strength for lock walls. The stone used above lock 6, is in general excellent, principally the Seneca (red sandstone,) limestone, and granite. The details will be found in the answers to the questions given in the appendix.

Of the entire distance between Georgetown and Cumberland, 134½ miles, to dam No. 6, the Canal is completed, and has been in constant use since the year 1839. The lower portion of it, from Georgetown to Seneca, embracing an extent of about 20 miles, has been in use from the year 1830, and that from Sen-

eca to Harper's Ferry dam, a further distance of 40 miles, from 1834.

The remaining 50 miles, from dam No. 6 to Cumberland, remain yet to be opened. Upon this portion, however, a large part of the work has been done, and three fifths of the estimated cost have been expended, amounting to $2,892,000. Of the 50 miles of Canal unopened, 31.7 miles are in fact completed, except that the finished parts are separated by unfinished sections, in such manner, that the water cannot be admitted to them, and they consequently remain useless. The estimated cost of completing the unfinished work, as computed by the chief engineer in 1842, was $1,545,000; and according to a revised estimate, made in 1845, based on a lower rate of wages, it was $1,404,000.

There are, therefore, in fact, but 18.3 miles of Canal, on which the work remains unfinished. These consist in part of the most difficult portions of the 50 miles, and those which although commenced early, were unfinished at the period of the suspension of the work, on account of the large amount which was to be done on the respective sections Another part consists of the lighter sections, which are not yet commenced, and which were deferred, on account of the comparatively short space of time which would be required for completing them. On some of these sections, there is little work to be done, except the earth excavation and embankment, which is of moderate amount.

The heaviest piece of work, on the whole Canal, consists of the tunnel above mentioned. This is so far advanced, that the entire opening is made, from one extremity to the other, at a cost of $514,000. The length of the tunnel, exclusive of the deep open cutting in rock, at the entrances, is 3,118 feet. It will be, when finished, with side walls, and an arched roof of brick, to be laid in hydraulic cement, 24 feet in height, to the crown of the arch, or 17 feet from the surface of water; 19 feet wide at the Canal surface, and 24 feet, including a tow path of 5 feet. The most elevated part of the ridge, through which it passes, is 360 feet above the Canal. Two double shafts were sunk, during the execution of the work, each shaft 8 feet in diameter, one pair of them 126 feet, and the other 187 feet in depth. A large portion of the rock, removed in the excavation of the tunnel, was taken out through these shafts. The whole of the tunnel excavation was through rock, viz., 70,690 cubic yards, at a cost of $218,000; the shafts at a cost of $44,000; the open rock cuttings at the entrances, 163,000 cubic yards, at a cost of $228,000; and other work at a cost of $24,000. The work which remains to be done, in the removal of rock from the sides and bottom of the tunnel, and open cutting, is esti-

mated at $42,000; the brick masonry at $14 a thousand, $78,400; and other work $57,000, making a total of $178,000 for the completion of the tunnel.

The amount of excavation and embankment, which has been done on the 50 miles of Canal, consists of 2,609,000 cubic yards of earth excavation, at an average cost, including cost of carrying into embankment, of 22.76 cents per yard; 801,825 yards of rock and slate excavation, at an average cost, including amount paid for rip-rap, of 85.14 cents, and 1,955,000 yards of embankment from outside of the Canal, at a cost of 29.92 cents. The remainder, which is to be removed shorter average distances, consists of 1,234,000 yards of earth excavation, estimated at 16.88 cents; 104,300 yards of rock and slate excavation at 74.61 cents; and 674,000 yards of embankment, at 21.23 cents. The total cost of earth and section work done, is $1,897,000, and the estimate for what remains to be done, is $431,400.

There will be, on this portion of the Canal, 21 locks, of which 6 are finished, and part of the materials are furnished for the other 15. There will be four aqueducts, of which two are finished, at a cost of $103,371, and the cost of the two which remain to be built, is estimated at $67,677. The foundation for dam No. 8 across the Potomac at Cumberland, is laid, at a cost, including the guard lock and flume to be connected with the dam, of $80,772. The dam is 400 feet in length, and it contains 3,600 perches of rubble masonry, laid in cement under the bed of the river. The cost of the works which remain for completing the dam, is estimated at $21,800. There are also to be built, 19 waste wiers, estimated to cost $34,830; 17 lock houses, at a cost of $11,000; a weigh lock and house, $18,500; bridges, tow paths and ferries, $17,554; and miscellaneous works and contingencies, estimated at $231,767—making a total, as above stated, of $1,404,471.

The amounts here stated are taken from the most recent of the estimates made by the chief engineer. The sufficiency of these estimates, or rather the adequateness of the means at the disposal of the Canal Company for the completion of the work, being the most important part of our inquiry, we present a separate paper, in which these estimates are given in detail, accompanied with remarks upon the principal items of cost. To this we append the very full and intelligible answers of Mr. Fisk, the chief engineer, to the interrogatories which were addressed to him.

To these papers we refer for a full view of this subject. On a careful examination of the estimates of the chief engineer, we have come to the opinion, that while we place great confidence in their accuracy, so far as any calculations depending

on so uncertain a basis, as the rates of wages at any given time can be confided in, we deem it unsafe to trust implicitly to the sufficiency of the lowest of these estimates, in every contingency, for the completion of the work. This hesitation arises from the fact, that they are necessarily predicated on an assumed cost of labor and materials, which is liable to change, and which may be materially increased within the two ensuing years. In taking a limit of expenditure which we deem it safe to assume, as the measure of cost which can be relied on under these contingencies, we are of opinion that the estimate of 1842, making an aggregate of $1,545,000, may be relied on as a safe one. Under favorable circumstances, particularly in regard to the prices of labor and provisions, a material saving from this amount might doubtless be realized.

In forming this opinion, we throw out of view the contract which has been entered into by the directors of the Canal Company, for the completion of the Canal, and for making payment therefor in the bonds of the company. It seems proper, however, that we should consider the effect of this contract, as well as the amount and character of the bonds proposed to be issued, as constituting the resource relied on, for the means of completing this work, referred to in the commencement of this report.

By an act of the Assembly of the State of Maryland, passed on the 10th day of March last, the president and directors of the Canal Company are authorized, on condition of a certain guaranty being given, to borrow on the bonds of the company, a sufficient sum of money to pay for the completion of the Canal, with the interest on the said bonds, in aid of the net revenues of the company, not exceeding the sum of $1,700,000. The bonds so issued under this act, are to be made payable in not less than 35 years, to be on interest not exceeding 6 per cent. per annum, and are to have no preference over one another, on account of priority of date. They are to be entitled to a prior lien, over other obligations of the company, on the revenues and tolls, that may accrue from every part of its works between Georgetown and Cumberland, and these are pledged and appropriated to the payment of the same, and the interest thereon, with the exception, that the president and directors of the company are authorized, to apply such portion of said revenues and tolls as, in their opinion, may be necessary, to keep the Canal in good condition and repair for transportation, to supply it with water, to pay the salaries of officers and agents, and to defray the current expenses of the company. The State of Maryland thus releases its claims upon the Canal Company for all advances made to it, and the interest thereon, so far as to give a preference to this loan; but the act expressly

declares, that the State shall in no case be bound or held responsible, for the payment of the said bonds, or the interest thereon. The act specially authorizes the Canal Company, if the president and directors deem it expedient to do so, to contract with parties who may engage to complete the work of the Canal, to pay them, in whole or in part, in the bonds so authorized to be issued.

The act of Assembly authorizing the issue of the said bonds, required, as a preliminary condition to the issue thereof, that a guaranty should be given, by proper instruments in writing, executed by one or more incorporated companies of Alleghany county, or other corporations or individuals, with ample security, to be approved by the agents, representing the State in the Canal Company, and also by the Governor, insuring to the said company, that for a period of five years, commencing from the expiration of six months from the opening of the navigation on the Canal to Cumberland, there will be an aggregate transportation on the entire length thereof, between Cumberland and the District of Columbia, of not less than 195,000 tons per year, on an average of the said five years. The guaranty thus required having been given, and approved in conformity with the provisions of the act, and the president and directors of the company having deemed it expedient to contract for the execution of the work without delay, and having ascertained that they could contract for the completion of the Canal, for a sum within the limit prescribed by the act of the Legislature, and at a cost not varying essentially from the lowest estimate of the chief engineer, on the 27th day of September last, entered into a contract to that effect with Walter Gwynn, Wm. B. Thompson, James Hunter and Walter Cunningham. The terms of this contract were deemed by the directors advantageous to the interests of the company, as securing the completion of the Canal within the shortest practicable period, at a reasonable cost, and with the best assurance which could be obtained, of its completion by the means which are thus provided.

The parties to this contract with the Canal Company engage, in consideration of the sum of $1,625,000, to be paid in bonds to be issued in pursuance of the above mentioned law, to complete the Canal from below dam No. 6 to Cumberland, on or before the 1st day of November, 1847, and also to pay the interest on the bonds that shall be issued, up to the 1st of January, 1848, inclusive, (which will amount to about $100,000,) and to pay $100,000 to the company in specified instalments, to be appropriated to the discharge of certain lands taken for the Canal, and to the payment of expenses of engineering and salaries, during the progress of the work. Deducting these

payments, which the contractors engage to make for account of the Canal Company, the amount which they will realize for the work of completing the Canal, on the supposition that they negotiate the bonds at par, will be about $1,425,000. This exceeds by $20,000 the estimate of 1845, and is less than that of 1842 by $120,000.

By the terms of the contract here referred to, the work is to be executed under the direction of the chief engineer, and in conformity with the plans, specifications and estimates made by him. The agreement contains such stipulations on the part of the contractors, as appear to be judicious, and such as were deemed by the President and Directors of the Company sufficient, to ensure the execution of the work by the contractors, within the period named; or in case of their failure, to secure the Company against loss. Among these stipulations is an engagement, entered into by the contractors by bond, under the penalty of $150,000, with sureties approved by the Directors and State agents, that they would commence the work within 30 days from the execution of the contract, and continue the same with an adequate force, to an expenditure of at least $150,000. By their contract, they engage to keep such a force employed on the different portions of the work, as shall be deemed by the chief engineer sufficient to ensure its completion within the stipulated period. It is a condition of the contract that the bonds, to be given in payment, shall be delivered from time to time, only for such portions of the work as shall be actually done, and that a specified amount shall be held in reserve, and a power is expressly reserved to the Directors, to annul the contract, in case of the failure of the contractors, to perform any of the essential conditions of it.

The contractors, Messrs Gwynn, Thompson and Hunter, are gentlemen of character and intelligence, and of experience in works of this kind, two of them as engineers, and the other as a contractor for large works. They must of course have entered into the contract, in confidence of their ability to execute it. They have already entered upon the execution of it, and have let out the principal portions of the work, on terms which they deem satisfactory, to sub-contractors, on whose efficiency and ability they rely. These facts, although they cannot be relied on as absolutely ensuring the execution of the work, on the terms of the contract, must serve to give a higher degree of confidence in the sufficiency of the estimates, and to remove all serious apprehension of failure, of the completion of the work on the terms stated.

It is evident, however, that the ability of the contractors, to execute so large a contract, must be contingent on their being able to dispose of the bonds, which they have engaged to re-

ceive in payment, (or the greater part of them), without material sacrifice, as it is not understood, that they rely upon their own resources, independently of the bonds, for the means of going on with the work, except to a limited extent. Should they succeed in negotiating the bonds on satisfactory terms, our opinion of their ability to complete the contract, may be inferred from what we have already stated, and we may add that the information which we have obtained of the character of the sub-contracts made by them, for specific portions of the work, is such as to increase the probability that they will meet the expectations of the Directors of the Canal, and make the operation an advantageous one to themselves. But it is apparent that the sub-contractors must rely mainly upon the contractors, for the means of carrying on their work. In general, persons who undertake to execute work of this nature under others, have little or no means of their own to invest. Their efficiency depends upon their skill, their energy, and their industry. These qualities constitute the capital with which they perform their portion of the work. It is rarely that men possessing pecuniary means of any extent, embark in sub-contracts, on public works in this country. If fair prices be allowed, and regular payments made, the work, as a general rule, will be executed, when undertaken by men of skill and industry, even without pecuniary means of their own to resort to. Their ability to execute their engagements consequently depends on their receiving regular payments, at the stipulated periods, for the work.

It is proper to observe, that in the contingency of the inability of the contractors to fulfil their engagement, the Canal Company would be probably placed in a less favorable position for completing the work, within the limits of the estimate, and without loss of time, than if this contract had not been made. But the precautions taken in the contract, against payments in advance of work done, and against loss of time, under the vigilant supervision of the chief engineer, and of the Directors, appear to afford a satisfactory guarantee against serious loss, even in such a contingency. The amount of bonds authorized to be issued under the act of the Maryland Legislature, gives a surplus of $75,000 beyond the amount which is to be paid to the contractors. This surplus is exclusive of a full provision made in the contract, for the payment of the engineering expenses, and also the whole interest on the bonds, to Jan. 1, 1848. This balance is a resource relied on, if not required for other purposes, in aid of the current income from the finished portions of the Canal, for the extraordinary repairs to be hereafter spoken of. But in the contingency above supposed, the repairs might probably be limited as heretofore, without serious

injury, to such a scale of expenditure, as might be met from the ordinary revenues, or at least to so moderate an excess, that it could cause no serious embarrassment.

As it seems proper that we should express a more definite opinion, in regard to the sufficiency of the means provided by the law of 1845, for the completion of the Canal, and as it is necessary that this opinion should be expressed with some qualification, we proceed to state it, with as much definiteness as the case seems to admit of, in the following propositions:—

1st. As the only means provided for the work in question, consist of the bonds of the Canal Company, to be issued under the act of 1845, amounting to $1,700,000, the proceeds of these bonds will not be sufficient for the object, unless they can be negotiated, without any heavy sacrifice on their par value.

2d. In case the contractors above named, are able to realize on the bonds nearly their par value, and still more if the bonds can be negotiated at par, we are of opinion, that under any probable contingencies of the cost of labor, and of other events which may affect the successful prosecution of the work, the contractors will be able to execute their contract, and in that case, the means provided will be adequate to the proposed object.

3d. In the contingency of the failure of the contractors to execute their engagement, we are of opinion, that although the Canal Company might be in that case subjected to the delay of part of another year, in the completion of the work, and, possibly to some embarrassment, from a small deficiency in the amount of funds required, it would yet be in their power, by means of some probable increase of revenue on the finished part of the Canal, during the progress of the work, and with such aid as it would be for the interest of other parties to afford, without any encroachment on the income pledged for the redemption of the bonds, to complete the Canal, within such period, as to render its increased revenues available, for meeting punctually the interest and principal of the bonds.

In the annexed paper, as well as in the answers of the chief engineer, an enumeration is given of a variety of items, of expenditures which it is desirable should be made, for repairs and new works, on the part of the Canal below dam No. 6. These works would tend to give additional security to the Canal, and increase its efficiency, by guarding against a waste of its waters. These items amount to $194,000, but in the opinion of the engineer, a great part of this amount could not be judiciously expended within the two ensuing years, and some other portions of it, are not of urgent necessity, and may be deferred, until funds from the resources of the Company can be spared for the purpose. Should the unfinished part of the Canal be completed under the contract, or at a cost not ex-

ceeding the lower estimate, the surplus of the proposed loan, which will remain at the control of the Directors, will be adequate to the making of the necessary repairs and improvements. In the event of the failure of the execution of the contract, which, although an improbable, must be looked to as a possible contingency, for the reasons which have been stated, the amount of expenditure, for such repairs as appear to be necessary, would not, probably, be greater than the directors would be able to meet, with such assistance, should any be necessary, as might be relied on from sources indicated in the preceding paragraph.

It may be of interest to state here the cost of the Canal, on the supposition of its being completed for the sum thus proposed to be raised. The cost of the Canal to the present time, including not only the construction, but the amount paid for lands, damages to land, engineering and other expenses, according to the statement of the chief engineer, amounts to $9,502,345. In addition to this expenditure, for the Canal itself, there has been paid, or promised, for interest, loss on the sale of bonds, guaranty of dividend to the State of Maryland, and other financial engagements, the sum of $4,458,970. This swells the amount of expenditure, together with the engagements of the company, including the interest for which they are liable, to the present time, to $13,961,315. If to this we add the amount of the proposed loan, which is assumed to be sufficient to complete the Canal, we have the total cost of the Canal itself, amounting to $11,202,345; and of the Canal with interest and financiering charges, not including the interest of the debt already contracted beyond the present date, amounting to $15,661,315.

The peculiarity of this great investment of property is, that at present it produces no income, beyond the cost of maintenance, on an actual expenditure of nine and a half millions of dollars. It is now proposed to pledge the whole property, with its entire income, after deducting the necessary expenses of repairs and management, as security for the loan still necessary to complete the Canal, and to render it productive of income, by making it useful to the public.

The question next to be considered is, whether, on being thus completed, the Canal can be relied on for affording an income sufficient for this purpose, from the business which it will be then not only capable of doing, but beyond question likely to do.

The prominent and main purpose of the Canal, as a work limited to the valley of the Potomac, is to lay open to the inhabitants of the Atlantic states the mineral treasures of Alleghany county, particularly its inexhaustible mines of coal and

iron. It is of course impossible to determine, by any course of reasoning previous to the trial, to what extent these valuable materials will be brought into use, by being thus made accessible, and available for the use of the inhabitants of all the Atlantic states, by the opening of this channel of easy and cheap transportation. But certain data can be established, which will justify the inference, that a large amount of these articles, of essential and extensive use, will be brought to the Atlantic markets, through this channel, with a degree of certainty equal to positive demonstration. It is only necessary, for the present purpose, to show that this amount will be sufficient, in addition to the business already established, to ensure the object above stated.

The interest, on the proposed loan, at 6 per cent. will amount to $102,000 per annum. The cost of repairs of a work of this nature, from year to year, must necessarily be a matter of great uncertainty, on account of the latitude, in the amount of work to be done, which must be left to the discretion of those who have the superintendence; and more especially on account of the contingent nature of the injuries to the work, which afford the chief occasions for repairs. The very particular and satisfactory information, given by the chief engineer, in his answers to the interrogatories addressed to him, in regard to the expenses of repairs hitherto, and the precautions for guarding against injury to the works hereafter, as well as the very satisfactory condition of the work, as it appears on personal inspection, both in regard to the care and skill used in the construction, and to the materials of which it is constructed, justify the belief that this work may be maintained, at a low rate of cost, compared with that of most works of a similar kind. But we do not deem it requisite or expedient, in an estimate for our present purpose, to seek for all the reasons which might justify the lowest estimate of annual cost, but choose rather to assume a sum which may be presumed sufficient, under all ordinary circumstances, to keep the Canal in a good and probably improving state. This we think may be done, at a cost not exceeding $600 a mile, including the cost of superintendence, making for the 186 miles of Canal, including the Washington Branch, an annual charge of $111,600; this, together with the interest on the proposed loan, makes an annual charge of $213,600.

For meeting this sum, the first resource of the Canal Company is the income derivable from the business accruing, on that part of the Canal which is already finished. This income, for the average of the last six years, has amounted to $50,000. To this may be added, the income from the transport of merchandise, exclusive of the produce of the mines

between Georgetown and Cumberland, for supplying the rapidly increasing population of that place, already the second town in the State, in the number of its inhabitants, and that of the neighboring mining district; and also the income to be derived from merchandise, passing from the Atlantic to the Western states, by way of the Canal and the improved navigation of the Monongahela River. It would perhaps be regarded as a moderate estimate, to take this branch of the transportation, from and after the date of the opening of the Canal to Cumberland, at an equal amount, or $50,000; but, for greater certainty, we take but half this amount, or $25,000. The opening of the Baltimore and Ohio Rail-road, and the prospect of the early opening of the Canal, has led to the establishment of several iron manufacturing companies in the county, on a footing which authorizes the expectation of a large and rapid increase of their productiveness. These establishments can afford to manufacture rail-road iron, at a lower price than it can be purchased for, at the present moment, in England, to say nothing of the freight and the import duty. Leaving to the Baltimore and Ohio Rail-road its share of the transport of iron, there can be no doubt that considerable quantities of rail-road, pig, and other iron, will be transported on the Canal, from the moment of its completion to Cumberland. Should the iron manufacture in that vicinity be prosecuted with a vigor, which the demand for the article is likely to invite, and which the present movements of the owners of some of the mines seem to promise, a supply of 25,000 tons for rail-roads alone, from that region, would seem to be a moderate amount. We will assume, however, that 25,000 tons only per annum, of iron, of all descriptions, will be transported on the Canal, from the date of its completion, producing an income of the same number of dollars.

The most important source of future revenue to the Canal remains to be named. This is the transport of the bituminous coal of the Cumberland mines, to the ports of Georgetown and Alexandria, for the supply of the Atlantic states. The more accessible portions of this immense deposite of coal, are situated from 10 to 30 miles distant, from the Canal basin in Cumberland. To this basin the coal will be transported, until the Canal navigation shall be extended by other means than those now provided, by locomotive power, over rail-roads of which two are already constructed for the purpose. The amount of coal which is likely to be transported must be estimated, not by the quantity which the mines are capable of supplying, at a very low cost, but by the extent of the probable demand.

The use of mineral coal in the Atlantic states, except to a very limited extent, and that confined chiefly to supplies im-

ported from Great Britain, is of very recent origin. There are two obvious reasons why coal was not earlier introduced into common use:—1st, that the great abundance of fire wood, in almost every part of the country, made that a preferable fuel for most purposes; and 2d, that coal, of a good quality, was unobtainable, except from abroad, and that only at a high cost. Within a few years past, a great change has taken place, and is still going on, in the relative proportions of the two kinds of fuel consumed, particularly in the manufacturing states, in all domestic and economical uses. This arises from the three fold cause, of a rapid increase of population, and consequently of the amount of consumption of fuel; the rapidly diminished supply and consequently increased cost of wood; and the recent introduction of coal, of excellent quality, at a low price, from the previously unwrought mines of our own country. This supply has been hitherto, almost exclusively, from the mines of the State of Pennsylvania, and it consists of the different descriptions of anthracite coal. A comparatively small quantity of bituminous coal, of inferior quality, has been brought from Virginia. To facilitate the transport of the anthracite coals to appropriate markets, and to places of shipment, at a moderate cost, extensive improvements have been made in Pennsylvania, New Jersey and New York. In consequence of the facilities thus afforded, the quantity of anthracite coal brought to market, for the supply of the Atlantic states, has increased, in the space of 25 years, from 365 tons only, brought to market in 1820, to over two millions, in 1845. Within the last four years, the increase has been more than 100 per cent.: that is, from less than a million of tons to more than two millions; and notwithstanding an increase of nearly 400,000 tons in the supply of last year, there has been an increase, rather than a diminution of price. The quantity brought to the port of Boston, the last season, for the supply of the city and vicinity, was 170,000 tons, and the average brought there in the last five years, 130,000 tons. There is also a large quantity brought to the other ports of Massachusetts, and to the interior of the State, over the Norwich and Worcester Rail-road. There was besides, in the last five years, an average import of bituminous coal at Boston, of 45,000 tons, of which the greater part was from Nova Scotia and Liverpool, and 6,000 tons only from Virginia. The consumption of coal in Massachusetts has increased, during the last ten years, in a ratio of more than 6 per cent. per annum, and the increased use of Pennsylvania coal, has been in a greater ratio, than that imported from abroad. It is probable that there is an equal ratio of increase, in the consumption of the other States.

There is another fact which must serve to confirm the belief,

that there will be a rapid introduction of the Cumberland coal, as soon as it shall be made practicable. It is that it is the first and only supply, of bituminous coal of good quality, at a low price, which has been introduced in this vast market. Although the consumption of anthracite coal has increased, as we have just stated, during the last twenty years, at the rate of 100,000 tons a year, and for five years at a rate of 200,000 tons a year, it is well known, to those who are conversant with the history of this article, that its introduction into common use has been greatly retarded, by the difficulty of combustion, which distinguishes it from the bituminous coals. This characteristic of the anthracite coal, with others of less prominence, excludes it from many uses, and will give a preference to the bituminous of good quality for many others, as soon as the consumer can have a choice between the two at nearly equal prices. Very many housekeepers give a preference to bitumous coal, especially that which burns freely, thoroughly, and without smoke or soot, at even a great disadvantage of price. It is entitled to a like preference for certain mechanical uses. It is not necessary to determine here what comparative rank will be assigned to the use of bituminous coal, in comparison with the anthracite, in the various branches of consumption. It is sufficient for the present purpose to know, that there is so general a desire for the introduction, into the markets of the Atlantic states, of an abundant supply of bituminous coal of good quality, that it must insure an immediate demand for it, to a large extent. The extent to which that demand will increase, and the proportions in which this coal will be used, in comparison with the anthracite, for which there is already a demand, as we have stated, of 2,000,000 tons a year, is a question which must depend upon the experiment yet to be made, on a very large scale, of the comparative properties of the two descriptions. But there can be no doubt that, with an annually increasing demand of 200,000 tons of coal, while the supply is limited to one species, there will be a still greater increase of consumption, when another species, the want of which has been long felt, is added to the supply.

One of the uses, to which the qualities of the Cumberland coal appear specially to adapt it, either in its crude form, or when coked, and for which anthracite coal has been found by repeated experiments not to be adapted, is the making of steam in locomotive engines. This is a purpose for which wood is almost exclusively used in this country, for want of suitable coal at a moderate price. The failure of wood will in a short time render it necessary to substitute coal; and now, in a large part of the country, coal or coke, at a moderate price, would undoubtedly be preferred. To show the extent of the demand

likely to be thus created, it may be stated, that the cost of fuel, now exclusively used, to the seven rail-roads which lead from the city of Boston, is not less than $150,000 per annum, not including rail-roads immediately connected with them, of more than an equal extent, belonging to other companies. The rail-roads of New England, if supplied by the Cumberland coal, would require more than 100,000 tons per annum; and rail-roads in all the Atlantic states will doubtless require it for this use, should it prove to be as well adapted to the purpose, as has been inferred from the limited experiments which have been made of it.

The undersigned, after having completed the excursion already referred to, over the route of the Canal, accompanied by the president and other officers of the Canal Company, for the purpose of being better able to understand the descriptions of the mining region, and to judge of its capability of affording the supplies anticipated from it, proceeded to visit some of the coal mines nearest to Cumberland, and also the works of the Mount Savage Iron Company.

The Mount Savage Iron Works belong to a company, which has already invested in them a capital of nearly a million of dollars. They are situated in the north-easterly part of the coal field, 8 or 10 miles distant from Cumberland, and about two miles from the border of the State of Pennsylvania. They are approached by a rail-road, which belongs to the same company, and which unites with the Baltimore and Ohio Rail-road, at Cumberland. This rail-road proceeds along the vallies of Wills Creek, a large tributary of the Potomac, and Jennings's Run, and terminates, for the present, at the iron works. Preparations, however, are already made, for extending it to works and mines situated on other estates. The rail-road has an ascending grade in its course from Cumberland to the works, rising in some parts to 130 feet in a mile. But a locomotive engine without difficulty, carries over it the passenger trains, as well as the empty wagons which return loaded. The mountains along the route are high and abrupt, and in some parts almost overhang the narrow passage which is traversed by the railway. They, however, become less abrupt near the works, and open into an extensive basin, the sides and summits of which are adapted to any degree of cultivation. The works are situated in the immediate vicinity of convenient openings, to the mines of coal and iron. They consist of smelting, puddling and casting furnaces, forges, rolling mills, steam engines and machinery for the making and manufacture of crude, bar and cast iron, in the various usual processes. There are, also, large and commodious buildings, machinery and yards, advantageously arranged, for the most convenient despatch of the

different branches of work. Dwelling-houses for a population already exceeding 5000, all occupied in, or dependent on, the works, are erected on the declivities of the adjoining hills. Among the descriptions of work in progress at the time of our visit, we observed two patterns of heavy rail-road iron, an article which is likely to be in great demand. We did not attempt to obtain an estimate of the annual produce of the works, because it is manifest that the present produce can afford no just criterion, by which to judge of the quantity which may be expected, after a lapse of two or three years.

In leaving the valley of Jennings's Run, for that of Braddock's Run, (another branch of Wills Creek on which the Maryland Company's estates are situated,) and passing along a valley which branches from the former, we observed the grading for an extension of the Mount Savage railway, leading towards Frostburgh, designed to reach the Clifton, Alleghany and Cumberland Companies' mines. This cross route brought us to Frostburgh. Near this town, Braddock's Run, in crossing the field, forms a valley so low, as to cut through the upper mineral strata, leaving them to be entered horizontally, in each direction, from opposite sides of the valley. Through this valley runs the national road, and on the north-eastern side of it, lie the mineral lands of the New York and Boston Company and other parties; and on the south-western side, those of the Maryland Company. Near the level of the road, are the principal entrances to the thickest vein of coal, which, at this place, is 11 feet in depth, slightly separated by a thin coating of soft slate. The mine has been worked to some extent, for the supply of coal to the inhabitants of Frostburgh and the neighboring country. We entered the principal opening for a distance of 1500 feet, in which several parties of miners were at work, the coal being brought out in small cars, running upon a wooden railway, and drawn by horses and mules. This vein, as well as the other strata above it, where not obliterated by the valley, and also those below it throughout the coal field, lies in a horizontal direction, from northeast to southwest; but laterally the sides curve upwards from the middle, so that the transverse or divergent passages have a slight inclination upward, and whatever water trickles from any part of the mine, is easily made to flow out, through the passages by which the coal is conveyed.

Opposite to the middle and principal entrance to this vein, viz: that at the lowest part of the curve, and in which all the other subterraneous passages may be made to concentrate, is the termination of the Maryland Company's Rail-road. The level of the rail-road at this point is a few feet below that of the entrance to the mines, so that the cars of the mines may be

easily discharged into the larger cars upon the rail-road. By this rail-road, the distance to Cumberland and to the proposed termination of the Canal, is about 10 miles. The road was nearly completed at the time of our visit, with the exception of a tunnel, through which it passes. Before reaching Cumberland at the mouth of Braddock's Run, the rail-road unites with that of the Mount Savage Company. Within the present month, this rail-road has been completed, so that the locomotives and wagons of the Baltimore and Ohio Rail-road may now proceed directly to the mouth of the mine. This rail-road may be, if required, extended to any desirable distance into the coal mine itself, with very little excavation beyond the depth of the coal vein. It may also be extended above ground, if desired, to the estates of other proprietors, and particularly to the mines of the Lonaconing Company on George's Creek, where the principal vein is 14 feet in thickness, and the iron ore is easily accessible.

The mineral region or "coal field," is at this part, by the course of the National road, four and a half miles in width. Its whole length is about 60 miles. As it extends northeastwardly into Pennsylvania, the veins of coal and ore diminish in width and thickness, until they come to a termination. Towards the southwest, it extends beyond the Potomac, into Virginia, and in its greatest breadth it is 10 miles wide. Taking its limits, as indicated on the map which accompanies one of the reports of the Canal Company, it extends over an area of 300 square miles. Its limits, however, are not very definitely ascertained, and the area of the available portion of it is computed by Mr. Duchatel, the Maryland geologist, in his report of 1841, at about half the above extent.

The coal vein of which we have spoken above, embraces but a comparatively small part of the mineral wealth of the coal field. There are other parallel veins or strata, both of coal and iron, of various thicknesses, situated both above and below the principal vein, except that where the valleys of streams cross the field, in their irregular courses, the upper strata are broken through and obliterated, leaving their edges open to view, along the sides of the valley, covered only by a coating of soil. These strata succeed one another, without any regular order, and consist of coal, iron ore, or iron balls in clay bands, sandstone, slate, fireclay, limestone and other descriptions of stone and earth. The depth of the coal field, without going below the bed of the Potomac River, which may be considered its base, (no explorations having been made to a lower level,) taking the collective thickness of the several strata, or layers, above named, is from 1,000 to 1,800 feet. The principal strata appear to be coëxtensive with the coal field, with the exception

of the interruptions, by the beds and valleys of streams already spoken of, but they vary essentially in thickness. The rich vein of coal already spoken of, which is nearly 800 feet above the level of the Potomac, and which, at the Maryland mine, where it is broken through and obliterated by the valley of Braddock's Run, is but 11 feet in thickness. At a distance of more than 20 miles towards the southwest, where it is severed by the Potomac River, at the mouth of Abraham's Creek, it is 17 feet in thickness, and at the intermediate position of the Lonaconing works, it is 14 feet thick.

Had the strata of this formation been entire, to the summit of Dan's and Great Savage Mountains, or even to the height of some of the less elevated ridges, without being intersected by rivers and valleys, the coal veins would probably have remained undisturbed, to the end of the world. But the Potomac River, in passing nearly through the middle of it, forms a valley which severs the coal field, to the base above described, and the various tributaries of that river, to the number of fifteen or twenty, intersect it in every direction, laying open to view the mineral strata, to greater or less depths, and affording channels by which they may be approached for working, and by which they may be kept free from water, with little or no labor. In this particular, they are remarkably, and most advantageously for the facility of working them, distinguished from the rich mineral deposits of England and Wales. No pump or steam engine is required, in any part of this coal region, for draining it of water, or raising the coal.

Mr. Shepherd, who explored these mines, at the request of the Potomac and Alleghany Coal and Iron Manufacturing Company, has attached to his description a drawing, representing the successive strata, in a section of the field near the junction of Abraham's Creek, with the Potomac River. This section begins at the bed of the Potomac, and rises to an elevation of 1,000 feet. It is imperfect, in leaving all the strata above that elevation unexplored. Some of the principal strata in this drawing are the following:—

Near the level of the Potomac, a stratum of coal 8 feet thick. Immediately above this, is a rich bed of iron ore, 20 feet thick. At a height of 100 feet, a coal bed of 5 feet thickness, and immediately above it, a stratum of fire clay. At a height of about 250 feet, a coal bed of 6 feet, and above it iron ore of 5 feet. From 300 to 400 feet, is a space unexplored. At 500 feet height, is a coal vein of 7 feet; at 600, iron and coal. In the next 200 feet are several layers of coal and iron, but partially explored. At the height of 800 feet is the great vein of coal before described, here 17 feet in thickness, and shortly below it, are balls of iron ore; and at 900 feet, a coal vein of 4 feet in thickness.

Mr. Shepherd estimates the quantity of coal within the limits of the estates of the above named company, which embrace a tract of 20,000 acres, at about 100,000 tons an acre, making 2,000,000,000 tons; or, rejecting one half for waste, and to be reserved as pillars to support the roof in mining, an available quantity for use, of a thousand million tons. He computes that, within the same limits, there are 1,936 millions of cubic yards of iron ore, which, when smelted, will produce as many tons of metallic iron. There are within the same space large quantities of limestone, hydraulic lime, and fire clay. This estimate embraces the possessions of a single company, occupying not more than a sixth part of the known area of the coal field. All this is situated above the level of the principal tributaries of that river. The supply of coal and iron, therefore, may be safely assumed to be inexhaustible.

Professor Duchatel, by a different mode of calculation, after deducting about a fifth part of the area of the coal basin, for those portions of it which are carried away in the formation of the valleys, along the course of the various streams, and making a much larger allowance for unavailable portions of the strata, computes the remaining portion to be 86,847 acres, the average thickness of the available beds of coal, at 45 feet, and that of the strata of iron ore at 15 feet. These data give the quantity of coal 6,305,000,000 cubic yards, amounting to about that number of tons, and the quantity of iron ore 3,237,000,000 tons, or sufficient to produce 1,079,000,000 tons of crude iron. This is a quantity more than equal to the present produce of the kingdom of Great Britain, continued for a period of 500 years, without penetrating below the level of the Potomac River.

The principal streams which, besides the Potomac, intersect the coal field, opening practicable avenues to almost every part of it, are George's Creek, Savage River, Three Forks Run, and Wolf-den River, which fall into the Potomac, on the Maryland side, and Deep Run, Spring Run, Abram's Creek, and Stoney River, on the Virginia side. These are exclusive of Jennings's Run, and Braddock's Run, which fall into Wills Creek, and have been already more particularly described. These last named streams lay open the mines, to a much less depth, and as has been remarked, at a part where the richest coal vein is of less thickness. These mines contain consequently a much less quantity of coal and iron ore, within an equal area, than those which are situated upon and near the Potomac. They possess, however, the advantage, of being situated nearer to Cumberland, which is likely to be for some years to come, the termination of the Baltimore and Ohio Railroad, as well as of the Chesapeake and Ohio Canal. They

have also the advantage of rail-roads, already partially constructed, and some of them completed, leading from Cumberland to the mouths of the principal mines, and they are capable of affording so large a supply, that no deficiency can be apprehended, for a period of many years.

But if the navigation were extended from the Cumberland basin, according to a very feasible plan, which has been long matured, and which will no doubt be executed, so soon as the development of the resources of that region shall afford a sufficient assurance, of immediate business to justify the expenditure, by a system of slack water navigation on the Potomac, to the mouth of Savage River, an easy access will be afforded to the centre, and most productive portion of the mineral region. In that vicinity are the deepest and most productive portions of the above described strata, lying both on the Virginia and Maryland sides of the Potomac. Here the coal field is approached at its lowest level, viz., at the bed of the Potomac. In this vicinity, chiefly in the State of Virginia, are the extensive lands of the Potomac and Alleghany Coal and Iron Manufacturing Company, and on the Maryland side, near the mouths of George's Creek and Savage River, are the estates of J. Swan, Esq., of Baltimore, and of Gen. D. Green.

From this description, it will be apparent, that the quantity of these minerals, now for the first time laid open to access from the Atlantic States, is sufficient to supply all the uses of those states, for economical and manufacturing purposes, for ages, that being situated above the level of the water courses, they admit of being worked with little labor and expense, and that being distributed among a number of proprietors, who have been for some years awaiting with impatience the opening of the canal, to render them available, measures will be immediately taken by rival companies, to bring their products into the market thus laid open to them.

