

CUMBERLAND ROAD EAST OF THE OHIO.

[To accompany bill H. R. No. 631.]

JANUARY 19, 1837.

Mr. MERCER, from the Committee on Roads and Canals, made the following

REPORT :

*The Committee on Roads and Canals, to which were referred sundry memorials from citizens of the United States, praying that Congress would complete the Cumberland road, east of the State of Ohio, by erecting a bridge between the town of Wheeling and the island, in the State of Virginia, lying opposite thereto, have, according to order, had the subject under consideration, and submit the following report in relation thereto.*

Without deciding the question whether the compact between the United States and the State of Ohio, under which the Cumberland road was begun, imposes upon Congress the obligation on which the memorialists insist, it cannot be doubted that the completion of this road requires the erection of bridges over the various streams which it crosses, and especially over the largest river which it has encountered in its route towards the capital of the State of Missouri, its ultimate destination.

It is believed that, if a doubt has at any time existed of the expediency of constructing a bridge across the Ohio at Wheeling, it has arisen either from the magnitude of the probable cost of such a structure, or the possible obstruction which it might occasion, if erected on any of the plans hitherto proposed, to the safe and ready passage of steamboats of large dimensions beneath its arches.

The plan which the committee presume to recommend by the accompanying bill, for a suspension bridge at Wheeling, will be liable, it will be apparent, to neither of those objections.

By elevating its platform to the level of the main street of Wheeling, at or near the point where the Cumberland road descends from the adjacent hill, and dispensing with the erection of piers in the current of the river, every imaginable danger of obstructing or endangering its navigation will be avoided, since the elevation of this street is 100 feet; and it is proposed that the flooring of this bridge shall be not less than 90 feet above the ordinary low water of the river Ohio.

The only questions remaining to be decided, resolve themselves into two: can a durable bridge be constructed at the proposed elevation, without piers? and can its cost be reduced to a reasonable sum?

As to the practicability of erecting such a structure, sufficient evidence is afforded by a recurrence to document No. 374, of the 1st session of the 23d Congress, containing the letters of a highly respectable civil engineer of the United States, then but recently returned from a visit of professional inquiry to Europe, where similar structures have been submitted to the infallible test of experience, with universal approbation.

The character of Mr. Charles Ellet, now a resident engineer on the James river canal, in Virginia, is well known to the chairman of this committee, and his statements are entitled to the highest confidence. When consulted for a plan of the bridge then in contemplation across the river Potomac, at Washington, he recommended, in a communication which reached the committee too late to change its action on that subject, a suspension bridge, with openings of 600 feet, sustained by wire cables, instead of those chains of which America affords many examples; and computed the entire cost of such a structure above the surface of the Potomac, apart from its abutments and piers of masonry, at \$362,419 60.

The length of the flooring of this bridge would have been 4,940 feet, and of the wire cables required to sustain it, 5,400 feet.

It was to have eight piers and two abutments; but their cost below the water surface had not entered into the above estimate.

The breadth of the left channel of the Ohio at Wheeling is but 760 feet, and of the right channel but      feet. It is proposed, therefore, to dispense altogether with piers in the current, and, consequently, with any masonry whatever, except that of the abutments, and their necessary supports against the lateral pressure of the wire cables.

The letters of Mr. Ellet to the Secretary of the Treasury and the chairman of the Committee on Roads and Canals are hereto annexed for the information of the House, accompanied by a profile delineation of the bridge which he recommends for the river Ohio at Wheeling. Referring to those communications for the reasons which have induced the committee to concur in the recommendation of their author, and to their late report on the extension of the Cumberland road west of Columbus, for their view of the importance of the proposed work, they deem it unnecessary further to enlarge on the expediency of supplying this essential link of the only chain of direct communication between the capital of the United States and the seats of Government of four of the largest States of this Union.

It is, however, proper to remark, that the estimated cost of the contemplated bridge is much enhanced by the omission of any reference to the very elevated banks of the river Ohio where it is proposed to erect it; an element of a just computation, obviously affecting the largest sum in the estimate, the cost of the masonry of the abutments, and not included in the estimate of the engineer, because it had not been comprehended in the description of this river, in reply to which his last communication was made to the chairman of the committee.

