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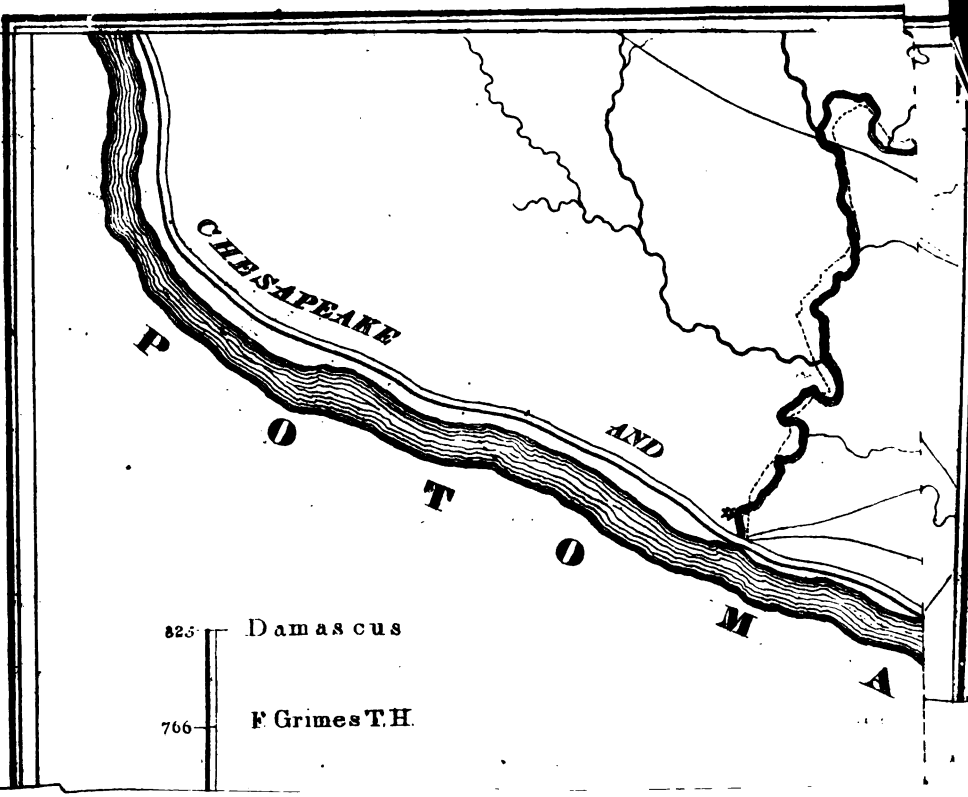
CHESAPEAKE
AND
P O T O M A
825 Damascus
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REPORT

OF

C. Trimble, Isaac R.

THE ENGINEER

APPOINTED BY THE

COMMISSIONERS OF THE MAYOR AND CITY COUNCIL

OF

BALTIMORE,

ON THE SUBJECT OF THE

MARYLAND CANAL.

BALTIMORE.
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ENGINEER'S REPORT.

BALTIMORE, *March*, 1837.

To

JAMES CARROLL,
J. I. COHEN,
WILLIAM DICKINSON, } *Commissioners of the Mayor and City Council of Baltimore.*

Gentlemen,—The appointment which you were pleased to confer upon me as "Engineer of the Mayor and City Council of Baltimore, for the purpose of making the surveys, reports and estimates in relation to the Maryland canal," having been placed in my hands on the 22d of September last, I forthwith proceeded to execute the trust confided to me, with the view, agreeably to your wishes, of preparing the subject for the action of the City Councils at their present session.

It has been impossible, much as I desired it, to present the results obtained at an earlier period.

To select the necessary competent assistants and instruments for the organization of two field brigades—which unavoidably occasioned some delay, especially from the difficulty of procuring instruments on a sudden requisition at a time when the demand for them was unexampled;* to make the surveys which we did; to collate and compare their results with a mass of information derived from previous surveys, embracing the whole scope of country from Westminster to Georgetown; to mature the whole subject, which for many years has been a vexed one, so as to reach myself, a just conclusion, and render it intelligible to others; has, I find, been ample occupation for myself and assistants for a period of less than six months.

By your instructions I am required to investigate this subject under two different aspects; the one with reference to "the *practicability* of a canal with due supply of water exclusively within the territory of Maryland;" the other with reference to the relative merits of each route to the Potomac—or in other words, to ascertain the *preferable* route, without restriction as to locality—the route best calculated to secure to Baltimore the greatest portion of the western trade.

* It was owing to the liberality of the Baltimore and Susquehanna Rail Road Company that we were at last able to obtain, on a temporary loan, the principal instruments required.

The question of a *practicable* route from the basin of Baltimore to some point on the Chesapeake and Ohio Canal is fraught with momentous consequences to this city. Its solution, under ordinary circumstances, would impose upon me great professional responsibility. Standing towards the city, as its engineer, somewhat in the attitude of an agent whose opinion as to the *preferable* route *may* affect its interest, now, and for all future time, I feel, superadded, a painful sense of accountability, and therefore do not desire to, nor will it be expected that I should, offer any excuse or apology for requiring all the time which I deemed essential to do the subject, and especially the interests of the city, justice. I proceed at once to the task.

In order that the subject may be fully understood by those not familiar with the geographical features of the country between Baltimore and the Potomac, a brief description of its principal characteristics will be necessary. Reference is requested to the general map accompanying this report.

About 31 miles from Baltimore is an elevated belt of land, which, sweeping round somewhat in a circle, from the Susquehanna river to the Potomac, below the mouth of the Monocacy, encompasses Baltimore on the north, northwest and west.

This zone of land, called Parr's ridge, is distant about 125 miles from the ocean on the east, and about 20 miles from the South mountain on the west. It has a well defined outline, and maintains, with occasional depressions, a remarkably uniform elevation of about 850 feet above the ocean. It separates the waters of Codorus and Monocacy on the north and northwest, from those flowing directly into the bay of Baltimore and the Chesapeake. Like all mountains and elevated lands this ridge discharges, *in torrents*, the waters which fall upon its summit and sides, into the ravines and valleys of streams which rise at its base.

By reference to the map it will be seen that the Monocacy flows into the Potomac *west* of Parr's ridge, and the Seneca immediately *east* of it.

By a further inspection of the map, it will also appear, that, at Damascus, a subordinate ridge deflects from Parr's ridge, and running south eastwardly, with a pretty uniform elevation of 600 feet above tide, separates into two other ridges at the head of Rock Creek, which continue on in a south and south east direction with a gradual descent, and terminate respectively at the heights of Georgetown and Vansville. The northern part of this subordinate ridge separates the waters of Seneca from those of the Patuxent.

