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MR. LATROBE'S COMMUNICATION.
(CONCLUDED.)

The advantage of so level and soft a surface for the cut is counterbalanced by the total absence of water to supply it. This circumstance is very important in determining the choice of the line of the canal, among so many that are equally practicable; for as all its water must be brought from the higher grounds upon the ridge, its location ought to be as near the ridge as possible, in order that the feeder being short, the leakage and evaporation of a long feeder may be avoided. The location of the two ends of the canal does not, however, entirely depend upon its general course along the summit; and a great variety of terminations have been proposed; as equally eligible, both on the Chesapeake and the Delaware side. The former, after long and careful examination, has been decided in favor of Welch point, where there has, within the memory of man, been no diminution in the depth of the water, which is below the deposit of alluvium from Elk creek, and where the water is so wide and so deep, as to furnish a very capacious basin for many years to come, for the considerable land wash of Back creek and the small drains in the neighborhood. But on the Delaware side much difference of opinion has prevailed. The summit level of the canal in every case must reach the principal road leading from Christiana bridge down the peninsula, near a tavern called the Bear. This place is only two miles from Hamburg or Red hood, on the bay of Newcastle, and a cheap and short cut might be made to either of these points, especially to Red hook, did not two considerations forbid it—the broad & wild water of the bay, & its shallowness at a great distance from the shore, there being only 4 feet 6 inches at low water. Newcastle, is the next eligible point. Newcastle is situated on a prominent point, which is swept both by the flood and ebb tide. There will therefore be always deep water at the *outer* wharves and piers at that place, and less than 21 feet has not been found on the outside of any of the piers lately erected; or formerly, and even at the present, at the wharves excepting only where the eddy occasioned by the piers has accumulated soft banks of mud.

There could not be a moment's hesitation in fixing the termination of the canal at Newcastle, unless the following reasons should be thought to outweigh the advantages of the best water in the Delaware, and the shortest navigation across the peninsula, which this point offers. It is in the first place feared, that in time of war, when the canal would be invaluable as a means of conveyance of military stores and bodies of men, an enemy's ship of war might destroy the works at Newcastle in a sudden incursion, and return to sea, before the mischief could be prevented. It is further urged, that the mouth of the canal on the river below the tide would be liable to be filled up, in a very short time, as are all places on the Delaware where there is an eddy. And it is also alledged, that Newcastle is situated so far below Philadelphia (33 miles,) that unless with a favorable wind, dull sailing vessels cannot reach Newcastle in one tide, when they might reach the mouth of Christiana, 4 miles higher up the river, and go up the creek with the flood.

The first argument appears to me to be deserving of consideration in a national point of view, and a small fort would be necessary to defend the mouth of the works against an enemy who should attempt to land, to blow them up. But they could not be injured even by shells beyond the destruction of the gates, which a few hours could put again into repair. To obviate the second objection it would be necessary to place the tide lock as far out as possible, and to carry out and wharf the side of the canal below the lock as far into the river as the most projected wharf. The line of the wharves is now limited to 600 feet beyond the lowest street, called Water street, and unless further protruded into the river by a law of the state, this distance presents no formidable difficulty to the work, and places the utmost extension of the wharves, beyond the present time. The third objection is not without foundation. But the narrow and crooked navigation of Christiana creek, presents infinitely more cause of delay than the distance of four miles in the bold navigation of the Delaware. There is however in these objections enough to render it an object of infinite importance both to the nation and to the company, to avail themselves of both the eastern terminations of the canal, and to make a cut also from the Bear to the Christiana creek, about three miles above Wilmington, on a line not altogether so favorable, nor so short as to Newcastle, but presenting no difficulties of importance whatsoever. From the point (Mendenhall's) at which the termination is proposed, 10 feet may be carried out to the river Delaware. The objections to this termination are: the tedious and very crooked navigation of the creek for seven miles to the Delaware. The drawbridge at Wilmington, which must be passed; but more than any other, the opposition of the tides of Delaware and Christiana creek. For if a boat comes into the canal at Welch point at high water, and passes across in six hours, she will find half flood in Christiana, and must wait the ebb to go down. On her arrival in the Delaware in two and a half or three hours, she will have again to wait three or four hours for the flood to proceed to Philadelphia, or up the Brandywine, to the celebrated mills, the interests of which are well worthy of attention. Whereas a vessel arriving at Newcastle and finding the flood tide running, which will always happen if she comes to Welch point with a flood tide, may at once proceed up the Delaware, or up the Brandywine or Christiana creek, without delay. It must also be mentioned, that without a favorable tide, it is difficult to work down the Christiana creek against the wind, which is always unfavorable in some reach or other of its crooked navigation, when on the contrary, there is ample room in the Delaware to use all advantages of wind and tide.