The character and qualities of these minerals have been so frequently described, and so fully attested, that it will be unnecessary to go into a particular inquiry in regard to them. The analyses of Prof. Duchatel, Prof. Silliman and son, and Prof. Shepherd, upon a careful examination of many specimens, have been a long time before the public, and those of Prof. Johnson have been more recently published. The reports upon different specimens, taken from all parts of the coal fields, of course vary in their results, and more particularly in the quantity of ashes and clinker, and also in the relative proportions of carbon and bitumen. Of a great number of reported analyses, which have come under our notice, the proportions of the different component parts vary between the following extremes. Pure carbon

67 to 80 parts in 100; bitumen and volatile matter, 11 to 20.5; ashes and earthy matter, 5 to 12.3; water 0 to 3.5. Professor Johnson, in the course of his very elaborate and thorough experiments, made at Washington by direction of the Navy Department, for testing the properties and comparative power in the making of steam, of the different descriptions of American coals, and also of several foreign coals, subjected to his various tests, five distinct samples of coal, from the Cumberland mines. The result of his experiments establishes the rank of this coal, among the most valuable descriptions, found in this country or in Great Britain, by the tests of chemical analysis, and of practical experiment under the steam boiler, and in the blacksmith's forge. He describes it as of a specific gravity nearly equal to the anthracite, of an average weight, in its solid state in the mine, of 84.6 lbs. per cubic foot, and 53½ lbs. when broken up and in a marketable state. It burns freely, with a deep red flame of moderate size, and with little or no smoke. In most of the valuable properties of coal for domestic and manufacturing uses, these experiments prove the decided superiority of the Cumberland specimens, over those of Liverpool, Newcastle, or Nova Scotia coal, with which they were compared. We may add that our own observation of the coal while burning, both in the parlor grate and in the furnace, in various forms, as well as the concurrent testimony of those who have made trial of it, in steamboats and in locomotive engines, establish its character, in our opinion, beyond question, as a coal of superior quality, and which must consequently come into extensive use.

From this review of the extent and rapid increase of demand for coal, in the country, and in the market to which the canal will introduce it,—of the inexhaustible masses of it which lie within a short distance of the termination of the canal, in situations to be mined with very little labor—and of the character of the coal, and its adaptation to all the most important uses for which the article is demanded, there can be no hesitation in inferring, that large quantities of it will be transported upon the canal, as soon as that work is completed. It would be useless to attempt any specific estimate, of the quantity which it may be expected will be transported in the first season. If it be but a quarter part of the amount which was transported in the last year from the Schuylkil mines, on the Reading Railroad and Schuylkil Canal, it will exceed 250,000 tons. The transport of this quantity would alone afford an income more than sufficient to meet the charge, arising from the interest of the proposed loan, and the cost of repairs and management of the canal, independently of the $100,000 which we have supposed may be derived from the transport of other merchandise.

Should this quantity not be equalled the first year, the period cannot be long, before it will be realized.

It may be proper here to advert to the guaranty, required by the act of Assembly authorizing the proposed loan, to be given by corporations or individuals, with ample security, that an average quantity of merchandise, not less than 195,000 tons per annum, shall be transported on the whole length of the canal, between Georgetown and Cumberland, for the period of five years, from the date of its completion. Bonds to this effect have been given by substantial parties, and approved by the Governor and State agents. These bonds have been signed by persons of large property, able to respond, and who, from their acquaintance with the prospects of business on the canal, feel the utmost confidence, that there will be more than the amount of transportation specified in the bonds, and that their engagement will be but nominal.

It may be proper here to give some description of the means provided, for the accommodation of the coal trade at Cumberland,—the railways built from the coal mines to the basins at Cumberland,—and the present condition of the facilities which already exist in the District of Columbia, for transhipping coal from the coal boats, to the vessels which are to carry it to the Atlantic ports.

By referring to the accompanying "plan of the Chesapeake and Ohio Canal basins at Cumberland," it will be seen that four separate basins are to be provided for the accommodation of the boats at Cumberland. The plan here referred to is not embraced in the printed report.

1. The "north branch basin," $1\frac{3}{4}$ miles in length, 250 feet in width, with a depth of from 9 to 14 feet, created by a natural basin in the river above Wills Creek, and by the erection of the Cumberland dam across the river, a short distance below the junction of Wills Creek, with the "north branch" of the Potomac. This basin presents an area of upwards of 50 acres, and it may be reached in its whole length, either by continuing the Mount Savage Rail-road, along the west side of Wills Creek, and along the north side of the North Branch, from one extremity of the basin to the other, or by a branch rail-way passing through a gap of Wills Mountain, and thence by an inclined plane to the basin.

2. A basin formed in Wills Creek by the same dam referred to in the preceding paragraph. This basin will extend some hundred feet up the creek, but some expenditure of money by the proprietors of the adjacent lands will be necessary, in order to deepen the channel of the creek in certain places.

3. A basin formed near the termination of the Canal below

the mouth of Wills Creek, by giving it a width of 100 feet for a distance of about 1,500 feet in length.

4. A "branch basin," as it is designated, of about 1,500 feet in length and 175 in width, running parallel with the Baltimore and Ohio Rail-road, and about 400 feet from it.

All these basins, having an aggregate water front of 2½ miles, may be provided with rail-way tracks along their margins, connected with the existing rail-roads, to the coal mines. It is evident from this description, that abundant accommodation for boats engaged in the coal trade, may be provided at Cumberland.

At this time there are three rail-roads either built or in progress, already briefly alluded to:—

1. A road from the terminus of the Baltimore and Ohio Rail-road in Cumberland, to the Mount Savage Iron Works, by the valley of Jennings's Run, a branch of Wills Creek. The length is 10 miles. This road is completed with one track, having a hollow or bridge rail, as it is sometimes called, the grades are quite heavy, being from 100 to 130 feet per mile. A locomotive engine, however, without difficulty, carries up the passenger trains, and the empty wagons which return loaded with coal, but of course, in smaller trains, and to less advantage, than if there were a uniform grade from the Canal basin to the works.

2. The road of the Maryland Mining Company, now nearly completed. This road is 9¼ miles long, and branches from the Mount Savage Road, about 1½ miles from the Cumberland depot of the Baltimore and Ohio Rail-road. It ascends to the mines of the Maryland Mining Company, through the valley of Braddock's Run, a branch of Wills Creek. It is a road of a single track also, with an edge rail of a new pattern, called the Z rail, weighing about 38 lbs. to the yard, and supported entirely by a longitudinal string piece. The grades of this road are similar to those of the Mount Savage Road of 100 feet to 130 feet. A short branch is made from the main stem, near the principal mine of the Maryland Mining Company, to the mine of the Boston and New York Company.

3. A road is now being graded, from the Mount Savage works, through the valley of a branch of Jennings's run to the vicinity of Frostburgh, three miles in length. A rail-road is in contemplation also, from the Lonaconing Iron Works, on George's Creek, across to the road of the Maryland Mining Company, intersecting it at Cleary's tavern, on the National Road, and near the terminus of the Maryland Company's Road; other branches will doubtless be constructed hereafter.

Of the extension of the Chesapeake and Ohio Canal, from Cumberland to the middle of the great coal field, at the mouth

of Savage River; of the improvement of the river itself, between these two points, by a lock and dam navigation; or of the construction of a rail-road between the points named, we are unable at this time to speak with any certainty.

It is well known, that the veins of coal, near Savage River, are found of much greater thickness, than those now worked by the Mount Savage or Maryland Mining Company, of excellent quality, easily mined, and in quantities which may be considered inexhaustible by the present and future generations.

To open a water communication with this part of the great coal field, is doubtless an object of importance to the Chesapeake and Ohio Canal, but it is probable that the great cost of the undertaking will, for some time to come, prevent capitalists from embarking in it.

The distance from Cumberland to the mouth of Savage River is about 30 miles, and the rise of the Potomac in that distance is 312 feet. The Board of Internal Improvement, of the General Government, in 1826, estimated the cost of an independent Canal between the two points, at $1,795,000.

Mr. Fisk has estimated the cost of a Canal and slack water navigation, by means of locks and dams combined, as equal per mile to that of the Schuylkil navigation, an improvement of the same nature, say $30,000 per mile, or $840,000 for 28 miles.

We do not mean to be understood to express the opinion, that the means at present created, viz. the railways enumerated above, are not sufficient to supply the Canal with all the coal which, for the present, there may be a demand for. On the contrary, we believe enough may be brought down by the roads in question, for any demand which will be created for some time to come; ultimately it will, without doubt, be found expedient to open a communication with the Savage mines.

In reference to the facilities for shipping coal, in the District of Columbia, it is believed that neither in Georgetown, nor in Washington, is there any suitable basin, presenting the facilities needed for an extensive coal trade.

Neither the Rock Creek Basin nor the basin at the mouth of the Tyber, if either were of sufficient extent, is accessible for vessels of any considerable size. The Canal boats would be required to descend from the basin to the river, and discharge their loads into the vessels lying at anchor in the stream. It was designed by the projectors of the Canal, that vessels should lie on the river side of the mole, or dike, which forms the barrier between the basin and the river, and that the boats should lie opposite the vessels in the basin, and discharge their cargoes across the mole. But it is evident that this mode of conducting the business would answer, for a very limited trade only, the mole, exclusive of waste and lock, being but 840 feet in length.

Alexandria appears to offer greater facilities for the shipment of coal, than either of the other places mentioned. The Canal locks down to the river at that place, and although no basin has as yet been formed there, it is, so far as the coal trade is concerned, we should suppose, more convenient for carrying on an extensive business of that nature, than Georgetown. It may be safely assumed, that in proportion as the business on the Canal increases, ample accommodation will be provided for doing it advantageously, especially as the two ports will be, in some degree, at least, competitors.

The navigation of the river between Alexandria and Georgetown, 7 miles, is by no means free from difficulties, particularly above the bridge which crosses the Potomac, some three miles below Georgetown. At high water, vessels may carry eleven feet to the wharves in Georgetown and less at low water. When fresh winds from the north prevail, the water in the river is very low. Vessels may reach Alexandria at all times, except occasionally for a short period in the winter, when the river is frozen.

We append to this report a map of the Potomac River, showing the route of the Canal from Georgetown to Alexandria. Upon this map, the relative positions of the three points at which the Canal is connected with the river, is shown, to wit: Rock Creek Basin, Tyber Basin, and the outlet of the Alexandria Canal. This last connection is more clearly shown, upon the map of the city of Alexandria, which will be found in the appendix to this report. The maps and plans are not embraced in the printed copies of the report.

An important point of inquiry, is to determine the cost of transporting coal from the mines to the District of Columbia. Mr. Fisk, in his reply to the 26th interrogatory, has entered very fully into the details of this cost. The data for the most part are derived from actual experience. The estimates are liberal, and we believe sufficient. We are confirmed in this opinion, by comparison of the details and results, with estimates made at our request, in different forms, by persons thoroughly conversant with the business of transportation on the New York Erie, and Pennsylvania State Canals.

The year of navigation is assumed at 300 days, and the facts stated at the close of his paper prove, that in the four years preceding the 1st December, 1845, there were in all but 188 days on which boats did not leave Georgetown, averaging 47 days each year, and but 162 days during which the Canal was closed by ice, or upon an average, 40½ days in each year, in which boats might not have run.

The annual cost of maintaining a boat and horses, and for repairs, deterioration, interest, wages of crew, &c., is stated at

$1,336 24, and 17 trips are assumed as the work of a season. 100 tons of coal can be taken each trip, or 1,700 tons per annum, resulting in a *cost* of transportation of a fraction more than 4¼ mills per ton per mile, or $78\frac{6}{10}$ cents per ton, from Cumberland to Georgetown. To this is to be added the estimated cost to the Canal Company, of 5 cents; and the cost of bringing coal from the mines to the Canal at Cumberland, 30 cents; making the estimated *cost*, without profit to any one, $1 $13\frac{6}{10}$ per ton.

We shall assume that coal may be purchased and transported from the mines to Georgetown, including a fair compensation to the miner, the carriers and to the company, for tolls, at the following rates:—

1. Cost of one ton of coal, delivered in cars at the mines, ...	$1 00.0
This is allowing a profit to the proprietors, from which a large deduction may be made, should they find it necessary for bringing the coal into market.	
2. Transportation and delivery of the same by rail-way, at Canal Basin, 10 miles, . . .	30.0
This is a high computation of the cost of rail-way transportation, in consideration of the steep grades, and probably more than the rail-road proprie-tors will deem it necessary or expedient to charge.	
3. Freight and profit per ton on 184.6 miles, . .	1 00.0
4. Toll on do. do. half cent per ton per mile, . .	92.3
Add fraction, ...	2.7
Say $3 25 per ton at Georgetown, . . .	$3 25.0

Another important question to be considered is, whether the transportation of coal, on the Canal, is liable to be interfered with, or in any sensible degree diminished, by the competition of the Baltimore and Ohio Rail-road.

As this road may have been regarded as a competitor for the coal and iron trade of Alleghany county, it appears to us necessary to describe its principal features, in order that means may be afforded for judging of its character, and its ability to sustain a successful competition with the Canal, for the trans-portation of coal and iron, from the mines to tide water.

The road extends at this time, from Baltimore to Cumber-land, 179 miles, intersecting the line of Canal at the Point of Rocks, on the Potomac River, 48 miles above Georgetown, and 12 miles below Harper's Ferry.

The maximum gradient, except at Parr's Spring Ridge, (40

miles west of Baltimore,) is $39\frac{6}{10}$ feet per mile in both directions, eastward and westward. There are about 17 miles ascending westward, and about 15 miles ascending eastward, of 30 feet per mile, and upwards. At Parr's Spring Ridge, (813 feet above tide water,) on the east side, nearly two miles of the road ascends at 81.84 feet per mile; on the west, the ascent is 82.50 feet per mile, for the same distance.

Since the publication in 1831, of the 5th annual report of the Company, in which the grades and curves of the road as located from Baltimore to the Point of Rocks are stated, some modifications of the curves and grades have been made, but *substantially* it is believed the curves remain as they were at the time that report was made, to wit:—

Straight line,	. . . . .	.	Miles,	33.00
5,730 feet radius and over	. . .	.	"	3.50
2,865 " "	to 5,730 feet	. . .	"	3.50
1,910 " "	to 2,865 "	. . .	"	3.50
1,432 " "	to 1,910 "	. . .	"	3.25
955 " "	to 1,432 "	. . .	"	5.00
716 " "	to 955 "	. . .	"	3.50
573 " "	to 716 "	. . .	"	2.75
477 " "	to 573 "	. . .	"	2.60
395 " "	to 477 "	. . .	"	6.50

At this time there are $16\frac{3}{4}$ miles of road curved with a radius of less than 1000 feet. Of this distance, 15 miles are east of Harper's Ferry, and $1\frac{3}{5}$ miles west of that point. Of the main line, 116 miles are laid with an edge rail, and 63 miles with plate rail; the edge rail weighs 51 pounds to the yard, and the plate rail 15 pounds.

The Passenger engines (4 and 6 wheels) east of Harper's Ferry, running upon the plate rail, and upon that part of the road which is most curved, weigh 15 tons, those west of Harper's Ferry weigh 10 tons. The freight engines are of 10, 15 and 22 tons weight, respectively. The last are designed for the coal trade.

For the 10 ton engines (8 wheels,) the gross load east of Harper's Ferry, is 55 tons, west of ditto, 75 tons, net load east 30 tons, net load west, 40 tons.

For the 15 ton engines east of Harper's Ferry, 90 tons gross, 45 tons net, west of do. 120 tons gross, 65 net.

For the 22 ton engines (8 wheels,) east of Harper's Ferry, 250 tons gross; west of ditto, 330 ditto. East of Harper's Ferry, net 175 tons; west of ditto, 230 tons.

Auxiliary engines are often used at Parr's Ridge. The engineer, Mr. Latrobe, remarks that "the engines are able in a good state of the rails, to pass upon the edge rail over the grade

of 82½ feet per mile, with the load they bring to the foot of it, over the plate rail, upon an extreme grade of 37½ feet."

The time of the freight trains from Baltimore to Cumberland, averages 16 hours. From Cumberland to Baltimore, about 19 hours. The western trains being the lighter, make better time than the eastern trains.

It is in contemplation by the Company, to extend the road from the outer depot to the "basin," in order that locomotive power may be used in transporting the coal from the depot to the vessel. The length of the extension would be, from 3 to 4 miles.

In the report for the year 1845, it is recommended to replace the plate rail with an edge rail, and to remedy or alter "some of the sections along the Patapsco, to avoid the short curves, which so seriously obstruct the efficiency of the motive power."

Between 16,000 and 17,000 tons of coal were brought down last year by the Rail-road, from Cumberland to Baltimore.

It would seem to be not difficult to show, that a rail-road of the character of the Baltimore and Ohio, could not sustain a competition with a Canal, of the character of the Chesapeake and Ohio. The road is exceedingly crooked, and its grades unfavorable, to any effort at a very cheap rate of transportation. Not less than 15 miles ascend to the eastward, (the direction of the coal transportation,) at an inclination of 30 feet and upwards per mile, and about 2 miles of this distance ascend at the rate of 82½ feet per mile; while there are between Harper's Ferry and Baltimore, 15 miles of the road curved, with a radius of less than 1,000 feet. With the exception of the portion near Baltimore, (say below Ellicott's mills, on the Patapsco, 15 miles,) the track in use is single, and more than one third of the entire line is laid with a plate rail, weighing but 15 pounds to the yard.

To enable the rail-road to engage in a successful competition with the Canal, in the transportation of coal or any other heavy commodity, in large quantities, it should possess at least three essential requisites:—

1. Its grades and curves should be light.
2. It should have two tracks.
3. It should be provided with a heavy edge rail throughout.

It will be seen, by the preceding description, that both its grades and curves are very unfavorable; that it is provided with a single track only, except for a short distance near its eastern extremity, and finally that a considerable portion of the line is laid with a plate rail, and this, too, upon that part of the road where the curvature is the greatest. To enable the rail-road to transport the coal from the depot in Baltimore to vessels by locomotive power, there is required an extension of

the line from 3 to 4⅛ miles, by a new route to be established for the purpose. At present, horses are used in passing through the city, at a good deal of cost, and annoyance to the city travel.

The Canal, on the other hand, is one of the first class. Its width and depth place it in that rank. Its locks will admit of the passage of boats carrying 100 tons of coal, and the amount of lockage, 3⅓ feet per mile, is by no means unfavorable.

The Baltimore and Ohio Rail-road, and the Chesapeake and Ohio Canal, are sometimes compared, with the Reading Rail-road and the Schuylkill navigation. There is no accurate parallel between the two cases. On the Reading Rail-road, of 100 miles in length, there is no inclination to the east, except between the Schuylkill River and the Delaware. All the planes either descending to the east, or being level. The track is double and provided with an edge rail. In short, the road is of the first class.

The Schuylkill navigation, 108 miles in length, is made up of slack water and Canal combined; its locks do not admit of the passage of boats carrying more than 54 tons; and the lockage amounts to 5.7 feet per mile. Important improvements are now in progress, but no experiment has been made of the improved Canal.

In the first case, we have a rail-road of an inferior class, and a Canal of the first class, compared. In the second, a road of the first class is compared with an inferior Canal.

Mr. Fisk, in his reply to the 26th interrogatory, has entered into a comparison of the cost of transporting coal by the Canal, and by the Baltimore and Ohio Rail-road. The substantial accuracy of his conclusions, will not be denied.

To this we may add, that it can be no essential interference with the interests of the rail-road, to be deprived of this heavy traffic, at the low prices at which it must be done, if it be intended to secure the successful development, of the coal and iron business of Alleghany county. The growth of this business will serve, to increase the more profitable branches of rail-road transportation, and will render Alleghany county a very valuable accessory to the commerce of Baltimore, although a great portion of the heavy transportation may pass through another channel. The transportation by the rail-road, to an extent necessary to supply the anticipated demand for coal, would greatly embarrass the more profitable business, and exhaust the resources which seem to be required, for the extension of the rail-road to the Ohio. So much of the coal transportation, as is required for the supply of the citizens of Baltimore, or is immediately connected with its trade, will, of course, remain to the rail-road. It is to be presumed, there-

fore, that the proprietors of the rail-road, and the citizens of Baltimore, instead of regarding the assumption of a great portion of this transportation by the Canal with jealousy, will look to it as the only effectual means, of rendering fully available to the nation, the rich treasures of the mineral region. By laying open these treasures, and making Alleghany county the seat of an extensive and most important manufacture, a great accession will be made, to the private wealth of the State; the city of Baltimore will necessarily participate in its benefits, by an increase of its own trade; and the revenues of the State will be benefited, through the increase of its taxable property, as well as from its large participation in the direct income of the Canal.

We close this report by recapitulating briefly the conclusions at which we have arrived, on the principal questions which have been the subject of our investigation.

1. That the Canal, between dam No. 6 and Cumberland, can be completed and brought into use, within two years from this time, for the sum of $1,545,000, exclusive of the "pay of officers," "general expenses," and "lands not paid for." That these items last named amount, according to the estimate of the engineer, Mr. Fisk, to $55,000.

2. That the contractors, Messrs. Gwynn & Co., will, in our opinion, be able to execute their contract for the completion of the Canal, between the points above mentioned, by the 1st of November, 1847, if there should be no material increase of the prices of labor, over those of the last season, provided they shall be able to negotiate the bonds of the Canal Company, which they have contracted to receive in payment, without serious loss, but not otherwise.

3. That in the contingency of the failure of the aforesaid contractors, to complete their engagement, in case the directors of the Canal Company should be able to negotiate, at near their par value, the bonds which they are authorized to issue, having a prior lien on the income of the Canal, it will, in our opinion, be in their power, with the proceeds thereof, and with such moderate aid as they would be able to obtain, if necessary, from parties interested in the immediate completion of the Canal, to complete the same, within such period, as to ensure the prompt payment of the interest, and the final payment of the principal of the said loan, in conformity with the condition of the bonds authorized to be issued.

4. That $200,000 can be expended advantageously upon the portion of the Canal, between dam 6 and Georgetown, in elevating the tow path above freshets, securing the water in the Canal, at the limestone cuts, to a depth of 6 feet, repairing

dams, &c., according to the schedule attached to the chief engineer's reply to the 24th interrogatory. Further, that the exigencies of the case are not, at this time, so great, that more than $50,000 need be expended for this object, in any one year.

5. That the Canal and its accessory works can be maintained in repair, at the rate of $600 per mile per annum, or for the entire line, $111,600 per annum, making, with the interest on the proposed loan of $1,700,000, an annual charge of $213,600.

6. That coal can be transported from the mines to the District of Columbia by the Canal, and the rail-roads leading to it from the mines, for $2 25 per ton of 2,240 lbs. The coal can be mined and delivered at the termination of the rail-roads at a low cost. The price of the coal must depend on the pleasure of the proprietors, of whom there is a large number, owning independent estates, within the coal field.

7. That the Baltimore and Ohio Rail-road cannot, without a great expenditure, become a successful competitor for the coal trade, and even with such expenditure, cannot transport coal so cheaply, as it can be transported on the Canal.

8. That the rail-ways connected with the Canal basins in Cumberland, already completed, and which will doubtless be extended to other mines, can, when properly equipped with engines and cars, furnish the necessary means of transporting, from the mines to the Canal basins at Cumberland, 500,000 tons of coal annually, and the same railways when furnished with double tracks, can bring down from 800,000 to 1,000,000 tons.

9. That the income of the coal trade alone, independently of other sources of revenue, will be sufficient to cover the above estimate of annual charge and interest, from the date of the opening of the Canal, and that there will be, for a long period, a constantly increasing demand for the coal, as well as an increasing revenue from other sources.

All which is respectfully submitted by the undersigned.

WILLIAM H. SWIFT,
NATHAN HALE.

WASHINGTON, Feb. 20, 1846.

REMARKS ON THE ESTIMATES.

Description and Estimates of the Unfinished Work of the Canal.

Having, in the foregoing report, given a brief description of the whole Canal, and of the work which remains to be done, the undersigned propose here to describe more particularly the unfinished portions of it, extending from dam No. 6 to Cumberland, and to examine the estimates of the cost of completing it.

The answers of Mr. Fisk to the interrogatories, submitted by us on the 4th of November last, are so very full and clear that it will not be necessary to repeat here many details. We shall condense some of the principal statements, and add the entire paper of Mr. Fisk as an appendix. It will be found to be both valuable and interesting.

Of the 50 miles between dam 6 and Cumberland, about $\frac{3}{5}$ths of the distance has been completed, that is to say, $31\frac{3}{4}$ miles have been finished, and $18\frac{1}{4}$ remain to be finished. The cost of that portion which is completed, is $2,892,000—and by the estimate made by Mr. Fisk in 1845, the unfinished part will cost $1,404,471—total, $4,296,471.

1. Earth Work.

The principal items are as follows:—

Earth excavation—2,609,000 cubic yards have been excavated at an average cost, including cost of carrying into embankment, of 22.76 cents per cubic yard, and there remains to be excavated 1,234,000 cubic yards, estimated to cost 16.88 cents per cubic yard.

Rock and slate, 801,825 yards executed at 85.14 cents, including amount paid for rip rap. 104,300 ditto to be excavated at 74.61 cents.

Embankment from outside of Canal and embankment bridges, 1,955,300 yards at 29.92 cents. 674,500 to be placed at 21.23 cents. Whole amount of earth and section work executed, $1,897,500.

Whole amount to be executed, $431,400.

2. The Tunnel.

The tunnel is 3,118 feet in length, 24 feet in height, or 17 from surface of water to crown of the arch—19 feet at Canal surface, with a tow path 5 feet wide—making total width 24 feet. Two shafts were sunk during the progress of the work; one 126 feet, and the other 187 feet in depth, and 8 feet diameter each. The height of the most elevated part of the ridge above the tunnel is 360 feet.

The work executed at the tunnel is as follows:—

In the tunnel proper, 70,690 cubic yards rock, removed at a cost of $4 00, $3 00 and $1 50 per yard, respectively,	$218,051
Shafts,	43,913
163,995 cubic yards rock, at the deep cut at entrances, at $1 40,	228,333
Other work,	23,638
Total of work executed,	$513,935

To be done:—

8,184 cubic yards bottoming and finishing at $3 00, and $1 50, (same prices as above stated,)	$18,572
5,600,000 bricks laid in arch and side walls, at $14 00,	78,400
17,000 cubic yards rock in deep cut at $1 40,	23,800
Other work,	57,228
Total of work to be executed,	$178,000

3. Locks.

There are to be 22* lift locks on this portion of the line.

Six of these locks are completed, the aggregate lift being 53.8 feet. The average cost per foot lift, exclusive of gates, castings, excavation of pits, and embanking and puddling, $1,801 96. The masonry cost, per perch, for 7,750 perches, $9 72—2,274 perches dry wall has cost, per perch, $4 04.

Seven of the remaining locks are to be constructed, upon the same plan as those first specified—aggregate lift to be 55.75 feet, and estimated to cost $1,720 per foot lift.

8,165 perches "scrubbled" masonry in walls, estimated at $8 50 per perch.

3,020 perches dry wall, estimated at $3 79 do.

* Subsequently reduced to 21.

The remaining nine locks are to be composite, that is to say, rubble walls lined with timber—total lift 72.38 feet.

Estimated to cost per foot lift, exclusive of gates, excavation of pits and embankment, $1,382 84.

3,600 perches rubble masonry laid in cement at $5 75, and 7,650 dry do at $4 00 do.

The value of work executed on the lock, is .	$134,914
And the estimated cost of that which is to be done,	208,444

4. Aqueducts.

There are four aqueducts between dam 6 and Cumberland, two of which are finished.

1,109 perches cut masonry in them cost, per perch, .	$21 94
7,460 " rubble masonry cost per perch . .	6 54

In those which remain—

1,028 perches cut masonry estimated at . .	20 00
7,500 " rubble " " at . .	6 00
Whole amount of work done in the aqueducts,	$103,371 00
" " " to be done, . .	67,677 00

5. Dams.

The only dam at present contemplated, is that at Cumberland. This dam is 400 feet long, and the crest is 17 feet above the base. The amount expended upon the dam, the guard lock, and the flume for feeding the Canal, connected therewith, is $80,722; some of the principal items are as follows:—

3,600 perches rubble masonry laid in cement under water, $5 75 per perch. Foundation, including excavation, pumping, &c., $24,000. 1,800 perches rubble masonry laid in lock at $9 00; 644 perches dry wall laid in ditto at $3 25.

Estimated cost of completing dam, $21,800; in this is included 650 perches dry wall, at $4 00 per perch.

6. Culverts.

There are to be 29 culverts, between dam 6 and Cumberland, varying in span from 3 feet to 20 feet—aggregate span, 204 feet. Of these, 5 are completed at a cost of $13,832; 226 perches scrubbled masonry in the arches, cost $12 per perch, and 1,560 of other masonry, averaged $6 10 per perch.

The 23 culverts to be finished, are, by the estimate, to cost $109,717—of which about $11,000 in value is finished. The arches of these culverts are to be of brick principally, for which $14 per thousand laid is estimated—1,093 perches estimated at $6 64 per perch, and 10,590 perches estimated at $5 75.

7. Wastes and Waste Weirs.

These are to be 19 in number—eleven of masonry and eight of wood, with 39 gates—the total overfall 740 feet.

No work has been executed upon them as yet.

The estimated cost of all, is $34,830

8. Lock-houses.

Nothing done. 17 to be constructed substantially of logs, estimated to cost $11,000

9. Weigh Lock and House.

Nothing done—is to cost $18,500

10. Puddling. *Excavation of Lock Pits, &c.*

Value of work done, $43,078. Estimated cost of that which is to be done, ... $48,575

11. Transportation of Cement.

Cost of the transportation of that used, $10,241
remaining to be transported, . 19,011

12. Bridges and Ferries.

7 bridges, 3 tow path bridges and 4 ferries to be provided—no work done upon them; estimated cost of all, $17,754

13. Cumberland Dam. See paragraph 5th.

14. Miscellaneous Work.

Superintendence and contingencies, . . . $231,767

Total amount of present estimate, (1846,) $1,404,471

Upon the Estimates of the Cost of Completing the Canal.

Three estimates of the cost of completing the work, have been made by Mr. Fisk, the chief engineer of the Canal, to wit:—

1. An estimate made in great detail on the 1st Dec., 1842. It forms the *basis* of the contract made by the company Sept. 25, 1845, with Messrs. Gwynn & Co., for completing the Canal. This estimate amounts to $1,545,000.

2. An estimate was made on the 12th August, 1845, for the use of the board of directors, to aid them in deciding upon the proposition of Messrs. Gwynn & Co., to complete the work for the sum named by them in their proposals. This second estimate amounted to $1,404,471.

3d. The estimate of 22d January, 1846, in the accompanying answers of the chief engineer to the interrogatories submit-

ted by the undersigned on the 4th November, 1845. This estimate is the same in amount as that of 12th August, 1845—($1,404,471.) But the distribution of the items is different, as will be found in the following table, in which the three estimates are exhibited together. The note at the foot of the table will explain the cause of the discrepancy.

Estimate of December 1st, 1842, of 12th August 1845, and of 22d January, 1846.

	Nature of Work.	1842.	1845.	1846.
1	Sections, (excavation and embankment,)	$532,727	$469,971	$494,851
2	Tunnel,	178,000	178,000	178,000
3	Locks,—Composite,	131,783	118,680	208,444
4	Locks,—Original plan,	125,375	109,151	
5	Aqueducts,	81,513	71,707	67,677
6	Culverts,	133,179	121,673	98,721
7	Waste, and Waste Weirs,	47,543	41,986	34,830
8	Lock-houses,	13,600	11,050	11,050
9	Bridges, Roads, and Ferries,	26,370	23,004	17,754
10	Completion of Dam 8, and Guard Lock,	21,800	21,800	21,800
11	Miscellaneous work,	17,035	16,746	48,575
12	Transportation of Cement,	25,348	19,011	19,011
	A Stop Gate,	. . .	. .	2,066
13	Weigh Lock and House,	20,000	18,500	18,500
	Contingencies, Superintendence, &c.,	190,727	183,192	183,192
		$1,545,000	$1,404,471	$1,404,471

It will be seen by the above table, that the total amount of the two last estimates, 1845, 1846, is the same (1,404,471) the distribution of the items is different, for example, the locks, culverts and wastes, and bridges, are considerably less in the estimate of 1846, than in that for 1845, while the items of "sections" and miscellaneous work are increased in a corresponding degree. The estimate of 1846 is a more *exact* statement of each item, than the estimate for 1845, as Mr. Fisk informs us.

Before we express an opinion upon the sufficiency of the estimates presented, we will, in this place, extract some statements from an official report made to the War Department in Dec. 1833, five years after the Canal was commenced, in which is set forth the actual cost of certain portions of the work at that time. This report was made by Captain McNeill, then an officer of the army, upon the application of the President of the Chesapeake and Ohio Canal Company, to the War Department, asking that the work might be inspected by one of its officers, and its condition made known to the public.

Cost of Locks prior to 1833.

Between Georgetown and the Point of Rocks, 48 miles, there are 27 locks overcoming a rise of 217 feet. The entire cost was $265,142, or at the rate of $1,221.85 per foot lift. This included foundations, lock gates, excavation of lock pits, &c., exclusive of the items specified, the cost was $1,136 per foot lift.

Between the Point of Rocks and the head of Harper's Ferry Falls, there are 7 locks ; the cost of the masonry of these was $56,643; of the foundations, $7,370; for gates, $3,850; and for excavation of pits and embankment, around the locks, $10,404; average cost, $1,280 per foot lift for masonry, gates and foundations.

The cost of masonry was $7 40 per perch, $1,050 for each foundation, and $550 for the lock gates.

Eight locks above Harper's Ferry cost $1,120 per foot lift.

The general average of the cost, per foot lift, of the 42 locks thus enumerated, is $1,167 50.

In an 8 foot lock, of the dimensions of those of the Chesapeake and Ohio Canal, there is about 1,084 perches masonry, 436 lineal feet of coping 1 foot thick and 3 feet wide. About 384 perches cut stone, and 700 perches backing, and from 3,000 to 3,300 bushels cement.

Cost of Aqueducts.—In the report quoted above, the gross cost of three principal aqueducts is given, to wit, $198,760, they contain 17,400 perches of masonry. The other items not being stated, we average the cost of the whole of the structures upon the quantity of masonry contained therein, and we find it to amount to $11 40 per perch.

Cost of Culverts.—59 culverts between Georgetown and the Point of Rocks, containing 11,357 perches of masonry, averaged $4 40 per perch.

19 culverts above the Point of Rocks, containing 6,800 perches, cost $4 18 per perch.

Cost of Excavation and Embankment.—The *actual cost* of excavating 1,893,000 cubic yards common earth in 1833, and prior to that date, was at an average, 10.8 cents per cubic yard, of 439,000 cubic yards hard pan, 23.5 cents per cubic yard; of 75,000 cubic yards of loose, or quarry rock, 31.5 cents; of 398,000 yards of blasted rock, 74.3 cents; of 571,000 yards of embankment from the prism of the Canal, 13.2 cents per yard; of 962,000 not from the prism of Canal, 19.3 cents per yard; 97,000 cubic yards of puddling, cost 25.8 cents per yard; 215,000 perches walling, laid up with stone from the prism of Canal, and paid for as excavation, 53.9 cents per perch; 15,000

do. not paid for as excavation, 101 7 cents per yard; whole amount of work executed at these prices, $1,085,853.

But in order to place the cost of the work prior to the year 1833, by the side of the estimate of Mr. Fisk, of 1842, we subjoin the following table. In the columns for 1833, all the work then completed and under contract, is stated, and in the columns for 1842, the work to be executed between dam No. 6 and Cumberland, is also stated.

Nature of Material.	Quantities in 1833. Cubic yards.	Quantities in 1842. Cubic yards.	Average cost per yard in 1833.	Average cost, (by estimate,) per yd. in 1842
Earth, - - - -	5,006,642	1,234,214	12.19 cts.	16.29 cts.
Rock, - - - -	907,678	104,318	65.99 "	78.04 "
Embankment from the Canal, -	1,017,879	346,021	12.22 "	9.71 "
Embankment not from the Canal,	1,866,120	594,210	20.48 "	24.12 "
Walling paid as excavation, -	387,000	.	50.69 "	.
Walling not paid as excavation, -	25,085	.	97.79 "	.
"Rip rap" work paid as excavation, - - - -	.	39.490	.	14.54 "
"Rip rap" work not paid as excavation, - - -	.	2,500	.	100.00 "

The entire value of work executed at the above prices in 1833, and paid to that time, was $1,619,625, and there remained to be executed under the contracts then existing, $420,180.

If the prices estimated in 1842, be compared with those which the work actually cost in 1833, it will be seen by the preceding table, that, in all the items, except for embankment, taken from the prism of the Canal, the estimates for the work to be done, exceed those which the work already finished has cost, *i. e.* the work executed prior to 1833.

So with the locks, the cost of those enumerated in a preceding page, ranged from $7, to $7 40 per perch, and upon an average, 42 locks overcoming about 340 feet rise, cost $1,167 50 per foot lift.

In the estimate of 1842, the work still to be executed upon the seven locks of cut stone, amounting to 7,896 perches laid in mortar, at $10 60 per perch, and 3,020 perches laid dry for backing, at $3,83 per perch, average, $8 74 per perch, instead of $7 20, and the estimated cost per foot lift, is $1,802.

In the aqueducts, we find the estimate for cut masonry, $24 38 per perch for 1,028 perches, and $7 01, per perch, for 7,790 perches masonry laid in mortar, the average is $9 00 per perch for both descriptions. In the former work, (1833) we find that 17,400 perches of masonry, with all the accessories of coffer dams, foundations, puddling, railings, &c. &c., amounted to $11 40 per perch, only. We conclude, therefore, that the

estimate of 1842 for masonry per perch, is considerably higher than the cost of the same descriptions of work in 1833.

The cost of 78 culverts in 1833, was at the rate of $4 33 per perch for upwards of $18,000 perches. The cost in the estimate of 1842, of 23 in number, with a certain portion of the materials already procured for seven of them, is per perch, for the masonry, $5 82, for 10,226 perches—of this quantity 9,046 perches is to be laid in mortar, and estimated to cost $6 11 per perch, and the residue to be laid dry at $4 09 per perch.

We have exhibited in a table the several estimates of the cost of completing the Canal at different periods, and we now state the actual cost of certain portions of work below dam 6. The cost of work actually executed above dam No. 6, and the estimated cost of that which remains to be done between dam 6 and Cumberland, according to the last estimate of Mr. Fisk, (Jan. 22d, 1846):—

	Work done.		Work to be done above Dam 6, average price.
	Below Dam 6, average price.	Above Dam 6, average price.	
Earth excavation, cubic yard, -	12.39 cts.	16.94 cts.	14.50 cts.
Rock, - - - -	67.05 "	81. "	70. "
Embankment, - - -	12.46 "	14.77 "	8.50 "
Locks, per foot lift, - -	1505.29 dolls.	1801.90 dolls.	1720.50 dolls.