It is apparent from the preceding description, that any route to the Potomac, through the valley of Monocacy and its tributaries must necessarily cross Parr's ridge, while a route to the Potomac through the valley of the Seneca will only traverse the subordinate ridge above referred to.

Parr's ridge, and the subordinate one above described, interpose a formidable barrier to any direct communication between Baltimore and the vallies of the Susquehanna and Potomac, at any point *above* the mouth of those rivers.

However, notwithstanding its formidable character, a passage to the Suequehanna on the north and the Potomac on the west, by some mode of improvement calculated to secure a portion of the trade of Pennsylvania and of the Potomac and Ohio vallies, has been for years the object which has called forth the energies and enterpiize of Maryland and of her commercial emporium.

The favourable position of Baltimore equi-distant about 40 miles from the tidal mouths of those great rivers and with easy access to sea will enable her by artificial means to command the trade of both.

The elementary data with reference to heights and distances from which conclusions have been drawn in this report, were obtained as follows, viz:

1st. From the surveys made under the Maryland Commissioners in 1823, by Isaac Briggs.

2nd. For those made at various times for the Baltimore and Ohio Rail Road, across Parr's Ridge.

3d. From the surveys made by Doctor William Howard in 1828, between Baltimore and Georgetown, with reference to the Maryland Canal.

4th. For the surveys made under the direction of J. Knight, esqr. for the location of the Branch Rail Road to Washington, for access to which I am indebted to the politeness of that gentleman.

5th. From the recent surveys made under my own direction by Mr. F. Harrison, in discharge of the duties imposed by your appointment, and which were terminated on the 19th of December last.

The surveys above enumerated intersect the country between Baltimore and the Potomac, and between Westminster and Vansville in every direction, and furnish, in connexion with minute personal examinations made by myself on previous occasions, and especially during the past fall, every useful fact connected with the subject of a cross cut canal.

The principal features of the country point out four prominent routes from the basin of Baltimore, to the Potomac river; all of which have at different times, been advocated by general or local interests, and their merits more or less investigated. They are as follows, viz:

1. The Westminster route,
2. The Linganore route,
3. The Seneca route,
4. The route to Georgetown.

These routes have each their various modifications and ramifications, which need not be pointed out, inasmuch as they do not affect the comparitive merits of each other.

dicated by guagings, for but one season, unless under extremely favourable circumstances for obtaining the minimum quantity.

These guagings, made in a very dry season, at all events strongly denote the *character* of the streams; and taken in connection with information derived from intelligent mill owners and residents, as to the relative quantities discharged by them at different seasons through a course of years, enables us to arrive, with as much accuracy as is usually attainable in similar cases, at their probable minimum supply in the driest season. We believe this to be *two-thirds* of the quantity as ascertained by our guagings, but to avoid, as far as we can, the liability to error, we shall assume for the minimum quantity discharged by these streams at the driest season, but *one-third* of that as ascertained by our guaging in November; or 8.38 cubic feet per second.

On the supposition that the streams discharge no more water at any season of the year, than in the driest season, we shall have for nine months, the period of canal navigation,

$$\frac{8.33 \times 60 \times 60 \times 24 \times 270 = 7.197.120}{27} \text{ cubic yards,}$$

which we are confident may be fully relied on, as the minimum annual supply from the natural flow of the streams, enumerated.

We will now compute the probable quantity of water which can be annually stored into reservoirs *above* the summit level and made available as a supply to it and the portions of canal contiguous.

The annual mean depth of rain and snow which fell at Lebanon, Pa., from 1829 to 1836, was 40.46 inches.

The greatest depth which fell in any one year during that period, being 44.78 inches, and the least depth 34.49 inches.

From observations made by Lewis Brantz, from 1817 to to 1824, in the vicinity of Baltimore, it was ascertained that during the eight years there fell a mean quantity of 39.89 inches.

The greatest depth which fell in any year being 48.55 inches, and the least depth 29.20 inches.

From observations made at Germantown, Pa., by Reuben Haines, from 1819 to 1827, it was ascertained there fell a mean depth of 38.10 inches. The greatest depth being 50.38 inches, and the least 30.73 inches.

Table No. 1.

Table of the Monthly depth, in inches, of rain at Baltimore,

FROM MR. BRANTZ'S TABLES.

	1817	1818	1819	1820	1821	1822	1823	1824	Mean.
January, . .	2.25	0.9	0.7	2.8	3.3	1.8	5.6	2.3	2.85
February, .	2.8	2.	1.9	2.2	5.4	4.8	0.7	5.9	3.225
March, . . .	4.5	3.	4.55	3.3	1.7	1.3	7.1	4.3	3.71
April, ...	1.5	2.1	2.7	1.1	2.1	2.1	1.8	4.7	2.20
May, ...	2.6	6.45	4.1	4.4	5.1	1.5	2.1	2.95	3.65
June, ...	9.1	1.15	1.3	4.6	1.8	1.5	1.6	5.03	3.66
July, ...	3.5	4.1	2.2	2.2	7.5	4.35	3.6	3.87	3.85
August, . . .	10.4	2.0	4.3	8.0	0.3	0.8	4.1	4.5	4.3
September, .	3.3	3.2	3.0	1.5	10.7	2.25	5.8	2.94	4.45
October, . .	1.8	3.1	0.7	7.8	3.4	2.5	2.8	1.77	2.975
November, .	3.7	2.0	1.1	2.7	5.6	5.1	3.1	2.27	3.2
December, .	3.6	2.6	2.2	1.9	3.3	1.2	6.25	2.25	2.9
Amount, .	48.55	32.6	28.75	42.5	50.2	29.2	44.55	42.28	39.89

Table No. 2.

Table of the Monthly depth, in inches, of rain at Germantown,

BY REUBEN HAINES.

	1819	1820	1821	1822	1823	1824	1825	1826	1827	Monthly Mean.
January, . .			0.48	1.70	3.38	3.67	1.84	1.48	2.72	2.18
February, .		2.55	4.82	2.90	3.86	3.94	4.54	2.50	3.57	3.58
March, . . .		5.01	0.57	2.20	6.87	2.63	5.40	3.54	1.42	3.07
April, ...			3.05	2.16	1.77	4.54	0.75	3.02	3.06	2.62
May, ...		6.36	5.92	2.17	1.60	1.59	2.57	0.22	2.58	2.87
June, ...		1.88	2.60	1.44	0.87	6.09	3.94	5.98	2.98	3.22
July, ...	0.74	6.50	1.84	3.89	6.12	8.80	1.68	5.87	2.90	4.25
August, . . .	3.86	3.64	0.41	1.33	4.68	6.39	4.06	4.30	6.56	3.48
September, .	2.44	1.95	5.74	5.45	3.46	6.60	2.23	2.82	1.18	3.27
October, . .	0.94	8.94	3.24	1.24	2.02	1.53	1.70	5.38	6.57	3.50
November, .	1.00	3.12	4.65	5.00	2.47	2.49	1.05	2.05	5.30	3.01
December, .	1.46	3.25	2.84	1.25	7.37	2.11	3.60	1.47	4.09	3.05
Amount, .	10.44	43.20	36.06	30.73	44.47	50.38	33.36	38.63	42.93	38.10

The average annual depth of rain deduced from these three series of observations, extending through a term of nearly 18 years, appears to be 39.48 inches.