On the other hand, it must be urged in favor of Christiana creek, that there is navigable water for boats drawing 8 feet above the proposed termination of the canal, as far as Christiana bridge, and that the navigation may be pushed still higher;—that the little town of Newport is now the depot of the produce of a very extensive and fruitful country, extending into Lancaster county, and is 20 miles nearer to Lancaster than Philadelphia, and that to connect so important a field of productive business immediately with the canal, it may be worth while to incur an increased expence and some inconvenience and delay in the mere *thorough fare* navigation: and it may be added, that the large fixed capital of the town of Wilmington, far exceeding that of Newcastle, demands from the good policy, as well as the good will of the company or the nation, some consideration.

Well aware of the thankless task of giving a decisive and honest opinion on either side, I content myself with furnishing the materials of determination to you, and proceed to describe the nature and principles of the work actually executed in the feeder, and proposed for the canal.

Between the waters of the Chesapeake and the Delaware there are three streams which, rising in the high land above the canal, may be brought down to it as feeders, the Christiana creek, the Whiteclay creek, and the Elk itself.

The Elk and the Whiteclay are nearly equal in the regular quantity of water they supply, the Christiana is both smaller and more irregular. The Elk descends in a very crooked and rapid stream, 84 feet in four miles from Elk forge to the tide near Elkton, and unites with the tide water of the Chesapeake at Turkey point. The ridge that separates its waters from those of the Delaware terminates in a high insulated hill, called Gray's hill, which is united to the high land by a low narrow ridge, crossing the post road on the boundary line of Delaware and Maryland. The Christiana creek is the first water falling from the high land in the Delaware. It collects all the waters that fall round the high insulated hill called Iron hill, at the N. E. foot of which it turns to the N. E. and running in that direction under the foot of the granite ridge into the Delaware, receives the Whiteclay, Redclay and Brandywine in its course, and also numerous land drains from the level land to the South East. Of these three streams it has been ascertained that they may all be brought to the canal, but the Elk with the least expence and the shortest cut. The vallies in which they all run having been worn in deep and rocky land, and branching into deep ravines, the beds of rapid rivulets, offer great difficulties to the work necessary to divert their course.

In the Elk feeder, the canal is cut in the rock for about half a mile; embankments are made across several vallies, but the principal difficulty and expence consisted in cutting through a tongue of high land called Belhill, through which the digging is 30 feet for near half a mile, and again thro' the dividing ridge, to the depth of 25 feet for above half that distance; these two difficulties have been conquered. Another smaller hill remains to be cut through, but it may be avoided by a circuitous cut, much less eligible. On the Delaware side of the ridge, the feeder is cut through a swampy flat of more than a mile in length, while the descent is only six inches. The general elevation of this flat is 86 feet above the tide, and as the head of the feeder at Elk forge is only 84 feet it could have little descent, and falls only 2 inches in a mile. It has on this account been made a spacious canal of three feet six inches water, 22 feet 6 inches on the surface, and 12 feet at the bottom, affording as far as it goes a good and valuable inland navigation. The feeder is six miles in length; at the end of 5 miles is a lock for the passage of boats, and a side cut to communicate with the reservoir. A contiguous valley offers the means of making a reservoir, of more than a hundred acres. It has been proposed to embank 30 acres for this purpose. The lock is of 10 feet lift. The reservoir will be level with the upper feeder, of course 10 feet above the level of the canal, and under such a head will give the canal a plenteous and rapid supply as it is wanted. Below the lock the feeder is 5 feet deep, and 27 feet on the surface of the water: it will join the canal about a mile west of Aikentown. In the construction of the feeder permanence has been a very principal consideration. All the culverts are of solid masonry; no land water can run into the cut; the banks are sloped as 2 to 3; the embankments are well puddled, and the piers of the bridges are of hewn stone.