We have now exhibited the actual cost of portions of the work below dam 6 and above dam 6—also the estimated cost of completing the work above dam 6, as set forth in the estimates of 1842 and 1845.

It will be seen that the estimated cost of much of the work yet to be completed, is greater than the actual cost of work already executed; for embankment the estimate is *lower*. It will also be perceived that the estimates for work to be done above dam 6, are, in every case exhibited, less than the actual cost of work already finished above the same point—in the embankment the difference is very considerable. Mr. Fisk remarks, in reference to this last item, that the embankment already executed, had a greater "average haul" than will be necessary for that which is to be done, and the cost of embankment being in proportion to the distance, to which the material of which it is formed is to be transported, it is evident that the short "average haul" will be the cheaper of the two. He states further, in his reply to the 13th interrogatory, "that, although the present estimated prices are somewhat lower than was paid for similar work above dam 6, yet, in consideration of the change of times

since that work was done, and the facilities afforded by the Baltimore and Ohio Rail-road for obtaining supplies, and for the transportation of cement, they may be regarded as fully equivalent in point of profit to contractors. In fact, they are higher than the average prices paid for the entire amount of similar work done to this time on the entire line."

The remark of Mr. Fisk is certainly true, that work at this time can be executed at less cost than it could be in the years 1836, '37 and '38. We are aware also that he has given great attention to the subject of his estimates; that he has had much experience in his profession; that his judgment is good, and that it has been his object to present an estimate which may be relied upon. All this, we believe—at the same time we feel it a duty to acknowledge that we have more confidence in the sufficiency of the estimates of 1842, than in that of 1845, as the measure of the expenditure which may be required in the extension of this work. There is still a considerable quantity of work to be executed, and prices, both of labor and provisions may continue to advance, as the latter has advanced already, even since the estimate of 1845 was made.

We shall prefer, therefore, to adopt the estimate of 1842, ($1,545,000,) rather than that of 1845, ($1,404,471,) as indicating an amount which, we think, might be relied on as sufficient to complete the unfinished portion of the Canal, independently of the contracts which have been entered into for the execution of the work. The nature of the contracts here alluded to, has been explained in the foregoing report, and no further reference to it here will be necessary.

We shall now exhibit a summary of all work remaining to be executed between dam 6 and Cumberland, according to the estimate of Mr. Fisk, of December 1st, 1842. This estimate forms the basis of the contract with Messrs. Gwynn & Co., as to quantities and nature of work to be executed. The printed specifications annexed hereto, will show the kind of workmanship and the character of the materials required to be furnished by the contractors.

A SUMMARY *of all work remaining to be executed, at this time, between Dam No. 6 and Cumberland, according to an estimate made by the Chief Engineer of the Chesapeake and Ohio Canal, on the 1st December*, 1842.

1. *Excavation and Embankment.*

Quantities.	Nature of Work.	Av. price pr cub. yd.	Amount.
	Grubbing and clearing, - - -	- -	$8,450 00
1,234,214	Cubic yards earth excavation, - -	16.29 cts.	200,995 00
104,318	do rock do - -	78.04	81,411 00
346,021	do embankment paid for as exca-		
594,210	vation, - - - - - -	9.71	33,605 00
36,100	Cubic yards embankment not paid for as excavation and hauled under ¼ of a mile,	24.12	143,341 00
1,200	Cubic yards embankment not paid for as excavation and hauled over ¼ of a mile, and under ½ a mile, - - -	30.13	12,681 00
38,490	Cubic yards embankment not paid for as excavation and hauled over ½ a mile, -	40.	504 00
2,500	"Rip rap" wall paid as excavation, -	14.54	5,598 00
	do do not paid for as excavation,	1.00	2,500 00
	Miscellaneous work, - - -	- -	43,642 00
	Total excavation and embankment, -	- -	$532,727 00

2. *Completion of the Tunnel, and the deep cuts adjacent thereto.*

Quantities.	Nature of Work.	Av. price pr cub. yd.	Amount.
3,987	Cubic yards of rock from the bottom of the tunnel, - - - -	$1 50	$5,981 00
4,197	Cubic yards "finishing," - - -	3 00	12,591 00
17,000	do rock excavation in the deep cuts, - - - - - -	1 40	23,100 00
5,000,000	Bricks for arching tunnel, laid in cement, (per thousand,) - - - -	14 00	70,000 00
12,000	Cubic yards packing over the arch, -	0 80	9,600 00
	Entrances to tunnel, tow-path, (extra work upon,) contingencies, &c., - -	- -	56,028 00
	Total of tunnel, - - -	- -	$178,000 00

3. *Locks of hammered masonry. Nos.* 54 *to* 58 *inclusively, and Nos.* 68 *to* 75 *inclusively,* 13 *Locks. Aggregate lift,* 109.56 *ft.*

NOTE. Locks 54 and 59, and 72 to 75 inclusively, are, in the masonry, nearly complete. The materials for Nos. 54, 56, and 58, in part prepared.

Quantities.	Nature of Work.	Av. price pr cub. yd.	Amount.
7,896	Perches masonry laid in mortar at 10.60 less the value of material prepared, (83,711—15,021,) - - -	$10.60	$68,690 00
3,020	Perches dry work for backing, &c., -	3.88	11,705 00
1,260	do paving, - - - -	3.34	4,209 00
930	Lineal feet of dressed coping laid in cement, - - - - -	2.00	1,860 00
	Foundations and mitre sills, $13,910 00		
	Less work executed, 4,345 00	- -	9,565 00
10,860	Cubic yards earth excavation, - -	0.31	3,379 00
1,500	do rock do - -	0.80	1,200 00
6,500	Embankment from the lock pit, -	0.15	975 00
23,000	do not from the pit, - -	0.25	5,719 00
7,000	Puddling, - - - -	0.257	1,800 00
	Lock gates, castings, and flume-ways for the 13 locks, each - - -	1,000.00	13,000 00
	Miscellaneous work, - - -	- -	3,273 00
	Total for hammered locks, - -	- -	$125,375 00

4. *Composite Locks, i. e. locks composed of masonry not cut, and wood for lining, combined. Nos. 59 to 67 inclusively. Aggregate lift, 72.38 feet.*

Quantities.	Nature of Work.	Av. price pr cub. yd.	Amount.
3,600	Perches masonry laid in mortar, - -	$7.06	$25,400 00
7,650	do dry masonry in the locks, -	5.06	38,675 00
3,900	do do above and below the locks, - - - - - -	4.04	15,737 00
1,170	Lineal feet dressed coping laid in cement,	2.00	2,340 00
30,600	Cubic feet timber, (for foundations,)	0.253	7,752 00
198,000	Sup. feet (inch measure) of plank, do.	30.333	6,006 00
	Mitre sills and platforms, - - -	- -	1,260 00
12,600	Cubic feet timber, (for lining,) -	0.353	4,452 00
108,000	Feet (board measure) plank, do. -	40.333	4,356 00
6,300	do do locust ties, do.	50.00	315 00
16,200	Pounds iron, do. - - -	0.125	2,025 00
12,400	Cubic yards earth excavation, - -	0.277	3,430 00
1,000	do rock do - -	1.00	1,000 00
6,500	do embankment from lock pit, -	0.15	975 00
2,000	do do not from the pit,	0.275	550 00
11,000	do puddling, - - -	0.259	2,850 00
	Lock-gates, castings and flume-ways for 9 locks, - - - -	- -	9,000 00
	Miscellaneous work, - - -	- -	9,750 00
			$141,760 00
	Deduct materials prepared, - -	- -	9,977 00
	Total for composite locks, - -	- -	$131,783 00

5. *Aqueducts—Nos.* 8, 9, 10 *and* 11. *Aggregate span*, 240 *feet. Masonry of Nos.* 8 *and* 11 *nearly completed. Materials for Nos.* 9 *and* 10 *prepared in part. Considerable amount of masonry finished at No.* 9, *and a little at No.* 10. *Wastes and waste weirs are connected with Nos.* 8, 9 *and* 10, *and their cost is included in the Aqueduct estimates.*

Quantities.	Nature of Work.	Av. price pr cub. yd.	Amount.
1,028	Perches cut masonry, - - -	$24.38	$25,058 00
7,790	do masonry, laid in mortar, - -	7.01	54,570 00
250	do dry wall, - - -	4.00	1,000 00
200	do paving, - - - -	3.50	700 00
	Coffer dam, and bailing water, - -	- -	600 00
3,300	Cubic yards earth excavation, - -	0.295	975 00
2,700	do rock do - -	0.769	2,075 00
4,600	do puddling, - - -	0.25	1,150 00
650	do gravelling, - - -	0.50	325 00
	Gates for waste weirs connected with Aqueducts Nos. 8, 9, and 10, - -	- -	400 00
	Iron railings, - - - -	- -	2,850 00
1,500	Cubic yards Rip Rap paid as excavation,	0.25	375 00
	Miscellaneous work, - - -	- -	8,964 00
			$99,042 00
	Deduct materials prepared for Aqueducts Nos. 9 and 10, - - - -	- -	17,529 00
	Total for Aqueducts, - - -	- -	$81,513 00

6. *Culverts*—26 *in number. Aggregate span*, 240 *feet. Materials in part prepared for Nos.* 202, 206, 235, 236, 237, 240, 241. *Arches are to be of brick for all except Nos.* 235, 236, 237, 240 *and* 241.

Quantities.	Nature of Work.	Av. price pr cub. yd.	Amount.
1,202,700	Bricks in the arches, (per thousand laid,)	$16.00	$19,243 00
9,046	Perches masonry laid in mortar at $6 11, less the value of materials prepared for culverts 202 and 206, viz: (55,277—593)	6.11	54,684 00
1,180	Perches dry work, - - -	4.09	4,830 00
2,900	do paving, - - - -	3.55	10,297 00
7,760	Cubic feet timber, (for foundation,) per M.,	0.25	1,941 00
41,910	Feet (board measure,) plank, do. - -	30.00	1,257 00
	Timber foundation culvert No. 202, -	- -	195 00
51,650	Cubic yards earth excavation, - -	0.262	13,543 00
3,800	do rock do - -	0.99	3,760 00
18,800	do puddling, - - -	0.255	4,799 00
2,560	do gravelling, - - -	0.50	1,280 00
	Bailing for foundation at No. 202, -	- -	50 00
	Miscellaneous work, completion 235, 236, 237, 240, and 241, - - -	- -	13,300 00
	Total for culverts, - - -	- -	$133,179 00

7. *Wastes and Waste Weirs*—19 *in number*, 8 *of wood and* 11 *of masonry. Wastes to have a total overfall of* 740 *feet. Waste Weirs to have* 39 *gates.*

Quantities.	Nature of Work.	Av. price pr cub. yd.	Amount
2,780	Perches masonry laid in mortar, - -	$5.96	$16,575 00
698	Lineal feet of dressed coping laid in cement, - - - - -	2.00	1,396 00
1,410	Perches dry wall, - - -	4.03	5,687 00
1,340	Perches paving, - - - -	3.55	4,760 00
1,360	Cubic yards gravelling, - - -	0.50	680 00
1,600	Cubic feet timber, - - -	0.25	400 00
38,000	Feet (board measure) plank, per M., -	30.00	1,140 00
6,900	Cubic yards earth excavation, - -	0.195	1,345 00
4,550	do rock do - -	0.774	3,520 00
5,700	do puddling, - - -	0.275	1,570 00
	Waste gates of masonry weirs, - -	- -	940 00
1,500	Cubic yards embankment, - - -	0.25	375 00
3,700	do do moved, -	0.15	555 00
	Miscellaneous work, - - -	- -	1,000 00
	Total of the 11 masonry waste weirs, -	- -	39,493 00
	Timber and all materials for wooden wastes, 8 in number, each - -	368.75	2,950 00
	Securing the outlets of same, each -	581.25	4,650 00
	Total for wastes and waste weirs, -		$47,543 00

8. *Lock-houses*—17 *in number, to be substantial log buildings.*

	Nature of Work.	Av. price each.	Amount.
	Estimated to cost, complete, including all contingencies, - - - -	$800 00	$13,600 00
	Total for lock-houses, - -		$13,600 00

9. *Bridges, Roads and Fences.*

Quantities.	Nature of Work.	Av. price pr cub. yd.	Amount.
	Pivot bridge over Lock 73, - -		$600 00
	3 road bridges over tails of Locks 58, 68 and 70, respectively,—		
330	Perches masonry laid in mortar, - -	$5.667	1.870 00
480	do dry masonry, - - -	4.00	1,920 00
3,000	Cubic yards embankment, - -	0.25	750 00
150	Lineal feet superstructure, (in the clear,) -	6.00	900 00
	2 tow-path bridges, (masonry included in Lock 54 and Dam No. 8.)—		
110	Lineal feet superstructure, per foot, -	5.00	550 00
	Sundries not enumerated, - -	- -	100 00
	Tow-path bridge across Canal, sect. 367—		
150	Perches dry masonry, - - -	4.00	600 00
70	Lineal feet superstructure, per foot, -	5.00	350 00
	Sundries not enumerated, - -	- -	50 00
	Completion of road-way over Sideling Hill Creek, and constructing a county road, Lock 58, - - - - -	- -	1,500 00
	4 ferries, each - - - -	875.00	3,500 00
	2 permanent lattice bridges (road) over Canal, sections 346 and 364, 64 ft. span, each 17 feet above Canal, viz.		
1,050	Perches dry masonry, - - -	4.00	4,200 00
13,500	Cubic yards embankment, - -	0.25	3,375 00
44,000	Feet (board measure) plank, per M., -	32.50	1,430 00
	Sundries not enumerated, - -	- -	200 00
	1 lattice bridge for road, and the support of a forebay over the Canal, section 334—		
100	Perches masonry laid in mortar, - -	6.00	600 00
100	do dry masonry, - - -	4.50	450 00
500	Cubic yards earth excavation, - -	0.25	125 00
750	do rock do - -	0.80	600 00
200	do puddling, - - -	0.25	50 00
55,000	Feet (board measure) plank for bridge and forebay, - - - - -	30.00	1,650 00
	Basin, - - - - - -	- -	1,000 00
	Total for bridges, roads and fences, -	- -	$26,370 00

10. *Completion of Dam No.* 8, *and Guard Lock at Cumberland, including lock-gates, castings, and flume-way,* - - - - - 21,800 00

11. *Miscellaneous Work.*

Quantities.	Nature of Work.	Av. price pr cub. yd.	Amount.
	Removing temporary banks, - -	- -	$180 00
	Work required for the protection of the village of Cumberland, - -	- -	14,500 00
300	Perches masonry laid in mortar, for stop-gate in section 363, - - -	$5 50	1,650 00
300	Cubic feet timber, - - -	25	75 00
11,000	Feet (board measure) plank, per M., -	30 00	330 00
	Sundries not enumerated, - -	- -	300 00
	Total for miscellaneous work, -	- -	$17,035 00

12. *Transportation of Cement,* - 25,347 00

13. *Weigh Lock, House, &c.,* - 20,000 00

14. *Contingencies,* - - 190,728 00

Recapitulation.

1	Excavation and embankment, - - - -	$532,727 00
2	Tunnel, - - - - - - -	178,000 00
3	Locks, (hammered masonry,) - - - -	125,375 00
4	do (composite,) - - - - -	131,783 00
5	Aqueducts, - - - - - -	81,513 00
6	Culverts, - - - - - -	133,179 00
7	Wastes and waste weirs, - - - -	47,543 00
8	Lock-houses, - - - - - -	13,600 00
9	Bridges, roads and ferries, - - - -	26,370 00
10	Completion of Dam No. 8 & Guard Lock, - -	21,800 00
11	Miscellaneous work, - - - - -	17,035 00
12	Transportation of cement, - - - -	25,347 00
13	Weigh lock and house, - - - - -	20,000 00
14	Contingencies, - - - - - -	190,728 00
	Total estimate, - - - - -	$1,545,000 00

Of the Cost of putting the Canal in thorough Repair between Dam No. 6 and Georgetown.

In one of the interrogatories addressed to Mr. Fisk, he was requested to make an estimate of the cost of placing the Canal in thorough repair, below dam 6, raising the tow path on that part of the line above freshets, &c. He has furnished an estimate, amounting to $194,000, of which the following is a synopsis:—

Dams Nos. 1, 2, 4, 5 and 6, estimated to require repairs to the amount of	$27,000
To raise 15 miles of tow path above freshets, .	30,000
Protecting 21 miles of do. against freshets, the great cost of raising same above them forbidding it, .	25,000
Rebuilding two culverts, ...	6,000
Guarding against loss of water at limestone sinks, to secure 6 feet at all times; repairing some culvert foundations, and repairing Tyber lock, .	73,000
Waste weirs, new and repairs, . . .	5,000
Flumes at some of the locks, . . .	5,000
Cast iron frames for wooden frames, at some of the lock gates, ...	3,000
Renewal of lock gates, ...	2,000
Channel for Rock Creek at the basin, . .	15,000
Renewal of certain bridges, . . .	3,000
	$194,000

Of this sum, $116,000, with the exception of $9,000 for bridges, lock gates, &c., is necessary to put the Canal in a condition to bear 6 feet water with safety; the balance, $78,000 is not necessary for that purpose, but may be considered essential for the proper preservation of the work generally.

Mr. Fisk is of opinion that $75,000 "is more than could be judiciously expended in the next two years, unless the immediate raising of the tow path, &c. should be determined on."

Upon the Cost of the Chesapeake and Ohio Canal.

In the reply to the 22d interrogatory, many details will be found in reference to the cost of the Canal, from its commencement in 1828 to 1st October, 1845. The following summary will exhibit the amount expended between Tyber basin and Cumberland, and the estimate for completing the unfinished portion of the Canal between dam 6 and Cumberland:—

Construction,	$8,604,448
Acquisition of lands,	380,801
Incidental damages,	25,106
Engineer department, pay of officers, law expenses, printing, and other expenses,	491,990
	$9,502,345
Add Mr. Fisk's estimate of 1845 for completing the Canal, between dam 6 and Cumberland, and engineer department expenses,	$1,404,471
Add lands not paid for,	35,000
Add pay of officers and general expenses,	20,000
	$10,961,816
If, to the above sum of $9,502,345, actually expended, there be added loss, occasioned by sale of bonds, interest paid and unpaid, dividends guarantied to Maryland, &c., making in all, $4,458,970, the entire sum for the finished portion of the Canal, is	$13,961,315
Add for unfinished portion of Canal,	1,459,471
Total for finished and unfinished,	15,420,786
Add difference between estimates of 1842 and 1845,	140,529
	$15,561,315

Upon the Cost of Repairs.

Different portions of the Canal having been opened for use for periods of various lengths, it will be proper to state the cost of repairs per mile per annum, from the opening of the first portion of the line to the present time. The lower part of the Canal from Seneca to Georgetown old locks, 18 miles, has been in use about 15 years, while the upper portion, or that part between dam 5 and dam 6, has been opened less than 7 years.

Prior to the year 1843, the books of the Company did not exhibit the cost of repairs for each year, but the gross amount paid for repairs and superintendence is stated, to wit: $547,-354, and the whole number of miles of Canal in use, was equal to 1,117½ *one* year. In the year 1843, 135½ miles was in use. In 1844 and three-fourths of 1845, the number of miles in use was equal to 237 miles one year.

Prior to 1st January, 1843, the cost of repairs, superintendence, pay of officers, construction, per mile per annum, is thus stated:—

Repairs, ordinary and extraordinary, per mile per annum,	$376 61
Superintendence, collectors and lock keepers,	113 19
Pay of officers, &c.,	65 38
	$555 18
Add an item for "construction" for comparison with the cost for subsequent years, per mile per annum,	58 77
	$613 95

In the year 1843, a year remarkable for high freshets:—

Repairing, ordinary and extraordinary, per mile per annum,	$461 64
Superintending, collectors and lock keepers,	87 26
Pay of officers, &c.,	65 38
Add construction (for comparison,)	58 77
Total per mile per annum,	673 05
Same items for 1844 and three-fourths of 1845, per mile per annum,	369 35
Same items averaged over the *whole time* per mile per annum,	580 42

That is, considering the Canal below dam 6 to have been in use 11 years, or 1,489 miles in use one year.

In the reply to the 25th query, Mr. Fisk states his estimate of the cost of repairs, including pay of officers, superintendence and improvements, at $500 per mile per annum. The details of the estimate are stated in his reply to that query.

Upon this estimate it is proper that we should state our opinion. It appears from the statements that the greatest cost per mile per annum for repairs, occurs in the year 1843—remarkable, it would seem for high freshets, the cost per mile amounted in that year to $673, while for 1844 and three-fourths of 1845, it amounted to only $369 35 per mile per annum. This being rather an important inquiry, it will be well to see what has been the cost of repairs on other works. The sum expended upon all the Canals of New York, for superintendence and repairs, during the year 1837, was $492,147. This includes 640 miles of Canal, say per mile $769.

The Erie Canal (363 miles,) had then been in use 12 years. For the year ending 30th September, 1838, the cost of superintendence and repairs on the Erie Canal, was $848 per mile. Upon all the New York Canals the average was $645.

The cost of superintendence and repairs upon the Ohio Canal, 309 miles in extent, for the year 1840, was $365 per mile, and for 1841, $320 per mile.

For the year ending 30th September, 1842, the cost of superintendence and repairs on the Erie and Champlain Canal, was $734 per mile—and for the year ending 30th September, 1843, the cost was $678 per mile. From the facts and estimates given by the chief engineer in his answer to the interrogatory on this subject, and from our own observation of the present state of the banks and masonry of the Canal, and the precautions against accidents, we are of opinion that a lower rate of expenditure, than the above, may be assumed as the average expenditure of this Canal.

Considering, however, the rather exposed condition of the lower part of the line in high freshets, the number of dams upon which the Canal is dependent for a supply of water—the number of extraordinary repairs now deemed desirable, for which no sufficient appropriation is made; the fact, that prior to 1843, the repairs, &c., amounted to $614; that in the year 1843, the repairs cost $673 per mile; and considering that for the whole time since the Canal was opened the repairs have averaged $580 per mile, we think it safe to estimate the cost of superintendence, repairing and renewals, at $600 per mile per annum.

For further details, we refer to the very full and satisfactory statements of the chief engineer, in reply to the interrogatories addressed to him, which are hereto annexed.

WILLIAM H. SWIFT,
NATHAN HALE.

Washington, Feb. 20, 1846.

APPENDIX.

NO. 1.

Washington, November 3, 1845.

CHARLES B. FISK, Esq.

Ch. Engineer C. and O. Canal.

Dear Sir,—To enable Mr. Hale and myself to communicate to Mr. Ward certain information upon various points connected with the Chesapeake and Ohio Canal, we have considered it expedient to state the points in writing upon which we wish to be informed and to beg that you will oblige us by furnishing answers to the following interrogatories:

1. What is the entire length of the Canal, from the Cumberland dam to the basin at Rock Creek,—the distance from Rock Creek basin to the Tiber basin,—and the distance from the aqueduct at Georgetown to the outlet lock, Alexandria?

2. What is the number of locks, from Cumberland dam to tide water at Georgetown, the dimensions of the locks, the total amount of lockage, and the materials used in the construction?

3. What is the number of aqueducts, the length, height of each above foundations, number of arches in each structure, and the material of which they are built?

4. What is the number of dams upon the entire line, where are they situated, (specified in miles above Georgetown,) the length and height of each, and the material used in the construction,—cost of same?

5. What is the number of arched culverts, their span and height,—character of the sheeting, whether cut or rubble, quality of the materials used in the construction? What number of box culverts,—their dimensions, generally?

6. Road and farm bridges, ferries and paved fords,—how many and where placed, height of bridges above canal surface?

7. Feeders,—are there any other sources of supply than such as the Potomac itself furnishes? If so, please state them. Is provision made for the erection of additional dams, in case the supply of water should be found inadequate for lockage, absorption, evaporation, waste, &c.?

8. What is the entire amount of earth work in the Canal, from dam 6 to Cumberland? What is the amount executed at this time, and at what cost has it been excavated and placed in the banks, per cubic yard? What amount, in cubic yards, remains to be executed, and what is the estimated (average) price of same. per cubic yard? The same of rock cutting, both finished and not finished? What amount of "rip rap" stone work has been laid, outside the tow path for its protection, in cubic yards, and at what cost per cubic yard has it been placed? What amount remains to be laid, and what is the estimated cost per yard, of laying the same?

9. What is the number of locks between dam 6 and Cumberland? What is the aggregate amount of masonry in same, in cubic yards? What number of the locks are completed (the masonry) and what is the cost per foot lift (average?) What is the estimated cost per foot lift, of those which are to be built?

10. Aqueducts. State those which are finished,—the number of cubic yards of masonry, of all kinds included, contained therein, and the average price per cubic yard. The same of the unfinished aqueducts,—estimated cost (average.) See note paragraph 13.

11. Cumberland dam—dimensions, and estimated cost.

12. Culverts, arched and box—gross amount of cubic yards of masonry laid in same, and average cost per yard of same, including the cost of foundations—number of cubic yards to be laid in unfinished culverts, and estimated cost of same per yard.

13. Puddling—quantity of laid, and cost of (average) per yard,—estimated cost per yard of that which is still to be introduced.*

14. What is the height of the tow path above the freshet of 1843? What provision has been made in reference to such parts of the same as fall below that freshet? This upon the *entire* line of Canal.

15. Waste weirs, wastes, &c.—what is the extent of provision made for these accessories?

16. What principle has been adopted in reference to lateral streams upon the canal side of the river? Some have been allowed to discharge themselves into the Canal; what circumstances have determined whether the stream should be received into the Canal or passed under it? What are the precautions taken in the cases where the streams are permitted to enter the Canal?

17. Lining the interior slope of the tow path—what mode has been adopted for this purpose, and to what extent has it been introduced?

18. Specifications of the several descriptions of work, masonry and earth work—such as the contractors were required to follow in the prosecution of their jobs—copies, if printed would be desirable.

* Paragraphs 10, 11, 12 and 13 refer to that part of the Canal between dam 6 and Cumberland.

19. Dimensions of the Canal at various points, both in earth and in rock cutting.

20. Basins for the accommodation of the trade at Cumberland, Georgetown, Washington and Alexandria. Please state the capacity of each, the extent of wharf, depth of water in each, (least depth,) and sketches or plans of same, on thin paper, if practicable,—no matter how roughly executed. That of Cumberland should exhibit the proposed connection with the railways to the coal mines.

21. Connexion of the Canal with the Potomac river—at what points does this take place?

22. What has been the actual cost of the Canal, from Tiber basin to dam 6? What amount has been expended between dam 6 and Cumberland, and what is the amount which you estimate that it will require, to complete the Canal between dam 6 and Cumberland?

23. What has been the cost of repairs, per mile, from dam 6 to Georgetown, since the Canal was opened for use? Has there been a sufficient sum expended for that purpose? In other words, if the Company had ample revenues at command, would your expenditures for repairs have been limited to the sums actually expended?

24. Have you made an estimate recently, of the cost of putting that portion of the Canal between dam 6 and Georgetown in thorough repair, including the raising of the tow path above freshets, repairing lock gates, &c.? If so, please state the sum which you think would effect that object.

25. The Canal being completed from dam 6 to Cumberland, and the older portion in thorough repair, what will it cost per mile, per annum, to maintain the Canal, dams, and all other subsidiary works, in the best condition for purposes of navigation, including superintendence, &c.

26. Will you make a detailed estimate of the cost of transporting 100 tons of coal, from Cumberland to the basin at Rock Creek, assuming that this quantity can be transported in a single boat.

27. Are there any outstanding claims against the Company for land, damages, right of way, &c.? If so, the probable extent of same.

NO. 2.

Washington City, 22d January, 1846.

To Capt. Wm. H. Swift,
U. S. Top. Engineer.

Sir,—I have the honor herewith to enclose my replies to several interrogatories relating to the Chesapeake and Ohio Canal, contained in your letter to me of the 3d November, 1845.

Having already apprised you of the circumstances that have occasioned the long delay there has been, in my furnishing you with these answers, it is not necessary for me to speak of them again. I desire to say, however, that from the unconnected manner in which I have been compelled to take up the subjects referred to in the interrogatories, there will be found in these answers some needless repetition in the statements presented,—and, besides, the answers are less condensed than I could have wished.

Upon some points, the information given, I had necessarily to obtain from officers of the Company not in my department,—the information thus obtained, I have every reason to place confidence in. As respects some of the matters of detail given, there might be found, upon reëxamination and revision, slight variations from the statements that are made. I am satisfied, however, that, upon the whole, they would be of little or no importance.

The statements, generally, come down to the 1st of October, 1845, as that was the commencement of the quarter in which most of them were prepared.

I am, very respectfully,

Your ob't servant,

(Signed.) CHARLES B. FISK,

Chief Engineer C. and O. C. C.

NO. 3.

Mr. Fisk's Answers to the Interrogatories submitted on the 3d of November, 1845.

1st. What is the entire length of the Canal from the Cumberland dam to the basin at Rock Creek,—the distance from Rock Creek basin to the Tyber basin, and distance from the Aqueduct at Georgetown to the outlet locks at Alexandria?

Answer. The entire length of the Canal, from the Guard lock at the Cumberland dam to tide lock A, at the Rock Creek basin, between Georgetown and Washington city, is $184\frac{4}{10}$ miles. The distance from tide lock A, to tide lock B, at the Tiber basin in Washington city, is $1\frac{3}{10}$ miles, and from the aqueduct of the Alexandria Canal Company, at Georgetown, which is $1\frac{1}{10}$ miles above tide lock A, to the tide lock at Alexandria, is $7\frac{1}{8}$ miles.

The distance, therefore, by the line of the canal from the Guard lock at Cumberland to tide water at Georgetown, is . . . . . $184\frac{4}{10}$ miles.

From the same to tide water at Washington, is . . $185\frac{7}{10}$ miles.

And from the same, by the line of the canal to Georgetown, and thence by the Alexandria canal to tide water at Alexandria, is . . . . . $190\frac{1}{2}$ miles.

2d. What is the number of locks from Cumberland dam to tide water at Georgetown, the dimensions of the locks, the total amount of lockage, and the materials used in the construction?

Answer. The number of lift locks is 74—(at first, 75 locks were contemplated, but the number is now reduced to 74, by the substitution, immediately below the tunnel, of four locks of 10 feet, in place of five locks of 8 feet lift each.)

The total lift of these 74 locks, is . . . . $605\frac{943}{1000}$ feet.

Add, elevation of the comb of the Cumberland dam above the water surface of the Canal, directly below the Guard lock at that dam, ... $0\frac{50}{100}$ feet.

Add, average lift of the tide lock at Georgetown, (above mid-tide,) . . . . . $3\frac{25}{100}$ feet.

Total elevation of the pool and basin formed by the Cumberland dam above mid tide, at Georgetown, . $609\frac{693}{1000}$ feet.

There are, also, upon and connected with the line of the Canal, between the Tyber basin, in Washington city, and Cumberland, two tide locks, viz: those already referred to, at the Rock Creek and Tyber

basins, six guard locks and one guard gate, at the entrance of feeders to the Canal, and three outlet locks for the accommodation of the Virginia trade.

It should be remarked that, in consequence of the river being used for navigation, at two points, viz: for $3\frac{3}{10}$ miles, between guard lock No. 4, and lift lock No. 41, and for half a mile between guard lock No. 5, and lift lock No. 45, along the back water above dams No. 4 and 5, respectively, two of the guard locks just referred to, are in the line of the main canal, and that through them all boats must pass, going between tide-water and Cumberland. These guard locks become, of course, lift locks, of variable lift, whenever the river rises higher than the level of the Canal directly between them,—thereby diminishing to the same extent the lift of the locks next above them.

The locks are all 100 feet long, in the clear, from mitre-sill to mitre-sill. Their width of chamber, in the clear, is 15 feet.

For the lift of each lock, the materials used in the construction of those built, and that probably will be used in those not yet constructed, the description of work, and for the lengths of the several levels of the Canal, from lock to lock,—and other information relating to the locks, —see Table No. 1.

Table No. 1, exhibiting the number of Locks upon the Chesapeake and Ohio Canal, between the Tyber basin, in Washington, and Dam No. 8, at Cumberland, the lift of each, the distance of each from the tide lock, at Georgetown, and the lengths of the several levels of the Canal from lock to lock.

	Distance from Lock to Lock.	Distance from the Georgetown Tide Lock.	Lift.	Total lift above mid-tide at Georgetown
	MLS. FT.	MILES. FT.	FEET.	FEET.
Tide Lock at the mouth of Rock Creek,—the lift is above said tide,	·	·	3.25	3.25
Lift Lock, No. 1, - - - -	0.1958	0.1958	8	11.25
" " " 2, - - - -	0.240	0.2198	8	19.25
" " " 3, - - - -	0.301	0.2499	8	27.25
" " " 4, - - - -	0.289	0.2788	8	35.25
" " " 5, - - - -	4.2707	5.215	8	43.25
" " " 6, - - - -	0.1911	5.2126	8	51.25
" " " 7, - - - -	1.3186	7.32	8	59.25
" " " 8, - - - -	1.1782	8.1814	8	67.25
" " " 9, - - - -	0.1812	8.3626	8	75.25
" " " 10, - - - -	0.459	8.4085	8	83.25
" " " 11, - - - -	0.1027	8.5112	8	91.25
" " " 12, - - - -	0.1636	9.1468	8	91.25
" " " 13, - - - -	0.446	9.1914	8	107.25
" " " 14, - - - -	0.445	9.2359	8	115.25
" " " 15, - - - -	3.5266	13.2345	8	123.25
" " " 16, - - - -	0.934	13.3279	8	131.25
" " " 17, - - - -	0.1844	13.5123	8	139.25
" " " 18, - - - -	0.539	14.382	8	147.25
" " " 19, - - - -	0.408	14.790	9	156.25

	Distance from Lock to Lock.	Distance from the Georgetown Tide Lock.	Lift.	Total lift above mid-tide at Georgetown
	MLS. FT.	MILES. FT.	FEET.	FEET.
Lift Lock, No. 20, - - - -	0.594	14.1384	8	164.25
" " " 21, - - - -	2.1863	16.3247	8	172.25
" " " 22, - - - -	2.5267	19,3234	7	179.25
" " " 23, - - - -	2.2554	22.508	8.50	187,75
" " " 24, - - - -	0.3508	22.4016	8.50	196.25
" " " 25, - - - -	8.123	30.4139	8	204.25
" " " 26, - - - -	8.3477	39.2336	8	212.25
" " " 27, - - - -	2.22	41.2358	8	220.25
" " " 28, - - - -	7.2613	48.4971	6	226.25
" " " 29, - - - -	1.4800	50.4491	7	233.25
" " " 30, - - - -	4.591	54.5082	8	241.25
" " " 31, - - - -	3.299	58.101	8	249.25
" " " 32, - - - -	2.1014	60.1115	8	257.25
" " " 33, - - - -	0.2553	60.3668	8	265.25
" " " 34, - - - -	0.4598	61.2986	8	273.25
" " " 35, - - - -	0.3862	62.1568	8	281.25
" " " 36, - - - -	0.507	62.2075	8	289.25
" " " 37, - - - -	4.3081	66.5156	9	298.25
" " " 38, - - - -	5.4399	72.4275	5	303.25
" " " 39, - - - -	1.1129	74.124	9	309.25
" " " 40, - - - -	5.1905	79.2029	6	318.25
Guard Lock, No. 4, - - -	6.1187	85.3216		318.25
Lift Lock, No. 41, - - -	3.1584	88.4800	10	328.25
" " " 42, - - - -	0.695	89.215	9	337.25
" " " 43, - - - -	3.4847	92.5062	9	346.25
" " " 44, - - - -	6.1525	99.1307	10	356.25
Guard Lock, No. 5, - - -	7.2799	106.4106		356.25
Lift Lock, No. 45, - - -	0.2739	107.1565	7	363.25
" " " 46, - - - -	0.759	107.2324	7	370.25
" " " 47, - - - -	1.1436	108.3760	8.25	378.50
" " " 48, - - - -	0.332	108.4092	8.25	386.75
" " " 49, - - - -	0.414	108.4506	8.25	395.
" " " 50, - - - -	0.333	108.4839	8.25	403.25
" " " 51, - - - -	13.4074	122.3633	8	411.25
" " " 52, - - - -	0.1366	122.4999	8	419.25
" " " 53, - - - -	7.498	130.217	8	427.25
" " " 54, - - - -	3.4688	183.4905	7.8	433.05
" " " 55, - - - -	0.900	134.525	7.8	442.85
" " " 56, - - - -	2.753	136.1278	7.7	450.55
" " " 57, - - - -	3.17	139.1295	8	458.55
" " " 58, - - - -	4.3665	143.4960	8	466.55
" " " 59, - - - -	2.2400	146.2080	8	474.55
" " " 60, - - - -	3.725	149.2805	8.385	482.935
" " " 61, - - - -	3.2259	152,5064	8	490.935
" " " 62, - - - -	1.289	154.73	10	500.935
" " " 63½, - - - -	0.1719	154.1792	10	510.935
" " " 64⅔, - - - -	0.547	154.2339	10	520.935
" " " 66, - - - -	0.547	154.2886	10	530.925
" " " 67, - - - -	6,5204	161.2810	8	538.925
" " " 68, - - - -	3.710	164.3520	8.258	547.193
" " " 69, - - - -	1.3198	166.1438	8	555.193

	Distance from Lock to Lock.	Distance from the Georgetown Tide Lock.	Lift.	Total lift above mid-tide at Georgetown
	MLS. FT.	MILES. FT.	FEET.	FEET.
Lift Lock, No. 70, - - - -	0.1243	166.2681	8	563.193
" " " 71, - - - -	0.1730	166.4411	8	571.193
" " " 72, - - - -	7.2038	174.1169	9	580.193
" " " 73, - - - -	1.109	175.1278	9	589.193
" " " 74, - - - -	0.600	175.1878	10	599.193
" " " 75, - - - -	0.911	175.2789	10	609.193
Guard Lock at Dam, No. 8, - -	8.4563	184.2072	0.50	609.693

There is, in addition to the locks entered in the preceding table, a tide lock in Washington of the same lift as that at the mouth of Rock Creek, which is at the termination of the Canal, $1\frac{3}{10}$ miles long, extending from the Rock Creek basin to the mouth of the Tiber.