The average of the *least* depth of rain which fell in that period, derived from the same observations, is 31.47 inches.

The observations we have referred to, were made with great accuracy, and may be fully relied on.

Those taken at Lebanon show a greater fall of rain by several inches than either of the others. This is very satisfactorily accounted for by the greater elevation on which the rain fell; Lebanon being about 7 or 800 feet above tide, which would give it, together with exposure, an average temperature of at least 3° of Farenheit colder than either of the other localities.

It is well known that greater quantities of rain fell on elevated than on low grounds in consequence of the difference of temperature, exposure, &c.; hence for our purpose, we deem the result of the observations at Lebanon most appropriate; especially as the local causes at Lebanon and Parr's Ridge—from almost exact similarity of situation, elevation and exposure—must operate to produce the same effects. They are each 130 miles from the sea coast; their elevation above the ocean is nearly the same, and they are each about 20 miles distant from the most eastern ridge of the Appalachian chain—the South or Blue mountain.

Parr's Ridge, from its height, without any elevated ground interposed between it and the ocean, and having none west of it for 20 miles, has a position remarkably favorable for the accumulation of clouds and moisture. Hence the proverbially copious and constant springs issuing from its sides.

These considerations, in our opinion, would fully justify the adoption of the result obtained at Lebanon, and the use in our calculations, of the average quantity of rain which fell there for a period of seven years, viz:—40.46 inches.

However, it will be safer to take an average of the mean quantity of rain which fell at these places.

Lebanon,	40.46 inches.
Germantown,	38.10 "
Baltimore,	39.89 "

$118.45 \div 3 = 39.48$ inches.

But to diminish still further the possibility of error in the computation, we will take an average of the least quantity of rain which fell at each place—

Lebanon,	34.49 inches.
Germantown,	30.73 "
Baltimore,	29.20 "

$94.42 \div 3 = 31.47$ inches.

That is, we are satisfied that the *least* quantity of rain which falls annually over the whole area of 26 square miles on Parr's ridge, amounts to 31½ inches.

The next step is to determine what amount of this annual fall can be accumulated into reservoirs; that is, what quantity will remain after evaporation, filtration, &c. have taken place.

Since there are no means of ascertaining the amount of evaporation and filtration with *absolute certainty*, the opinions and observations of those whose occupations lead them to observe closely the results obtained in other cases, must be brought in aid of our observation and reasoning, with reference to the one before us.

The following results obtained from the well known experiments of Dalton & Hoyle in England, show the proportion of evaporation from the ground, to that of rain, to be as 2 to 3.

	Inch of rain.	Inch of evaporation from the ground.	Inch of evaporation from water.
January,	2.46	1.01	1.50
February,	1.80	53	2
March,	90	62	3.50
April,	1.72	1.49	4.50
May,	4.18	2.69	4.96
June,	2.48	2.18	6.49
July,	4.15	4.06	5.63
August,	3.55	3.38	6.06
September,	3.28	2.95	8.90
October,	2.90	2.67	2.35
November,	2.93	2.08	2.04
December,	3.20	1.48	1.50
	33.55	25.14	44.43

The foregoing experiments were made on a *level* surface, for the purpose of ascertaining what proportion of all the rain which fell was evaporated, and what portion was absorbed by the earth, to the depth of 3 feet beneath the surface.

It is obvious that the result would have been widely different, had the rain fallen upon a surface sufficiently inclined to admit of its flowing rapidly off.

Without enumerating the opinions of authors and engineers on the subject of the ratio of evaporation, it may be observed, that opinions on this subject are usually given with reference to some particular case, under some circumstances which have a control over it; such as the nature of the soil on which rain falls; the structure of the substrata: the gentleness or abruptness of the slopes of the hill sides; the distance water has to flow ere it can reach the reservoir; the existence or absence of forests; heat of climate; prevailing winds; elevation, &c. &c.

Suffice it to say, these opinions vary in ascribing the loss by evaporation and filtration from ⅓ to ⅔ of the annual fall of rain. Or in other words, that in some situations ⅔ of the annual fall of rain can be stored into reservoirs; in others but ⅓—not including the evaporation from the surface of the reservoir when filled.

From the practical knowledge and observation of William Cubitt, Esq., one of the most eminent civil engineers of England, especially for the construction of canals—he expresses the opinion, that the available quantity of water which can be stored in reservoirs in England, is about one half the annual fall of rain.

It is well known that by far the larger portion of surface land in England is clear of forest and under cultivation, and that the face of the country is comparatively flat; circumstances very well calculated to evaporate and absorb a large portion of the rain which falls, before it can find its way into reservoirs.

Viewing the district of country on each side of Parr's ridge, the circumstances are widely different. The surface is elevated and covered with forrests; the soil unbroken by cultivation and hence favourable for shedding off water; the slope of the hills short and abrupt—a combination of circumstances admirably calculated to discharge rapidly the water falling on the surface, into reservoirs, before evaporation and absorption can take place to any great extent.

In consideration of these facts and deductions I do not hesitate to express the opinion, that in this particular district *two thirds* of the annual fall of rain can be collected into resevoirs. But on a more unfavourable supposition, desiring always to be safe, we will take but *one half* of the annual fall of rain, and that not from the average of a term of years, but from the *driest* year known during a period of near *eighteen years*, as ascertained at Lebanon, Germantown and Baltimore, viz: 15¾ inches, for the annual proportion of rain which can be accumulated in reservoirs.

As part of this will be lost by evaporation and filtration, *after* it has been stored in the reservoir and during its use for the canal, it is necessary to assertain how much these two items will amount to, in order to show what will be left as the *available* snpply for the canal.

We conclude from numerous data that during the six months from October to March, the fall of rain on the surface of the reservoir will make good the loss by evaporation and filtration. The tables constructed from observations of Dalton and Hoyle conclusively show this. The same tables show that the evaporation during the six summer months, from the surface of water, exceeded the rain which fell on it, by 12.18 inches, or 1-15th of an inch per day. William Cubitt states it at 1-10th of an inch per day, or 18 inches for six months. As our summer climate is more arid in this country than in England and evaporation consequently greater, we will suppose it to be double Mr. Cubitt's statement, or 36 inches for six months, lost off the surface of the reservoirs, by evaporation ; although their depth exceeding 30 feet, (which would prevent the temperature of the strata at the surface from becoming greatly heated by the sun) and the elevation of the district above the sea, might justify us in fixing the loss at a lower rate.