If the attention of the House be directed to the appendix of this report, it will be seen that in noticing all the objections that he could anticipate to his plan for a bridge across the Potomac where it has a breadth of 5,000 feet, the engineer, on whose authority the plan of a suspension bridge for the Ohio, at Wheeling, has been here recommended, has replied to every objection which he could anticipate to the erection of such a structure over the comparatively narrow channels of the Ohio, on either side of the island opposite to Wheeling, neither of which exceeds in breadth 760 feet.

The memorial, of which various copies have reached the committee through the House of Representatives, signed by 1,742 citizens of Ohio, and the States west thereof, is of the following tenor :

*To the Senate and House of Representatives of the United States in Congress assembled :*

The memorial of the citizens and inhabitants of the State of Ohio and of other western States,

RESPECTFULLY REPRESENTS :

That, for nearly thirty years, the Cumberland or national road, so called, has been in progress, and has, during all that period, been an interesting subject, not only to the inhabitants of the western country, but to the great body of the American people, and has daily increased in importance and interest, until there is no man, who understands its great utility as a channel of communication and bond of union between the Atlantic and the western States, and the immense advantages and facilities which it affords to the transportation of the United States mail, and to the commercial operations of our common country, who hesitates to approve the original policy and design of this road, as a national work, or doubts the propriety and expediency of its speedy and ample completion. We, therefore, feel at this time a conscientious conviction that the representatives of the people and the States will listen with attention and with patience to our petition ; and if we ask nothing but what is just, expedient, proper, and practicable, they will grant all we ask.

In the act of Congress of the 30th of April, 1802, "to enable the people of the eastern division of the Territory Northwest of the river Ohio to form a constitution and State Government, and for the admission of such State into the Union on an equal footing with the original States," sundry propositions were offered to the people of Ohio for their "free acceptance or rejection," upon condition that the State of Ohio would not tax the United States lands within her limits until five years after the sale of each tract or parcel thereof by the National Government ; which propositions, if accepted, were to be forever "obligatory upon the United States." Among those propositions was the following : "that one-twentieth part of the nett proceeds of the lands lying within said State, sold by Congress, from and after the thirtieth day of June [then] next, after deducting expenses incident to the same, should be applied to the laying out and making public roads, leading from the navigable waters emptying into the Atlantic, to the Ohio, to the State of Ohio; and through the same." This proposition, with the others contained in the act, was accepted by the convention of the people of Ohio which formed her constitution, by an ordinance passed on the 29th November, 1802 ; and thereby the proposition became "*obligatory upon the United States.*"

By the several acts of Congress which authorized *Indiana, Illinois, and Missouri* to form constitutions and State Governments,—the first in 1816, the second in 1818, and the third in 1820, the National Government obliged itself (in like manner as it had done in the admission of Ohio) to appropriate two per cent. of the nett proceeds of the sale of lands within each State to the making of a road or roads leading to each State, respectively ; and each of those States, as a consideration for this undertaking on the

part of the United States, gave up, as Ohio had done, her right to tax the public lands until five years after their sale. This consideration was of great value, and the Government of the United States received the benefit of it in the sale of their lands.

In pursuance of the aforesaid compact with Ohio, the Congress passed an act on the 29th of March, 1806, entitled "An act to regulate the laying out and making a road from Cumberland, in the State of Maryland, to the State of Ohio;" by which it was provided that the said road should be located from Cumberland to the *Ohio river*, instead of—"to the State;" and the act, also, authorized "prompt and effectual measures" to be taken in the construction of said road "through the whole distance." Sundry appropriations were subsequently made, at long intervals, for the purpose of making and completing this road to the *Ohio river*; but no appropriation, even for a survey and location for said road, or for any other, west of the eastern bank of the Ohio, was made until the year 1820; when the Congress, in pursuance of the compacts with Indiana, Illinois, and Missouri, as well as that with Ohio, passed an act to authorize the appointment of commissioners to lay out a road "from Wheeling, in the State of Virginia, to a point on the left bank of the Mississippi river, between St. Louis and the mouth of the Illinois river." Subsequent to the passage of this last act, in the year 1825, the Congress passed "An act for the continuation of the Cumberland road," and appropriated a sum of money "for the purpose of opening and making a road from the town of Canton, [now Bridgeport, Belmont county,] in the State of Ohio, on the right bank of the Ohio river, opposite the town of Wheeling, to the Muskingum river at Zanesville;" and the same act directed the further prosecution of the survey, authorized by the act of 1820; and it further directed, that such survey should be extended "to the seat of Government of the State of Missouri," and that the said road should "pass by the seats of Government of the States of Ohio, Indiana, and Illinois." Since the year 1825, further appropriations have been made to complete the Cumberland road to Wheeling, and to prosecute the survey and construction of the road from the right bank of the Ohio to the left bank of the Mississippi. We are not advised of any other appropriation whatever, ever having been made for the laying out or making any other road than the Cumberland road, from the navigable waters emptying into the Atlantic to the State of Ohio, or through the same.