There are, also, three guard locks on the feeders, from dam No. 2, the "government dam," and dam No. 6, and there will be one at the Cumberland dam. There is, also, a single set of guard gates on the feeder from dam No. 1, and there are outlet locks at three points, viz: at Edwards' Ferry, opposite Harper's Ferry, and opposite Shepherdstown; the first in two lifts,—the other two with one lift each. These outlet locks have an aggregate lift of about 37 feet.

The two tide locks, the lift locks from No. 1 to No. 53 inclusive, the guard locks, except the one at Cumberland, the guard gates on the feeders from dam No. 1, and the outlet locks,—being all below dam No. 6, are constructed and have been for several years in use. Some of the locks above that dam are also built, as will appear in the course of these answers.

The tide locks, and all of the lift locks constructed,—with the exception of the whole of two lift locks and the lower six feet of the masonry of two others, which are hammer dressed, are either of cut or closely rubbled masonry. The outlet locks, guard locks, and guard gates are some of them of rubble, and others of hammer dressed masonry.

The face stone of the two tide locks, of lift locks No. 1 to No. 4, inclusive, and of the masonry above the lower six feet in height of locks No. 5 and 6, are of the Aquia creek sand stone. The rest of the face stone for the locks of every kind, and the backing of all the locks are of sand stone from the Seneca quarries, of limestone obtained at different points along the valley of the Potomac, or of other equally durable stone. The quarries, generally, were within reasonable distances from the sites of the locks.

3d. What is the number of aqueducts, the length, height of each above foundations, number of arches in each structure, and the materials which they are built?

Answer. They are eleven, viz:—

Aqueduct. Over what stream.	Arches. Number of.	Arches. Space. Each.	Arches. Space. Total.	Arches. Rise of.	Piers. Number of.	Piers. Thickness.	Distance from. Face to face of abutment.	Distance from. End to end of wings.	Height of top of Copo. above. Canal bottom.	Height of top of Copo. above. Water surface of stream.	Height of top of Copo. above. Foundation.	Width of water way.	Thickness of. T. path parapet.	Thickness of. Beam parapet.	Of what materials built.	Description of work.
		FT.	FT.	FT.												
Seneca Creek, .	3	33	99	7½	2	7	113	-	7	18	-	*15	-	-	Seneca red Sandstone.	Cut work.
Monocacy, . .	7	54	378	9	6	10	433	1516	7	30	34	19½	8	5½	White Quartz-ose Sandst'ne	do.
Catoctin, . .	2 of 20 & 1 of 40		80	10	2	6	92	-	7	27¼	Say 33	21	7	5	Mostly of Granite.	Ranged rubble work below the tops of the piers—above the beds and joints are cut, and the face left rough.
Antictem, . .	2 of 28 & 1 of 40		96	10	2	6	108	-	7	23½	26	22 at top 20 at bot.	6 at top 7 at bot.	4 at top 5 at bot.	Limestone.	Beds and joints are cut, the face left rough.
Conococheague, .	3	60	180	15	2	8	196	254	7	30	Say 33	20	6½ at top 7 at bot.	4½ at top 5 at bot.	do.	The arches, skewbacks, ends of the piers, and abutments, water table and coping are cut, the rest of the face lines are hammer-dressed and ranged.
Licking Creek, .	1	90	90	15	-	-	90	180	7	34	37 6-10	21	7 at top 7½ at bot.	5 at top 5½ at bot.	do.	
Big Tonoloway, .	1	62	62	20	-	-	62	152	7	36	42 1-10	2	do.	do.	do.	The arches, skewbacks, water table coping and inside of the parapet are cut,—the rest of the masonry is of rubble work. Aqueducts, 4, 9, and 10, are only in part constructed; for further particulars respecting them, see remarks which follow.
Sideling Hill Creek,	1	66	60	12	-	-	60	150	7	24	36	21	do.	do.	Sandstone & Limestone.	
Fifteen Mile Creek,	1	50	50	10	-	-	50	140	7	29	31	21	do.	do.	A very hard Sandstone.	
Town Creek, .	1	60	60	15	-	-	60	150	7	29	32	21	do.	do.	Limestone.	
Evitt's Creek, .	1	70	70	14	-	-	70	160	7	27	34	21	do.	do.	do.	
			1225				1339									

*The masonry of this aqueduct, at its lower end, is connected with that of lock No. 24. The width of the trunk of the aqueduct, which is, in fact, an extension of the lock walls, above pper gates, has the same width as that of the lock chamber, viz:—15 feet.

From end to end of the *cut* wings, in addition, there are wings of rubble masonry.

The heights given, in the preceding table, of top of coping above "water surface of stream," have reference to the *low* water surface of the streams over which the aqueducts are constructed.

Seven of the aqueducts, those to No. 7, inclusive, are below; the remaining four are above dam No. 6. Of the latter, Nos. 8 and 10 may be considered finished, as regards the aqueduct proper, there being only a small amount of work to be done, consisting almost entirely of entrance walls that cannot be constructed until after the completion of the embankments and puddling about the aqueducts. The other two, Nos. 9 and 10, are only in part built. As regards the former, No. 9, nearly one fourth of its masonry is laid, and a large portion of the materials for its completion has been prepared. For the other, only a small quantity of materials has been prepared, and as to its masonry, but little of it has been laid.

4th. What is the number of dams upon the entire line, where are they situated, (specified in miles above Georgetown,) the length and height of each, and the material used in the construction, cost of same?

Answer.—There are seven dams. Their distances, lengths, heights, and cost, are as follows:—

	Dist. from Georgetown Tide Lock.	Length.	Height Above		Cost, including that of the Guard Lock and work caused by the Dam.
			River surface below the dam.	Foundation.	
	MILES.	FEET.	FEET.	FEET.	DOLLARS.
Dam No. 1, at the head of the Little Falls, . . .	5 6-10	1750	5	The bed of the river is very irregular, adding 2 feet to the preceding heights, for the heights above found.	$40,704
Dam No. 2, at the head of Seneca Falls, . . .	22 1-10	2500	. .		38,005
The "Government Dam," at the head of Harper's Ferry Falls,*	62 4-10	. .	. .	. .	7,208
Dam No. 4, . . .	84 4-10	810	15	20	79,095
Dam No. 5, . . .	106 8-10	706	16	20	81,924
Dam No. 6, . . .	134 1-10	470	15	20	104,426
Dam No. 8, at Cumberland, .	184 4-10	400	. .	. .	102,522
					$453,884

* This Dam was built by the United States, the Guard Lock by the Co.

It will appear, in the course of these answers, that the above amounts have all been expended on these dams, except the sum of $21,800, which is the amount of work remaining to be done on dam No. 8 and guard lock. That sum added to $80,722, the cost of the work done, makes up $102,522, given above as the cost of that dam, &c.

The materials of which the dams are built, the plans of construction, and the cost of the dams somewhat more in detail, are as follows:—

Dam No. 1, founded on rock, is in two parts, separated by an island.

From the Maryland shore to the island, a distance of 855 feet, the dam, with a cross section in the form of an arch, is of stone laid dry; the exterior stone were selected and laid with care, and the interior of the dam is filled in with rubble stone closely packed. From the island to the Virginia shore the dam is built of brush, stone and gravel; in other words, that part is a "brush dam."

The feeder from this dam is along the channel of the old Potomac Canal, on which there has been but little expended by the new company. It needs some enlargement.

This is the only dam that feeds the canal through a single set of guard gates, at all the others there are two sets; in other words, guard locks. The cost of the dam, guard gates, and the amount expended on the feeder by this company, are all included in the sum above given, viz., $40,704.

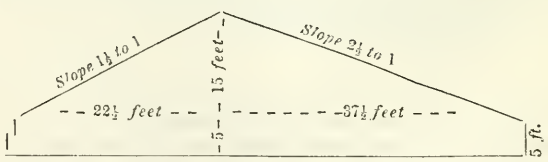
Dam, No. 2, foundation on rock was, originally, its whole length, an arched stone dam, like the part of dam No. 1, extending over to the island. Parts of the dam having given way, the gaps have been filled in with brush, stone and gravel, forming at these points "brush dams."

The cost of this dam, &c. is thus made up:—

The dam, proper, ...	$28,793
" guard lock, ...	7,296
" feeder, or rather clearing out the entrance, &c., to the guard lock, ...	1,916
Total cost, ...	$39,005

The "Government dam" was built and is kept in repair by the United States, as will subsequently be more fully explained. It is of crib work, filled in with stone. The feeder from it is along the channel of the old Potomac navigation. It required some enlargement, the cost of which is included with that of the sections. The guard lock cost the sum named in the preceding table, viz., $7,208. The "Government dam," in answer to the 7th interrogatory, takes the place of the dam (No. 3) that was to have been constructed in the Potomac, near the mouth of the Shenandoah river.

Dam No. 4 is built of wood and stone, and is founded on rock. Its Maryland abutment is of rubble masonry laid in cement mortar. The Virginia abutment is a natural one, of limestone-rock. The following is a cross section of the dam:—



In the foundation, three ranges of timber are placed, 30 feet apart, which are bolted to the rock, and extend the entire length of the dam.

On these, at every ten feet of their length, cross ties are placed. There are next longitudinal timbers, and then cross ties 10 feet apart, as before, dividing the spaces between those in the course below, and so on, alternately, longitudinal timbers and cross ties. The distances apart, of the longitudinal timbers, vary with their height above foundation, so as to form the above cross sections of dam. And each succeeding course of cross ties, as the dam rises, has its down stream end more and more elevated above the up stream end, (by connecting two or more courses of ties with the same longitudinal timbers of the up stream ranges, &c,) until when near the height of the dam an inclination is obtained corresponding with that of the up stream slope of the dam, viz. $2\frac{1}{2}$ to 1. On the sloping up stream surface of the dam, when thus far formed, ties 4 feet apart are placed, and securely bolted to and braced from the timbers forming the cribs. On the last mentioned course of ties, there are framed and fitted 15 courses of timber, lengthwise of the dam. To these timbers are secured the four inch plank, which cover the up stream slope of the dam. On the upper 12 feet of this slope, ice guards are placed. The perpendicular part of the upper side of the dam, is sheet piled with two inch plank scribed and fitted to the rock. The lower slope of the dam is covered with suitable plank secured to the timbers of the dam. The whole span between the timbers and under the ties is filled with stone well packed. On the up stream side of the dam, gravel is placed to secure greater tightness. Many details are omitted in this brief description. The specifications and a more full cross section of the dam may be found in a report by Gen. McNeill, printed in Congressional House Documents, No. 414, 23d Congress, 1st session, pages 163 to 165 inclusive.

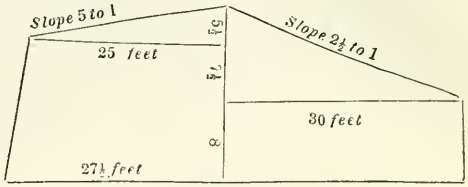
The dam proper cost, ...	$60,603
" guard lock, ...	9,091
" stop gate rendered necessary by the dam, crib, &c., connected with it, and a road in Virginia around the abutment, and other work occasioned by the dam, .	2,547
Total cost, ...	$79,095

Dam No. 5, founded on rock, has two abutments of rubble masonry laid in cement mortar. Through the Virginia abutment there is a large culvert for the passage of water to a mill for manufacturing purposes to be used, however, only when not required by the navigation. This dam has the same cross section as dam No. 4, and its plan and manner of construction are the same.

The dam proper cost, ...	$66,533
The guard lock cost	8,428
And a temporary lock at the Virginia abutment, for the accommodation of the river navigation, in freshets, while the dam was constructing, ...	6,963
Total cost, ...	$81,924

Dam No. 6, founded on rock, has two abutments of rubble masonry laid in cement mortar. This dam is somewhat similar in plan and construction to dams No. 4 and 5.

The following is its cross section :—



There are four ranges of longitudinal timbers in this dam in place of three, as in dams No. 4 and 5. The additional range is placed midway between the lower range and the comb of the dam. There are, besides, more timbers than in those dams placed directly under the flat slope in the lower side, which are so arranged, as to afford a very firm and almost continuous bearing of timber for the 6 inch thick pieces which cover the slope.

The advantages of the flat slope on the lower side of this dam are, that logs and trees brought down by the river in freshets, pass over the dam and leave, at once, without occasioning the slightest injury to the work ; and the pitch of the water is at all times such, that the bed of the river below the dam is not disturbed sufficiently near the front of the dam, to cause the least damage to its foundation. The entire wood work and foundation of the dam are in as good condition now, as when the dam was completed seven years ago, and have required no repairs during that time.

The cost of the dam, proper, and guard lock, was .	$100,727
And of the guard bank in Virginia, rendered necessary by the dam.	3,699
Total cost, ...	$104,426

Among the plans proposed for introducing, at some future day, an intermediate feeder or feeders to the Canal, between dams No. 6 and 8, there is one which would require the erection of a dam (No. 7,) on the Potomac, at a point between where the Canal line leaves the river, below, and returns to it, above the tunnel. The feeder from it would enter the Canal at the tail of lock No. 62,—154 miles from the Georgetown tide lock.

Dam No. 8. Its dimensions and cost in detail will be given in the 11th answer.

5th. What is the number of arched culverts, their span and height, character of the sheeting, whether cut or rubble, quality of the material used in the construction ? What number of box culverts, their dimensions generally ?

Answer.—There were 154 culverts built between the Tyber basin and dam, No. 6, with an aggregate span of 1,171½ feet. Between dam No. 6, and Cumberland, there are 5 built, aggregate span, 40 feet; and 23 to be built, aggregate span, 204 feet. There will have been constructed, therefore, when the canal is finished to Cumberland, on the entire line, 182 culverts, having an aggregate span of 1,415½ feet—26 of them below and 5 above dam No. 6, are and will be so constructed as to answer for road culverts.

	No.	Span in ft.
There is only one culvert entirely of wood. It is a circular one, in Washington, 2½ feet diameter, length, 122 feet, and is always covered with water, - - -	1	2½
There are two road culverts below Dam No. 6, which have abutments of rubble masonry, with two courses of three inch plank, in place of arches, under the water way of the Canal and the inner slopes of the banks, and stone arches under the rest of the banks, - -	2	21
There will be above Dam No. 6, a circular brick culvert, 3 feet in diameter, - - - - - - - -	1	3
There are two below, and will be 17 above, Dam, No. 6, with rubble abutments, and brick arches, - - - -	19	182
There are 149 below, and 3 above, Dam, No. 6, that have rubble abutments, and arches, - - - - - -	152	1166
There are 2 above Dam No. 6, and will be 5 more, with abutments of rubble masonry, and arches of well rubbled stone, - - - - - - - - - -	7	41
Totals, - - - - - - - - -	182	1415½

The culverts average, in length, about 112 feet. Their heights vary. It was the aim in planning the culverts last, and those still to be built, except in the case of road culverts, to make their spans sufficient to give ample water way, with abutments only 2½ feet high in the clear.

The culverts, generally, are built of materials that, as regards durability, are of a very good quality. Limestone and sandstone were used in the construction of far the greater number.

Twelve of the culverts earliest constructed, included in the number above given, have, at different times, given way—most of them several years ago, none lately; ten of them were situated within from 16 to 40 miles, and the other two within from 63 to 76 miles of Georgetown. Ten need not, and will not be rebuilt. The dispensing with them has caused no inconvenience to the navigation. For the other two, wooden trunks are temporarily substituted. They were of 8 and 12 feet span, and are to be rebuilt. One half of the larger one, which failed only in part, has already been repaired and made secure in its foundation, which was originally defective.

Some of these culverts failed from being situated where guard banks were required against the Potomac, others from having insecure founda-

tions. In high freshets, the upward pressure of the river against the arches of the former, cause them of course to give way. There are now no culverts remaining, that need be exposed to a like strain from the river; and as the culverts last built had unusual care given to receiving their foundations, which have in no single instance yielded, and as great attention has been, and will continue to be, given to making safe the foundations of the culverts where there was or may be reason to fear a failure, the culverts along the entire line of the Canal may now be considered as in a good and improving condition.

6th. Road and farm bridges, ferries and paved fords; how many and where placed, height of bridges above Canal surface.

Answer.—This Canal has comparatively few bridges. *Ferries* or *road culverts* have usually been made for the accommodation of the owners of land between the Canal and river. In many cases, the company purchased the land next the river, and have since sold it with the understanding that bridges or ferries were not to be constructed for its accommodation. Public roads, at several points, are carried under the canal through road culverts.

Several of the bridges in Washington and Georgetown are low; but from a point, below where the Alexandria Canal branches from this, to Cumberland, all the bridges, considered *permanent* ones, have and will have an elevation of not less than 17 feet, in the clear, above Canal surface. There are a few bridges above Georgetown and below dam No. 6, that have less height than 17 feet; but they were all of small cost, and are considered as temporarily placed at their present level. They might all, at no great cost, be raised to 17 feet, should it ever be found necessary.

None of the bridges on the Alexandria Canal have a less height, in the clear, than 12 feet above Canal surface.

The number of bridges on this Canal is as follows:—(The heights given, apply in all cases to the elevation of the bridges, *in the clear, above Canal water surface.*)

1st. In Washington, between the Tyber and Rock Creek Basins, there are:—

1 pivot bridge, over the middle of Tyber tide-lock.

2 bridges with wooden superstructures and stone abutments, spanning the whole width of Canal, 8 feet in height.

1 arched stone bridge, at a point where the Canal is narrowed for a stop gate; 10 feet in height at the highest point of the arch.

2d. In Georgetown, below the junction of the Alexandria Canal with this, there are,

3 arched stone bridges over the tails of locks, No. 2, 3 and 4, of 15 feet span each. Their heights, at the highest points of the arches, are $9\frac{1}{2}$, 8, and 7 feet. The arches of the two latter have a rise of 2 feet each.

2 arched stone bridges, spanning the entire width of the canal—one inclusive, the other exclusive of the tow path. The latter being near the head of the upper of the 4 locks in Georgetown; but little incon-

venience results from the tow path not passing under it. Its height at the highest point of its arch is 9 feet, that of the former, 19 feet.

4 bridges, with wooden superstructures and stone abutments, spanning the whole width of Canal and tow path. One of the bridges—the upper one of all, in Georgetown—serves both as a road and tow path bridge; the tow path at that point, changing sides of the Canal. These bridges are, respectively, 9, $8\frac{1}{4}$, $9\frac{1}{2}$ and $8\frac{1}{4}$ feet in height.

There is a bridge, with wooden superstructure and stone abutments, over the Rock Creek Basin, between Washington and Georgetown, which is kept up by the city of Washington. Its height is $10\frac{1}{2}$ feet.

The Georgetown market-house, of wood, crosses the Canal. Its height is $7\frac{1}{4}$ feet.

Whenever it shall be necessary, a greater elevation than the present, of such of the bridges in Washington and Georgetown, as may require raising, and of the market-house, can be had at no great cost.

3d. Between Georgetown and dam No. 2, a distance of 21 miles, there are:—

1 bridge, with wooden superstructure and stone abutments, spanning the whole width of the Canal. It is situated opposite the Little Falls bridge over the Potomac, and accommodates the public road leading to that bridge. Its height is $10\frac{1}{4}$ feet. This is one of the bridges, considered as placed at a *temporary* elevation, and will be raised whenever occasion requires. This bridge is not kept up by the Canal Company. A wooden tow path bridge, on trestles, is carried under the bridge within the width occupied by the water way of the Canal.

1 draw bridge over the middle of lock No. 20, opposite the Grea Falls.

4th. Between dam No. 2 and the "Government dam," a distance of $40\frac{1}{5}$ miles, there are,

4 pivot bridges—3 of them are over the middle of locks No. 25, 30 and 31, the other is at the Point of Rocks. The latter rests on a square pier of masonry in the middle of the Canal, and has stone abutments on the sides of the Canal; the tow path passing under the bridge. Its height is 12 feet. The superstructure recently required renewal, and as it had never been necessary to turn the bridge—its height being sufficient to pass all boats now running on the Canal—a wooden superstructure, not movable, has been temporarily substituted.

At Noland's Ferry, on this division, a bridge 17 feet in height, with a wooden superstructure and stone abutments, has been commenced, to take the place of the ferry now there. The abutments are in part built. The completion of the bridge is deferred for the present.

The Harper's Ferry viaduct of the Baltimore and Ohio Rail-road Company crosses the Canal on this division. Its height is 17 feet.

5th. Between the "Government dam" and the head of slack water above dam No. 4, a distance of $26\frac{4}{10}$ miles; there are—

1 pivot bridge over the tail of lock No. 38, opposite Shepherdstown.

1 wooden bridge over the head of guard lock No. 4, where the tow path changes sides, in consequence of the slack water navigation above

the guard lock. The height of the bridge varies with the level of the river surface along the slack water. It has been found, heretofore, sufficiently high. Being of only 15 feet span, it can easily be raised, at any time, if found necessary.

6th. Between the head of slack water above dam No. 4, and the head of slack water above dam No. 5,—a distance of $18\frac{4}{10}$ miles, there are :—

2 bridges with wooden superstructures and stone abutments, spanning the full width of the Canal and tow path. They are both 17 feet in height, and are built on the lattice plan.

2 wooden bridges; one of them over the tail of lock No. 42, where the tow path re-crosses the Canal above the slack water of dam No. 4, is 10 feet in height,—the other, at the head of guard lock No. 5, where the tow path changes sides in consequence of the slack water above the guard lock, like the bridge at guard lock No. 4,—has a variable height above the level of the slack water. Both this bridge and the one at lock No. 42, have been found sufficiently high, heretofore. A small sum would, at any time, raise them still higher.

7th. Between the head of slack water above dam No. 5, and dam No. 6,—a distance of $26\frac{8}{10}$ miles, there are :—

1 pivot bridge, at a point where the Canal is narrowed for a stop gate,—at the same place, there is a foot way, not moveable, of wood, 17 feet in height.

1 bridge with a wooden superstructure and stone abutments, over the tail of lock No. 46, where the tow path re-crosses the Canal above the slack water of dam No. 5. It is 17 feet in height.

8th. Between dam No. 6, and Cumberland, a distance of $50\frac{3}{10}$ miles, there will be ;—

1 pivot bridge over the middle of lock No. 73.

3 bridges with wooden superstructures and stone abutments, over the tails of locks No. 58, 68 and 70. Their height will be 17 feet.

3 bridges with wooden superstructures and stone abutments, spanning the entire width of the Canal and tow path. The height of two of them will be 17 feet. The other, being in a deep cut, will have a greater height. The latter, besides answering the purposes of a road bridge, will be so constructed as to sustain the forebay to a mill, that has to be carried over the Canal.

1 tow path bridge, with a wooden superstructure and stone abutments, spanning the Canal and tow path, just below Cumberland, for the accommodation of the branch basin at that place. Its height will be 17 feet.

1 tow path bridge over the head of the guard lock at Cumberland. This bridge may, at small cost, have any elevation given to it that may be thought necessary.

The North Branch Viaduct of the Baltimore and Ohio Rail-road Company crosses the Canal on this division, $9\frac{1}{10}$ miles, by the line of the Canal, below Cumberland. Its height is 17 feet.

It may be stated, in this connexion, that the tunnel, between dam

No. 6, and Cumberland, which is in length 3,118 feet, has an elevation of 17 feet, in the clear, above canal surface, at the highest point of its arch. The arch is a semicircle of 24 feet diameter;—the width of water way being 19 feet, and of tow path, 5 feet.

There are and will be upon the entire line of the Canal, in addition to the preceding road and other bridges, all of which *cross the Canal*, the following tow path bridges, which *do not cross the Canal*, viz.:—

4 tow path bridges of wood, over the feeders, from dams No. 1 and 2, the "Government dam," and dam No. 6.

3 tow path bridges of wood, at Edwards's Ferry, Shenandoah and Shepherdstown outlet locks.

1 tow path bridge, of wood, under the Little Falls road bridge, (already spoken of).

2 tow path bridges of wood, on the tow path along the slack water above dam No. 4.

And sundry small bridges of small extent in the aggregate, at wastes and waste weirs. At the former, (or the overfalls,) there is usually a paved tow path.

The following is a summary of the preceding,—with the aggregate spans, in the clear, of wooden superstructures, requiring to be kept up by this company.

9 pivot and draw bridges over the Canal, that have an aggregate span, in the clear, of 180 feet.

20 bridges, not moveable, over the Canal with wooden superstructures and stone abutments (not including the unfinished one at Noland's Ferry,) that have an aggregate span, in the clear, of very nearly 1,000 feet.

2 bridges, not moveable, over the Canal, with wooden superstructures, and stone abutments, not required to be kept up by this company.

1 market-house, of wood, over the Canal, in Georgetown.

6 arched stone bridges, over the Canal.

The Baltimore and Ohio Rail-road crosses the Canal twice.

4 tow path bridges of wood, over feeders, aggregate span, 182 feet.

3 " " " of wood, at outlet locks, aggregate span, 214 "

1 " " bridge of wood, under the Little Falls road bridge, length 135 feet.

2 tow path bridges of wood, along the slack water above dam No. 4, aggregate length 20 feet, and sundry small bridges at waste weirs.

The wooden superstructures on this Canal usually require to be renewed about every eight years. From the above, it appears that there are, and will be, on the entire line of the Canal from the Tyber basin to Cumberland,—

180 feet, aggregate span, in the clear, of pivot and draw bridges, over the Canal.

1,000 feet nearly, aggregate span, of bridges with wooden superstructures, not moveable, and stone abutments,—over the Canal.

531 feet, aggregate span, of tow path bridges of wood, not over the Canal, and

20 feet aggregate span, of tow path bridges along the slack above

dam No. 4, besides sundry bridges of small extent, in the aggregate, at waste weirs, &c.; the cost of removing which is usually put with that of removing the waste weirs, &c. that will require removing, say every 8 years.

There is a tracking path along the lower side of the Baltimore and Ohio River Road Viaduct, at Harper's Ferry, not yet spoken of, constructed by this company at an expense of $1,255 56, for the accommodation of boats entering the Canal from the Shenandoah River. This tracking path, being of wood, will require renewal from time to time.

The number of road culverts, and culverts that answer the same purpose,—and of ferries along the entire line, is, and will be, as follows:—

	Road Culverts.	Ferries.
In Washington and Georgetown—		
From Georgetown to Dam No. 2, - - - - - -	4	1
Thence to the "Government Dam," there were 11 Road Culverts, there are now only 10, one having failed, -	10	7
Thence to Dam No. 4, there were 2 Road Culverts, there is now only one, one having failed, - - - - -	1	. .
Thence to Dam No. 5, - - - - - - -	. .	1
Thence to Dam No. 6, - - - - - - -	9	2
Thence to Cumberland, - - - - -	5	8
Total number, - - - - - - - -	29	19

There are, besides, some few of the other culverts, that are and will be so constructed, that cattle can pass through them, for the accommodation of the owners of land between the Canal and river. And five of the aqueducts have, or will have, roadways under them.

The ferries are usually constructed with the sections on which they are situated; and their cost, in consequence, does not in all cases appear, separately, in the answers giving the cost of work done and to be done. Some of the ferries have been, or are to be constructed, by the proprietors of adjacent lands, at their own cost, under arrangements made when the lands on which the canal is constructed were required by the company.

The two road culverts that have failed, referred to above, are of the number of culverts stated to have given way, in the 6th answer. One of them was constructed at a place very unsuitable for the building of a culvert, and where one was not required for the purpose of drainage. The proprietor of the adjacent land, however, insisted on having a road culvert, and the company, to save trouble, agreed to build one. After the culvert failed, the proprietor having previously died, a reasonable arrangement was entered into with the present owners of the land by which the culvert is entirely dispensed with. The other road culvert has also been dispensed with, by an arrangement with the proprietor of the land, for whose benefit it was constructed.

7th. Feeders.—Are there other sources of supply than such as the Potomac itself furnishes? If so, please state them. Is provision made for the erection of additional dams in case the supply of water should be found inadequate for lockage, absorption, evaporation, waste, &c.?

Answer.—There are, at present, no other sources of supply than such as the Potomac itself furnishes.

To the finished part of the Canal, from Georgetown to dam No. 6, with the dams and the Canal in good condition, the Potomac is capable, at all seasons, of affording an ample supply of water for any amount of trade that may be put upon it,—and without any addition to the present number of dams and feeders.

On this portion of the line, the following are the points at which the water is taken from the Potomac,—the distances they are from the tide lock at Georgetown, and the several lengths of Canal and feeder supplied from each.

	Distance from the Georgetown Tide Lock.	Length of Canal and feeder supplied.
	MILES.	MILES.
1st. The Little Falls dam, called Dam No. 1, - -	5 6-10	
To the length of Canal from tide lock A, at Georgetown, to the entrance of the feeder at the tail of lift lock No. 5, - 5 miles.		
Add the extension of the Canal into Washington City, - - - - - - 1 3-10 "		
Add the length of the Alexandria Canal, the whole of which is supplied from this feeder, - - - - - - - 7 1-8 "		
Add the length of the feeder, from its entrance into the Canal to the dam, - - 0 6-10 "		
Add the total length of Canal and feeder supplied by Dam No. 1, is - - - - -		14
N. B. The Canal extension into Washington City, and the Rock Creek Basin, are usually supplied by Rock Creek, which enters the basin. The very small extent of Canal thus fed from a source other than the Potomac, especially as its aid is not needed, was not noticed above, when stating that the Potomac furnished all the water required for the Canal from Georgetown to Dam No 6.		
2d. The Seneca Falls dam, called Dam No. 2, - -	22 1-10	
The water supplied by this dam enters the Canal at the tail of Lock No. 23. The Guard Lock through which the water enters, is directly between the lock on the one side, and the Maryland abutment of the dam on the other. There is, therefore, no length of feeder dependent on the dam—and, in consequence, the total length of Canal, &c., dependent on Dam No. 2 for a supply of water, is the distance between lift locks Nos. 5 and 23, which is, - - - -		17 1-10

	Distance from the Georgetown Tide Lock.	Length of Canal and feeder supplied.
	MILES.	MILES.
3d. The "Government Dam," 1¾ miles above the bridge at Harper's Ferry, - - - - - - - - -	62 4-10	
This dam takes the place, and, so long as the Canal Company sees fit that it shall, will continue to take the place of Dam No. 3, originally contemplated at the head of the Falls below Harper's Ferry, at a point about two miles below the "Government Dam." The water from this dam enters the Canal at the tail of Lock No. 35.		
To the length of the Canal, between lift locks Nos. 23 and 35, - - - - 40 2-10 miles.		
Add the length of the feeder from Lock No. 35 to the Guard Lock at the dam, 0 1-10 "		
Total length of Canal and feeder supplied from the "Government Dam," - - - -		40 3-10
N. B. There are, also, dependent for their supply of water upon this dam, two outlet locks, viz: the Edwards's ferry, and the Shenandoah outlet locks.		
4th. Dam, No. 4, - - - - - - - - -	84 4-10	
The water from this dam enters through Guard Lock No. 4, which, as already stated, is in the line of the main Canal.		
To the distance between lift lock No 35, and Guard Lock No. 4, - - 23 3-10 miles.		
Add the length of slack water navigation, (which has a tow path,) between the guard lock and lift lock No. 41, the navigation of which is dependent on Dam No. 4, - - - - - - 3 3-10 "		
Total length of Canal, and slack water navigation, dependent on Dam No. 4, - - -		26 6-10
N. B. There is, also, dependent upon this dam, for its supply of water, the outlet lock opposite Shepherdstown.		
5th. Dam No. 5, - - - - - - - - -	106 8-10	
The water from this dam enters the Canal through Guard Lock, No. 5, which, as already stated, is in the line of the main canal.		
To the distance between lift lock No. 41, and guard lock, No. 5, - - - 17 9-10 miles.		
Add the length of slack water navigation, (which has a tow path,) between that guard lock and lift lock No. 45; the navigation of which is dependent on Dam No. 5, - - - - - - 0 5-10 "		
Total length of Canal and slack water navigation dependent on Dam No. 5, - - -		18 4-10

	Distance from the Georgetown Tide Lock.	Length of Canal and feeder supplied.
	MILES.	MILES.
6th. Dam No. 6, - - - - - - - - -	134 1-10	
The water from this dam enters the Canal at the tail of Lock No. 54.		
To the length of the Canal between lift locks No. 45 and 54, - - - - 26 6-10 miles.		
Add the length of the feeder from lock No. 54 to the guard lock at the dam, 0 2-10 "		
Total length of Canal and feeder supplied from Dam No. 6, - - - - - - - -		26 8-10

In Georgetown, and at some few other points between dam No. 6, water is furnished, but not to a large extent, for manufacturing purposes; but with the condition, in all cases, that its use shall be suspended whenever the navigation would not otherwise be fully supplied.

It may be well to remark that a *very cheap* feeder from the Potomac, can, at any time, be introduced into the Canal, at the Great Falls, 14 miles above Georgetown. In fact, a small feeder was made at the point referred to, while that part of the Canal was constructing, at a cost of from two to three thousand dollars; but not being found of sufficient use to justify the expense of keeping it in repair, it was in a few years abandoned. With a large trade, however, it may, hereafter be advisable, though merely as a matter of *convenience* in feeding the Canal, to reconstruct this feeder.

A feeder from the Monocacy, was, at one time, projected,—to enter the Canal near the mouth of that stream, at a point about midway of the $40\frac{1}{5}$ miles of Canal, now fed from the "Government dam." The length of this feeder would be $6\frac{1}{2}$ miles, and it would pass over ground favorable for its construction. It was, however, more particularly in reference to its being made part of an improvement contemplated at the time, extending 30 miles up the Monocacy, that this feeder was thought of. To facilitate the filling of the Canal after being drawn off for repairs, or from any cause, and, as a matter of convenience in some other respects,—and with a view to the additional trade that would be brought to the Canal in case an improvement, connected with it, should be made, extending up the Monocacy, a feeder from that stream might be desirable,—but for the purpose of furnishing an additional supply of water to the Canal beyond what is now at command, it certainly is not needed.

For the purpose of affording facilities to the trade of the Shenandoah River, and of the Winchester and Potomac Rail-road, it may be expedient, when the means of the company will permit, to construct a dam at the site originally selected for dam No. 3, (the place of which, as before remarked, is now supplied by the "Government dam.") This site is directly below the mouth of the Shenandoah, near the outlet lock already constructed for the accommodation of the trade referred to.

This dam would form a fine basin, at least six feet deep, in which the small Shenandoah boats might safely cross the Potomac to the Canal, and the Canal boats pass over to the Virginia shore and unload and load, directly along side of the Winchester and Potomac Rail-road. While, as before stated, the "Government dam" is entirely adequate to supply all the water required by the Canal now fed from it. Yet there are some advantages that would result to the Canal from the construction of a dam near the mouth of the Shenandoah, other than those I have named, but not, perhaps, of sufficient importance to be particularly referred to here.

The dispensing with dam No. 3, was from motives of economy. The "Government dam" was already constructed, and as the United States, for their works at Harper's Ferry, are only entitled to as much water, as remains after the Canal is supplied, they are compelled, of necessity, to keep the dam in good repair. I am not certain that the present Canal draws more water from the river, at that point, than the old Potomac navigation did, through the wide and rapid sluice constructed by them around the Maryland abutment of the dam,—and if not, the present supply for the United States' works at Harper's Ferry, is as great now as formerly.

A small feeder from the Tuscarora, that entered the Canal about 17 miles below the "Government dam," having been spoken of in former reports, it may be proper to say, that its cost was from four to five thousand dollars, and that, being found of little or no use, and not being required by the navigation, it was entirely dispensed with several years since, after it had sustained some damage, arising from its cheap and imperfect construction.

Having given, as I think, all the information you desire respecting feeders and the supply of water for the finished line of the Canal below dam No. 6, I now proceed to speak of the provision already made, and in contemplation, for the supply of the unfinished line between that dam and Cumberland.

Between dam No. 6 and Cumberland, an intermediate feeder or feeders will be required in dry seasons for a large trade. With a view to which, a site has been selected for a dam on the Potomac, (No. 7,) between the points where the Canal line leaves the river, below, and returns to it, above, the tunnel. The feeder from it, as stated in the 4th answer, would enter the Canal at the tail of lock No. 62, 154 miles from the Georgetown tide lock, and 20½ miles above the entrance of the feeder at dam No. 6.

A feeder may also be made from the south branch, that would enter the level between locks No. 68 and No. 69. Thirty-two and one-third miles of the Canal, from lock 69, to the feeder at dam No. 6, if dam No. 7 should not be constructed, might be made dependent on this feeder, leaving only $18\frac{1}{10}$ miles of Canal to be supplied from the Cumberland dam. The south branch feeder would require a dam on that stream, say 14 feet high, a feeder from it 1½ miles long, and an aqueduct, (which might have a wooden superstructure; not being on the main line, and therefore admitting of repairs and renewal without obstructing the navigation,) between 400 and 500 feet long over the North

Branch. The feeder, if made a navigable one, and the dam would, in reference to the present channel of the river, in fact, improve 11 miles of the South Branch; that is, the feeder in the above distance of 1½ miles from the Canal, would strike the South Branch near 6 miles above its mouth, by means of a short cut of no great depth across a bend of the river, and the back water of the dam would extend, say 5 miles up the river, making in all 11 miles.

The advantages that would result to Virginia from an improvement along the valley of the South Branch, which extends far into the interior, and passes through a valuable county, and the strong probability there is, in consequence of these advantages, that such an improvement will be made, induce me to think that, on the completion of the Canal to Cumberland, Virginia would willingly aid in the construction of the feeder referred to. It could be made at a reasonable cost.

The Baltimore and Ohio Rail-road Company have located its road with reference to the South Branch feeder and the dam near the tunnel—and has, in fact, already built a bridge or viaduct near the mouth of the South Branch for the passage of the former under the rail-road to the Canal.

There are, besides, some small streams between dam No. 6 and Cumberland, which may be made auxiliary feeders to the Canal if it should, in the course of time, be found necessary.