For loss by filtration and soakage from the reservoirs, we may add 24 inches, in consideration of the very favourable positions for dams, which will make reservoirs of the valleys of large streams, already saturated with water, and consequently well adapted to retain all that is accumulated in them. On this point Mr. Cubitt states, "the amount of soakage in many *canal* levels known to me, is certainly far less than the amount of evaporation, and both *together would not exceed an inch per week.*"

However, in accordance with the rule we have prescribed to ourselves, viz: to err on the safe side, we put down the loss by filtration and soakage the same as the evaporation, viz: 3 feet, making the loss from the surface of the reservoirs by evaporation, filtration and soakage, for the six summer months, 6 feet, or, assuming the depth of reservoirs, which we may safely do, at 30 feet, the loss from *all these causes together* is 1-5th of the whole amount of water, which can be accumulated in them.

We now have the data for computing the annual available supply of water which can be commanded from drainage and the natural flow of streams: as follows.

1st. BY DRAINAGE.

One half of the annual rains on 26 square miles gives 1760×1760×.4376×26 =	35.243.253	Cubic yards.
Deduct, loss by evaporation and soakage from surface of reservoirs, at one fifth,	7.048.650	
Total amount available from reservoirs	28.194.603	Cubic yards.
Add available flow of streams as before ascertained, - - - - -	7.197.120	
Total available quantity - -	35.391.723	Cubic yards.

We thus find the total available quantity of water from all sources to supply the summit of any canal by the Linganore route to be 35.391.723 cubic yards annually.

We will now proceed to ascertain the quantity of water which a canal will require, of the dimensions appropriate to the trade which the Maryland Canal is expected to transfer to Baltimore.

First, as to the dimensions of a canal, which will probably be able to meet the public wants in the event of an active trade when the Chesapeake and Ohio Canal shall have been finished to Cumberland.

We will not pause here to discuss the relative merits of large and small canals IN CONNEXION WITH THE TRADE OF THE VALLEY OF THE OHIO AND THE GREAT WEST—That question was ably discussed and decided by the Board of Engineers for internal improvement of the general government in their able report on the Chesapeake and Ohio Canal in 1826—Suffice it to say, that large canals are preferable in almost all situations, though from motives of economy small ones are sometimes preferred. With a view to but even a small part of the trade of the west, they are absolutely essential.

The dimensions of the Chesapeake and Ohio Canal above Harper's Ferry, are as follows, viz: 50 feet on water line, 32 feet at bottom, and 6 feet deep with single locks—It would seem to be unnecessary to assume any greater capacity for the cross cut canal to Baltimore than that possessed by the Chesapeake and Ohio Canal above Harper's Ferry; since if *no portion* of the western products or coal goes to Georgetown, the trade on the former cannot greatly exceed that on the latter.

But as public works, made during the rapid expansion of internal commerce and agricultural improvements of our country; when new projects and schemes of vast extent and importance, the mere creations of fancy to-day, may become splendid realities to-morrow—should not only be adequate to the existing wants of the community, but capable of meeting future requisitions and accessions of commerce; we shall assign to this canal larger dimensions than those of the Chesapeake and Ohio Canal above Harper's Ferry. On the supposition too, that much detention will ensue in consequence of the great number of locks, this inconvenience on the cross cut canal should in part be remedied by increasing its section, and the construction of double locks.

In accordance with these views we shall fix the width at the surface at 60 feet, at bottom 32 feet, with a depth of 6 feet, and double locks of 100 by 15 feet, and 5 feet lift.

These data being established, I proceed to complete the supply of water needed for the summit level of the canal and the contiguous portions, amounting to a length of 12 miles. Add for feeders from reservoirs, 3 miles, and there are 15 miles to be supplied by the water at command.

I shall divide the expense of water caused by the canal into two parts, viz: *Lockage* and *waste.* The latter including loss by evaporation, soakage, filtration, &c.

1st. *Lockage*—On the plan of double locks, one boat each way will require, if the ascending boats, alternate with the descending ones, but one lock full of water each, to pass them over the summit; which, on the supposition of an active trade would cause but little delay, as there would always be ascending boats ready to take the place of those descending; and as there will be as many boats passing in one direction as the other, there would be but two locks full drawn from the summit at each cross passage. But on the most unfavorable supposition there can be but three locksfull drawn off for each cross passage, as follows: A boat going *east* arrives at the eastern end of the summit, double locks, say both empty—one lock is filled, drawn off for its transit, but in drawing off this lock full one half of it is discharged into the twin lock by a communication between them a boat immediately follows in the same direction, and there is one going *westward* waiting its turn to be lifted into the summit level. The ascending boat enters the empty lock, which being filled, draws off a lockfull—the ascending boat waits till the lock which is half full, is filled, which draws off half a lockfull, or 1½ locks full for the cross passage of the two last boats—Or, to explain it more briefly, *one* lock at each end of the summit level is always kept half full of water, by a communication between the locks, which of course saves half a lock full on each cross passage, and reduces the expenditure of water to 1½ locks full at each end, or 3 locks full in passing two boats on the summit.

The liberal supposition will now be made that the activity of the trade requires the transit of 125 boats per day, each way, for a period of nine full months, or 270 days, which is found to be the *longest* season of canal navigation—Then these 125 boats, each way, will consume per day,

Lockage, $\frac{15\times100\times5\times125\times3}{27}$	=	104,166.66 cubic yards.
Waste $\frac{15\times75\times60\times24}{27}$	=	60.000.00
		164.166.66 cubic yards per day.
Total required for the use of the canal, for 270 days,		44,324,998.20 cubic yards.

The *waste* water which we have computed above, consists of evaporation, soakage, filtration, leakage of lock gates, &c., from the surface sides and bottom of the canal, for the whole distance of 15 miles, for which I have allowed 75 cubic feet per mile per minute.

General Bernard, in the able report on the Chesapeake and Ohio Canal, 1826, estimates this waste for the summit level and adjoining portions at 62 feet per mile per minute.

I have the authority on Benjamin Wright, Esq., for saying that 50 cubic feet per mile per minute, on a well constructed canal, is ample allowance.

Doctor William Howard, from minute personal inquiries on the Erie canal, fixed evaporation, filtration, and *lockage*, after the banks had become consolidated, at 90 cubic feet per mile per minute.