From the description which I have given of the soil of the peninsula, it is evident that the amount of digging constitutes the chief expence of the canal. To lessen this amount and to shorten the canal, it is proposed to quit the level in three places, and to cross three land drains that lead into Christiana creek, one at Aikentown, and two between Aikentown and the Bear. Small acqueducts and short embankments only are necessary to effect this. If the canal should terminate at Newcastle, a narrow marsh must also be crossed—if at Christiana, deeper cutting must be encountered.

But neither of these difficulties increase the expence of the canal more than $7,500 each, beyond that of the same length of the general cut.

On all other points the report of the committee furnishes ample information; and I will only add, that neither in Europe, nor in our country, do I know a line of inland navigation, which by so short a distance, and at so easy an expence, unites such extensive and productive ranges of commercial intercourse.

With the highest respect,
I am yours,
(Signed) B. H. LATROBE.

ALBERT GALLATIN, Esq.
Secretary of the Treasury.

April 1, 1808.

POSTSCRIPT.

In the questions proposed to me by you, the subject of artificial roads was comprehended. But being informed by you that the canal companies of Pennsylvania and Maryland, had transmited to you ample accounts of their undertakings, and as in their works, experience has taught a system and mode of execution, of the most perfect kind; I have refrained from adding any thing to the information thus acquired. It has has however occurred to me, that a few remarks upon rail roads might not be unacceptable to you, especially as the public attention has been often called to this sort of improvement, and the public mind filled with very imperfect conceptions of its utility.

Rail roads may be constructed of iron or of timber. The most durable (but also the most expensive) rail roads, consist of cast iron *rails* let down on stone foundations; such roads will last for ages. Cast iron rails secured on beds of timber, are sufficiently durable for our country, and of moderate expence. Rail roads entirely of timber, are fit only for temporary purposes.

A rail road consists of two pair of parallel ways, one pair for going, the other for returning carriages: single roads with occasional passing places, are applicable to some situations, and are of course less expensive. I will concisely describe the road best adapted to the objects that in our country can be attained by it:

——*The rails* are of cast iron, and consist of a tread and a flanch, forming in their section the letter L. The tread is 3 inches wide, the flaunch 3 inches high. The rails need not be more than 5-8 of an inch *average* thickness, and they may be cast in lengths of 5 to 6 feet each: each rail will, at 6 feet length, contain 225 cubit inches, which, at 4 inches to the pound, is 56lb. each rail, or 1 cwt. for every 6 feet in length of the road, or 44 ton per mile.

In order to form a road of these rails, they must be laid down at the distance of from 3 1-2 to 5 feet (according to the carriage that is to run upon them) parallel to each other; the ends of every two pair of rail being let and pinned down into a piece of timber lying across the roads, the holes for the pins must *be cast* in the rail. These pieces of timber may be of any form, provided they are level at the top, and they cannot be a great part of the expence of the road in any situation. The most durable is certainly the best; but no timber can be very durable in the situation it must occupy on the surface, and partly or wholly covered with earth. The perfection of the road consists in the parallel rails being laid perfectly level with each other across the road, and perfectly jointed. In most parts of the Union the rails could, I think, be delivered at from 80 to 90 dollars per ton, and in many parts at 60$—but taking 80$ as the average on the spot, the road will cost—

Rails delivered, 44 ton, at 80 dollars,	3,520
Levelling the road, very uncertain, but I will suppose as an average for levelling and filling in with good gravel or broken stone, $ 2 50 per perch, or per mile,	800
Timber and bedding at 50 per mile,	440
Incidents and superintendance,	240
	5,000
For a set of returning ways,	5,000
Total per mile,	10,000 $

The carriages which travel on these roads may be of various dimensions, agreeably to the material to be conveyed, and the necessary angle of the road. They have low cast iron wheels fast upon the axle, which turns round. Thus, the two wheels on the axle making the same number of revolutions in the same space of time, the carriage necessarily goes straight forward, and cannot be thrown off the ways by any small obstruction on one side.