For a trade on the Canal sufficient to meet the requirements of the law, passed by the Legislature of Maryland, at its last session, viz: a tonnage of 195,000 tons passing over the entire line per annum, the present arrangements for a supply of water at Cumberland are believed to be adequate, unless, perhaps, there should be a season of unusually low water, in which event there would probably be, for a short time, a scarcity of water.

On this portion of the Canal, great reliance is placed on the care that has been, and will be taken, in the construction of its embankments, in consequence of which the supply required for the leakage of the Canal will no doubt be reduced to a minimum. There will be no outlet locks on this part of the Canal, which always occasion from leakage, and require for lockage a considerable expenditure of water. The waste weirs will be constructed so as to occasion, in a dry time, no leakage; and every precaution will be taken that there shall be no unnecessary waste of water from irregularity in feeding at the locks.

In time and for a large trade, as before remarked, additional feeders will be required between dam No. 6 and Cumberland; adequate means of supply, for the purpose, are at command. For the present, it has been thought best, under all the circumstances, to leave the construction of these additional feeders, until the trade should be such as to justify and require their construction, although, in the mean time, in seasons of unusually low water, there may, at times, inconvenience result from the usual want of time.

Before closing this answer, I will make another remark respecting the supply of water below dam No. 6. There have been times when there was a scarcity of water, in dry seasons, on parts of that portion of the Canal, never, however, in consequence of an insufficiency of

water at the dams, but from some of them not having been sufficiently gravelled to secure them against leakage. In the estimate for putting the finished line of the Canal in good condition, see the 24th answer; there is provision made for tightening the dams referred to, which being done, the supply of water on that portion of the line will be adequate at all times and at all seasons.

8th. What is the entire amount of earth work in the Canal from dam No. 6 to Cumberland? What is the amount executed at this time, and at what cost has it been excavated and placed in the banks, per cubic yard; what amount in cubic yards remains to be executed, and what is the estimated (average) price of the same, per cubic yard,—the same of rock cutting, both finished and not finished? What amount of "rip rap" stone work has been laid, outside the tow path for its protection, in cubic yards, and at what cost per cubic yard has it been placed? What amount remains to be laid, and what is the estimated cost per yard of laying the same?

Answer.—In the table which follows, the quantities of earth work, &c., done, and to be done, with the *actual* average of the former and *estimated* average cost per cubic yard of the latter, are given.

The terms used in the table will be best understood by reference to the section specifications given in the 18th answer. It may, however, be well to remark here, that all excavated materials put into bank within a distance of 100 feet, are paid for merely as excavation; but if carried beyond that distance, there is a price paid in addition to the excavation, which appears under the head of "embankment paid," or "rip rap paid," as the case may be.

Heretofore, there were the two items of "rock" and "slate" excavation; in future, there will be but the one of "rock," which is to include "slate."

The trimming of the "rip rap" was formerly paid for in a separate item,—hereafter its cost is to be covered by the items of "rock" excavation, or "rip rap not paid," as the case may be.

Quantities of Earth and Rock Work, also of Embankment and of Rip Rap Protection, in the Canal from Dam No. 6, to Cumberland, DONE *and* TO BE DONE, *together with the actual cost of the former, and estimated cost of the latter.*

ITEMS.	Total quantities done and to be done.	WORK DONE.			WORK TO BE DONE.		
		Quantities.	Average price.	Amount.	Quantities.	Average price.	Amount.
	cubic yds.	cubic yds.	cents.	dollars.	cubic yds.	cents.	dollars.
Earth Excavation, ...	3,844,108	2,609,894	16.94	442,215.77	1,234,214	14½	178,961
Rock do.	820,954	716,636	81.	580,446.99	104,318	70	73,023
Slate do.	85,189	85,189	34.91	29,738.98	.	.	.
"Embankment paid," . . .	1,373,362	1,027,341	14.77	151,692.43	346,021	8½	29,412
Embankment not paid, hauled less than 120 ft.,	28,528	28,528	17.25	4,920.20	.	.	.
Do. do. less than ¼ mile, . . .	2,265,944	1,628,734	26.79	436,269.54	637,210	20 1-10	128,092
Do. do. less than ½ mile, . . .	328,747	292,647	36.94	108,095.15	36,100	30	10,830
Do. do. more than ½ mile, . . .	6,660	5,460	47.	2,566.20	1,200	37½	450
Emb. Bridges, ...	.	.	.	33,147.95	.	.	3,850
	sup. yds.	sup. yds.					
Rip Rap Trimming, per sup. yard, . .	276,435	276,435	3.26	9,018.38	.	.	.
	cubic yds.						
"Rip Rap paid,"	449,021	410,531	15.47	63,498.87	38,490	12½	4,811
Rip Rap not paid, ...	36,364	33,864	105.89	35,858.57	2,500	80	2,000
				1,897,469.03			431,429

The above quantities, thrown into a less number of items, are—

Earth excavation, including in its cost the amounts paid and to be paid for the transportation of such portions of it as are also included in the item of "Emb. paid," .	cubic yds. 3,844,108	cubic yds. 2,609,894	cents. 22.76	dollars. 593,908.20	cubic yds. 1,234,214	cents. 16.88	dollars. 208,373
Rock and Slate excavation, including in its cost the amounts paid and to be paid for the transportation of such portions of it as are also included in the item of "Rip rap paid," and including, also, the am'ts paid and to be paid for rip rap trimming, .	906,143	801,825	85.14	682,703.22	104,318	74.61	77,834
Embankment from outside of canal, including the amounts paid and to be paid for embankment bridges, ...	2,629,879	1,955,369	29.92	584,999.04	674,510	21.23	143,222
Rip rap from outside of the canal, . .	36,364	33,864	105.89	35,858.57	2,500	80	2,000
	7,416,494	5,400,952		1,897,469.03	2,015,542		431,429

	cubic yds.
Total quantity of materials from and not from canal, . . .	7,416,494
Of which there is *done*, ...	5,400,952
And *to be done*, ...	2,015,542

From this table, it appears that the estimated cost per cubic yard of the work to be done, is somewhat less than the actual cost of that done. This, as respects the items, "embankment paid," and embankment from outside of the Canal, is, in part, owing to the average haul of the embankments to be made being less than that of those made. The sections usually requiring the longest haul of materials for their banks, those along the river cliffs, being many of them entirely completed, and others, very nearly so. But there is another reason to be given, and a very satisfactory one, for the difference, which is general in its application to all the items. The greater part of the work executed above dam No. 6, was done in the years 1836, 1837, and 1838, while wages and provisions were extravagantly high. The effect on the cost of all public undertakings carried on during those years is well known. The prices then paid for work were higher than has ever been known in the public improvements of this country, either before or since. The average cost of all the work done *below* dam No. 6, per cubic yard, could not be prepared in time for these answers. I have, however, made out the following statement from the facts stated in the report already referred to, upon this Canal, by Gen. NcNeill, dated 1st December, 1833, which gives the actual cost of a large amount of work that had at that time been done, on the 107 miles of the Canal next above Georgetown, then far advanced to completion, and the estimated cost of certain work then remaining to be done,—the greater part of which was actually under contract.

Statement of the actual cost of Earth Works, &c. that had been done below Dam No. 5, on the 1st of December, 1833, and the estimated cost of certain work then to be done on that part of the Canal, most of which was, at that time, under contract at the estimated prices.

	WORK DONE.			WORK TO BE DONE.		
	Quantities.	Average price.	Amount.	Quantities.	Average price.	Amount.
	cubic yds.	cents.	dollars.	cubic yds.	cents.	dollars.
Earth excavation, ...	3,848,753	12.39	476,943	1,157,889	11.53	133,532
Rock do.	727,940	67.05	488,106	179,758	61.69	110,898
Slate do.	.	.	.	8,150	22.59	1,841
"Embankment paid,"	833,310	12.46	103,852	184,569	11.12	20,531
Embankment from outside of the canal, . .	1,356,957	20.52	278,477	509,163	20.37	103,734
	perches.					
Wall from canal excavation, per perch of 25 cubic feet,	318,840	51.24	163,358	68,168	48.15	32,822
Wall not from canal excavation, per perch, . .	18,845	99.42	18,736	6,240	92.85	5,794
			1,529,472			409,152
	cubic yds.	cents.	dollars.	cubic yds.	cents.	dollars.
Cost of the above earth excavation, including what was paid for the transportation of such portions of it as was included in the item "embankment paid," .	3,848,753	15.09	580,795	1,157,889	13.31	154,063

"Rip rap," as an outer protection against the river, has taken the place on the work last,—and that yet to be constructed, of the slope, and vertical walls on the lower part of the Canal.

The average prices of the work done, given in the preceding table may be considered as the fair average for the lower 107 miles of the Canal, below dam No. 5. Between that dam and dam No. 6, the averages are somewhat higher, a part of the work having been done in the years of high prices.

The work recently done is, no doubt, worth rather more, per cubic yard, than that first contracted, from the greater care required in forming the banks; but, taking all things into consideration, it is believed, that the adequacy of the estimated prices for the completion is fully sustained, by the actual cost of the work already done, on the entire line of the Canal. And here it may be well to remark, that the Baltimore and Ohio Rail-road, on the opposite side of the Potomac, running parallel with the Canal, affords facilities for obtaining supplies, while the Canal is completing, that were not enjoyed when the work was before in progress on the unfinished line.

This interrogatory and answer embrace nearly all the classes of work usually executed under *section* contracts. I will add those that are omitted.

	Work done.	Work to be done.
To the amounts of *section* work *done*, and *to be done*, already given, - - - - - -	$1,897,469 03	$431,429 00
Add grubbing and clearing, - - - - -	34,195 35	8,000 00
Add country and other roads along certain sections of the Canal, whose beds have been or are to be changed from the site of the Canal,	19,399 83	4,892 00
Extra allowances on certain work, - - - -	1,461 50	
Sundry work, not embraced under any of the preceding heads, or not yet distributed among them, - - - - - - - - - - -	18,012 87	50,530 00
	$1,970,538 58	$494,851 00
Add the work done, - - - - - - - - -		1,970,538 58
Total of section work *done* and *to be done*, - - -		$2,465,389 58

The cost of the tunnel and deep cuts adjoining it will next be given. The length of the tunnel is 3,118 feet. It is to be arched throughout with brick, except for 25 feet at each end, which will be of stone. The arch will be a semi-circle of 24 feet diameter; the width of the water way 19 feet and tow path 5 feet. The depth of water through the tunnel will be 7 feet, the height of the tunnel in the clear, above Canal water surface, 17 feet. The sides of the tunnel and the face of the rock bench, left for the tow path, are also to be lined with brick. Along the top of the brick facing of the tow path, there will be a one-foot thick, and three wide, dressed stone coping, and on this coping iron railings.

To facilitate the excavation of the tunnel, two sets of double shafts were sunk—each single shaft having a diameter of 8 feet; one set had a depth of 122 feet, the other of 188 feet;—the aggregate depth of all being equal to a single shaft, (of 8 feet diameter,) 620 feet deep.

The work done and to be done on the tunnel, and deep cuts adjoining it, amount as follows, viz:

1st. The work done.

In the Tunnel.

38,975 cub. yds. of	"heading,"	at $4,	$155,900 00	
21,996 "	"bottoming,"	" 1 50,	32,994 00	
9,719 "	"finishing,"	" 3 00,	29,157 00	
	shafts, . . .		43,913 15	
Sundry work (materials, &c.) chargeable to the tunnel, ...			2,072 72	
				$264,036 87

In the Deep Cuts.

Grubbing and clearing, including the cost of clearing over the tunnel, . .	$818 00		
39,363 cub. yds. of earth excava. at 20c.,	7,872 60		
10,771 " slate, " " 35c.,	3,769 85		
163,095 " rock, " at $1 40c.,	228,333 70		
Sundry work, viz., certain embankment, and other work not embraced above, .	9,014 36		
		$249,898 51	
		$513,935 38	

2d. The work to be done.

In the Tunnel.

3,987 cut yards of "bottoming," at $1 50, . . .	$5,981 00
4,197 " "finishing," " 3 00, . . .	12,591 00
5,600,000 bricks in the side walls, arch and tow paths, laid in cement, mortar, at $14, ...	78,400 00
12,000 cub. yards of dry packing over the arch at 80c,	9,600 00
1,000 perches of mas. in the tunnel portals, including 25 feet in, at each end, of stone arch side walls, and facing of the tow path, laid in cement mortar, at $8,	8,000 00
3,200 feet lineal of 1 foot thick and 3 feet wide dressed stone coping, laid on the brick work facing of the tow path, at $2 75, ...	8,800 00
3,200 cubic feet of 1 foot square white oak timber, to be laid along the tow path, directly back of the iron railing, at 30c., ...	960 00
2,500 pounds of iron bolts to secure ditto., at 10 c., .	250 00
500 cubic yards of slate earth, to be put on the tow path, at 35c., ...	175 00

Iron railing for the tow path, concrete backing behind the side walls and tow path facing; protection of the side walls, &c., against boats; additional packing, if any, that may be required in consequence of falls in the tunnel; additional rock excavation, if any, in the deep cuts beyond what are provided for in the next item, and contingencies generally, ...	$29,443 00
17,000 cub. yards of rock excavation in the deep cuts, (in this quantity allowance is made for slides,) at $1 40, ...	23,800 00
Total, ...	178,000 00
Add the work done, (in the last page,) . . .	513,935 38
Total of work *done*, and *to be done*, in the tunnel and deep cuts, ...	$691,935 38

9th. What is the number of locks between dam No. 6 and Cumberland? What is the aggregate amount of masonry in the same in cubic yards? What number of the locks are completed, (the masonry,) and what is the cost per foot lift (averaging)? What is the estimated cost per foot lift of those which are to be built.

Answer.—There will be 21 lift locks between dam No. 6 and Cumberland; (the number has been lessened, as stated in my answer to the 2d interrogatory, from 22 to 21, the aggregate lift remaining the same—as however the estimate for completing the Canal, to which I shall refer, was made in reference to the number of locks first contemplated, I shall, in my reply, give the quantities applicable to that number, merely remarking, that by the change a saving is effected in the cost of the work.)

The masonry of six of these locks may be considered as finished—there remaining only a small amount of work to be done upon the foundations of two of them, estimated to cost $194 56. These locks are

No. 55, of $7\frac{8}{10}$ feet lift,
" 57, " 8 "
" 72, " 9 "
" 73, " 9 "
" 74, " 10 "
" 75, " 10 "
} Aggregate lift $53\frac{8}{10}$ feet.

No. 55 is built of sandstone from quarries distant, on an average, $1\frac{1}{2}$ miles. The others are built of limestone from quarries at different distances from the locks; the average haul of which was from one to two miles, and in addition to the haul by wagons, the face stone for one of the locks, No. 27, were boated by canaland river, part of them 15 miles and part 5 miles. The locks are built of closely rubbled masonry, laid throughout in beds of cement mortar, and with joints grouted. The quantities of masonry in them and their cost, are as follows, viz:—

$7,749\frac{85}{100}$ perches of masonry, (of 25 cub. ft.) at \$9 72, (average price,)	\$75,296 42
Foundations and mitre sills. Four of the locks are on timber foundations, and two on rock. The four timber foundations and mitre sills cost, ...	7,215 00
The two rock foundations and mitre sills, (including \$194 56 of work yet to be done, referred to above,) cost, ...	3,512 65
$2,273\frac{1}{4}$ perches of dry wall above and below the locks, (including the cost of 688 feet lineal of dressed coping, laid in cement mortar, upon the walls on the tow path side. The number of perches include this coping,) at \$4 04, (average price,)	9,185 50.
$725\frac{95}{100}$ perches of paving below the locks at \$2 39, average price, ...	1,735 86
Total cost of the masonry and foundations, .	\$96,945 43

Which makes the average cost of these six locks, (including lock gates and castings, excavation, embankment and puddling,) \$1,801 96 per foot lift.

Seven of the locks yet to be built, are to be constructed on the same plan and in the same manner as those just spoken of and described, viz :—

No. 54, of $7\frac{8}{10}$ feet lift.		
" 56, " $7\frac{7}{10}$ "		
" 58, " 8 "		
" 68, " $8\frac{258}{000}$ "	}	Aggregate lift 55^{758} feet.
" 69, " 8 "		
" 70, " 8 "		
" 71, " 8 "		

The quantities of masonry in them, and their estimated cost, are as follows, viz :—

$8,165\frac{1}{3}$ perches of well rubbled masonry at \$8 50,—(average price,)	\$69,405
Foundations and mitre sills, ...	11,620
3,020 perches of dry wall, above and below the locks, (including its dressed coping, &c.,) at \$3 79—(average price,)	11,443
1,260 perches of paving below the locks at \$2 75—(")	3,465
Total estimated cost of the masonry and foundations, .	\$95,933

Which makes the average estimated cost of the seven locks, (excluding lock gates and castings, excavation, embankment and puddling,) \$1,720 50 per foot lift.

There has been work done on, and materials prepared for, these locks, which cost the company $23,263 17, but which are now valued at only $13,409; some of the materials having been injured, and the timber got out for foundations being of little or no value. This latter sum, therefore, should be deducted from the above estimate to arrive at the amount of work remaining to be done.

The remaining nine locks between dam No. 6 and Cumberland, (there are, in fact, only eight,) are to be built on the composite plan. They are locks

These are the five for which four are to be substituted.	No. 59, of 8	feet lift.	Aggregate lift $72\frac{385}{000}$ feet.
	" 60, " $8\frac{385}{000}$	"	
	" 61, " 8	"	
	" 62, " 8	"	
	" 63, " 8	"	
	" 64, " 8	"	
	" 65, " 8	"	
	" 66, " 8	"	
	" 67, " 8	"	

The quantities of masonry, &c., in these locks, and their estimated cost are as follows :—

3,600 perches of rubble masonry, laid in cement mortar, at $5 75,		$20,700
7,600 perches of dry masonry in the locks, at $4,		30,600
A dressed stone coping laid in cement mortar on this dry masonry estimated, as regards the increased cost occasioned by its substitution for the wooden coping originally contemplated, at		6,000
3,900 perches of dry masonry above and below the locks, including its dressed coping, &c., at $3—		14,723
1,675 perches of paving between the locks, at $2 75,		4,606
In the chamber of the locks, &c.	12,600 cub. feet of timber at 32 cts.,	4,032
	108,000 ru. feet inch measure of plank at $35,	3,780
	6,300 ru. feet of locust at $45,	284
	16,200 lbs. of iron at 11 cts.,	1,782
In the foundations.	30,600 cub. feet of timber at 25 cts.,	7,650
	198,000 ru. feet inch meas. of plank at $25,	4,950
	Mitre sills and platforms,	900
	Total,	$100,097

Which makes the average, estimated cost of the nine locks, (excluding lock gates and castings, excavation, embankment and puddling, and certain extra masonry referred to below,) $1,382 84 per foot lift.

The extra masonry just spoken of is thus entered in the estimate for the completion of the Canal :—" It is estimated, as probable, that there will be 1500 perches of rubble mortared masonry below the usual

level of the foundations of locks No. 63, 64, 65 and 66,—1st, to obtain a more secure foundation; and 2d, to allow the lower mitre sill to be placed 1 foot lower than usual, (they being the locks next below the tunnel,) valued at $6 50 per perch—$9,750."

There has been work done on, and materials have been prepared for these locks, and certain expenses have been incurred on their account, which cost the company $14,900 19, but which are now put at only $7,000, that being considered the value at this time. This latter sum, therefore, should be deducted from the above estimate to arrive at the amount of work remaining to be done.

It appears from the preceding, that the cost of the work done, and the estimated cost of that to be done on the 22 (21) locks between No. 6 and Cumberland, excluding the lock gates and castings, puddling, excavation and embankment, are as follows :—

	Aggregate lift.	Work done	Work to be done.
	FEET.		
1st. The "Six Locks," . .	53 8-10	$96,945 43 less 194 56 work to be done, $96,750 87	. . . . $194 56
2d. The "Seven Locks," . .	55.758	Materials, &c. which cost . . . 23,263 17	$95,933 less 13,409 the present value of the materials, &c. 35,524 00
3d. The "Nine Locks," . .	72.385	Materials, &c. which cost, . . . 14,900 19	$100,097 less 7,000 the present value of the materials. $93,097 add 9,750 on acc't of extra masonry. 102,847 00
	181.943	$134,914 23	$185,565 56

To arrive at the entire cost of these locks, there must be added such work as is not embraced in the preceding estimates.

To the work to be done as above, ...	$185,565 56
Add the lock gates, castings and flume ways of 22 locks, at $900, ...	19,800 00
Also, for extra expense that will probably be incurred in the foundation of lock No. 54, ...	1,500 00
Also, for certain work yet to be done at locks Nos. 57, 73, 74 and 75, and not embraced in any of the preceding items, ...	1,578 44
Total of work to be done, ...	$208,444 00
Add work done, see above, ...	134,914 23
Total of work done and to be done, ...	$343,358 23

N. B. The cost of the excavation of the pits and the puddling will be given with that of the other mechanical structures.

It appears in the course of this answer—That the six locks above dam No. 6, which are finished as regards the masonry, have cost, exclusive of lock gates and castings, excavation of their pits and the embankment and puddling about the locks, and transportation of cement, $1,801 96 per foot lift, and—

That the estimated cost of the 7 locks still to be built, upon the same plan, exclusive, as before, of lock gates, &c., is $1,720 50 per foot lift.

Now by reference to the general summary in the 22d answer, it will be seen that the 53 lift locks on the finished line of the Canal, with an aggregate lift of 424 feet cost, $638,242, which is an average of $1,505 29 per foot lift. In the latter case, the lock gates and castings, a part of the pit excavation, and a part of the embankment and puddling at the locks are included. The estimated cost, therefore, of the locks still to be built on the old plan is, per foot lift, considerably higher than the actual average cost of the 59 locks already constructed on this Canal.

10th. Aqueducts between dam No. 6 and Cumberland. State those which are finished, the number of cubic yards of masonry, of all kinds included, contained therein, and the average price per cubic yard, the name of the unfinished aqueducts, estimated cost per cubic yard, (average.)

Answer.—There are four aqueducts between dam No. 6 and Cumberland. Two of them may be considered as finished, so far as regards the aqueduct masonry,—the work remaining to be done consisting principally of entrance walls to the aqueducts along the inside of the tow path and berm banks, which cannot be built until after the embankments are made and the puddling is done about the aqueducts.

These two are aqueduct No. 8, over Sideling Hill Creek of 60 feet span, (with a waste weir and over-fall connected with the masonry of one of its wings,)—and aqueduct No. 11, over Evitt's Creek, of 70 feet span.

The quantities of masonry in them and their cost are as follows, viz :

1,109⅓ perches of cut masonry, (of this, there is yet to be done, work estimated at $89 44) at $21 94, (average price,)	$24,341 40
7,460⅓ perches of rubble masonry, at $6,54, (average price,)	48,824 17
Building and coffer dams, ...	1,630 00
McAdamizing and grouting over arch of aqueduct No. 11,	207 00
Total, ...	$75,002 57

The masonry of the waste weir and over-fall connected with aqueduct No. 8, is included in the above quantities.

The remaining two aqueducts, (and which are unfinished,) between dam No. 6 and Cumberland, are aqueduct No. 9, over Fifteen Mile

Creek of 50 feet span, and aqueduct No. 10, over Town Creek, of 60 feet span. A waste weir and an over-fall are connected with the masonry of one of the wings of each of these aqueducts, and the quantities of masonry in them and their estimated cost, are included in the estimate which follows, of the probable cost of the two aqueducts. The estimate includes, also, the entrance walls to these two aqueducts.

1,100 perches of cut masonry.	
Deduct, done, 72	
1,128 perches of cut masonry to be done, at $20, ...	$20,560 00
8,500 perches of rubble masonry.	
Deduct, done, 990	
7,510 perches of rubble masonry to be done at $6, ...	$45,060 00
250 perches of dry wall, at $3 25, . .	813 00
200 perches of paving, at $3, . . .	600 00
Bailing and coffer dams, ...	600 00
	$67,633 00

There has been work done on these aqueducts and materials prepared for their completion, and payments made by the company on their account, which cost $17,804 12, but which are now valued at only $14,000. Deduct this sum and there remains to be done, 14,00 000

Total amount of work to be done, (excluding iron railing and certain other work to be referred to below,) $53,633 00

To arrive at the entire cost of the four aqueducts, there must be added to the preceding amounts the work yet to be done at the aqueducts considered finished, as regards the aqueduct masonry,—and also all the work done on those not finished, and not given above.

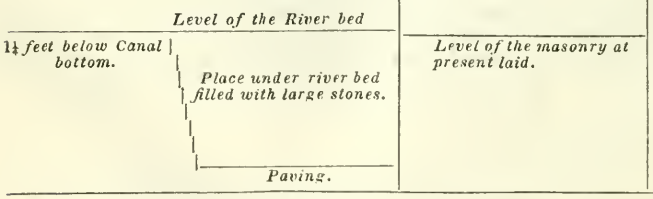
The following table shows that the estimated cost of the aqueduct masonry to be built, is a little less, per perch, than the actual cost of that already constructed above dam No. 6, but not more than is justified by the change of times since the execution of the latter. The effect of this change is more particularly alluded to in the 8th answer, when speaking of the cost of earth work, &c. done in the years 1836, '37, '38.

	Aggregate span.	Work done.		Work to be done.
	FEET.			
Aqueducts Nos. 8 and 11, . .	130	$75,002 57		
		less 39 44 work to be done,		$89 44
			$74,913 13	
Aqueducts Nos. 9 and 10, . .	110	72 perches of cut masonry at $22, .	1,584 00	
		990 do. of rubble masonry at $8, .	7,920 00	53,633 00
		Materials, &c. which cost, . . .	17,804 12	
Add to these amounts, work not given in the preceding pages, viz:				
Buildings and coffer dams, *done*, at Aqueducts 9 and 10, . .			1,150 00	
Gates for the waste weirs connected with Aqueducts Nos. 8, 9 and 10, to be done, ...				400 00
Iron railings on the tow-path parapet, for the four Aqueducts, . . .				2,700 00
And for Aqueduct No. 8, 280 perches of entrance walls, (including its coping,) of rubble mortared masonry, at $6½=$1820. Also 25 perches of rubble mortared paving at the waste weir, at $10=$250. Also 100 perches of McAdamizing, grouted, over arch, at $4=$400, . . .				2,470 00
And for Aqueduct No. 9, sundry work about and connected with the waste weir and overfall, and occasioned by them, estimated at				2,000 00
And for Aqueduct No. 10, 102 feet lineal of dressed coping placed along the overfall, extra expense occasioned by it, $204; also 1500 perches of rip-rap paved around the wings=$300, ...				504 00
And for Aqueduct No 11, its entrance walls and certain other work required for its completion, and contingencies on the Aqueducts generally, are estimated at				5,380 56
Aggregate span, 240 ft.			$103,371 25	$67,677 00
Add work done, ...				103,371 25
Total of work *done*, and to *be done*, on the four Aqueducts, . .				$171,048 25

11th. Cumberland dam, dimensions and estimated cost.

Answer.—This dam throughout, including its abutments, is founded on rock, which on an average is $9\frac{4}{10}$ feet below the bed of the river at the site of the dam.

The following is a cross section of the dam:



Average level of the rock bed of the river 10.65 *feet below Canal bottom, and* 17.15 *feet below the comb of the dam.*

The entire dam and its abutments are of a superior class of rubble masonry, laid throughout in cement mortar and grout. The top slope of the masonry is to be covered with a course of well rubbled stone, placed on edge; over the whole upper surface of which will be placed one foot square, white oak timber laid close, and bolted to the masonry, running longitudinally of the dam. At right angles to these timbers, and on them, will be a course of 3 inch plank closely jointed, and then in guards. A large mass of gravel will be thrown above the dam.

On the rock bed of the river below the dam, there is a well rubbled paving laid in mortar, and the whole space over the paving, up to the bed of the river, which was excavated in the course of construction, is filled with large stone.

The abutments, except a few perches of coping, and the entire dam between the abutments, to within one fourth of a foot of the bed of the river, and the paving below the dam are laid.

First, cost of the work *done*, on dam No. 8, &c.

In the Dam.

3,608½ perches of rubble masonry was laid in cement mortar, at $5,75,	$20,748 88	
Add extra allowances, &c., chargeable to the masonry,	911 34	
		$21,660 22
Foundation of the dam, including excavation, pumping, bailing, and coffer dams,	24,235 00	
Add cost of pumps and steam engine for foundation,	1,263 34	
		25,498 34
95 perches of dry walling at $4,		380 00
225 " of mortared rubbled paving below the dam, at $12,		3,060 00
1,400 perches of large stone thrown below the dam on the mort'd paving, at $1 25,		1,750 00
1,250 cubic yards of gravelling above the dam at 30 cts.,		375 00
Materials prepared for the completion,		3,079 46
		$55,803 02

In the Guard Lock and Flume.

1801¼ perches of rubble masonry laid in cement mortar, at $9,	$16,030 93
644 perches of dry wall at $3 25,	2,093 00
297 feet lin'l of dry wall coping, dressed and laid in cement mortar, (extra) at $2,	594 00
Loss on materials got out for the masonry,	565 09
Materials prepared for the completion,	881 25
Add allowance for extra work caused by the flume,	1,121 00
Cutting recesses at the head of the lock and flume,	50 00

Foundations of the guard lock and flume, in part, .	$2,328 00
Mitre sills for both, ...	250 00
2,450 cubic yards of excavation of gravel in the guard lock and flume foundations, $41 05 (average), .	1,005 80
Total cost of work done, ...	$80,722 09

Second, cost of the work *to be done* on dam No. 8, &c.

At the Dam.

900 perches of mortared masonry, yet to be laid between the abutments at $6 60, ...	$5,940 00
7½ perches of coping for the west abutment at $17, .	128 00
6,500 cubic feet of one foot square, white oak timber to be placed on the top sloping surface of the dam, at 25 cents, ...	1,625 00
20,500 run feet inch measure of 3 inch yellow pine plank, for the top surface, at $25, ...	513 00
19,500 run feet of white oak in guards (6 inches thick at one end, 2 inches at the other end,) 12 feet long, at $20, ...	390 00
10,000 lbs. of iron bolts to secure the timber to the dam, at 10 cents, ...	1,000 00
1,800 cubic yds of gravelling above the dam at 33⅓ cts.,	600 00
1,300 perches of large stone to be thrown below the dam and about the abutments, at $1 25, . .	1,625 00

At the Guard Lock and Flume.

650 perches of dry wall, (none of which, however, will be mortared, the additional expense of which is provided for in the contingent item below,) at $4, .	2,600 00
146½ lineal feet of dressed coping in do, laid in cement mortar, (extra) at $2, ...	293 00
110 perches of mortared paving at the head of the lock and flume, to be well rubbled, at $12, . . .	1,320 00
1,200 cubic feet of foundation timber, at 20 cents, .	240 00
8,000 run feet inch measure of yellow pine plank, for completion of foundation and sheet piling, at $23, .	184 00
Gates and castings for the lock and flume, . .	1,500 00
Add miscellaneous and sundry work about the lock and flume, and dam to cover loss in the materials prepared for completion, and also bailing coffer dams, for the dam, lock, &c., ...	3,842 00
Total work to be done, ...	21,800 00
Add, work done, ...	80,722 09
Total of work done, and to be done, . . .	$102,522 09

12th. Culverts arched and box, between dam No. 6, and Cumberland,—gross amount of cubic yards of masonry laid in same, and average cost per yard of same, including the cost of foundations,—number of cubic yards to be laid in unfinished culverts, and estimated cost of same per yard?

Answer.—The finished ones are:—

Culvert Nos. 199, of 6 feet span, } The arches of these culverts
" " 200, of 10 " " } are of well selected rubble
" " 201, of 10 " " } stone.
" " 234, of 7 " " } The arches of these are of
" " 239, of 7 " " } stone, well rubbled.

The first three are founded on timber, the other on rock or slate.

On account of the difference in the arch masonry of these culverts and their foundation, I will give separately the cost of the first three culverts, and the last two.

Culverts Nos. 199, 200, and 201, cost as follows:—

$927\frac{6}{10}$ perches of masonry laid in cement mortar, (including the arches,) at $6,			$5,565 60
In foundations.	4,399 cubic feet of timber at 25 cts.,	$1,099 75	
	24,631 run feet of inch measure of plank at $20,	492 62	
			1,592 37
Cost of three culverts,			$7,157 97

Culverts No. 234 and 239, cost as follows:—

226 perches of rubbled arch masonry, at $12,	$2,712 00	
634 perches of other masonry at $6 25,	3,962 50	
Cost of the two culverts		6,674 50
" " " five culverts,		$13,832 47

The culverts not yet built or finished, are 23; making, in all, with the five culverts that are built, 28, between dam No. 6 and Cumberland.

These 23 culverts, to be built, are—

Culvert No.	202,	of 6 feet span.	
" "	204,	" 8 " "	
" "	206,	" 12 " "	A road culvert.
" "	207,	" 8 " "	A house culvert.
" "	208,	" 12 " "	A road culvert.
" "	210,	" 12 " "	
" "	211	" 14 " "	A road culvert.
" "	212,	" 8 " "	
" "	215,	" 16 " "	
" "	216,	" 6 " "	
" "	217,	" 20 " "	In 2 spans of 10 feet each.
Culvert No.	218,	" 3 " "	A circular "brick culvert" of 3 feet diameter.
Culvert No.	221,	" 6 " "	
" "	223,	" 6 " "	
" "	224,	" 12 " "	In 2 spans of 6 feet each.
" "	228,	" 12 " "	A road culvert.
" "	230,	" 4 " "	
" "	231,	" 12 " "	

The arches of these culverts are to be of hard burnt brick, laid in cement mortar.

" "	235,	" 4 " "	
" "	236,	" 4 " "	
" "	237,	" 5 " "	A waste wier at its head.
Culvert No.	240,	" 10 " "	A road culvert.
" "	241,	" 4 " "	

The arches of these culverts are to be of well rubbled stone laid in cement mortar.

Aggregate span, 204

These 23 culverts are estimated to cost as follows, viz:

	Work done.	Work to be done.
1,202,700 bricks in the 18 culverts that have brick arches, at $14,	.	$16,838
400 perches of masonry in the arches of the 5 culverts that are built of well rubbled stone, at $12.50,	.	5,000
1,093 6-10 perches of straight masonry, *laid* in certain culverts at $6.64 (average price),	$7,265.35	
10,591 perches of straight masonry, to be laid in the unfinished culverts, at $5.75,	.	60,898
25½ perches of paving *done* at $3,	76.50	
2,900 " " " *not done*, at $2.75,	.	7,975
1,180 " " " dry wall, at $3.25,	.	3,835
798 cub. ft. of foundation timber laid, at 25 cts.	199.50	
7,760 " " " " " not laid, at 25 cts.	.	1,940
4,730 run feet inch meas. of plank laid, at 20 cts.	94.60	
41,910 " " " " " " not laid, at 25 cts.	.	1,048
Also, the completion of the timber foundation of Culvert No. 202,	.	195
Bailing the pit of Culvert No. 202,	.	50
Materials prepared for the completion of certain culverts, which cost the company,	3,360.31	
Add to cover loss on the materials prepared, and certain contingencies,	.	942
	10,996.26	98,721
Add work done,	.	10,996.26
Total of work done and to be done on the 23 culverts,	.	109,717.26
Add the cost of the 5 culverts built,	.	13,832.47
Total cost of the 28 culverts, between Dam No. 6 & Cumberland,		123,549.73

In reference to the culverts to be built, the same remark may be made as in the case of the aqueducts, viz: that the change of times since the years 1836, 1837, and 1838, justifies the estimating of work now to be done at less than was paid in those years. This assertion is strengthened by the fact that the cost of the culverts constructed on the lower 107 miles of the Canal, (see Gen. McNeill's Report, before referred to,) was at least one-fifth less, per perch, than the present estimated cost of the culverts remaining to be built.

13th. Puddling, between dam No. 6 and Cumberland, quantity of, laid, and cost of, (average,) per yard, estimated cost, per yard, of that which is still to be introduced.

Answer. There is but little puddling on this Canal, except about the mechanical structures. With the cost of the puddling, I will give, also, that of the other work rendered necessary by those structures, and not already stated, viz: the excavation of their pits, the gravelling behind some of the masonry, &c.

(N. B. The excavation for the foundation and the puddling and

gravelling of dam No. 8 and guard lock, are included in the estimates of those works.)

The cost of puddling is, with one trifling exception, merely that of mixing and working it,—the cost of excavating and transporting the materials being included in the items of excavation, embankment, &c.

	Work done.	Work to be done.
64,438 6-10 cub. yds. of earth excavation *done*, in the lock, aqueduct, culvert, &c. pits, at 32.19 cts. (average price,)	$20,744.04	
87,110 cub. yds. of earth excavation *to be done*, at 25 cts. (average price,)		$21,789
11,113 cub. yds. rock excavation, *done* in do., at $1 12.9-10 (average price,)	12,550.50	
14,450 cub. yds. rock excavation *to be done*, at 77.4 cts. (average price,)		11,185
1,915 cub. yds. slate excavation *done* in do., at 80.3 cts. (average price,)	1,537.30	
None of do. *to be done.*		
931 cub. yds. of gravelling *done*, at 56.2-10 cts. (average price,)	523	
4,570 cub. yds. of gravelling *to be done*, at 40 cts. (average price,)		1,828
2,900 cub. yds. embankment at the locks, "moved back" from pit excavation, at 20.9-10 cts. (average price,)	660.50	
16,700 cub. yds. embankment at the locks and waste weirs, "moved back" from pit excavation, *to be done*, at 12½ cts. (average price,)		2,089
23,634 cub. yds. of puddling, *done*, at 23.49 cts. (average price,)	5,552.11	
54,300 cub. yds. of puddling *to be done*, at 21.52 cts. (average price,)		11,684
Add sundry work *done*, not embraced under the above heads, or not yet distributed among them,	1,565.52	
	43,078.97	48,575
Add the work done,		43,078.97
Total of the work done and to be done,		91,653.97

The $43,078 97 of work *done*, may be thus distributed:

Chargeable to the 6 locks, 2 aqueducts, and 5 culverts, considered finished as regards their masonry—

30.127	cubic yards	earth excavation,	$10,158 33
6.760	" "	rock "	7,797 75
1.661	" "	slate "	1,314 30
600	" "	gravelling "	344 00
2.900	" "	emb. " removed back,	606 50
11.756	" "	puddling,	3,416 67
		sundries,	1,328 92
			$24,966 47

Chargeable to unfinished locks, aqueducts and culverts—

34.311$\frac{6}{10}$	cubic yards	earth excavation, . . .		$10,585 71
4.353	" "	rock " . . .		4,752 75
254	" "	slate " . . .		223 00
331	" "	gravelling " . . .		179 00
979	" "	puddling, ...		263 82
		sundries, &c., ...		236 60
				$16,240 88

Add, chargeable to sections 10.899 cubic yards of puddling, $1,871 62

That is, to the finished work, .	$24,966 47	
" " unfinished " . .	16,240 88	
and to sections, . .	1,871 62	
Total,		$43,078 97

The cement on the portion of the line referred to has been furnished by the Company, at the works, and charged to the contractors, at 25 cents per bushel of 70 pounds. The price at which the cement was purchased by the Company at the mill, averaged somewhat less than 25 cents,—but, in consequence of waste in handling, and the loss of a considerable quantity of cement by high water in the river, the cost to the Company of the cement, per bushel, used in the works exceeded 25 cents.