In 1824, judge Bates, who had charge of a portion of the Erie canal, took great pains to ascertain the loss by evaporation, filtration and soakage, the first year the water was let into his portion of the canal. He found it to be 100 feet per mile per minute.

There had been no puddling and the soil was porous; and as is well known in all new canals, the filtration and absorption must have been far more than usual.

The waste of water on a canal has been put down by engineers at from 50 to 75 cubic feet per mile per minute. I have never known greater allowance made on a well constructed canal than 75 feet. Under the favourable circumstances found at Parr's ridge, I think this ample allowance, and have accordingly estimated the waste as before.

By recapitulation it is found that the whole available annual supply of water which can be collected on the summit of the Linganore route, from a drainage of 26 square miles, and from the natural flow of the streams amounts to 35,391,723.20.

That there is required for the due supply of a canal by this route, with an active trade for but 9 months of the year, 44,324,998.20, leaving a deficiency of 8,933,275.20 cubic yards.

I therefore reach the conclusion that a canal by the Linganore route, of the requisite dimensions and capacity, with due supply of water to support the trade which may be carried upon it at the period of its completion, is impracticable.

Seneca route.

Length, - - - - -	76 miles.
Lockage, - - - -	761 feet.
Cost, - - - -	$6,324,300.

This route leaving Baltimore pursues the valley of the Patapsco to Elk Ridge Landing; thence ascends the vallies of Deep and Licking runs to Merrill's ridge, thence across the ridge, and down Chandler's branch to the North branch of Patuxent; thence crosses the tongue of intervening land at a depression, near a school house, and reaches the main Patuxent; thence ascends the same to Etchison's mills; thence crossing the summit descends the Seneca to the Potomac.

The subject under consideration being the practicability of carrying a canal over this summit, with due supply of water, our investigations will be confined to this point.

The principal surveys made last fall were in this district. Four separate lines were traced across the summit within a space of four miles, with a view to develope every fact, which might have an influence in solving the question of a practicable canal communication over it. Here we will observe, that surveys over this summit were never before made.

These lines and the topography in their vicinity are accurately laid down on the map of this summit, to which reference is requested, as also to the maps and profiles from the Washington road to the mouth of Seneca, Nos. 1 to 9. I would here repeat the remark that the ridge which forms this summit, is not the Parr's ridge—but a spur from it diverging at Damascus, in a south-east direction, and dividing the waters of the Patuxent on the east from those of Seneca on the west.

It is similar in character and appearance to Parr's ridge, though much less elevated.

Patuxent river rises near Parr's spring, flows south-easterly, and after a course of eight miles receives Cabin branch—a tributary from the north, seven and a half miles long. Four miles lower down it receives the Cattail branch, nine miles long, also from the north. Six miles further Hawling's river enters, twelve miles in length; a stream whose character was compararively little known until the recent surveys. These are the main branches of the Patuxent in this district, and are remarkable for their constancy.

By an inspection of the map of this summit it will be perceived that about two miles above the mouth of Cabin branch, the Patuxent approaches within a short distance of the Dividing ridge, between it and Seneca. In fact the river may be said to run *against* the ridge, at this point, cutting off, as it were, a portion of its base on the eastern side, and reducing it to less than one mile. Opposite to this point on the west side of the ridge, one of the chief branches of Seneca takes its rise, and after a course of 3 miles, receives a large branch, four miles long heading at Damascus—one and a fourth miles further Magruder's branch enters—four miles long; one mile further, Wild Cat branch empties in—a stream of about the same length as the preceding; descending still further, Daws' branch, four miles long, comes in from the east; four miles further down, Whetstone branch, four miles long, unites with Seneca at Middle brook. These are the main branches of Seneca, and are fed by constant and copious springs.

A cursory view of the ridge in the vicinity of Henry Griffith's seemed to justify favorable expectations, as to the facility of passing the canal through it. In consequence a careful line was traced across it, and its position, elevation, &c., with respect to the adjacent county carefully ascertained.

It was found to be both narrower and lower than at any point for several miles north-west or south-east of it.

The height of the ridge at a depression about one mile north of H. Griffith's, is 578.83 feet above mean tide, and 122 feet above the Patuxent at Etchison's mill.

A tunnel of 690 yards length, at this point, with a deep cut of 50 at each extremity, will reduce this summit to an elevation of 495 feet above tide and 36 feet above the Patuxent at Etchison's Mill. This elevation has accordingly been assumed as the summit level of a canal by the route now under consideration.

A height of 36 feet above Patuxent was chosen with reference to a remarkably narrow pass on this stream about 1½ miles above, near the Annapolis Rocks. The level of the water in the stream at this pass, is the same as that of the summit proposed for the canal. Consequently, a slight dam and feeder would divert the waters of Patuxent into the Seneca, were this tunnel constructed. A cut of 40 feet near the Annapolis Rocks, will also divert the waters of Cabin Branch, into the Patuxent.

As the natural flow of streams, which can be brought into the summit, is not sufficient to supply the wants of a canal, resort must be had to reservoirs, as on the Linganore route.

It is upon the natural flow of Patuxent, Cabin Branch, heads of Hawling's River and branches of Seneca, and the drainage of the basins of these streams, that we propose to rely for water to supply the summit level of the canal and adjoining portions.*

For the latter purpose, a part of the annual fall of rain on the area of those basins must be collected into reservoirs, during the winter and spring. The vallies of Patuxent, Cabin Branch and Seneca, are admirably adapted to the formation of artificial lakes, by dams, erected at no extraordinary cost, across them; remarkably favourable sites for which, are numerous.

The rain falling in these basins is discharged rapidly from steep side hills, as from so many roofs, into the vallies below.

It is this favourable character of the country which will enable us to accumulate a large portion of the annual rains, which, if they fell on a more extended and level surface, would, ere they could reach the reservoirs, be exposed to evaporation and leakage in so great a degree, as to deprive us of a large portion of the winter and spring floods.

We proceed at once, to compute the quantity of water which may be relied on to supply the summit level and adjoining portions of the canal, extending from the mouth of the Cattail on the Patuxent to Wild Cat on the Seneca—a distance of 12 miles.

We reject, as we did on the Linganore route, all methods of supplying the canal with water, by elevating it from a lower to a higher level by machinery.

The area which can be commanded for the purpose of collecting water into reservoirs to supply the summit level and adjoining portions, amounts to 46 square miles, without including the inferior areas amounting to 12 square miles, which can also, without extraordinary expense, be made to contribute their portions of annual drainage.

* In ascending the Patuxent, the discharge from Cattail, Hawling's River, and the Patuxent, not estimating the redundant water from the summit—will, without a reservoir on Cattail—certainly with it, supply the lower portions of the canal with water; while that portion of canal in the lower Seneca valley will in like manner, be supplied with water from Wild Cat, Daw's Branch, Magruder's Branch, Whetstone Branch and Seneca.