Your memorialists have taken the liberty to present the above brief review of the legislation of Congress on this important subject, that they may be the better understood in making known the causes which have induced them to adopt this memorial, and the grounds and principles upon which they rest their claim to the immediate and efficient action of the National Government; to redress a public grievance, burdensome and oppressive to all classes of the community; not only for the present day and generation, but will be entailed upon generations yet unborn, through all time, unless that Government fulfil its sacred obligation, and redeem its solemn pledge, to the people of the east, north, and south, as well as the west.

We consider the want of a bridge over the Ohio river, at Wheeling, to connect the eastern section of the Cumberland road with the western section thereof, as a deep and intolerable grievance, which can never be removed and fully remedied but by the timely and efficient action of the

National Legislature, in carrying into effect and fulfilling their sacred obligation to complete the Cumberland road, "*to the State of Ohio.*" Why this *chasm*, this connecting link of the great national chain of intercommunication between the east and the west, has not long heretofore been supplied, we can only answer by conjecture. The compact between the General Government and the State of Ohio, by which the former became obliged "to lay out and make public roads leading from the navigable waters emptying into the Atlantic, *to the Ohio, to the State of Ohio, and through the same,*" it seems to us, was and is as obligatory upon the National Government as a like undertaking would have been upon an individual; and in the faithful observance and fulfilment of this compact, the people of the Atlantic States have ever been, and are now, equally, if not more deeply interested than the people of the west. On what principle, then, we most respectfully inquire, has the Government of the Union excused itself for a non-compliance with its just and voluntary obligation and plighted faith? Has the General Government yet made a single road from the navigable waters emptying into the Atlantic "*to the State of Ohio?*" If it has not, we ask, *why not?* Surely we shall not be told that the Government of the United States, which wields the most powerful arm of any Government on earth (if wealth be power) *is too poor*, and excuses itself for a breach of obligation and public faith, in leaving one mile of the public highway, which it had surveyed and undertaken to make, in a worse condition and more truly grievous to the people, than a huge forest, morass, or perfect *void*, for the sole reason that this great link, a bridge over the Ohio, would cost two hundred thousand dollars. Such an excuse would be the more unwelcome and unjust, because the omission of a compliance with this part of the compact, in which the people are the most deeply interested, and have not the power to supply, leaves them forever without redress.

We ask permission further to suggest, most respectfully, to the representatives of the people and the States, some other considerations and reasons, which, if not sufficient of themselves, are irresistible, in connexion with those already stated, to sustain the call which we make for the erection of a bridge over the Ohio river at Wheeling, by and under the direction of the National Legislature, and with the national purse.

Looking forward to the succession of ages, and even of years, it is beyond the foresight of human intellect to say what innumerable happy results would flow from the erection of a bridge over the Ohio at Wheeling on a permanent and useful plan, both to the *Government* of the Union and to the *people* of this vast, enterprising, and happy republic. The *Government* would experience from a safe and permanent bridge, despatch, certainty, and regularity in the transmission of the mail, and the like despatch, certainty, and regularity in the transportation of troops and military stores in times of war or turbulence; an object of immense importance, not only to the Government itself, but to the inhabitants of the country, whose lives and the salvation of an entire army, yea, even of the nation itself, might be suspended upon the non-existence of such a bridge. *The people* would find, not only for the present, but for all future time, a safe, easy, certain and immediate passage, on a road of more importance than any other in the Union, over the fluctuating waters of one of the most interesting, and, at times, one of the most dangerous streams of America. The delay which is now experienced in the transmission of the mail, and in the journeys of

travellers and emigrants, *at all seasons of the year* ; the expense attending the crossing of the streams on either side of the island at Wheeling—yea, even the loss of time in the passing of those streams by the people of the surrounding country, on either side of the Ohio, would, either of them, in one-half, perhaps in one-fourth of a century, be a greater loss to the public, than the expense of constructing the most durable and elegant bridge in the world.