The transportation of cement *done*, and the loss arising from waste, &c., (exceeding the 25 cents, per bushel,) amounts to	$10,241 63
The cost of the transportation of cement, to be done, is estimated at	$19,011 00
Total done and to be done,	$29,252 61

I will next present the remaining items that make up the entire cost and estimate of the work done and to be done, between dam No. 6 and Cumberland, that are not particularly referred to in these interrogatories, and which have not yet been given.

1st. Wastes and waste weirs.

There are to be nineteen, eight of them are to be ordinary wooden waste weirs, the other eleven are to be constructed of masonry. There will be in the waste weirs, in all, 39 gates, and the wastes will have a total overfall of 740 feet.

Work to be done, (none having been done.)

2,780 perches of rubble masonry laid in cement mortar, (including the dressed coping along the over-falls,) at $5 94,		$16,512
1,410 perches of dry wall, at $3 25,		4,583
1,340 perches of paving, at $2 75,		3,685
1,600 cubic feet of foundation timber at 25 cts.,		400
38,000 run feet inch meas. of plank in foundations, at $25,		950
Gates in the masonry waste weirs,		900
Miscellaneous work,		1,000
Total estimated cost of the eleven masonry wastes and waste weirs,		$28,030
Timber and all other materials, and workmanship, of the eight wooden waste weirs,	$2,400	
Securing the outlets of do.,	4,400	
		6,800
Total estimated cost of the wastes and waste weirs, all of which is *to be done*,		$34,830

2d. Bridges and Ferries.

1 pivot bridge, over lock No. 73, the lock walls answering for its abutments,		$500
3 road bridges over the tails of locks No. 58, board 70, estimated to cost:		
330 perches of rubble masonry laid in cement mortar, at $5,	$1,650	
480 perches of dry wall, at $3 25,	1,560	
150 feet lineal, in the clear, of wooden superstructure,	750	
		3,960
2 permanent lattice road bridges over the Canal, of 64 feet span each, in the clear, estimated to cost:		
1050 perches of dry masonry, at $3 75,	$3,938	
44,000 run feet inch meas. of plank at $30,	1,320	
Sundries,	200	
		5,458
1 permanent lattice road bridge, at Old Town, to be used also for the support of a forebay to a mill, estimated at:		
100 perches of rubble masonry laid in cement mortar, at $5 25,	$520	
100 perches of dry wall, at $3 50,	350	
55,000 run feet, inch measure of plank, for the bridge and forebay, at $27 50,	1,513	
	2,388	
Add the estimated cost of a basin in place of one destroyed by the Canal, to be constructed in connection with the forebay,	1,200	
		3,588

1 tow path bridge, crossing the Canal below the basin at Cumberland, estimated, &c.:

150 perches dry masonry, at $3 25,	$488	
70 feet lineal, in the clear, of superstructure, at $4 50,	315	
Sundries,	50	
		$853

N. B.—All the above bridges, except the pivot one, are elevated in the clear, above Canal water surface, 17 feet. In fact, one of them, at Old Town, (being in a deep cut,) has a greater elevation.

2 tow path bridges, one over the feeder entrance, at the tail of lock No. 54; the other over the guard lock at dam No. 8. The masonry of the former is connected and estimated with the masonry of lock No. 54. The walls of the guard lock answer for abutments to the latter. The superstructure is estimated to cost, 100 feet lineal, at $4 50 = $495; add for sundries, $100,	595
4 ferries, including the cost of the paved fords, boats and all other expenses chargeable to them, are estimated at.	$2,800
Total amount of work *done*, and *to be done*,	$17,754

3d. Lock-houses.

They are to be substantial log buildings. There are 17 to be constructed. They are estimated to cost,	$11,050

4th. A stop gate, two miles below Cumberland, is estimated to cost (there has been no work done):

300 perches rubble masonry laid in cement mortar, at $4 75,	$1,425	
300 cubic feet of timber, at 22 cts.,	66	
11,000 run feet inch meas. of plank at $25,	275	
Sundries,	300	
		$2,066

5th. A weigh lock, house, and expenses, consequent on the weigh lock, are estimated to cost,	$18,500

In reference, generally, to the items of work remaining to be done embraced in this answer, this remark may be made, that although the present estimated prices are somewhat lower than was paid for similar work above dam No. 6, yet, in consideration of the change of times since that work was done, and the facilities afforded by the Baltimore and Ohio Rail-road for obtaining supplies and for the transportation of cement, they may be regarded as fully equivalent, in point of profit, to contractors. In fact, they are higher than the average prices paid for the entire amount of similar work done to this time on the entire line.

General Summary of the Cost of the work done, and estimated Cost of that to be done, between Dam No. 6 and Cumberland.

	Work done.	Work to be done.
Sections—see the 8th answer,	$1,970,538 58	$494,851
Tunnel and deep cuts adjoining it—see do.,	513,935 38	178,000
Locks—see the 9th answer,	134,914 23	208,444
Aqueducts—see the 10th answer,	103,371 25	67,677
Dam No. 8 and Guard Lock—see the 11th do.,	80,722 09	21,800
Culverts—see the 12th answer,	13,832 47 10,996 26	98,721
Puddling, gravelling and excavation of the pits, for the mechanical structures, &c.—see the 13th answer,	43,078 97	48,575
Transportation of cement, and loss on cement—see do.,	10,241 63	19,011
Waste and waste weirs—see the same,		34,830
Bridges and Ferries—see the same,		17,754
Lock-houses,		11,050
A Stop-gate,		2,066
A Weigh-lock,		18,500
	$2,881,630 86	$1,221,279
During the progress of the work *done*, there were certain contracts abandoned, in consequence of which about $11,000 of retained money, (included in the amounts of cost above given,) was forfeited to the Company. This sum, in addition to that of $10,369 14, which I shall here add to the cost of work done, will, it is thought, cover allowances that may yet have to be made to one or two contractors who have still unsettled accounts with the Company for work done,—also the judgment in favor of the contractor for Aqueduct No. 8, by which he obtains more than his contract prices for his work,—and also some very small amounts of work done, not included in any of the preceding statements of cost,	10,369 14	
Add to the estimated cost of the work *to be done*, for Superintendence and Contingencies,		183,192
	$2,892,000 00	$1,404,471
Add the work *done*,		2,892,000
Total cost of the work *done*, and *to be done*, below Dam No. 6 and Cumberland, so far as regards expenditures chargeable to construction,		$4,296,471

14th. What is the height of the tow path above the freshet of 1843? What provision has been made in reference to such parts of the same as fall below that freshet? This upon the entire line of the Canal.

Answer.—The freshets of 1843, of which there were two, in April and September, were the highest that have occurred since the Canal was commenced in 1828, and for many years before, except that at two points, and for very short distances, in consequence of the damming of ice on its breaking up in the river, the water has been rather higher, since 1828, than it was in 1843, at both of which points the tow path has since been raised, and at one of them made entirely secure.

Below dam No. 5, about 35 miles of the tow path were overflowed in 1843.

Between dams No. 5 and 6, one mile, the greatest depth 1½ feet, average depth ¾ feet, requiring but a small expenditure to make it secure against such freshets.

Between dam No. 6 and Cumberland, no part of the tow path, if completed, would have been overflowed. In fact, a higher freshet than either of these in 1843, within the limits likely ever to occur, would not reach the top of the tow path and guard banks on this portion of the Canal, and, with the exception of about two miles in distance, the Canal between dams No. 5 and 6 is equally secure.

About 15 miles of the 36 miles of the tow path overflowed in 1843, can be placed out of the reach of similar freshets, the other 21 miles cannot be, at a reasonable cost and without endangering several of the culverts; though much of it may be made secure against ordinary high freshets. By means of overfalls, however, at suitable points along this part of the tow path, the damage done by high water may be materially lessened.

At a few points, where the greatest damage was done in 1843, the tow path has since then been raised and made secure. The rest of the 15 miles spoken of as admitting of being made safe, will be taken in hand from time to time, and as the means of the company will permit, as will, also, the raising of such portion of the 21 miles as can be placed above ordinary high freshets, and the construction of the necessary overfalls, several of which of a temporary kind, are already made.

If a freshet were now to occur as high as those of 1843, the damage done to the Canal would not be as great as it was then, and when the work in contemplation is executed, the damage from such a freshet would not exceed one half that of the highest of the 1843 freshets. Extend this over the average time between such freshets, which might safely be put at 20 years, but say 10 years, and the average annual charge upon the Canal would be small. The most expensive of the 1843 freshets cost from $30,000 to $40,000. Half of this spread over 10 years would not exceed $2,000 per annum. In this connection, attention may be called to the fact, that the cost of keeping up this Canal in 1843, in which there were two freshets higher than had before been known for exceeding 20 years, was somewhat less per mile per annum, than the usual expenditures on some of the principal Canals of this country, in ordinary seasons. The difference in favor of this Canal would be still greater, if it were completed to Cumberland, as regards expenditures occasioned

by freshets, as there would be an additional number of miles among which to average the damages, without any increase in their aggregate amount; the Canal above dam No. 6, as already stated being entirely above the reach of freshets.

15th. Waste weirs, wastes, &c. What is the extent of provision made for them?

Answer.—On the finished line of Canal there are—

12 stone waste weirs, (five of which have stone overfalls connected with them) with 38 gates.

1 brick waste weir, with two circular openings of 2 feet diameter each.

19 wooden waste weirs, with 49 gates.

7 small square wooden trunks through the tow path, most of them $2\frac{1}{2}$ feet by $2\frac{1}{2}$ feet.

12 stone overfalls, including the five connected with the stone waste weirs.

2 paved overfalls, and

12 temporary overfalls at points where permanent ones are required.

The aggregate length of all the overfalls, in the clear, is 2330 feet, the permanent ones being about 2-5ths of this length and the temporary ones 3-5ths.

On the unfinished line of the Canal there will be—

11 stone waste weirs and overfalls, and

8 wooden waste weirs, with 39 gates in the waste weirs, and an aggregate length of overfall of 740 feet.

16th. What principle has been adopted in reference to lateral streams upon the Canal side of the river? Some have been allowed to discharge themselves into the Canal; what circumstances have determined whether the stream should be received into the Canal or passed under it? What are the precautions taken in the cases where the streams are permitted to enter the Canal?

Answer.—The principles now, and of late years, adopted on this Canal, in reference to lateral streams upon the Canal side of the Potomac, are these:—

1st. Not to build culverts where guard banks are constructed against the river. The Canal is so located, and the locks are so distributed and placed, that all the large streams enter the river where guard banks are not required, and have been passed under the Canal. Those parts of the Canal that have guard banks, and into which small streams are allowed to discharge themselves, have usually been so located that they have an extra width where those streams enter with a view to the deposites from them, if any, being received and permitted to accumulate for a length of time outside the ordinary width of Canal, and being occasionally removed if it should be necessary, when convenient and without interruption to the navigation. There are many cases, where the deposite is so small, and the space for its reception so great, that for years, I may say for ages, the Canal limits cannot be encroached upon, and for the purpose of controlling the water brought into the

Canal by those streams, in rains, overfalls of sufficient length are always constructed below the termination of the guard banks.

2nd. As culverts, even small ones, are costly when well and securely constructed, and, as they generally cause more interruptions to the navigation than any other class of structures or works on a Canal of large dimensions, from the difficulties there often is in making their foundations by what many would consider a sufficient expenditure for the purpose, the plan has been, of late, even where there are not guard banks, to admit small streams into the Canal, the water from which in rains can be fully controlled by overfalls near their entrance, and the deposites from which will be received into eddy pools of sufficient extent outside of the regular Canal width, or where that is not the case, if the stream passes over a rocky bed and brings down little or no wash, or, where the ravines are small and narrow, if rock dikes thrown across their mouths, allowing the water from the ravines to pass through them, will keep the deposites back so that they can be occasionally removed, at convenient times. In all other cases, culverts are constructed for the passage of streams under the Canal.

The Canal by its culverts and the side ditches leading to them, running parallel with the Canal where there is wash from the hills, and by the precautions taken to control the deposites and water thrown in by rains where streams are allowed to discharge themselves into the Canal, may be said to be, generally, very well protected against the drainage of the country. So far as the Canal is finished, there has been full opportunity for observing that such is the case, and as regards the unfinished line above dam No. 6, before it was finally located and the plans of its works decided on, the surface drainage of each stream was ascertained with a view to learn which might be safely allowed to discharge themselves into the Canal, or if not allowed, how large a waterway would be required for each. The character of the country drained, whether level or hilly, and the elevation of the Canal above the river, were, of course, taken into consideration at the same time.

17th. Lining the interior slope of the tow path, what mode has been adopted for this purpose, and to what extent has it been introduced?

Answer.—The mode first adopted, was to place on the interior slope of the tow path, from bottom of the Canal to above top water line, a paving of stone one foot thick, which generally cost, where the stone was already quarried and within 120 feet, $12\frac{1}{2}$ cents per superficial yard. The present mode is, after the water is admitted into the Canal, and an offset formed on the inner slope at water line by the action of the water, to place upon this offset and on the slope, for a foot or more below, and about $1\frac{1}{2}$ feet above water surface, spalls from quarries, if to be had, or stone broken to a small size.

The tow path on the finished line of the Canal, (in a distance of $135\frac{4}{10}$ miles,) has its interior slope protected by inner paving, including a few short lengths of vertical wall, and by spalling, for about 52 miles; more than one half being by the latter mode. The interior slope of the berm bank is in like manner protected for about 12 miles; more than one half being by inner paving and walling. The Canal for

about 32 miles, is either in rock cutting, or has an enlargement of width sufficient to render unnecessary any protection of the berm interior slope. The berm bank, therefore, is secure against wash for 44 miles.

These distances may not be strictly correct. They are made up from the accurate lengths of the inner paving, &c., on the larger portion of the line, and assumed lengths, which cannot be far wrong, on the rest, the precise lengths not being at hand to refer to.

"Spalling" is preferred, on this Canal, to paving. It is less costly, is equally effective as a protection against the washing of the banks, and occasions none of the inconveniences that sometimes result from inner paving. The inconveniences alluded to, are most frequently felt on Canals constructed over a limestone country, and subject to *lime sinks*. Where these *sinks* take place in or near either of the banks, they can most generally be checked, and the places made temporarily secure, if there is not inner paving in the way, by throwing in earth, without taking the water out of the Canal, and can be thoroughly examined and repaired at some time, when the navigation will suffer little or no interruption. The spalling of the banks, in the manner described above, does not, like inner paving, interfere with this temporary mode of repair.

18th. Specifications of the several descriptions of work, masonry and earth work, such as the contractors were required to follow in the prosecution of their jobs. Copies, if painted, would be desirable.

Answer.—The printed specifications communicated herewith, are for sections, locks, (masonry and composite,) aqueducts and culverts. They are, as regards the character of work required, almost literally the same that have been in use for all the work done above dam No. 5. Below that dam, the specifications differed in some particulars from the present ones. The aim was, in framing the last, to guard against such imperfections as were found to exist in the earlier ones.

There are some other classes of work, the specifications for which, as regards the character of work required, are in keeping with those of which copies are given.

The stone coping spoken of at the close of the composite lock specifications, will be placed along the entire length of the composite lock walls to be built above dam No. 6.

19th. Dimensions of the Canal at various points, both in earth and rock cutting.

Answer.—The depth of the Canal throughout, is six feet. Between Georgetown and Williamsport, a distance of 100 miles, the bottom of the Canal is level from lock to lock. From Cumberland to Williamsport, there is an inclination given to the bottom of $\frac{1}{10}$ of a foot per mile, but the top of the tow path is level and the locks are raised to the same height they would be, if there were no such inclination, and with reference to the full depth of 6 feet at the tail of each lock.

From Georgetown to lift lock No. 33, opposite Harper's Ferry, and $60\frac{7}{10}$ miles above the Georgetown tide lock, the top width of the Ca-

nal, at water surface, is 60 feet, the bottom width 42 feet, and slopes $1\frac{1}{2}$ to 1.

From Harper's Ferry to dam No. 5, $106\frac{8}{10}$ miles from the Georgetown tide lock, the top width is 50 feet, bottom width 32 feet, and slopes $1\frac{1}{2}$ to 1.

Thence to Cumberland the top width is 54 feet, bottom width 30 feet, slopes 2 to 1.

The above are the widths and slopes in earth cutting.

In rock cutting, a greater bottom width is generally given to the Canal than in earth, but not usually to the extent necessary to give a water cross section equivalent to that in earth cutting.

The slopes in rock vary with its character. They are from 3 to 6 inches base to 1 foot rise.

Along the entire line between Georgetown and Cumberland, the Canal is, in many places, and occasionally for considerable distances, enlarged beyond its regular width. Many of these enlargements were made from its being cheaper to construct the wide than the narrower Canal.

20th. Basins for the accommodation of the trade at Cumberland, Georgetown, Washington and Alexandria, please state the capacity of each, the extent of wharfing, depth of water in each, (least depth,) and sketches or plans of same, on thin paper, if practicable, no matter how roughly executed. That of Cumberland should exhibit the proposed connexion with the railways to the coal mines.

Answer.—The accompanying rough sketch of the basins at Cumberland, shows the arrangements there made for the accommodation of trade.

1st. The Canal below the guard lock, for a distance exceeding 1500 feet, is enlarged to a width of 100 feet at water surface, and 88 feet at bottom, for the purpose of a basin, the tow path slope being 2 to 1, and the berm side cut plumb. The proprietors of the land, on the berm side, gave the ground to the company on which the Canal is here constructed, on condition that the Canal should be thus enlarged in width, and without requiring the company to build the wall or wharf required on the berm side.

2d. From the lower termination of the above enlarged Canal or basin, there diverges what is called the "branch basin." Its length exceeds 1500 feet. It averages not less than 175 feet in width, and has on its two sides a front of more than 3,000 feet. Its longer side is nearly parallel with the Baltimore and Ohio Rail-road, from which it is distant, on an average, about 400 feet.

These two basins have a depth not less than 6 feet, are protected by guard banks against the highest freshets, and have a water front, (exceeding, as stated, 4,500 feet,) they may all be made available for the purposes of trade, and may be reached by branch tracks from the coal rail-roads.

3d. The guard lock at dam No. 8, opens into a natural basin of

still water on the North branch, that has now, a width exceeding, on an average, 250 feet, and a length of about 9,000 feet. Its present depth lessens gradually from, say 10 feet at its lower end, to about 5 feet at the upper end. When the dam is finished, this depth will be increased 4½ feet—but the length of the basin, in consequence of a small fall near its head, and its width, will be but slightly increased. The back waters of the dam will extend several hundred feet up Will's Creek, a part of which distance the proprietors along the banks of that stream may make available, as a basin, by going to some expense in deepening the channel. The Maryland water front on the North branch basin, is owned in part by individuals, and in part by two of the coal companies,—the Maryland Mining Company and the Boston Company, as it is generally called, having some time since purchased a sufficient extent of front to accommodate a large coal trade.

This natural basin on the North branch, is a remarkably fine one. It has evidently been formed by the deposite of gravel thrown across the bed of the North branch by Will's creek, at and below the entrance of the latter. This deposite of gravel, or natural gravel dam, as it may be called, has a depth to the original rock bed of the North branch, of nearly 10 feet at the site of dam No. 8, and a very gradual descent on its surface, down stream, with a steep slope on its up stream side. It was through this gravel that the excavation to the rock was made for the foundation of the dam. The North branch evidently brings very little deposite into this basin, so that fears need not be entertained, of inconvenience resulting from a diminution in its depth, and especially, as 4½ feet will be added to it by the dam. The river banks along this basin have an elevation very well suited to the purposes of the coal trade, and may be reached by the rail-roads from the Frostbury coal region, either by tracks down the right bank of Will's creek, or by a route that can be had through a gap in Will's mountain, at which an inclined plane would be required.

All of the above basins at Cumberland, leaving out the Virginia side of the North Branch basin, have a front, in the aggregate, exceeding 13,500 feet.

At Georgetown, there is a basin at the mouth of Rock Creek. It is formed by an embankment or mole, 1080 feet long on its river side, made across the mouth of the creek, in which is constructed a waste weir and overfall 200 feet long, to pass the waters of the creek, and a tide lock, connecting the basin with the river. This embankment is 160 feet wide. It is walled on both sides, and was constructed with a view to warehouses and buildings being erected on it, facing the river on one side and the basin on the other, with a space along each front for a street and landing. The river front of the mole, along which vessels may lie, is, (including the space occupied by the waste weir and tide lock,) 842 feet long. The basin, which covers 8¼ acres, had originally on the whole and along its sides a water front of 5,500 feet. Such, however, has been the extent of the deposites brought into the basin by Rock Creek, that a large part of it has not now a sufficient depth for boats. Nothing more has been done with this basin, since the company has been deficient in means, than to keep open a channel

hrough it to the tide lock, and thence to the entrance of the Canal in Washington City, extending to the mouth of the Tyber. More than this, in fact, has not, hitherto, been absolutely necessary, as the Canal boats usually pass through the tide lock, run up to the Georgetown wharves, or along side of the vessels lying at them, and there discharge their cargoes and receive their return loads. The defect in the plan of the basin may be remedied, when means will permit, by confining Rock Creek to a channel of proper and uniform width, that will, by the current in it, keep itself clear, leaving a smaller basin than at present, from which the deposites from Rock Creek may be entirely excluded. This separation of the creek from the basin will no doubt be undertaken when the trade on the Canal occasions a demand for the sites for warehouses, on the mole,—but not probably, until then,—as the owners of the wharves and the present warehouses, &c., in Georgetown merely desire, or rather, are contented with such facilities as enable the Canal boats to drop into the river and run up along side of their wharves, &c.

In Washington, from the termination of this Canal at the mouth of the Tyber, there is a Canal extending to the Eastern Branch, constructed by the city of Washington, which rises and falls with the tide. It has, for about a mile, a width that makes it, in fact, for that distance, a continuous basin. This city Canal admits of such improvements being made in it, and of being put in such condition, as to afford at its termination in the Eastern Branch and at other points, good accommodations to the trade of the main Canal. A part also of the $1\frac{3}{10}$ miles constructed by this company in Washington, for several hundred feet can, at small cost, be made a convenient point for coal business. The distance between the Canal and the river is very well suited to the purpose. The owner of the river front intends completing a wharf already commenced on the river at that point, as soon as there shall be occasion.

At Alexandria, there is a basin on and near the termination of the Alexandria Canal, suited to the present trade on that and the Chesapeake and Ohio Canal. And, as at Georgetown, the boats may enter the river through the locks at that place, and run down along side of the Alexandria wharves and warehouses, and vessels that may be at them. All further facilities that may be required at Alexandria, to give full accommodation to the coal trade will be provided, I am informed and believe, as soon as there is occasion for them.

From the attention now given to the subject, both in Alexandria and Georgetown, and the competition between those places for the Canal trade, there is every reason to believe that every possible facility required for a quick and economical transfer of coal, on its reaching tide water, from the Canal boats to the vessels in which it is to be shipped to other ports, will be in readiness at an early day. In Washington, also, the coal trade will no doubt receive proper attention.

At present, as already remarked, there are three points, (at Georgetown, Alexandria and Washington,) where coal boats may enter through tide locks into the river, and run along side of wharves and vessels, to discharge their coal and receive their return loads.

21st. Connexion of the Canal with the Potomac River, at what points does this take place?

Answer.—The Chesapeake and Ohio Canal, at its eastern termination, is connected with the tide water of the Potomac River at these points, that is, directly at two points, and indirectly at one.

1st. At Georgetown, by the tide lock at the Rock Creek basin.

2d. At Washington, by the tide lock at the mouth of the Tyber, and

3d. At Alexandria, by means of the Canal to, and its tide lock at, that place.

Between Georgetown and Cumberland the Canal is, and will be, connected with the river at several points.

1st. At the feeder from dam No. 1, 5 miles from the Georgetown tide lock. As there is but a single set of gates on this feeder, boats can only pass between the river and Canal in ordinary stages of the river. This is the only case of the kind, at the entrances of feeders on this Canal, all the others having guard locks.

2nd. At the guard lock of dam No. 2, $22\frac{1}{10}$ miles from the Georgetown tide lock. The back water of this canal is navigable in ordinary stages of the river from four to five miles above the dam, for boats drawing four feet.

3d. At the Edwards's Ferry outlet locks, $30\frac{1}{2}$ miles above the Georgetown tide locks. These outlet locks are nearly opposite the mouth of Goose Creek in Virginia, and accommodate the trade to and from the flouring mills on that stream. An improvement of Goose Creek, by locks and dams, has frequently been talked of by the owners of property on and adjacent to it, which will, no doubt, in time be accomplished. The effect would be to bring flour to the Canal from mills high up the stream that now takes a different direction.

4th. At the Shenandoah outlet lock, $60\frac{6}{10}$ miles above the Georgetown tide lock. This lock is opposite Harper's Ferry and the mouth of the Shenandoah. It was constructed for the admission of boats that come down the Shenandoah river when above its ordinary stage. The Shenandoah runs from and through a large extent of valuable country, and has been partially improved by locks and sluices, at many of the most rapid points upon the river.

Should a dam (No. 3,) be constructed at the site originally contemplated for one, directly below this outlet lock, the advantages resulting to the Canal from the connection with the river at this point would be greatly increased, not from the extent of back water of the dam, as the fall in the Shenandoah near its mouth, and in the Potomac immediately above the site of the dam is so great, that this would be small; but from the facilities that would in consequence be afforded to the transfer of trade to and from the eastern termination of the Winchester and Potomac Rail-road, which is at the mouth of the Shenandoah, and directly along side of the basin that would be formed by the dam.

5th. At the guard lock, at the "Government dam," $62\frac{4}{10}$ miles above the Georgetown tide lock. The back water of this dam is navigable from three to four miles up the Potomac for Canal boats.

6th. At the Shepherdstown outlet lock, $72\frac{7}{10}$ miles above the Georgetown tide lock. The back water of Boteler and Reynold's mill dam, on the Potomac, about $1\frac{1}{4}$ miles below this outlet lock, extends about two miles up, above Shepherdstown, forming a basin of deep water in the river between the lock and that place.

7th. Guard lock No. 4, $85\frac{6}{10}$ miles above the Georgetown tide lock, admits boats from the back water of dam No. 4, which extends about 8 miles above the dam. The Opequon, in Virginia, enters the pool of this dam. On that stream are several mills.

8th. Guard lock No. 5, $106\frac{8}{10}$ miles above the Georgetown tide lock, admits boats from the back water above dam No. 5, which extends about 6 miles above the dam.

9th. The guard lock at dam No. 6, $134\frac{1}{10}$ mile above the Georgetown tide lock, admits boats from the back water of that dam, which extends about $4\frac{1}{2}$ miles up the Potomac.

10th. The guard lock at the Cumberland dam, (dam No. 8,) $184\frac{4}{10}$ miles above the Georgetown tide lock, will admit boats from the back water of that dam, which will extend nearly 2 miles up the North Branch of the Potomac.

The connection of the Canal with the Potomac River, at these guard lock and feeders, and outlet locks, between Georgetown and Cumberland, does and will extend the advantages of Canal navigation for boats drawing four feet water, directly, to about 33 miles, and for boats of the draft usual on a Canal of six feet depth, to about 25 miles of the Virginia shore of the Potomac; and, besides, along nearly the whole extent of its territory, bordering on the Potomac, between tide water and Cumberland, Virginia, by means of fords and ferries on the river, is, and will be, largely benefited by the Canal. Virginia now contributes very considerably to the trade carried on upon the Canal.

22d. What has been the actual cost of the Canal from Tyber basin to dam 6? What amount has been expended between dam 6 and Cumberland, and what is the amount which you estimate that it will require to complete the Canal between dam 6 and Cumberland?

Answer.—There has been expended from Tyber Basin to dam No. 6, to the 1st of October, 1845:

For "construction,"	$5,712,448	
" "acquisition of land," (in part,) .	223,868	
" "incidental damages," (in part,) .	21,269	
		$5,957,585

And from dam No. 6 to Cumberland.

For "construction,"	$2,892,000	
" "acquisition of land," (in part,) .	75,230	
" "incidental damages," (in part,) .	200	
		2,967,430

Add chargeable to the whole line, because not yet distribu-

ted to their proper divisions, payments on account of "acquisition of land" beyond the amounts above given,		$81,703
Also, for the same reason, add payments on account of "incidental damages" to the amount of, . . .		3,637
There must be added, as chargeable to the whole line, payments on account of		
"Engineer department,"	$364,491	
"Pay of officers,"	148,927	
"Law expenses,"	25,578	
"Printing and stationery,"	18,137	
"Contingent expenses,"	8,744	
"Postages,"	2,650	
Expenses not embraced under the above heads,	20,873	
	$589,400	
Deduct from this sum, such part of it as is properly chargeable to the maintenance of the finished Canal, and which, in my 23d answer, is estimated at, ...	97,410	
		491,990
The amount estimated as being required to complete the Canal between dam No. 6 and Cumberland, including the cost of the "engineer department," and of superintendence and contingencies, (see the "general summary" following the 13th answer,) is . . .	1,404,471	
To this, add for lands condemned and not paid for, exclusive of the interest in arrear, and also for a small quantity of land that may yet have to be condemned, say	35,000	
"Pay of officers," and general expenses of the company during the completion of the Canal, so far as the same are properly chargeable to the unfinished line, say	20,000	
		1,459,471
Total cost of the Canal from Tyber basin to Cumberland, supposing the work above dam No. 6, finished at the estimate, and excluding the items of "profit and loss," "interest," and all similar items, . .		$10,961,816
The amount expended on the Canal from the Tyber basin to Cumberland, to the 1st of October, 1845, as given above, is		9,502,345

To arrive, however, at the total amount of expenditures and liabilities of the company, for and on account of the Canal up to that day, there must be made sundry additions :

1st. There has been paid for the survey and location of the Canal west of Cumberland, ... $9,483

2d. "Bonds due to creditors of the Potomac Company," by the Chesapeake and Ohio Canal Company, under the provisions of the charters of the latter, and of the arrangement between the old and new companies, by which the latter became possessed of the rights and privileges of the former, viz. principal, $57,548 42

Annuities thereon, in arrear, on the 1st October, 1845, less the amount properly standing to their credit, from the tolls paid by the works of the old company, after they came into the possession of the new company, and before any tolls accrued on the works of the latter, 15,303 11

72,852

3d. The balance on the 1st of October, 1845, against the company, on the account of "profit and loss"—the loss mainly occurring in the sale of the bonds with which Maryland paid her $3,000,000, and $1,375,000 subscriptions to the stock of the company, . . . 997,837

4. The interest paid to Maryland, on her loan of two millions to the company, including $602 for the conversion of paper into coin, in paying said interest, . . . 410,200

5th. The interest due and in arrear to Maryland, upon the said loan, on the 1st of October, 1845, ... 745,000

6. The interest paid by the company on the $3,000,000 and $1,375,000 subscriptions by Maryland—the company having agreed to pay the first three years' interest on the bonds with which the State paid those subscriptions, ... 95,445

7th. The balance of said first three years' interest on the said bonds, last mentioned, the whole of which balance, as regards the company, is now due and in arrear, including a charge of $9,375 by the treasurer of Maryland, for converting paper into coin, at sundry dates, . 672,987

8th. The interest paid by the company to others than Maryland, less the interest received from delinquent stockholders and others, ... 155,204

9th. The interest due and in arrear, on the 1st of October, 1845, to others than Maryland, say, ... 248,657

10th. Until within the last two years, the revenues of the finished canal have been insufficient to keep it in repair and pay the cost of its maintenance. For all *practical purposes*, in making out the cost of the Canal to the company, on the 1st of October, 1845, the deficiency in its revenues, for the above mentioned purposes, to

that time, should be included. It is shown, at the close of the 23d answer, that the deficiency on that day amounted to	$198,180
To this sum of	$13,108,190
11th. Add the six per cent. dividends guarantied to Maryland, by the company, on her $3,000,000 and $3,375,000 subscriptions, commencing at the expiration of "the first three years" after those subscriptions were made—which are payable out of the profits of the Canal when sufficient for the purpose, but not until then—and which, on the 1st of October, 1845, ($3\frac{1}{4}$ years,) amounted to .	853,125
Total, ...	$13,961,315

It appears from the preceding statement, that the entire expenditures of the company, to the 1st of October, 1845, for all on account of the Canal, and the liabilities that had then been incurred therefor, on the supposition that the subscriptions to the stock of the company had all been paid in current funds, and there had been no necessity to borrow money in aid of these subscriptions; in other words, extending the items, "profit and loss," "interest," "guarantied dividends," and all other items not strictly chargeable against the Canal, in the view usually taken when speaking of the cost of the work, amounted, (including $9,483 for the survey, &c., west of Cumberland,) on that day, to $9,511,828.

It also appears that, inclusive of the items of "profit and loss," "interest," the deficiency in the revenues of the finished Canal for its maintenance, (a larger part of which is owing to the slow progress made in prosecuting the Canal to completion at Cumberland,) and including all other items except the "guarantied dividends" to Maryland, the same amounted on the above day to $13,108,190.

And, further, that including the said "guarantied dividends," which by the terms of the two last subscriptions by the State, the company is required to make good, out of the future profits, the amount was, on that day, (1st October, 1845,) $13,961,315.

These several sums are presented and views taken, to account for the difference in statements made by persons unacquainted with the facts, in regard to the cost of the Canal up to this time.

It may be well to show, in like manner, what the canal will have cost, in these several views, at the time by which, under the contract recently made, the canal is to be completed; or, rather, at the termination of the half year in which that completion is to take place. The 31st December, 1847, will be the close of that half year.

1st. The Canal to Cumberland, supposing it to be completed for the estimate, (a cash one,) will have cost—including the $9,483 for the survey, &c., west of Cumberland, and excluding the items of "profit and loss," "interest," "guarantied dividends," &c.—as already shown, $10,971,299

2d. It will have cost, including all the items omitted above, except that of "guarantied dividends," as follows:

To the amount already given, ...	$13,108,190
Add 2¼ years' interest, on the loan of two millions, by Maryland, ...	270,000
Add 2¼ years to other creditors than Maryland, say .	145,000
Add interest to the 1st of January, 1848, on the amount required to complete the Canal, also certain other charges,—which, as the interest and charges referred to are to be met out of the $1,625,000 issued in bonds, to the contractors for the completion,—may be put at the difference between that amount, and the sum already put down for the completion, viz: $1,459,471. The difference is	165,529
I will add, (for the same reason that I did the past "deficiency" in the revenues of the finished Canal for its maintenance,) the $75,000 spoken of in the 24th answer, as the amount that would probably be advantageously expended in the next two years, on the Canal, below dam No. 6, ...	75,000
Total cost, including all but "guarantied dividends," on the 31st of December, 1847, (on the supposition that the $75,000 is in the mean time expended,) .	$13,763,719

And 3d. It will have cost, including the "guarantied dividends," as follows:

To the amount above, ...	$13,763,719
Add the "guarantied dividends," to 1st of October, 1845,—see above, ...	853,125
Add do., for 2¼ years, from the 1st Oct., 1845, to 1st of January, 1847, ...	590,000
Total cost, "guarantied dividends" inclusive, on the 31st December, 1847, ...	$15,207,469

I ought, perhaps, to remark, in justice to those who have had charge of the work, that the items "pay of officers," "engineer department," and some others of less amount, are larger than they would have been, had the Canal been carried through to an early completion, and with ample means at command. So far from this having been the case, the construction of the Canal has now extended over more than seventeen years, and is still unfinished, and the Company, at times, has been in great embarrassments, and which caused an increase of probably 20 per cent. in the cost of fully one-fourth of the work done. Allow for these causes of increased expenditures, and I have no doubt the cost

of the Canal, completed to Cumberland, excluding "profit and loss," "interest," &c., would be less than $10,400,000, in place of $10,971,299.

Immediately following the 13th answer, there is a *general summary* of the work done, and to be done, between dam No. 6 and Cumberland,—a like *summary* of the work done between the Tyber basin and dam No. 6, and its cost is as follows:

1st. Sections. Tow path along slack water and basin at Rock Creek. The sections cost	$3,506,829	
$3\frac{8}{10}$ of tow path along the slack water above dams No. 4 and No. 5, cost . . .	57,576	
The Rock Creek basin and mole, including the waste weir at mouth of the creek, .	69,093	
		$3,633,498
2d. Locks—		
53 lift locks, aggregate lift, 424 feet, cost	$638,242	
2 tide locks, ...	26,796	
Outlet locks, at 3 points, aggregate lift about 37 feet, cost, ...	52,068	
		$717,106
3d. Lock houses and other buildings—		
14 stone lock houses, ...	12,659	
22 brick do., ...	24,727	
1 brick do., } 1 wood do., } used, also, for public houses,	8,511	
2 wood do., (one of them rather temporary in its construction,) .	577	
1 wood do., a temporary one, .	81	
1 ferry house, of wood, for the ferry over the Canal at Noland's Ferry, . .	484	
1 log building, for the superintendent of repairs in the upper division, . .	500	
		$47,539
4th. Stop gates—		
7 of them, of masonry, ...		19,220

N. B. There is another stop gate, of masonry, which is in a line with dam No. 4, as its construction was rendered necessary by the plan and arrangements of that dam, and the adjacent works, its cost is put with that of the dam.