The character of the district adjacent to this summit, with regard to flowage of streams, drainage, &c., being entirely similar to that on the Linganore route, it is not necessary to indulge in any repetition respecting them.

The same data, deductions, and reasoning will be used on this, which were used on that route, varied only so far as to render their application just and proper.

Assuming as before, that one half the annual fall of rain can be stored into reservoirs, and that 4-5ths of this can be made available as a supply for the use of the canal. We have the following result from an area of 46 square miles.

	Cubic Yards.
1760×1760×46×.4376,	63.253.448.96
Loss by evaporation, &c., 1-5th,	12.470.689.79
Available annual supply from reservoirs,	49.882.759.17

The streams whose natural flow can be rendered available to feed the summit level are as follows—with the quantity of water discharged by them per second, by measurements made in November.

Hawling's River,	4.98	Cubic	Feet
Patuxent,	7.65	"	"
Cabin Branch,	5.01	"	"
Darby's Br. of Seneca,	5.03	"	"
Seneca,	3.83	"	"
Adam's Run,	1.56	"	"
Daw's "	.48	"	"
Riggs Run,	1.99	"	"
White's Branch,	1.17	"	"
Lemmon's Branch,	.57	"	"
3 small branches,	1.53	"	"
		"	"
Total,	33.80 cubic feet per second.		

As before remarked on the Linganore route, we might in consequence of the dryness of the last fall, take ⅔ of the above as the average discharge in August, for a term of years. We will however for reasons given before, assume but ⅓ of the quantity as above, or, 11.27 cubic feet per second, the minimum discharge at the driest season, which gives for the 270 days of canal navigation, a yield of

$$\frac{11.27\times60\times60\times24\times270}{27} = 9.737.280 \text{ Cubic yards.}$$

Add quantity supplied by reservoirs	49.882.759.17
Total	59.620.039.17

Thus we have for the total available supply, the foregoing result.

The next step is to ascertain the wants of a canal such as we contemplated on the Linganore route, with the same amount of trade as there assumed, viz. 125 boats per day in each direction for 270 days.

1st Lockage $\frac{15\times100\times5\times125\times3}{27}$ = 104.166.66 Cubic yards.

2d Waste on 12 miles of canal
and 11 " of feeder

23 Miles.

$\frac{23\times75\times60\times24}{27}$ = 92.000.00

Total 196.166.66

or, for 270 days, 52.964.998.20 cubic yards.

RECAPITULATED.

Total supply	59.620.039.17 cubic yards.
Wants of canal	52.964.998.20
Surplus	6.655.040.97 cubic yards.

Leaving a surplus of 6,655.040.97 cubic yards annually for contingences of all kinds.

From the foregoing facts and deduction we are *forced* to the conclusion, that a canal by this route, with due supply of water, for an active trade is practicable—and however much we may regret a variation of opinion with predecessors, whose character entitles them to confidence, but who have not of course reasoned from the same data as ourselves—else would they have arrived at the same conclusion—we are compelled to announce the practicability of a canal by the Seneca route, especially as an additional area of 12 square miles can be drained into the canal adjoining the summit which will yield 18.972.800 cubic yards, increasing the surplus to 25.549.374.30 cubic yards annually.

Having expressed the above opinion, candour compels us to say at the same time, that the supply of water for a canal, obtained from reservoirs, has been usually attended with partial disappointment, either from hidden causes or defective calculation, and that every sound engineer would seek, in preferance, a supply from other sources if such were within his reach. However, numerous canals are in operation in this country and Europe, whose chief supplies are from reservoirs.

An interesting fact relating to the demand for water in the driest season is found in the report of the canal commissioners of Pa. for 1836, viz. that the months of most active trade are June and October, when water is comparitively abundant. In 1836 the trade on the Pennsylvania canals in August, was to that of either June or October in the diminished ratio of 45 to 72 or 37 1-2 per cent less, and that the trade of July and September was to that of June and October in the ratio of 122 to 144, or 15 per cent less.

These facts would show that the demand for water during the months of July, August and September, but especially in August, will be much less than we have allotted in the preceding estimates.

4. Route to Georgetown, D. C.

Length, - - - - - - -	44¾ miles.
Lockage, - - - - - - - -	262 feet.
Cost, - - - - - -	$3,530,000

For the route of the canal to the District of Columbia we might for our comparisons, adopt that preferred by Dr. William Howard, eminently qualified as he was on the subject, on experimental surveys made in 1825, under his directions.

There are, however, some changes from this route which we deem advisable, and which were in fact suggested, and would doubtless have been selected by him, on further maturing this plans and on making a final location.

The principal change consists in the selection of the most southern line, spoken of by Dr. Howard, from the point where his route crosses Merrill's ridge to Bladensburg. By this route, deep cuts similar to those he projected through Middle ridge and Snowden's ridge—the *first* between two Patuxents, with a cut in the deepest place of 74 feet and 1⅝ miles long—the *second*, between Big Patuxent and the eastern branch of the Potomac 72 feet greatest depth, and 2½ miles long; may be substituted by others of very ordinary magnitude through the same ridges, but at much lower depressions.

The propriety of this change is fully confirmed by facts developed on the surveys made under the direction of J. Knight, Esqr., for the location of the rail road to Washington.

From these surveys it appears that the ridge or tongue of land between the two Patuxents on the most southern route, suggested by Dr. Howard, is at a depression near a school house, but 135 feet above mean tide—and that a depression in Snowden's ridge on the farm of Zelic Duvall, is 155 feet above mid tide. The elevation of land and nature of the soil, &c. at these two points, exhibits the most favorable character both for slight cuttings and easy excavation.

The height of the summit level assumed by Dr. Howard, is 146 feet above tide—This level if carried through the route we have spoken of, would be 21 feet *above* the depression in Middle ridge—and but 9 feet below that at Zelic Duvall's.

These facts are of extreme interest in connexion with the proposed canal, and show that not only a lower level through Middle and Snowden's ridges than that referred to by Dr. Howard, will be expedient, that the height of the summit and consequently lockage, may possibly be diminished with advantage, but also that the cost of the formidable cuts through Middle and Snowden's ridges, may be so reduced as to require nothing more than an ordinary expenditure of money.*

*It is confidently believed that such a level for the canal can be assumed, as will avoid the necessity of any injury to the extensive Savage Cotton Factory on the north branch of the Patuxent.

These facts also present the subject in so new and favorable a light, that it is scarcely necessary for me to suggest the great propriety of making further surveys during the ensuing summer, with reference to this special object.