The principle upon which such astonishing loads may be drawn on the ways by a single horse, is the diminution of friction in the greatest possible degree. On a good rail road, descending under an angle of only one degree, one horse may draw eight tons in 4 waggons of 2 tons each without difficulty. The astonishing loads drawn upon rail roads by single horses in England, have induced many of our citizens to hope for their early application to the use of our country. I fear this hope is vain, excepting on a very small scale, and that chiefly in the coal country near Richmond. For it is evident that upon a rail road no other carriage but that which is expressly constructed for the purpose, can be employed—and that to render a rail road sufficiently saving of the expence of common carriage, to justify the cost of its erection, there must be a very great demand for its use. But the sort of produce which is carried to our markets is collected from such scattered points, and comes by such a diversity of routes, that rail roads are out of the question as to the carriage of common articles. Rail roads leading from the coal mines to the margins of James river, might answer their expence, or others from the marble quarries near Philadelphia to the Schuylkill. But these are the only instances, within my knowledge, in which they at present might be employed.

There is, however, a use for rail roads as a temporary means of overcoming the most difficult parts of artificial navigation, and for this use they are invaluable, and in many instances offer the means of accomplishing distant lines of communication which might otherwise remain impracticable, for centuries to come.

MR. FULTON'S COMMUNICATION.
(F.)

SIR,

By your letter of the 29th of July, I am happy to find that the attention of Congress is directing itself towards the opening of communications thro' the U. S. by means of roads and canals; and it would give me particular pleasure to aid you with useful information on such works, as I have long been contemplating their importance in many points of view.

But a year has not elapsed since I returned to America, and my private concerns have occupied so much of my time, that as yet I have acquired but very little local information on the several canals which have been commenced.

Such information, however, is perhaps at present not the most important branch of the subject, particularly as it can be obtained in a few months at a small expence, whenever the public mind shall be impressed with a sense of the vast advantages of a general system of cheap conveyance.

I hope, indeed, that every intelligent American will in a few years, be fully convinced of the necessity of such works to promote the national wealth, and his individual interest. Such conviction must arise from that habit of reflection which accompanies the republican principle, and points out their true interest on subjects of political economy. From such reflection arises their love of agriculture and the useful arts, knowing them to augment the riches and happiness of the nation; hence also their dislike to standing armies and military navies, as being the means of increasing the proportion of non-productive individuals, whose labor is not only lost, but who must be supported out of the produce of the industrious inhabitants, and diminish their enjoyments.

Such right thinking does great honor to our nation, and leads forward to the highest possible state of civilization, by directing the powers of man from useless and destructive occupations, to pursuits which multiply the productions of useful labor, and create abundance.

Though such principles actuate our citizens, they are not yet in every instance, aware of their best interests; nor can it be expected that they should perceive at once the advatages of those plans of improvement which are still new in this country. Hence, the most useful works have sometimes been opposed; and we are not without examples of men being elected into the state legislatures for the express purpose of preventing roads, canals and bridges being constructed. But in such errors of judgment our countrymen have not been singular. When a bill was brought into the British parliament 50 years ago, to establish turnpike roads throughout the kingdom, the inhabitants for 40 miles round London petitioned against such roads: their arguments were, that good roads would enable the farmers of the interior country to bring their produce to the London market cheaper than they who lived nearer the city, and paid higher rent: that the market would be overstocked, the prices diminished and they unable to pay their rent, or obtain a living.— The good sense of Parliament, how-