5th. Aqueducts—	
7 stone aqueducts, aggregate span, 985 feet, . .	373,405
There may be added, under the head of aqueducts, the cost, so far as the work has been estimated, of the northern abutment of the Alexandria aqueduct, which the Chesapeake and Ohio Canal Company agreed to construct, ...	24,277

6th. Culverts—

153 culverts, of stone, except two, which have stone abutments, with a plank covering, under the water way of the Canal, and stone arches under the banks, ... $378,171

These culverts have an aggregate span of 1169 feet, and an average length of about 112 feet.

1 circular wooden culvert, (in Washington,) 2½ feet diameter,—length 122 feet. It is entirely below the water surface of the Potomac, ... 435

$378,606

7th. Waste weirs and wastes or over-falls—

12 stone waste weirs, 5 of them having stone over-falls, connected with them, the whole costing 26,880

1 brick waste weir with two circular openings of 2 feet diameter, each, passing through the Canal bank,—used principally for drawing off water for manufacturing purposes, at Georgetown. Its cost is included with that of the other work, ...

19 wooden waste weirs, ... 8,054

7 small square wooden trucks through the tow path, that serve as waste weirs, . . 1,506

10 over-falls or wastes, (beside the 5 connected with the waste weirs,) 7 are of stone, 2 are cheap paved ones, and 1 is a very temporary one, ... 9,978

46,418

N. B. There are, in addition, 11 temporary wastes, of recent construction, the cost of which is put with that of other work.

8th. Bridges, roads and ferries—

8 moveable bridges,—7 of them pivot bridges, —the other is a draw bridge.

Cost of their superstructure, . . 4,106

Cost of the pier and abutments of one of these bridges,—(6 of them being over locks, and 1 at a stop gate, required no other masonry than that of the locks and stop gates,) 2,685

6,791

3 stone bridges, over the Canal, at the tails of locks No. 2, 3 and 4, in Georgetown, . . 8,025

3 stone bridges, over the Canal, in Georgetown, 15,445

7 wooden bridges over the Canal—Cost of their superstructure and a small amount of other work, . . .	7,490		
Cost of the abutments of masonry and other work of 2 of them, the abutments of the others being principally connected and included with other work, . .	5,859		
		——	13,349
2 wooden bridges, with stone abutments over the Canal, at the market-house in Georgetown, and taking down and rebuilding that part of the market-house, which is over the Canal, ...			7,970
8 tow path bridges, superstructure of wood—abutments of stone. Cost of their superstructure, including some small part of their abutments,—the rest of the cost of the abutments, except of one of the bridges, which is given below, being included with the cost of other work, .	2,019		
Cost of the abutment of the bridge just referred to, ...	2,390		
		——	4,409
Noland's Ferry bridge, intended to take the place of the ferry at that point, unfinished,—abutments of stone, in part built,—amount expended, .			1,189
Tracking path along the lower side of the B. and Ohio Rail-road viaduct, at Harper's Ferry, for the accommodation of boats from the Shenandoah, ...			1,256
Removal and re-construction of roads, rendered necessary by the Canal,—a part of the cost, however, is included in that of the sections, . .			15,721
2 Ferries. There are several others along the Canal, the cost of which is included with that of the sections, ...			1,200
1 tow path bridge of wood—omitted above—under the Little Falls road bridge. Its cost is included with that of other work, . . .			
		——	75,355
9th. Dams, guard locks, and other works connected with the dams.			
6 dams,—(one of them, the "Government dam," cost the Company nothing,)—5 guard locks, 1 guard gate and feeders, and other work rendered necessary by the dams,			351,362
10th. Add, for sundry work and expenditures, not embraced under, or not yet distributed among the other heads, ...			45,862

11th. "Incidental damages," so far as distributed, . .	$21,269
12th. "Acquisition of land," do. do., . .	223,868
Total amount, the same as given at the beginning of the answer,—expended on "construction," for "acquisition of land," and "incidental damages," so far as the two latter have been distributed,—between the Tyber basin and dam No. 6, ...	$5,957,785

The preceding summary does not, in all cases, give the accurate cost as regards each particular class of work, as, for instance, the cost of the locks includes that of one of the culverts with which its masonry is connected,—of the stop gates, that of one of the stone wastes,—of the aqueducts, that of one of the stone waste weirs connected with one of them,—of the culverts,—that of three of the stone waste weirs connected with the head of as many of the culverts, &c. &c. Different classes of work were often undertaken in the same contract,—and as the masonry of all was frequently connected, the final estimates do not always show what amount is chargeable to each structure. It must also be stated, that with the cost of the mechanical structures *below* dam No. 6, there is included much of the cost of excavating the pits, and puddling and embanking around the masonry. *Above* dam No. 6, it will have been observed, these items are kept distinct.

23d. What has been the cost of repairs per mile, from dam 6, to Georgetown, since the Canal was opened for use? Has there been a sufficient sum expended for that purpose?—in other words, if the company had ampler resources at command, would your expenditures for repairs have been limited to the sums actually expended?

Answer.—The different portions of the finished line of Canal below dam No. 6, were opened for use in the order and at the times stated below.

1st. The Canal between the old locks near Georgetown, and the Seneca dam, was the part first finished. Boats commenced running upon it in the fall of 1830.

2d. The navigation between the old locks and the Georgetown tide lock commenced late in 1831. The Canal in Washington City between the Rock Creek basin and the Tyber tide lock was not finished until early in 1834.

3d. From the Seneca dam to the "Government dam," the Canal was opened for use in November, 1833.

4th. From the "Government dam" to dam No. 4, it was opened, in June, 1834.

5th. From dam No. 4 to dam No. 5, in April, 1835.

And 6th. From dam No. 5 to dam No. 6, in April, 1839.

The books of the company do not show, respectively, the expenditures chargeable to each year for repairs, prior to the spring of 1844, but only the payments made in each year. Since that time, the books of the company are so kept, and monthly returns of expenses incurred are required from and made by the superintendents of repairs in such form, that the cost of repairs per year or month may be readily arrived at, whether the same are paid or not.

From necessity, therefore, in arriving at the cost of repairs prior to the 1st of January, 1843, all that had been expended for that purpose up to that day, and the amount then due and in arrear for the same, must be thrown into one sum, and that, divided by the number of miles of Canal which had then been in use *one year*. There had been, I find, *equal* to $1,117\frac{1}{2}$ miles of Canal in use, *one year*, on the 1st day of January, 1843.

The cost of repairs in 1843 will be given by itself. In that year, there were $135\frac{4}{10}$ miles of Canal in use.

The cost of repairs in 1844, and for three quarters of 1845, (to the 1st of October, 1845, the day to which the accounts were last made up,) will be put together. During this time, there were equal to ($135\frac{4}{10} \times 1\frac{3}{4} =$) 237 miles of Canal in use one year.

1st. The cost of repairs prior to the 1st of January, 1843, and the other expenses chargeable to the maintenance of Canal, were:—

			Which is equal per mile per annum to
For repairs, ordinary and extraordinary, including some "improvements," - - - - -		$422,857	$376 61
For pay of Superintendents, - - -	$31,686		
" " " Collectors, - - - -	11,258		
" " " Lock-keepers, - - -	83,533		
		126,497	113 19
Totals, - - - - - - - -		$547,354	$489 80
The cost of the same, in 1843, was, for repairs, ordinary and extraordinary, - - - - -		$62,506	$461 64
For pay of Superintendents, - - -	$2,400		
" " " Collectors, - - - -	1,379		
" " " Lock-keepers, - - -	8,036		
		11,815	87 26
Totals, - - - - - - - -		$74,321	$548 90

The year 1843, it should be remembered, is the one in which great damage was done to the Canal by the two extraordinary high freshets in the Potomac, that occurred in April and September of that year.

			Which is equal per mile per annum to
3d. The cost of the same, in 1844, and 3-4ths of 1845, was—			
For repairs, ordinary and extraordinary, - - -		$37,756	$159 31
" pay of Superintendent, - - -	$4,067		
" " " Collectors, - - - -	2,363		
" " " Lock-keepers, - - -	13,927		
		20,357	85 89
Totals, - - - - - - - -		$58,113	$245 20
The entire cost of repairs, &c., extending over the whole time, gives the following results—			
For repairs, ordinary and extraordinary, prior to 1st January, 1843, - - - - -	$420,857		
In 1843, - - - - - - -	62,506		
In 1844 and 3-4ths of 1845, - - -	37,756		
		$521,119	$349 77
For pay of Superintendents, Collectors and Lock-keepers, prior to 1st Jan., 1843, -	$126,497		
In 1843, - - - - - - -	11,815		
In 1844 and 3-4ths of 1845, - - -	20,357		
		158,669	106 50
Totals, - - - - - - - -		$679,788	$456 27

While making the Canal below dam No. 6, there was work, in places, left undone, with a view to its being more conveniently constructed after the opening of the Canal for use. In some instances, work was found necessary, upon admitting the water that had not been previously contemplated, and at some points, the banks of the Canal proved to be too low in reference to *high* freshets in the Potomac, and required, or still require, to be raised. Work such as the above, (subsequent to the admission of water,) is usually done by the superintendents of repairs, and its cost is charged to " construction" ; the rule, on this Canal, being to charge to that head all work that is an *addition* to, or *enlargement* of, the plan of the Canal as left, when opened for use.

In the years 1843, 1844 and three quarters of 1845, a period of $2\frac{3}{4}$ years, there was charged to " construction" for work done below dam No. 6, $21,882, which is at the rate of $7,957 per annum,—and an average of $58 77 per mile, of finished Canal, per annum. This work was in part, the building of a stone over-fall, 250 feet long, in the clear, on the 4th, or Georgetown level, and the raising of the banks of that level, (now nearly completed,) to guard against a recurrence of damages to that part of the Canal, such as were caused by the high freshets of 1843; in part the raising of the masonry of the Shenandoah outlet lock, and the adjoining tow path above the level of the freshets referred to;—in part, the raising of the tow path and guard

banks of other parts of the Canal for a like purpose; and, in part, sundry other work of not sufficient cost to justify a more particular reference here.

Whether properly chargeable to "construction" or not,—work of the above character is certainly calculated to lessen the cost, in future, of keeping up the Canal, so far as the same is liable to be affected by the freshets of the Potomac. As there is still work of the same kind to be done, that may extend over several years,—it may be proper to add the average amount per mile per annum, charged to "construction" since the 1st of January, 1843, to the averages previously made out of the cost of repairs and maintenance of the Canal, as shown by the books of the company, for the years 1843, 1844, and three quarters of 1845.

I have not ascertained the amount of similar work done prior to the 1st of January, 1843, and charged to "construction." It no doubt exceeds, per mile per annum, the average since that time. From the great care taken in the construction of the work last done, and of that now in progress, and in view of the fact that the Canal between dam No. 6 and Cumberland, is entirely out of the reach of freshets as high as those of 1843, there is every reason to believe that, on the completion of the Canal to Cumberland, the amount required to be expended per mile per annum, for work such as that spoken of, will be less than heretofore. It certainly will be the case, if the work referred to in my 24th answer, as being necessary to place the Canal in thorough repair, is executed at an early day.

There are other items of expense connected with the maintenance of the finished Canal, not yet noticed. They are the "pay of officers," (viz.: the pay of the president, directors, clerk, treasurer and others, in the Canal office)—the contingent and other expenses of the Canal office, and of the pay of chief engineer, whose time has always been given in part, to the finished portion of the Canal.

Up to this time, and until the Canal is completed to Cumberland, it is and will be impossible to say, precisely, what these items amount to as regards the *finished* Canal. The amounts given in the company's books apply, of course, to the whole Canal, both *finished* and *unfinished*. In 1843 and 1844, when no work was in progress on the unfinished portion of the Canal, the "pay of officers," expenses of the Canal office, and pay of chief engineer, amounted to, on an average, $8.852 per year, (see the 16th and 17th annual reports), which is an average of $65 38 per mile of finished Canal, per annum. It may, under all the circumstances connected with the expenses of these two years, be proper to consider the average just given as the fair charge against the finished Canal, per mile per annum, for "pay of officers," &c., during the whole time that it has been in use. Multiply this average $65 38 by the number of miles of Canal that had been in use *one year*, on the 1st day of October, 1845, viz.: $1,489\frac{9}{10}$ miles, and we have $97,410 for the amount chargeable to the finished Canal for "pay of officers," &c., and to be added to the cost of its maintenance prior to the day above named.

The preceding results may be summed up thus :—

Prior to the 1st of January, 1843.

Cost of repairs, ordinary and extraordinary, per mile per annum, (while keeping equal to 1,117½ miles of Canal in use one year,)	$376 61
Pay of superintendents, collectors and lock keepers, per mile per annum, ...	113 19
" Pay of officers," &c., ...	65 38
	$555 18
Add, merely for comparison, for the item of " construction," an amount equal to that subsequent to the 1st of January, 1843. See the preceding remarks, . .	58 77
Total per mile per annum, ...	$613 95

2d. In 1843—(the year of high freshets) :—

Cost of the repairs, ordinary and extraordinary, per mile per annum, ...	$461 64
Pay of superintendents, collectors and lock keepers, per mile per annum, ...	87 26
" Pay of officers," &c., per mile per annum, . . .	65 38
	$614 28
Add the item of " construction." See preceding remarks,	58 77
Total per mile per annum, ...	$673 65

3d. In 1844, and three-fourths of 1845 :—

Cost of the repairs, ordinary and extraordinary, per mile per annum, ...	$159 31
Pay of superintendent, collectors and lock keepers, per mile per annum, ...	85 89
" Pay of officers," &c., per mile per annum, . . .	65 38
	$310 58
Add the item of " construction." See preceding remarks,	58 77
Total per mile per annum, ...	$369 35

And lastly, the average extending over the whole time that the finished portion of the Canal has been in use, are—

Cost of repairs, ordinary and extraordinary, per mile per annum, ...	$349 77
Pay of superintendents, collectors and lock keepers, .	106 50
"Pay of officers," &c., ...	65 38
	$521 65
Add the item of "construction." See the preceding remarks,	58 77
Total cost per mile per annum, ...	$580 42

The extent of time covered by these last averages, is the same as though the $135\frac{4}{10}$ miles of Canal below dam No. 6 had been in use 11 years. $135\frac{4}{10}$ miles multiplied by 11, being $1{,}489\frac{4}{10}$ miles, which is within a very small fraction the extent of line that had been in use one year, on the 1st of October, 1845.

In reply to the inquiry, whether, "if the company had ample revenue at command, this expenditure for repairs would have been limited to the sums actually expended,"—it may be said, that during fully one-third of the time covered by the averages last above given, there was probably as much expended for *repairs* of the Canal in use, as there would have been upon the supposition made; the company, when in funds for the active prosecution of work on the unfinished line, having generally appropriated what was considered necessary to keep the finished portion in good condition. For the rest of the time, and especially within the last four or five years, there has not been as much expended below dam No. 6, as there would have been, if the company had had ample revenues at command; but the increased expenditure in that case would have been, mainly, upon improvements of the Canal, and in strengthening its works, and making them more and more secure against high freshets and heavy rains, work of the character of much of that described in my 24th answer, as being necessary to put the Canal in good condition. There would have been an increase in the expenditures strictly chargeable to repairs, but not, comparatively, to a larger extent. It must not be inferred, however, from the preceding, that the Canal below dam No. 6, is, each year, getting in worse condition. On the contrary, the Canal at several points where it was formerly insecure against freshets, has been made entirely safe within the last two years. At some of the points, it is true, the Canal is not now in as good condition as formerly—but taking into consideration the whole line, I do not hesitate to say that the Canal is now in better condition than it was three years ago. The rule adopted, with the limited means of the company is, to make one insecure point entirely safe before commencing at others, in preference to expending the same amount over a greater extent of line, and leaving the whole insecure for want of the ability to accomplish all that is necessary. This year (1845,) there has been less interruption to the navigation than in any

former year. The most extensive forwarder of produce on the Canal, from a point nearly $\frac{2}{3}$'s up the line from Georgetown to dam No. 6, says, in a letter recently received, (29th Nov., 1845,) "my boats have lost less time during this season, from interruptions in the navigation, than any other since the water has been let in."

Until within the last two years, the revenues of the Canal have been insufficient to keep it in repair. The deficiency, so far as it has been paid, has been met out of the funds heretofore provided for its "construction." The Canal now keeps itself up, and there is no reason to doubt that it will continue to do so until the coal trade is reached by the completion of the Canal to Cumberland. In my 22d answer, I thought it necessary, in giving the entire expenditures for and on account of the Canal, to include the deficiency in the revenues of the finished Canal, to meet its expenses prior to the 1st of October, 1845.

This deficiency amounts to $198,180, and is arrived at thus:—

Amount expended for repairs, &c., of the Canal, and in the payment of superintendents, collectors and lock keepers, to the 1st of October, 1845. See above— .	$679,788
"Pay of officers," &c., chargeable to the finished Canal. See above, ...	97,410
Total, ...	$777,198

N. B. The amount expended on "construction" since the admission of water, is not added here, it being already included in the item of "construction of Canal," &c., in the 22d answer.

The revenues of the company on the 1st of October, 1845, were—

For tolls, ...	$554,018	
From water and other rents, say, (there are some *small* matters of account connected with these rents, not yet adjusted,) . .	25,000	
		$579,018
Deficiency, ...		$198,180

24th. Have you made an estimate recently of the cost of putting that portion of the Canal between dam No. 6 and Georgetown, in thorough repair, including the raising of the tow path above freshets, repairing lock gates, &c.? if so, please state the sum which you think would effect that object?

Answer.—There had been no estimate of the kind referred to, made at the time this interrogatory was received; but I have since directed my attention to the subject, and have arrived at the following conclusion, which, however, it is proper to remark, I do not rely on with the same confidence that I should, if all the examinations, meas-

urements and calculations had been made, necessary to the making out of an accurate estimate, of the cost of putting the Canal below dam No. 6 in the condition contemplated in this interrogatory.

Dams No. 1 and 2 require repairs, the feeder from the former, needs some enlargement, and dams No. 4, 5 and 6 must be gravelled, (which was never done to the full extent intended, when they were planned, in consequence of their having been built when the company was deficient in means,) before *six* feet water can be maintained in the levels of the Canal next below those dams, in ordinary seasons. With these repairs and this gravelling, the depth can always be maintained. The cost of this work, including that of a feeding flume that must be constructed at dam No. 4, is estimated at $27,000

It is stated in the 14th answer, that 15 miles of the tow path overflowed by the freshets in 1843, can be raised above the level of these freshets. To do this would cost, say $30,000

In the same answer, it is represented, that there are 21 miles of the tow path that cannot, at a reasonable cost, and with safety to the culverts along that distance, be raised above the level of the freshets referred to, that the greater part of it, however, may be placed out of the reach of ordinarily high freshets, and that the whole, by means of overfalls, may be put in such condition that the damages arising from being overflowed, would be materially lessened. The cost of this partial raising of the tow path along these 21 miles, and of the overfalls, may be estimated at $25,000

The rebuilding of the whole of one, and the one half of the other of the two culverts, stated in the 5th answer to have given way, and at which there are now temporary wooden trunks, the former of which originally cost $2,179, and the latter $3,445, (the whole of the first of those two sums, and one half of the last, amounting to $3,902) may cost, on account of the great care required in rebuilding . $6,000.

The work necessary to make the Canal safe for a continuous depth of six feet water along its entire length, which is mainly required on those parts of the line that are in a limestone region, where there is a liability to *lime-sinks*, and the securing the foundations of a few of the culverts and the repairs of some others, and the putting of the Tyber tide lock in good condition, may cost . . . . $73,000.

There ought to be waste weirs in several of the levels below dam No. 5, on which there are none now. These, constructed of wood, and the renewal of some of the present ones, may cost . . $5,000.

As a matter of convenience, though not of absolute necessity, there might be advantageously expended for flumes, at some of the locks where there are none at present, below dam No. 5, say . $5,000.

The substitution of valves with cast iron frames in place of those with wooden frames, which some of the locks now have in their gates, may cost . . . . . $3,000.

The lock gates probably require, at this time, more than the average annual expenditure for their renewal, necessary in a series of years. The excess beyond this average may be estimated at . $2,000.

The construction of a channel for Rock Creek that shall be independent of the basin at the mouth of that stream, in Georgetown, may cost . . . . . $15,000.

It will probably be advisable, in the course of time, to change the present steep slope on the lower side of dams No. 4 and 5 to a flat slope like that of dam No. 6, to get rid of the reaction at those dams in the freshets, which occasions almost every year an expenditure for the renewal of plank, broken by the timber brought down the river in high water. As, however, this annual expenditure, on an average, is not a very heavy item, and is covered by the estimate in the next answer of the cost of keeping the Canal in repair per annum, and as, under any circumstances, it would not probably be advisable to make the change of slope spoken of for several years, I have made no estimate of what the cost of the change would be.

There is an expenditure required for the renewal of the wooden superstructures of certain bridges, which, as in the case of lock gates, may exceed the average annual cost of the renewal of bridges for a series of years, say . . . . . $3,000.

The preceding sums amount to $194,000, of which only $6,550 is required to be expended on the Canal between dams No. 5 and 6, the portion of the Canal last completed, and which has been in use between 6 and 7 years, and of this sum $5,000 is for gravelling omitted to be done at dam No. 6, when it was built, for want of means. I call attention to the fact here stated respecting the condition of the Canal between dams No. 5 and 6, as the character of the work on that portion of the Canal is the same as that of the work done above dam No. 6, and to be done, under the contract recently made for the completion of the Canal to Cumberland.

Of the items which in the aggregate make up the above sum of $194,000, the following have no reference to putting the Canal in condition to bear six feet of water with safety, viz :—

Raising the tow path along "the 15 miles," . . .	$30,000
Raising the tow path and constructing overfalls along "the 21 miles,"	25,000
Part of the amount estimated for waste weirs and part of that for flumes, say for both	5,000
Substituting valves with cast iron for those that have wooden frames, in such of the lock gates as have the latter, . .	3,000
Constructing an independent channel from Rock Creek through the basin at Georgetown	15,000
Total, ...	$78,000

The postponement for a time of the work referred to in these items, would only be, as regards the larger portion of it, to leave the Canal liable, as at present, to occasional damage from high freshets. The damage hitherto from that cause, on an average per annum extending over a series of years, has not been of very serious extent, and was not, even in the year 1843, sufficient to make the average cost per mile for

the maintenance of the Canal in that year, exeeed that in ordinary years on some of the principal Canals in this country.

As respects the construction of an independent channel for Rock Creek, it may be (see the 20th answer) postponed for the present without serious inconvenience. And, as for the smaller items, they have more reference to convenience than absolute necessity. Ultimate economy, however, would unquestionably be promoted by constructing all of this work at as early a day as practicable.

Of the sum of $116,000 (deducting $78,000 from $194,000) about $80,000 is the amount required to put certain parts of the Canal in such condition, that a continuous depth of six feet water may be had along the entire line; $27,000 is the sum necessary to be expended on dams and feeders to give six feet water, at all seasons, on the levels next below the dams, (during the greater part of each year, the dams and feeders are now competent to furnish that depth,) and the rest of the $116,000, viz: $9,000 is for expenditures on bridges, lock gates, waste weirs, &c.

If the company had ample means at command, I should doubt the propriety of undertaking immediately, and at one time, *all* the work necessary to put the Canal in good condition, as the consequence would be a serious interruption to the navigation and consequent loss of tolls, besides a great addition to the cost of the work. The better course, in my opinion, would be to carry on the repairs and improvements gradually, especially such of them as are required in the limestone region, of which the greater part can only be made with the water out of the Canal, and which may be taken in hand from time to time when the navigation would suffer, comparatively, little inconvenience. Most of the work is of a character that does not admit of being placed under contract, but requires the personal attention of the Superintendents of Repairs, who, from observation and their familiarity with the line, have become acquainted with what is necessary to be done. This is another reason why the amount of work required cannot all be advantageously carried on at the same time. By the course recommended, it is true, the time will be somewhat postponed when the full advantages will be derived from having a continuous six feet navigation, but by undertaking the worst points first the depth may be gradually increased, and by the time the Canal is completed to Cumberland, a continuous depth of $5\frac{1}{4}$ to $5\frac{1}{2}$ feet may be had, and, in two or three years after, the full depth.

$75,000 is probably more than could be judiciously expended in the next two years, unless the *immediate* raising of the tow path and construction of all the other work of the same class referred to in this answer, should be determined on; and even then I doubt whether that sum would be much, if any, exceeded. I name the sum of $75,000 as the limit of the expenditures in the next two years, not only because I think it sufficient for the purpose, but for the additional reason also, that that amount is the margin, left by the recent contract for the completion of the Canal and all that, under the law of Maryland providing for the completion of the Canal, is applicable to the putting of the Canal in good condition and repair. For the further expenditure beyond the $75,000 that will, from the estimate presented, be necessary to do the work re-

ferred to in this answer, and for any additional amount that may possibly be called for exceeding this estimate, (it not being based on as full measurements, examinations and calculations as are necessary to the making of an estimate on which full reliance may be placed,) there is sufficient provision made, I think, in the estimate given in the next answer of the cost of maintaining the Canal and keeping it in repair per annum. In that estimate is an item for an annual expenditure on improvements of the Canal, that may be continued as long as there shall be occasion for any improvements, and which it is believed will be found ample for the purpose.

25th. The canal being completed, from dam No. 6 to Cumberland, and the older portion in thorough repair, what will it cost per mile per annum to maintain the Canal, dams, and all other subsidiary works, in the best condition for purposes of navigation, including superintendence, &c. ?

Answer.—The following estimate of the cost of maintaining the Canal, &c., is made, as regards the number of officers, collectors, &c., that will be required, and in all other particulars, with reference to a tonnage, passing over the entire line, equal to that required by the law of Maryland, providing for the completion of the Canal to Cumberland, to be guarantied for the five years next after the expiration of the six months from the time it is finished to that place, viz. 195,000 tons per annum.

"Pay of officers," &c. viz., the pay of the president, directors, and officers, in the Canal office, and the expenses and contingencies of that office, including "printing and stationery," and the pay of chief engineer, at . .		$14,000
Pay of superintendents, collectors, and lock-keepers, and contingent expenses of the superintendents and collectors' offices, at		20,000
Cost of 10 parties employed on the repairs, say, for 10 bosses, 80 laborers, &c., and 10 horses, .	$24,500	
And for the repairs of house, boats, the cost of tools and contingencies, ...	4,350	
		28,850
Repairs and renewal of lock gates, wooden superstructures of bridges, wooden waste weirs, lock plumes, planking on the dams, and of wood work generally, (the renewal of wood work of the kind now on the Canal is usually required, on an average, every 8 years, unless where constantly covered with water,) also the repairs of certain other work, not embraced in other items and of small amount, ...		10,000
"Improvements" required on the older portion of the line, (see the last answer,)		20,000
Total, ...		$92,850

Which, for the $185\frac{7}{10}$ miles of the Canal between the Tyber tide lock and Cumberland, is an average per mile per annum, of $500.

The table below shows the average per mile per annum, of each of the items of the preceding estimate, and also the averages of the same for different periods, heretofore, as given in the 23d answer:—

	Pay of Officers.	Pay of Superintendents, Collectors, and Lock keepers	Repairs.	Improvements.	Totals.
Prior to the 1st of January, 1843, for a period equal to 8 3-4 years, for 135 4-10 miles of Canal, the cost was, per mile per annum, - -	$65 38 assum'd.	$113 19	$376 61	Construc'n assumed at $58 77	$613 95
In the year 1843, in which the two extraordinary high freshets occurred, the cost of maintaining 135 4-10 miles of Canal, was, per mile,	65 38	87 26	461 63	"Constr." 58 77	673 05
In 1844, and 3-4 of 1845, in which equal to 237 miles of Canal were kept in repair, one year, the cost was, - - - - - - - -	65 38	85 89	159 31	"Constr." 58 77	369 35
The general averages of all the preceding, while equal to 135 4-10 miles of Canal were kept in repair 11 years, are per mile per annum,	65 38 in part assum'd.	106 50	349 77	"Constr." 58 77 in part assumed. "Improvements"	580 42
The present estimate is - -	75 39	107 70	209 21	107 70	500 00

When it is considered that the Canal above dam No. 6 will be entirely out of the reach of freshets, and that great care has been, and will continue to be given to the forming of the embankments on that portion of the Canal, and the construction of its works, (the economical effect of which, on the amount that will be required for repairs above dam No. 6, may be inferred from the comparatively small cost of the maintenance of the Canal between dams No. 5 and 6, which was constructed in the same manner;) and as this estimate is made with reference to a considerable expenditure being made on the older portion of the line, in perfecting its works, before the Canal is completed to Cumberland, which will lessen the cost of the annual repairs; and as, moreover, in 1844, and the first three quarters of 1845, the Canal generally was improving in condition, with a less annual expenditure per mile than the present estimate, after deducting from the latter the item for "improvements," there is reason, I think, to believe that $500 per mile, per annum, will be found sufficient for the maintenance of the Canal, &c., after it reaches Cumberland.

That the cost, in the first years after the completion of the older portions of the Canal, was higher than it has been of late, was in part, and to a considerable extent, owing to breaches occurring at certain weak points on the work earliest constructed. After each break, how-

ever, and its thorough repair, the Canal became less liable to failure, until, at this day, a breach in the embankments rarely happens.

After the Canal shall have been placed in thorough repair, and the "improvements" all made, named in the 24th answer, there will be a portion of the estimate that may be advantageously applied to other "improvements"—for instance, "spalling" the interior slope of such portions of the banks as are not now protected in that way or by inner paving; which, although not absolutely necessary, would be desirable as one of the means by which the annual charge for repairs may be ultimately lessened. There are also other "improvements," of a similar kind, that might be advantageously undertaken and for a like object; and, it may be added, that the change of the lower slopes of dams Nos. 4 and 5, already spoken of, will be advisable when those dams require a thorough repair, to be paid for out of the item for "improvements" in the estimate.

There have been statements made of the probable cost, in future, of keeping up the canal, less in amount than the present estimate. They were, however, in reference to the present depth of water maintained in the Canal, and a more gradual increase of that depth than is now contemplated, and without providing for many of the "improvements" spoken of in the last answer.

Many of the levels of the Canal either now have in them, or could bear with safety, 6 feet of water; other levels range from 5 feet to $5\frac{1}{2}$ feet, and some few, in the limestone region, have $4\frac{3}{4}$ feet. Boats of the latter class, in this Canal, now carry from 70 to 80 tons. And notwithstanding the limited means of the company, of late years, for improving the condition of the Canal, the maximum loads of the boats running on the Canal during that time have been increased. With the full depth of water in the Canal, boats will be enabled to carry with ease 100 tons.

26th. Will you make a detailed estimate of the cost of transporting 100 tons of coal from Cumberland to the basin of Rock Creek, assuming that this quantity can be transported in a single boat.

Answer.—Assuming that the year of navigation will be 300 days; that animal power will be used, as at present, for the tracking of boats, (for which purpose mules are considered on this Canal preferable, in every respect, to horses;) that the average rate of travelling, including the time consumed in passing locks, will be 30 miles per day; that 17 round trips will be made each year, and that there will be no return load, and I estimate as follows:—

First cost of a boat and its fixtures, . .	$1,000 00	
Add, for the time required for repairs, which may generally be made during that portion of the year when the navigation is suspended, but for which, notwithstanding, I will allow $\frac{1}{10}$th; in other words, that 11 boats are required to keep 10 running, . .	100 00	
		$1,100 00

First cost of 3 mules, ...	$240 00	
Add, for occasional lost time from accidents, &c. $\frac{1}{10}$th; in other words, say, that 11 mules are required to keep 10 at work, .	24 00	
		$264 00
		$1,364 00
The interest on this sum, per annum, is, . . .		$81 84
The depreciation of boats and mules, assuming that they will last, (taking into consideration the occasional loss of a mule,) 10 years, will be per annum, . . .		136 40
The annual repairs of the boat and fixtures, including the additional $\frac{1}{10}$, say 8 per cent. on their first cost, .		88 00
The cost of feeding and shoeing the mules, and other expenses attending them, and their harness, say $80 each, to which add $\frac{1}{10}$th for the reason above given, making $88, which for 3 mules amounts to . .		264 00
Wages of a captain per month, ...	$18	
Wages of a bowsman and tow boy, . . .	18	
Board of the three per month, ...	18	
	$54	
Which for ten months amounts to		540 00
Tow ropes, rubbing and other ropes, per annum, . .		40 00
Tools and fixtures for unloading, ...		50 00
Extra expenses, beyond those provided for in other items, for loading and unloading, say per trip $8, and for 17 trips, ...		136 00
Total cost, per annum, ...		$1,336 24

As 1700 tons will be taken down in 17 trips, (the number assumed for the year's work,) the actual cost, by this estimate, of transporting a ton of coal from Cumberland to Georgetown, exclusive of tolls, will be $78\frac{6}{10}$ cents; which, for the distance between the two places, $184\frac{4}{10}$ miles is a small fraction over $4\frac{1}{4}$ miles per ton per mile.

If the price charged by the carrier for *freight*, exclusive of tolls, from Cumberland to Georgetown, should be $1, the amount received for a year's work would be $1,700; deduct the actual cost, as estimated above, and there is left $363 76 for the year's profit per boat.

In some cases, the captain of a boat may also be its owner. He would then save the wages of a captain, $180, which, added to $363 76 would make $543 76. He would also be saved paying his board, elsewhere, for 10 months in the year. But, generally, persons engaged in the transportation of coal will own several boats, as in that way the business can be most advantageously carried on. If 10 boats were run by the same person or company, requiring a capital of $13,640, invested in boats, fixtures and mules, the profits would be

per annum, at the assumed rate of charge and estimate of cost, $3,637 60; if 20 boats, requiring a capital of $27,280, the profit would be, $7,275 20, for transporting, in the former case, 17,000 tons, and in the latter, 34,000.

When a number of boats are owned by the same person or company, if from any cause two of them should be out of employ for a time, the loss in consequence of their not running would not be serious, as the greater part of the cost of transporting coal is made up of charges, that are at an end when the boat ceases to run, and the amount of capital invested per boat is not great.

The rate of charge assumed above for *freight*, exclusive of tolls, and including profits to the carrier, viz. $1, from Cumberland to Georgetown, is a fraction over $5\frac{2}{5}$ mills per ton per mile; what the charges will be, must of course depend on circumstances. If it should be put at 5 mills per mile—that is, $92\frac{1}{5}$ cents per ton for the entire distance—there would still be a profit per boat, per season, of $234 16 for 10 boats, of $2,311 60, and for 20 boats, of $4,623 20. Now taking into consideration that no allowance has been made for the back trade, to which a coal business always gives rise, and which may be considered almost entirely clear profit to the carrier, it is not, I think, unreasonable to suppose, that as soon as the transportation of coal becomes a regular business and competition exists, half a cent per ton per mile will be found a fair charge for the transportation of coal in 100 ton-boats, and that it will be carried at that rate.

The cost of transportation on the Canal is made up of two items—that of *freight* paid to the carrier, and that of *toll* paid to the company for the use of its work. I will now speak of the latter.

The *toll*, it is to be presumed, will be established within the limits of the charter, with reference to its producing the greatest *net* revenue. The first question to determine, is the actual cost to the Canal Company from the carriage of coal over its work; the second, how much more than the actual cost may be charged for toll, in view of competition from other works.

In treating of the actual cost, I will look merely to a tonnage of *coal* passing down the Canal per annum, equal to that *of all kinds* required to be guarantied for 5 years, by the Maryland law of last winter, viz., 195,000 tons. 1,950 round trips of boats carrying 100 tons each would transport this quantity—occasioning, in a year of 300 days, rather less on an average, daily, deducting Sundays, than 16 lockages in the two directions; that is to say, 8 lockages, daily, in *each* direction.

The trade on the Canal and revenues of the Company, since the close of 1843, have kept up the navigation. When the work reaches Cumberland, there can be little doubt that the trade, other than coal, for the first years after the completion of the Canal will not only, as at present, keep it in repair, but that it will also make the improvements contemplated in the estimate for the maintenance, &c. of the Canal in the 25th answer, and that it will in a few years do greatly more than this.

The other trade at present requires, and will hereafter continue to

require, that it may be carried on, a certain number of superintendents, collectors and lock-keepers, and a certain amount to be expended on the repairs of the Canal and its works. The same number of superintendents, collectors and lock-keepers are, and will be entirely competent to attend to the passing over the line, on an average per day, 8 additional boats in each direction; and at no increase of cost to the company, unless perhaps for a few clerks in the collector's offices, and it may be some increase in the compensation of the collectors, in view of greater responsibility, &c., and as respects the cost of the repairs they can be but very slightly increased. At all events, 5 cents per ton of coal on 195,000 tons per annum, amounting to $9,750, is fully equal to the cost to which the Canal Company would be subjected by the transit of that quantity of coal over its work, beyond what would be the cost of the maintenance, &c. of the Canal, without that additional trade.

The next question, as has been already remarked, is, how much more than this actual cost, viz: more than 5 cents, can be charged by the Canal Company for *toll* from Cumberland to tide water, without putting the cost of the coal in market too high, in view of competition from other improvements. As bearing directly on this question, I will compare what the Baltimore and Ohio Rail-road Company, on the 74th page of their 18th annual report, represent will be the *actual cost* to them of *freight* and *toll* for the carriage of coal over their road, with the estimates of the cost of the same on this Canal, given in this answer. This comparison admits of being made, since, in both cases, a regular business is assumed,—and in the Rail-road calculations, as in those of the Canal, there is only charged against the Canal trade the additional cost occasioned by it, to the two Companies, by its transit over their respective works.

The Baltimore and Ohio Rail-road Company, in the page of their report referred to, represent that the actual cost of carrying coal on their road, from the mines to Baltimore, will be, *to them*, per ton, per mile, $1\frac{046}{1000}$ cents.