The estimate of cost which has been prefixed to this chapter, has been made on the assumption that a canal on the most liberal scale, with double locks, to meet any future emergencies of a crowded trade, will be necessary between Baltimore and the District.

We have carefully reviewed Doctor Howard's estimates, made in detail, with all the advantage of his experience, while with the Board of Internal Improvement of the general government for several years; during which time he assisted to frame the estimates for the Chesapeake and Ohio Canal, the accuracy of which subsequent experience has so fully verified—and have arrived at the conclusion, viz: That although the wages of labor, &c., are greater now than at the time these estimates were made, the cost of the canal, in consequence of avoiding the deep cuts alluded to, and including the necessary walling, not estimated by Dr. Howard, will very little exceed the entire cost as estimated by him, viz, $2,980,815,40—We, have, however, supposed it may reach $3,530,000.

Doctor Howard investigated the resources for water on this route with great care. Numerous guagings of streams were made, and repeated after an unexampled drought in the autumn of 1828, when, as he remarks, "the inhabitants observed that the waters were then lower than at any previous time within their recollection."

He ascertained that at this season of drought there could be commanded to supply the summit level 40.19 cubic feet per second; which he deemed amply sufficient to supply it with water, without the aid of reservoirs. Should a resort to these be unexpectedly necessary, there can be accumulated by dams, at remarkably favourable points across the Patuxent, water, to the most redundant excess.

The portion of canal next to Baltimore will be amply supplied from the Patapsco, and that between Georgetown and Bladensburg will receive abundant supplies from the Potomac.

There can be no question, therefore, without going into details, that an ample supply of water for the whole canal on the most liberal scale, and with double locks, can be obtained at a moderate expense.

The following table will exhibit a comparison between the four routes.

	Table No. III.	Miles length.	Lockage.	COSTS. Dolls. Cts.
1st	Westminster route, ...	113	850	
2	Linganore route, ...	81	827	8.810.000
3	Seneca route, ...	76	761	6.324.300
4	Georgetown route, ...	44¾	262	3.530.000.00
5	Mouth of Seneca to Georgetown by Ohio and Chesapeake canal.	23	205	
6	Mouth of Seneca to Baltimore, via. Georgetown, ...	67¾	431	

Of the preferable Route to the Potomac.

It now becomes necessary to determine which of the two practicable routes in the preceding table is best calculated to secure to Baltimore a portion of the western and coal trade.

This enquiry has on various occasions elicited the feelings of the citizens of Baltimore. It is now invested with extraordinary interest, as the time approaches for the completion of the Chesapeake and Ohio Canal to Cumberland, and calls for some decided and vigorous movement on the part of the city to secure to her the advantages she possesses from locality, and the benefits of the coal trade, which she may well claim for the uniform, active and efficient support with counsels and with money, which the State of Maryland has extended to that great national work. The canal to Cumberland may, and doubtless will, be completed in two years, and the agricultural products and rich minerals unlocked by this great enterprize, be found floating on its bosom to tide water at Georgetown.

The citizens of Baltimore will scarcely deprive those from the western part of the State of Maryland of the advantage of her markets or relinquish herself the benefits—so certainly to be conferred upon her or the citizens of the District, by the coal trade of Cumberland, by longer delaying the commencement of a cross-cut canal.

If such a canal is not to be made, it may very pertinently be asked, for what reason has the State of Maryland invested her funds so liberally in aid of the Chesapeake and Ohio Canal?

A consideration of all the facts now before us, without reference to any interests to be promoted or injured, leads directly to the conclusion that the route to Georgetown is that which any engineer would select on which to construct the *shortest*, *cheapest*, and most *capacious* canal, to connect the harbour of Baltimore with the Chesapeake and Ohio Canal. A glance at routes 3 and 4 in table III. will bring any individual to this conclusion.

the relative distance to Georgetown and Baltimore, and that he was

An inspection of table III, and a comparison of routes No. 3 and 6, will as readily and *clearly* convince ony one that, the cities of the District out of the question, the route from mouth of Seneca to Baltimore through Georgetown, for the purpose of transporting burthens in the cheapest and most expeditious manner, is decidedly better than that of No. 3 through the Seneca and Patuxent vallies, though there were less disparity in the cost of the two.

Let the relative expense of transporting one ton of coal from the mouth of Senaca to Baltimore by hoth routes, be computed.

We suppose the rate of travelling on each route to be 3 miles per hour, and that the passage of each foot of lockage will occupy one minute—then the time of travelling each route will be as follows, viz.

Route No. 3,	$76 \div 3 = 25.20$ $761 \div 60 = 12.41$	= 38 hours 1 minute.
Route No. 4,	$67\frac{3}{4} \div 3 = 22.35$ $431 \div 60 = 7.11$	= 29 hours 46 minutes.
Difference, - - -		8 hours 15 minutes.

Showing the time of travelling the Senaca route to be 8 hours 15 minutes longer than through Georgetown—or $27\frac{1}{10}$ per cent. longer time. Hence if the freights $\frac{5}{10}$ cent per ton per mile, on the route from Seneca to Baltimore *through* Georgetown, they would be on the Seneca route, $\frac{6386}{10000}$ parts of a cent per ton per mile.

Then the relative expense, including tolls and freight for transporting one ton of coal by both routes to Baltimore, will be as follows—as also the expense of transporting the same from Georgetown to Baltimore.

TABLE IV.

	Length in miles.	Lockage feet.	Tolls per mile.	Freight per mile.	Total expense.
Seneca route,	76	761	$\frac{1}{2}$ cent	$\frac{6386}{10000}$	86 $\frac{53}{100}$ cents.
Georgetown route,	$67\frac{3}{4}$	431	$\frac{1}{2}$ cent	$\frac{5000}{10000}$	67 $\frac{75}{100}$ "
Georgetown to Baltimore,	$43\frac{3}{4}$	262	$\frac{1}{2}$ cent	$\frac{5000}{10000}$	44 $\frac{75}{100}$ "

Shewing a difference of $18\frac{3}{4}$ cents per ton on coal, in favor of the route through Georgetown, and 44 3-4 cents to transport one ton of coal from Georgetown to Baltimore.

But it will be asked "is it not better to construct a canal on route No. 3, which will divert the trade to Baltimore, ere it reaches Georgetown?" Certainly, if such a canal *would* divert the trade. Let us take an example—A boat descending the canal arrives at the mouth of Seneca. It would be an extravagance to suppose that the owner of this boat could be kept in ignorance, even if he were previously so, of the fact that he was but 23 miles from the latter, and 76 miles from the former. Would the owner of this boat, with this knowledge, take the Seneca route to Baltimore, unless there were strong inducements of some kind to draw him there? And supposing such inducement did exist; that it was to his interest to dispose of his cargo in Baltimore; would these same inducements, operating upon him at the mouth of Seneca, become impaired by his passage through Georgetown? In a word, if the markets were equally good, a cargo at the mouth of Senaca would be taken to Georgetown and there disposed of. If the markets at Baltimore were better, the cargo would still be taken *through* Georgetown to Baltimore, as a cheaper and more expeditious route, than that by Seneca. This view of the subject is so clear that we should disparage the understanding of the community by further detail.