This, for the distance of 188 miles, will be . . .	$\$1\frac{966}{1000}$
On page 72, of the same report, there is allowed, for transporting a ton of coal through the streets of Baltimore, 10 cents,—*the actual cost* is not stated. In the comparison about to be made,—as the unloading, on the Canal, is included in the calculations of cost on that work, while, on the Rail-road it is not,—the whole 10 cents may be set down, ...	10
Total *actual cost*, on the Rail-road, of *freight* and *coal*, .	$\$2\frac{066}{1000}$
On the Canal, we have assumed the *freight*, including a profit to the carrier,—and without allowing for back loading, at $1 per ton,—but have supposed that, allowing for back trade, it might be put at half a cent per ton, per mile, or $92\frac{1}{2}$ cents for the entire distance,—but, say, for the present, the larger sum, ...	$1.00

The cost, to the Canal Company, from the carriage of a ton of coal over its work, as estimated above, is . .	$0.05
Add, for comparison, the rate set down by the Rail-road Company,—see page 70 of their report,—as the cost of bringing down, on the Coal Rail-roads, a ton of coal, from the mines to the Canal at Cumberland,—10 miles, at 3 cents, ...	0.30
Total cost of taking coal from the mines, by way of the Canal to Georgetown, including *profit* to the carrier, on the freight, and putting the toll at the actual cost to the Canal Company, from its carriage on the Canal, . .	1.35
Difference in favor of the Canal, ...	$ .71 6/10

Apply this result to a coal tonnage, of 195,000 tons, per annum, on each work, and it appears—

1st. If the rates on the works are put at the *actual cost* on the Canal, as regards *toll*, and a charge for *freight* that allows a fair profit to the carrier, (which amount, including the bringing of the coal from the mines to the basin at Cumberland, to $1,35,)—that the Canal Company would neither make nor lose by the trade, while the Rail-road Company would lose, on every ton carried over its work, 71 6/10 cents;—which would be, on 195,000 tons, a loss, per annum, of $139,620.

2d. If the rates on both works are put at the *actual cost* of *freight* and *toll* on the Rail-road, (including, as before, the bringing the coal from the mines,) viz., $2 06 6/10, the result would be a profit to the Canal Company, the freight remaining as before,—of 71 6/10 cents per ton, and to the Rail-road Company, neither a profit nor loss,—which, on 195,000 tons, would be to the Canal Company a profit of $139,620.

3d. If the rates should be the same on both works, and such as would put the *toll* on the Canal at $1, (other things remaining as before,) viz., $2 30, and there would be a profit to the Canal Company of ($1 00 less 5 cents,) 95 cents, and to the Rail-road Company of 23 4/10 cents, on every ton carried,—which, on 195,000 tons, would be to the former a profit of $185,250, and to the latter, of $45,630.

In the preceding calculations, with $1, as the charge for *freight* on the Canal, there is a margin for profit to the carrier, as has been shown, of 21 4/10 cents per ton, without back loading, but with it, that margin may exceed 30 cents. Now if, as I have supposed, and already said, 1/2 cent per ton per mile, that is 92 1/5 cents per ton for the entire distance should be found, with a large and regular business, a fair charge for freight, for the carrier, the following would be the results instead of the preceding, upon the suppositions made, of the total charges being the same on both works.

1st. If they should amount to $1 27 1/5 per ton, there would be neither a profit nor loss to the Canal Company, but to the Rail-road Company a loss of 79 2/5 cents on every ton carried.

2d. If, to $2 05, a profit to the former of 79⅖ cents, and to the latter, no profit, and

3d. If, to $2 30, a profit to the former, of 95 cents, and to the latter, of 15⅗ cents, on every ton.

The Canal Company has always supposed that coal would bear a charge for *toll* of $1 per ton. Now, when it is considered that by the first of the views above taken of the *freight* being $1, the *toll* may be put at 76⅗ cents, and by the last, of its being 92⅕ cents, it may be put at 84⅖ cents before the point of equality in the cost on the two works is reached, (upon the supposition that the calculations of actual cost on the two works are correct,) I think there is little doubt, in view of other considerations that may be presented, that the charge for *toll* heretofore thought of by the company, viz., $1, may be safely made, so far as regards competition from the Rail-road. And if so, the cost of delivering coal by the Canal, would be for *toll* and *freight* $2 per ton, putting the freight at 5⅖ mills per mile; or $1 92⅕ per ton, if at ½ cent per mile, (the cost of delivering the coal at Cumberland not included.)

As to what the charge for *toll* may be on the Canal, so far as it is liable to be controlled by the Rail-road, it is not material that the preceding calculations, in respect to the actual cost of freight and toll on the two works shall be strictly correct, provided they are proportionally erroneous either in excess or deficiency, as there must still remain a proportional difference in favor of the Canal.

Will these calculations in regard to the cost of transportation on the two works be carried out in practice?

The Rail-road calculations require and assume perfect regularity in the trade, and the running of one, two or more trains, full loaded, from Cumberland daily, for each of 300 working days in the year,—each train taking daily 182 tons of coal in 26 cars, which in 300 days amounts to 54,600 tons. The first cost of the locomotives and cars, four days being required for a round trip,—to keep a train running daily from Cumberland, is, as per statement on the 74th page of the Baltimore and Ohio Rail-road report, already referred to as follows:—

6 locomotives, (of 20 tons weight,) at $9,450, . .	$56,700
200 cars, (each car carrying 7 tons, and each locomotive taking 26 cars per trip, and 4 days being required for the round trip, viz.: two days for descending, and two days for ascending the road; the 200 cars are thus disposed of,—52 on their way down, 52 on their return, 26 loading, 26 unloading, and 44 that may be undergoing repairs, and to cover irregularities in loading and unloading,) at $340, ...	68,000
Total, ...	$124,700

At this rate for 54,600 tons per annum, there would be required, by proportion, for 195,000 tons an investment in locomotives and cars, of $445,357.

To take on the Canal the same quantity, 195,000 tons, annually, requires the constant running of 115 boats, each making 17 round trips per annum. The first cost of each boat and its fixtures, and of the mules, (adding $\frac{1}{10}$ to each) is $1,364. The cost, therefore, of boats and fixtures for the carriage of 195,000 tons per annum, would be $156,860.

A new trade that is to be created, like the coal trade from the Cumberland region, will be gradual, although it may be rapid in its increase. In this view, it seems to me, that those facilities for the carriage of coal, which admit of being gradually added to as occasion requires, will be more economical in their effect upon the cost of transportation, than such as only admit of a far less gradual increase, and that require a much greater outlay for each additional provision made. By reference to what has already been stated respecting a trade of 195,000 tons, per annum, it appears that the facilities required, as regards the Canal, may be increased by successive additions of a boat or more, at a time, up to the number of 115, each addition, per boat, a capital of $1,364, amounting for the whole number to $156,860, while, on the Rail-road, (if fractions in a case of this kind are admissible,) there are less than four stages or steps of accommodation, each requiring a capital of $124,700, and, in the aggregate, of $445,357.

Again, a coal trade is, at all times, somewhat irregular in the quantity sent, per week, to market. In evidence of which, it is only necessary to examine the weekly reports, which I have before me, of the quantity of coal sent to tide water when the Schuylkill navigation was the exclusive carrier of the coal from the Schuylkill region; and since then, while there have been both a rail-road and canal competing for its carriage. The occasional falling off and irregularity of the trade, requiring at one time a less number of cars or boats than at others, is, it seems to me, less disadvantageous to a canal than a rail-road. A train, if it runs half-loaded, does so at very nearly the same cost as if it were full loaded, while upon a canal a less number of boats may be run, those not running, causing to their owners comparatively little expense. The importance attached by the Rail-road Company to the running full trains, is shown by the fact that they will not carry coal for the rate stated in their calculations, unless under a contract previously entered into, securing to them the payment for full loads, whether they be so or not, extending over a considerable length of time. Now it certainly matters not, as regards the cost of delivering coal at tide water, whether the person sending it pays for a larger quantity than he actually ships, at a *low* rate per ton, or for the quantity actually sent, at a higher rate, that amounts, in the aggregate, to the same. If $1\frac{1}{3}$ cents per ton is paid for 54,600 tons nominally sent, and but half that quantity is sent, it is the same as paying $2\frac{2}{3}$ cents per ton for the quantity sent to market. The only difference is, that, in the former case, the irregularity of the trade is thrown upon the person sending the coal to market, and in the latter, upon the Rail-road Company.

Boats running on a canal may be used for other purposes than the carriage of coal; on the other hand, the coal cars on the Rail-road are constructed on a plan not admitting of their being used for other

purposes. In the former case, there will be little hesitancy to anticipate the wants of the coal trade, by building boats in advance of the demand for them, and especially as there will be a competition among individuals for carrying the coal; in the latter, the outlay being so large for each additional daily train put upon the road, the Rail-road Company requires, as has been already stated, contracts in advance, before they will provide the necessary facilities for transportation, at the rate stated in their answer to the Legislature, in which their calculations appear, viz., $1\frac{1}{3}$ cents per ton per mile, and then, only, on the condition that the irregularities of the trade shall be at the cost of those sending the coal, and for a long period of time.

Again. The Rail-road calculations are in reference to machinery of the most improved construction, and to locomotives of 20 tons weight, (those constructed weigh 22 tons.) Now having stated in these answers that the Canal is not, *at present*, in condition to afford the full advantages of its large dimensions, so, on the other hand, it may be proper to remark, that, for the larger portion of the 82 miles below Harper's Ferry, the Rail-road has the old flat bar originally placed on the road, where horse power and small locomotives were in use, which must necessarily give way to a rail of different pattern and greater weight before 22 ton engines can be extensively run over the road. The calculations respecting transportation on the Canal, with the exception of assuming that the Canal will be put in good condition for 100 ton boats, are in reference to things as they are, without relying on any advantages to be derived from improvements in motive power, or to any greater facilities being afforded to the coal trade at tide water, than those now presented. That there will be great improvements in both these respects there is every reason to believe.

In view of all these considerations, and believing, moreover, that there is less practical information to be had, and necessarily so, of what will be the effect on the cost of transportation, of running heavy engines and large loads, for a series of years, on a road of heavy grades in both directions and great curvature, I have come to the conclusion, in my own mind, that the calculations of the cost of coal transportation on the Canal are less liable to differ from the reality in their practical application, than those made of the cost of the transportation on the Rail-road, and that although at the outset, and until the trade is once regularly established, the cost of *freight* on the Canal may be higher than is estimated, yet that the same may be said with more force respecting the commencement of the trade on the Rail-road.

Much might be said of the importance to the coal region of its having a public highway to market open to all, individuals as well as incorporated companies, and untrammelled with contracts to be made in advance and penalties to enforce them, in order to its rapid development and a competition that will ensure the placing of the coal at tide water at a minimum price. The lower that price is, the greater will, of course, be the demand for the article. But this is a view that cannot properly be dwelt on here.

I have one more remark to make respecting the competition of the Rail-road for the coal trade; it is that I regard that competition as no.

calculated to lessen materially, if at all, the profits per ton to the Canal company on the carriage of coal. If there were not other coal regions in the United States, it would be otherwise, but that not being the case, the Cumberland coal must be taken to tide water, whether by Canal or Rail-road, at a cost that will enable it to compete with the coal from other regions. The price at which the coal must there be sold to compete with the other coal, and to ensure a large demand for it, is, in my opinion, one that will give the Canal company a very fair profit, but will leave to the Rail-road little or none.

The competition between the Schuylkill Navigation and the Philadelphia and Reading Rail-road, is often referred to in connection with this Canal and the Baltimore and Ohio Rail-road. Respecting the controversy between those two works, it is not necessary for me to speak in this place, even if it were proper to do so, further than to show that the two cases are not parallel.

The Schuylkill Navigation is $108\frac{2}{10}$ miles long. It has 109 locks through which boats must pass, (of which 13 are guard locks, usually without lift, 20 guard locks with some lifts, and 76 lift locks,) and a total lockage of 616 feet. It has less width and depth than this Canal, and its boats carry 54 tons. The year of navigation there is rather shorter than on this Canal.

The Chesapeake and Ohio Canal is $184\frac{4}{10}$ miles long. It has (including 1 tide lock and 3 guard locks, through which boats will generally pass,) 78 locks and a total lockage of $609\frac{7}{10}$ feet. The larger class of boats can now carry from 70 to 80 tons, and when the Canal is put in good condition will carry 100 tons. The difference of lockage per mile in favor of this Canal, its greater dimensions, and the consequent larger burthen of its boats, and its longer year of navigation, make it one upon which the transportation will cost less per mile than on the Schuylkill Navigation.

On the other hand, as respects the two Rail-roads: the one from the Schuylkill region is in length 94 miles. It was constructed with express reference to the coal trade, and to a competition for it with the Schuylkill Navigation. Its curves are favorable, and it has not an ascending grade against the coal tonnage, except for a short distance near the lower termination of the road.

The Baltimore and Ohio Rail-road is 178 miles long. It has in places great curvature, heavy grades against the descending trade, and was not constructed for a coal trade, to be carried on with heavy engines and large loads, as is apparent from the facts already stated, of its still having a common flat bar on a large part of the lower 82 miles of the road. It has, besides, but a single track, while the Reading Rail-road has two. For all the purposes of a coal trade, the Baltimore road is, in fact, far less efficient than the Reading. No other proof of this need be adduced than the fact that the coal trains on the latter are of more than double the net tonnage of those of the former.

While, therefore, on the one hand, the Chesapeake and Ohio Canal, from its larger dimensions, less lockage per mile, and longer year of navigation, may be considered as having its length materially shortened, as to the cost of transportation, in comparison with the Schuylkill

Navigation, the Baltimore and Ohio Rail-road on the other has, in fact, an actual length nearly *double* that of the Reading road, and grades and curvatures that greatly increase this disparity, by not permitting it to carry net loads equal to *one half* the weight of those on that road. Now if we assume for argument, that the *actual cost* of transportation is precisely the same on the two rival works in Pennsylvania, it follows from what has been stated, that the *actual cost* on the Baltimore and Ohio Rail-road must be more than double that on the Chesapeake and Ohio Canal.

27th. Are there any outstanding claims against the Company for Canal damages, right of way, &c.; if so, the probable extent of same?

Answer.—In the year 1838 there were lands condemned and damages assessed to the amount of $23,777, for which no payment has yet been made.

To this sum	$23,777
Add interest unpaid, (some little interest having been paid,) say	10,500
There was, also, about the same time, a condemnation, which the company resisted on the ground of excessive damages having been given, and upon which no final action has yet been obtained in Court. Suppose the inquisition confirmed, and the damages assessed, with interest and costs, may amount to	8,250
Add, for the condemnation that may be necessary, of a few acres of land, to furnish materials for embankment, and also to cover possible contingencies, say	5,000
And we have	$47,527

as the probable extent of claims against the company for land damages right of way, &c., to be provided for.

I have purposely left, for the close of this answer, the presentation of the facts on which, in part, the assumptions, in my estimate, of the cost of transporting coal on the Chesapeake and Ohio Canal, are based.

In reference to the length of the year of navigation, as regards obstructions from ice, two statements are given: the first showing the number of the departures of boats from Georgetown each month; the second, each day of the three winter months, of the four years ended the 1st of December, 1845.

1st. *Statement of the number of departures of boats from Georgetown in each month of the four years between the* 1st *of Dec.*, 1841, *and* 1st *of Dec.*, 1845—*taken from the books of the Collector at that place.*

	1841.	1842.	1843.	1844.	1845.
In January, .	The departures of boats in this year, are only given for the month of Dec'r, for the purpose of making four full years to the 1st of December, 1845.	24	16	25	59
" February, .		61	2	7	26
" March, .		113	114	185	163
" April, .		120	77	201	163
" May, .		115	161	205	158
" June, .		98	189	184	112
" July, .		38	69	61	53
" August, .		94	98	185	144
" September, .		153	47	114	120
" October, .		137	37	191	148
" November, .		177	231	221	189
" December, .	98	78	183	137	See remarks which follow, 27 was the number.

The preceding statement was prepared before the close of December, 1845, and in reference to four full years ending 1st of December, 1845; but, as the answers were not all made out before the 1st of January, 1846, the opportunity is afforded for saying, that the present winter having set in earlier, and being more severe than usual, there was very little navigation in December, 1845. Only 27 way bills were issued for ascending boats.

These are not included, as it was necessary for the purpose in view, in this and the following statements, the departures of certain boats running to stone quarries, from 5 to 24 miles, from Georgetown, in regard to which there were such arrangements that way bills were not given each trip.

2d. *Statement showing the number of departures of boats daily, from Georgetown, in the winter months of each of the four years referred to in the last statement.*

Day of the Month.	1st of Dec. 1841, to 1st of March, 1842, viz:			1st of Dec. 1842, to 1st of March, 1843, viz:			1st of Dec. 1843, to 1st of March, 1844, viz:			1st of Dec. 1844, to 1st of March, 1845, viz:		
	Dec.	Jan.	Feb.	Dec.	Jan.	Feb.	Dec.	Jan.	Feb.	Dec.	Jan.	Feb.
1st,	7	.	1	.	.	.	5	2	.	.	4	6
2d,	5	.	4	.	.	.	15	2	.	2	3	.
3d,	2	.	2	.	.	.	3	3	.	10	4	.
4th,	8	.	4	.	.	.	5	4	.	5	2	.
5th,	2	.	.	1	.	.	11	4	.	9	1	.
6th,	13	.	.	1	.	.	15	3	.	3	1	.
7th,	6	.	1	4	.	.	6	.	.	15	.	.
8th,	5	.	4	3	.	.	11	.	.	1	4	.
9th,	5	.	4	1	.	.	15	2	.	9	5	.
10th,	.	.	3	9	.	.	2	.	.	7	3	.
11th,	10	1	5	2	.	.	4	.	.	10	2	.
12th,	.	.	3	9	.	.	7	.	.	7	.	.
13th,	7	1	.	5	1	.	11	.	.	8	1	.
14th,	9	.	2	13	.	.	4	.	.	12	5	.
15th,	4	.	6	6	.	.	2	.	.	.	2	.
16th,	.	.	5	3	1	.	3	.	.	5	.	.
17th,	.	.	.	2	1	.	1	1	.	4	4	.
18th,	5	1	.	.	.	.	2	.	.	3	1	.
19th,	.	1	.	4	2	.	12	.	.	.	1	.
20th,	3	3	.	7	4	.	7	3	.	.	.	.
21st,	1	3	.	2	.	.	7	.	.	.	3	2
22d,	2	5	1	.	.	.	4	.	.	.	3	1
33d,	.	.	1	6	.	.	12	.	.	5	1	.
24th,	3	3	9	.	1	.	1	1	.	10	.	.
25th,	.	.	1	.	2	.	.	.	.	5	3	1
26th,	.	1	2	.	2	.	4	.	1	2	.	6
27th,	.	1	.	.	1	.	9	.	3	1	1	3
28th,	.	3	3	.	.	.	4	.	2	2	.	7
29th,	.	.	.	.	.	.	1	.	1	.	1	.
30th,	.	.	.	.	1	.	.	.	.	.	2	.
31st,	1	1	.	.	.	.	.	.	.	2	2	.
	98	24	61	78	16	2	183	25	7	137	59	26

The remark follows statement No. 1, that in December, 1845, there were only 27 way bills issued to ascending boats. They were given on the following days.

On the 1st,	5
2d,	5
3d,	4
4th,	1
5th,	1
6th, 7th,	0
8th,	1
9th,	4
10th to 15th inclus.	0
16th,	3
17th,	0
18th,	3
19th to 31th, inclus.	0
	27

During nearly, but not the whole of this month, owing to the unusual severity of the weather, the navigation may be considered as having been, for all useful purposes, suspended. Most of these 27 boats made their way along the Canal with difficulty.

Statement No. 2 shows that occasionally, in the three months, there was a day when boats did not leave Georgetown, but they were running freely on the preceding and following days. This is often the case, with the present limited trade, in other months, when there were none leaving for several successive days, it may be assumed, though not without exception, that there was ice in the Canal.

1st. In the year ending 30th November, 1842, the days that the navigation may be considered as having been suspended from ice, were the following:—

Say from the 25th of December, 1841, to the 17th of January, 1842, inclusive,	24 days.
And from the 17th to the 21st of February, inclusive,	5 "
Total,	29 days.

There were, however, during these winter months, 40 days in which ascending boats did not leave Georgetown.

2d. In the year ending 30th November, 1843,

The first four days in December, 1842, (this may not have been owing to ice,) and the last 8 days,	12 days.
Say the first 15 days in January, 1843, the 21st, 22d, and 23d and the last four days,	22 "
And say the whole of February,	28 "
Total,	62 days.

This is the precise number of days, viz. 62, in which boats did not leave Georgetown during the winter months. It is necessary in reference to February, to say, that, for a large part of the month, boats might have been running as regards ice, but did not, as that time was

selected for putting a new set of guard gates in the Little Falls feeder, and for the purpose of enlarging the latter somewhat, it being thought that the navigation would then suffer the least interruption.

3d. In the year ending 30th November, 1844, navigation suspended, say for the two last days in December, 1843, 2 days.
In January, 1844, from the 10th to the 16th, inclusive, and from 21st, inclusive, to its close, ... 18 "
And in February, the first 25 days, ... 25 "

Total, ... 45 days.

There were 49 days, in these winter months, in which boats did not leave Georgetown.

4th. In the year ending 30th November, 1845,

Navigation suspended, say on the 19th to the 22d December, 1844, and for 2 days late in the month, . . 6 days.
In January, 1845, not at all, ...
In February, the first 20 days, ... 20 "

Total, ... 26 days.

Way bills were not given to ascending boats in 37 days of these winter months.

A Summary *of the preceding is as follows :—*

	Number of days boats did not leave Georgetown	Time navigation was suspended from ice, say	There remain, after deducting from the year the days in the	
			1st column.	2d column.
1st. In the winter months of the year, ending 30th November, 1842,	40	29	325	336
2d. Do. do. 30th November, 1843,	62	62	303	303
3d. Do. do. 30th November, 1844,	49	45	317	321
4th. Do. do. 30th November, 1845,	37	26	328	339
	4)188	162	1273	1299
Averages, - - - -	47	40½	318¼	324¾

On reaching Cumberland, there will no doubt be somewhat more time lost, from ice, than on the lower parts of the line ; but, with a trade that would have justified the expense of breaking the ice, the navigation might have been continued during, at least, one half the time it appears to have been suspended, in the winter months of the last four years. The most extensive forwarder on the Canal, to whom I have already referred, from a point nearly half way to Cumberland, says, in a letter to me, in November last :—"From my own experience in breaking ice, (and I have had a good deal,) with an ice-breaker, properly constructed and built for that purpose, I do not believe that more

than 10 days, during each winter for the last 3 years, would have been lost in navigating the Canal, and the expense would not have been more than $550, per annum, leaving out the cost of the breaker."

The time lost I think would have been greater than he estimates, but not very materially. The present winter—judging from the first half of it—there will be more time lost from ice than the usual average.

The great advantage of an ice-breaker will be in the occurrence of short spells of severe weather, and during the early and latter part of the winter. There is scarcely any advantage in having the Canal open for merely four or five days in the middle of the winter, if preceded and followed by two or three weeks of very cold weather.

Under all the circumstances, and in view of the facts presented, I think that the assumption made, of an average of 300 days of navigation per annum, in the estimate given in this answer, can be relied on.

A STATEMENT, *showing the number of Trips made in the year* 1845, *by two boats, which may be designated as boats No.* 1 *and No.* 2, *both owned by the same person, and running to Georgetown from a point* 81 *miles up the Canal from that place, (about a quarter of the trips, however, were made to Alexandria,) the times of the arrival of each at Georgetown, and the number of barrels of Flour taken down each trip, &c.*

BOAT NO. ONE.			BOAT NO. TWO.		
Time of arrival at Georgetown.	Time between arrival.	Barrels of Flour carried.	Time of arrival at Georgetown.	Time between arrival.	Barrels of Flour carried.
1845.			1848.		
February 27	.	680	February 27	.	700
March 8	9 days	706	March 11	12 days	700
" 17	9 "	700	" 21	10 "	710
" 25	8 "	655	" 28	7 "	601
" 31	6 "	696	April 4	7 "	700
April 7	7 "	697	" 12	8 "	699
" 14	7 "	700	" 19	7 "	701 & equivalent to 10
" 21	7 "	708			
" 28	7 "	650 & equivalent to 37	" 26	7 "	666
			May 6	10 "	606
May 10	12 "	100 & equivalent to 357	" 13	7 "	710 & equivalent to 15
" 19	9 "	617	" 26	13 "	575 & equivalent to 15
June 2	14 "	658 & equivalent to 37	June 9	14 "	377
" 18	16 "	562	" 26	17 "	572 & equivalent to 9
" 25	7 "	474 & equivalent to 75	July 25	29 "	500
July 24	29 "	482 & equivalent to 23	August 2	8 "	700
			" 11	9 "	711
" 31	7 "	701	" 19	8 "	600
August 7	7 "	703	" 29	10 "	700
" 14	7 "	548	Sept. 8	10 "	613 & equivalent to 15
" 25	11 "	568			
Sept. 2	8 "	567	" 16	8 "	710
" 10	8 "	650 & equivalent to 12	" 26	10 "	753 & equivalent to 17
" 23	13 "	700	October 7	11 "	607
October 23	30 "	760	" 13	6 "	690
			" 18	5 "	750
			" 29	11 "	750 & equivalent to 25
Nov. 1	9 "	700	Nov. 11	13 "	710
" 14	13 "	755 & equivalent to 16	" 20	9 "	814
" 25	11 "	900	Dec. 2	12 "	650
26 loads,	271 days.	17,214	28 loads,	278 days.	18,501

N. B. It should be observed that the aggregate of the times, between the arrivals, does not extend over the entire time the boats were running, as the times of descending, the first, and returning, the last trips, are not given.

The descending loads taken by these two boats, as given in the preceding statement, classified in reference to the number of barrels of flour carried each trip, or the equivalent weight in barrels of flour of other articles carried, (those were in the year, of grain and other articles, equal in weight to 663 barrels of flour taken down,) are as follows:—

	Barrels.	Weight in tons of 2240 lbs.
1 load of	900 . .	86 3-4
1 " "	814 . .	78 1-2
1 " "	791 . .	76 1-4
1 " "	775 . .	74 3-4
1 " "	760 . .	73 3-10
1 " "	750 . .	72 3-10
1 " "	725 . .	69 9-10
18 loads, varying from 700 to 711 bbls. each, amounting in all to	tons. 12,670 = 1,221 3-4	averaging per load, 67 7-8
17 loads, ranging from 600 to 699 bbls. each, amounting in all to	11,136 = 1,073 5-6	averaging per load, 63 1-6
12 loads, ranging from 377 to 590 bbls. each, amounting in all to	6,394 = 616 1-2	averaging per load, 51 3-8
54	35,715 = 3,443 9-10	

The 54 loads average $661\frac{4}{10}$ barrels of flour, which is equal to $63\frac{3}{4}$ tons of 2,240 lbs. per load.

For two months, in 1845, the streams entering the Potomac were low, not allowing the millers to grind as usual, in consequence of which the loads average less than they would otherwise have done. It should also be remarked, that the depth of water in the Canal was not, for the entire year, sufficient for loads as large as the maximum one, viz. $86\frac{3}{4}$ tons.

The times between the arrivals of these two boats at Georgetown, as given in the statement, classified, are as follows:—

1 of	5 days interval, ...	5 days.	
2 "	6 "	12	"
13 "	7 "	91	"
7 "	8 "	56	"
6 "	9 "	54	"
5 "	10 "	50	"
4 "	1 "	44	"
3 "	12 "	36	"
4 "	13 "	52	"
2 "	14 "	28	"
1 "	16 "	16	"
1 "	17 "	17	"
2 "	29 "	58	"
1 "	30 "	30	"
52		549 days.	

There were 54 trips made, but as the time of descending (the first trip,) and returning, (the last,) are not given, not having the means of readily ascertaining them, we can only give the time of making 52 trips, viz :— . 549 days.

It will be seen, in reference to the statement, that there were in July intervals of 29 days in the arrivals of the two boats. This was in consequence of the water having been taken out of the Canal in that month for three weeks, for certain repairs. 42 days must, therefore, be deducted from the aggregate time for the *two* boats, . 42 "

Leaving, ... 507 days.

It will also be seen that, in September and October, there was an interval of 30 days between the arrivals of one of the boats, which was owing to the lowness of the streams, already referred to, which prevented the millers from grinding as usual, in consequence of which there was not employment for both boats. Deduct for this, say 30 days less 10 days, ... 20 "

Leaving, ... 487 days.

The average time of these 52 trips, making no deduction whatever, is $\frac{529}{52}$ = ... $10\frac{56}{100}$ days.

The average, deducting for the three weeks when the water was drawn off, is $\frac{507}{52}$ = ... $9\frac{3}{4}$ "

The average, deducting further for the time lost by one of the boats for want of loading, is $\frac{487}{52}$ . . $9\frac{37}{100}$ "

It appears that 34 of the trips, very nearly two thirds of the whole number, were made in 268 days, which is an average per trip of ($\frac{268}{34}$ =) . . $7\frac{88}{100}$ days.

These boats did not run on Sundays after the 1st of June, 1845.

I am informed, by the owner of the boats, that, with a regular business, and the Canal in good condition—without running on Sundays—and " with no extra exertion or extra expense, as to loading or unloading," he could make 4 trips per month, which is a fraction under 8 days per trip. The statement of the trips made this season by the two boats, shows that 29 of the shortest trips—more than one half the whole number—were made in 218 days, which is an average of $7\frac{1}{2}$ days per trip ; or, if we take 23 of the shortest trips, the average is $7\frac{1}{8}$ days, which, taking into consideration that a part, and only a part, of the trips were made, running on Sundays, would be just about equal to 4 trips per month, not running on Sundays. He also says that time was lost this year from taking loading—some of the trips, both for Alexandria and Georgetown, requiring the boat to stop at both places.

Putting the time at 8 days for a trip, from a point 81 miles from Georgetown, including loading and unloading, and inclusive of Sundays, but not running on that day ; and add, for the additional distance

to Cumberland (184 miles less 81 =) $103\frac{4}{10}$ miles, which will be $206\frac{8}{10}$ miles, descending and ascending, at 30 miles per day, and we have

1st. For loading and unloading, and passing down 81 miles of the Canal, and returning the same distance, . . 8 days.

2d. Time required to run over $103\frac{4}{10}$ miles twice, at 30 miles per day, ... $6\frac{9}{10}$ days } $8\frac{05}{}$ "
To which add $\frac{1}{6}$ for Sundays, . . . $1\frac{15}{}$ " }

Total per trip, from Cumberland to Georgetown, and back, $16\frac{05}{}$ days.
Multiplying by 17 trips, the number assumed in the estimate, 17 "

And we have, ... 273 days

required for the whole number of trips, which leaves 27 days of "the 300 days" for contingencies.

The distance of 81 miles was usually run by the two boats in $2\frac{1}{4}$ and $2\frac{1}{2}$ days—say 5 days in the two directions—which is $\frac{162}{5} = 32\frac{4}{10}$ miles per day. Now, on this distance, there are 40 lift locks and 1 tide lock to be passed through; in the distance between the 81 mile point on Cumberland, viz, $103\frac{1}{10}$ miles, there are only 34 lift locks and 3 guard locks to be passed through, which is proportionally a less number. A large part, too, of the latter, it should be recollected, will be over a Canal constructed in a manner that does and will afford greater facilities to the navigation than the lower 81 miles. Thirty miles run per day is, therefore, I think a safe estimate. It is one, which is as fully sustained by the boats generally running on the Canal, as by the two that have been referred to.

As for the number of trips assumed per annum, it is less than has been named by any one engaged in boating on the Canal with whom I have conversed.

Explanatory Documents, accompanying the printed report, here omitted.

No. 4 is a map from an etched engraving, printed in 1826, of the country between Washington and Pittsburg, exhibiting the route and profile of the proposed Canal, including the two lines referred to in the estimates.

No. 5 is an engraved chart of the Potomac River, from Alexandria to Washington and Georgetown, exhibiting the topography of the adjoining shores, with the routes of the lower part of the Chesapeake and Ohio Canal, and the chief part of the Alexandria Canal, printed in 1838.

No 6 is an engraved plan of the town of Alexandria, exhibiting the termination of the Alexandria Canal, printed in 1845, with the depth of water in the neighboring parts of the river.

No. 7 is a manuscript drawing, exhibiting, on a scale of 400 feet to an inch, the termination of the Chesapeake and Ohio Canal, at Cum-

berland; the Main and Branch basins; the proposed dam, with the guard lock and sluice; the basins of the North Branch River and Will's Creek; the adjoining streets of the town of Cumberland, with the termination of the Baltimore and Ohio Rail-road, and also that of the Mount Savage Rail-road.

No. 8 consists of a number of printed specifications of various parts of the works of the Canal, which served as the bases of proposals and contacts, referred to in the answer of the chief engineer to the 18th interrogatory.

No. 9 is a copy of the contract referred to in the report, between the Chesapeake and Ohio Canal Company, and Walter Gwynn and others, for the completion of the Canal for the sum of $1,625,000, payable in the bonds of the Canal Company, executed September 25, 1845.

Letter from B. H. LATROBE, *Chief Engineer of the Baltimore and Ohio Rail-road, dated Baltimore, November* 12, 1845.

CAPT. W. H. SWIFT:

Dear Sir,—At the time of receiving your letter, of the 7th inst., I was so much occupied that I could not reply to it, as I would otherwise have immediately done, and I am now using my first leisure in answering the questions you propose.

1. The length of the Baltimore and Ohio Rail-road, from Cumberland to Baltimore, is 179 miles, including two miles within the city of Baltimore on which horse power is employed.

2 & 3. The ruling, or rather the maximum gradient of the road, is one of $39\frac{6}{10}$ feet per mile in both directions, eastward and westward, except at Parr's Ridge, 40 miles from Baltimore, where the grade on either side of that summit is about 82 feet per mile. There are $16\frac{8}{10}$ miles ascending westward, and $14\frac{76}{100}$ miles ascending eastward; of 30 feet per mile and upwards, besides the grades at the ridge just mentioned, and which are as follows:—

East of the ridge,	1.88 miles;	ascending	$81.\frac{84}{100}$	feet per mile.
West of the ridge,	1.90 "	"	$82\frac{56}{100}$	"
"	.37 "	"	$46\frac{5}{10}$	"
"	.46 "	"	$30\frac{2}{10}$	"

With an intermediate level at the summit of $\frac{29}{100}$ of a mile.

At the ridge, assistant power is used for the tonnage, but not for the passenger trains.

4. There is $16\frac{3}{4}$ miles of road curved with a radius less than 1000 feet; of this, 15 miles, 790 feet is east of Harper's Ferry, and 1 mile 3120 feet west of that point.

5. Of the main line of 179 miles, 116 miles is laid with edge rail and 63 miles with plate rail; besides this, there are 3 miles of edge rail, and 29 miles of plate rail, in lateral tracks and sidings, and portions of double track.

6. There are 26 miles of double track.

7. The passenger engines east of Harper's Ferry, running upon the plate rail and the most curved part of the road, weigh 15 tons. Those west of Harper's Ferry, 10 tons. The freight engines are of three classes: 4 and 6-wheeled, with 2 drivers, weighing 10 tons; 8-wheeled, with 4 drivers, weighing 15 tons; 8-wheeled, with 8 drivers, weighing 22 tons. These last were built for the coal trade. The weight on the 4 drivers of the 8-wheeled engines is between 22 and 23,000 pounds; on the 2 drivers of the 6-wheeled engines, about 15,000 pounds; and on the 8 drivers of the 8-wheeled 22 ton engines, of course, the whole weight of the machine.

8. The *gross* and *net* loads in tons of 2240 pounds, which the three classes of freight trains carry in either direction between Baltimore and Cumberland, are

1. *For the* 4 *and* 6-*wheeled engines*, *weighing* 10 *tons :*

East of Harper's Ferry ; 55 tons gross ; 30 tons net.
West of " 75 " 40 "

2. *For* 8-*wheeled engines*, *weighing* 15 *tons :*

East of Harper's Ferry ; 90 tons gross ; 45 tons net.
West of " 120 " 65 "

3. *For the* 8-*wheeled coal engines*, *weighing* 22 *tons :*

East of Harper's Ferry, 250 tons gross ; 175 of coal.
West of " 330 " 230 "

These engines are frequently assisted over Parr's Ridge by an auxiliary engine, but they are often able, in a good state of the rails, to pass upon the edge rail over the grade of 82½ feet per mile, with the load they bring, to the foot of it, over the plate rail, up an extreme grade of 37½ feet per mile.

9. The edge rail we use, weighs about 51 pounds per yard, and the plate rail about 15 pounds per yard.

10. Our iron coal car weighs 2⅝ tons of 2,240 pounds, and carries 7 tons of the same measure.

11. The time of the freight trains, from Baltimore to Cumberland, averages 16 hours. They go through in one day, leaving Baltimore at 3 A. M. and reaching Cumberland about 7 P. M. The freight trains, from Cumberland to Baltimore, run from Cumberland to Harper's Ferry in about 9 hours, and lie over 12 hours at that point. Thence proceeding to Baltimore, they occupy about 10 hours more in the journey. Thus the running time of the eastward trains, which are much heavier than the westward, is 19 hours.

12. The length of the extension, from Mount Clare depot to the basin, will be, according to the route which may be chosen, from 3 to 4⅛ miles in length.

I am, very respectfully,

Your obedient servant,

(Signed,) BENJ. H. LATROBE.

Note from T. B. Curtis, Esq., *relative to the adaptation of the coal of the Cumberland mines for steamboat use.*

Boston, Feb. 23, 1846.

N. Hale, Esq.

Dear Sir,—In connection with what has been heretofore stated, upon the coal from Cumberland, Maryland, I have the pleasure to add, that the agent in Boston, Mr. James Tisdale, acting for the "Maryland Mining Company," has, within a few days, received an order from Samuel S. Lewis, Esq., the agent for the "British and North American Royal Mail Steamers," for a large quantity of the bituminous coal from the Eckhart mines, to be delivered in the month of April next. This order is consequent upon several extensive trials of the coal on board the ships of that line, as well as of analyses of it made in England under supervision of the Board of Directors. The trials made on board the steamers "Massachusetts," on the Long Island sound, and "Troy," on the North River, are equally satisfactory, fully establishing the utility of the coal for generating steam, while the absence of sulphur, soot, and clinker, makes it preferable for all purposes.

The Baltimore and Ohio Rail-road is now connected with these mines, and an inexhaustible supply is open to consumption.

Yours, faithfully,

THOMAS B. CURTIS.