We have thus arrived at the conclusion that the *preferable route* for a canal from the basin of Baltimore to the Chesapeake and Ohio Canal and thence to Cumberland, is that to the District of Columbia—Its *length* and *lockage* and *cost* are less than any other; its capacity for the transportation of heavy burthens at the least expense and the shortest time exceeds greatly that of any other, and its facilities for future enlargement incomparably greater—for while the canal by Seneca will admit of no future enlargement, the one to Georgetown can be inceeased to any desirable extent.

We will subjoin some remarks as to the relative advantages of Baltimore and Georgetown, with reference to a communication with the sea.

The position of the cities of the District on tide water, and at the debouche of the Chesapeake and Ohio Canal, is supposed to confer on them an advantage over Baltimore in the coal trade, and that of other articles, from the circumstance of boats being compelled to encounter additional time and expense in coming 44⅜ miles further by canal for the sole purpose of reaching Baltimore.

But there are two considerations which influence by natural causes, the relative advantages of Baltimore and Georgetown or Alexandria. 1st. The facilities of reaching these cities from the west; and 2d. the facilities of going thence to sea.

These considerations should be weighed, on the supposition that each city stands purely on its local merits, without ascribing any present advantage to Baltimore, from her wealth, enterprise and established connexions in business, which may hereafter be possessed by the others.

From Georgetown to the mouth of the Potomac, the distance is about 125 miles—From Baltimore to the mouth of Potomac, the distance is 100 miles.

The depth of water from Alexandria to the mouth of Potomac is sufficient to carry out a frigate without her armament, or about 19 feet—but owing to the intricacies of the channel at the Kettlebottom shoals, it is not safe to carry out more than 17 feet, unless vessels are towed by steamers. Sandy Point, about 30 miles below Georgetown, is also a difficult pass—but there is undoubtedly depth of water sufficient for all commercial purposes, from Alexandria to sea.

From Georgetown a greater depth than 14 feet has not been obtained, and this not constantly, even with great expense of dredging, the channel being liable to fill up by a single flood of the Potomac.

The obstacles to the navigation of the Potomac river are its deficiency of width and circuitous course, making it almost impossible for vessels to beat through the *reaches*, as they are termed—and a rare occurrence for any ship to get out with the same wind.

Mount Vernon reach and Maryland reach present great difficulties unless the wind is from the exact quarter to carry ships through. We have understood that ships nave been detained in the Potomac, by contrary winds, two weeks.

From Baltimore the egress to the sea is easy. The same wind from several quarters will carry ships to sea; while the width of the bay affords ample room for vessels to beat with facility against head winds.

The difference of time in going to sea from Georgetown and Baltimore, is probably *three days*, on the average, in favor of the latter.

If steamers are employed to tow vessels on the Potomac, this advantage in point of time will in a great measure be neutralised, though at a greater cost on the part of Georgetown.

It is believed, with ordinary favourable winds that vessels could sail to the mouth of the Potomac from Baltimore, or at all events from the Bodkin, as soon as they could reach the same point from George town by the aid of steam tow boats.

The advantage possesed by Baltimore, in the greater facility of getting to sea with ships, will, in respect to the coal and coasting trade be obvious—it is upon the number of trips which any vessel can make that her profits depend, and no vessel would be willing to lose three days in a voyage along the coast, with the risk of occasional detention in the Potomac two weeks, when she could come to Baltimore three days sooner.

But the unrivalled advantage possessed by Baltimore is in the now well ascertained fact that navigation during the severest and most protracted winter weather, can be kept open, and freed from any embarrassments which would impair seriously the facility of going to sea.

This is effected by ice boats, which in ordinary winters are only required to open occasionally a passage to the Bodkin, about 15 miles from Baltimore.

The use of ice boats from Georgetown, is, undoubtedly practicable, but with this serious disadvantage. The Potomac (freezing earlier in winter and opening later in spring than the Patapsco) is closed with ice nearly to its mouth. Hence the necessity of ice boats traversing the whole length of the river; which if not absolutely impracticable, would hardly prove expedient, owing to the expense attending its execution.

The foregoing facts, showing the decided superiority possessed by Baltimore in the facilities of ingress and egress to and from her harbour, but especially during the winter season, lead to the inference that importations of foreign goods will be made into Baltimore when they cannot be introduced into the cities of the district. As a consequence of this, western produce will seek here, in preference, a market, where it can be sold to pay for dry goods and other articles required for the western markets. For where purchases are made, sales will be effected, if prices are equally high, as a natural consequence depending upon the fixed principles which regulate all trade and interchanges.

If therefore, the way is open, Baltimore will become the great mart to which western produce will be sent, to make payments, directly or indirectly, through the usual changes and transfers of commerce, for the merchandize which is required for the west, and which we have shown can be imported into Baltimore at the earliest period to accommodate the spring purchases.

With artificial communications to the GREAT WEST, open equally to her as to her rivals, Baltimore may securely rest her prosperity on the unrivalled advantage she possesses in a harbour open at all seasons of the year to foreign and domestic importations.

On this advantage, her greater proximity to the west, her reputation and enterprize, must Baltimore rely, for the prosperity which she, in common with every Atlantic city, is aspiring to, and which doubtless will be the lot of all—sharing as they must with each other the illimitable trade of the gigantic west—which it is not too much to say *no one city could accommodate* and which ere twenty years, will require double the number of avenues now completed or *projected* to transfer it to the cities on the Atlantic coast.

In conclusion, I deem it proper to remark; that much credit is due to Mr. F. Harrison, for the energetic manner in which he conducted the field operations, which his former experience well qualified him to direct. And to Messrs. Wilson, Edes, Chiffelle and Finley, levellers and surveyors, as also to the respectable young gentlemen attached to the brigade. The activity and cheerfulness with which duties were discharged by all, even amidst the rigours of winter, are worthy of all imitation.

The maps, profiles, and discriptive memoir, illustrative in detail, of the Linganore and Seneca routes, herewith presented, confer great credit on Mr. F. Harrison, and on Messrs. Wilson, Edes, Chiffelle and Edward H. Harrison, for the promptness and neatness with which they have been executed.

All which is respectfully submitted,

by your obedient servant,

ISAAC TRIMBLE,

Civil Engineer.