Permit us still further to suggest, that although a bridge may be built over the river at Wheeling, by *individuals* or by a *private corporation*, which would unite what is yet disconnected—the eastern with the western section of the Cumberland road—and thereby afford to the United States mail, and to the travelling public, for the time being, safety and expedition in passing the waters of the Ohio ; still we conceive, and most earnestly urge upon the deliberate consideration of the representatives of the people and of the States, not only that a bridge *so built* will not excuse a compliance on the part of the General Government with its solemn compact and obligation, in which the whole people of our common country have a deep interest, and impose *heavy tolls* upon the people, where, by that compact, they ought to pass free ; but that the superior advantages which may be expected to result to the Government and the people, from the erection and future protection of such a work, by the National Government, both as to its construction and future usefulness, over one that should be erected by *individuals*, or by a *private corporation*, are not only apparent and striking at first view, but are in their beneficial results beyond the calculation of the wisest statesman. Corporations, as well as individuals, always have in such works interests and views aside from the main object, and will, necessarily, in the construction and subsequent control of such a work, seek to subserve their own, and not the public welfare. And it does seem to us, that this consideration alone, when it shall be duly weighed by the intelligent and faithful servants of the people, in reference to a great, *national*, public work, so important in every point of view, not only to the west, but to the east, north, and south, will awaken that spirit of inquiry and liberal action which has ever distinguished, and, we trust, ever will distinguish, the enlightened and patriotic American statesman.

Nothing but a deep regard for the public welfare and a love of truth and justice, has induced us to prefer this memorial ; and, with like sentiments, we shall continue to hope that we shall be heard and answered in the spirit of patriotism and of justice.

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EXECUTIVE OFFICE, OHIO,  
Columbus, February 10, 1836.

SIR: In compliance with the request of the General Assembly of this State, as expressed in their resolutions of the 12th ultimo, I herewith transmit to you duplicate copies of a preamble and resolutions, relating to the Cumberland road bridge across the Ohio river, at Wheeling.

Very respectfully,

Your obedient servant,  
ROBERT LUCAS.

The Hon. S. MASON,  
Member of Congress.

*Preamble and resolutions relating to the Cumberland road bridge, at Wheeling.*

Whereas, the people of the State of Ohio feel a deep interest in the extension and completion of the Cumberland road, and especially in the erection of a bridge across the Ohio river at Wheeling, to connect the eastern section of said road, which now terminates at the eastern bank of said river, with the western section thereof, which commences at the western bank of said river, leaving a chasm in said road of nearly a mile, which is at times impassable: *And whereas*, it is believed by the General Assembly to be as much the duty of the Government, resulting from its compact with Ohio and the other western States, to erect such a bridge, as it was to commence and construct said road: *And whereas*, the erection of a bridge at Wheeling, on a plan which will insure convenience, safety, and permanency, will be of immeasurable public and national utility: Therefore,

*Resolved by the Senate and House of Representatives of the General Assembly of the State of Ohio*, That our Senators in Congress be instructed, and our representatives be requested, to use their endeavors to procure further and more ample appropriations of the public money, for the continuation and more speedy construction and completion of the said Cumberland road, and for the purpose of erecting a permanent bridge across the Ohio river, at Wheeling, Va., to connect the eastern with the western section of said road.

*Resolved*, That the Governor be requested to forward duplicate copies of the foregoing resolution and preamble to each of our Senators and Representatives in Congress, and also to the President and Vice President of the United States, to the Secretary of State, Secretary of War, Secretary of the Navy, and the Postmaster General.

WILLIAM SAWYER,

*Speaker of the House of Representatives.*

ELIJAH VANCE,

*Speaker of the Senate.*

January 12, 1836.

STATE OF OHIO, SECRETARY'S OFFICE,  
Columbus, February 9, 1836.

I certify, that the foregoing preamble and resolutions is a correct copy of the original roll on file in my office.

B. HINKSON, *Secretary of State.*

IN THE HOUSE OF REPRESENTATIVES, U. S.  
 March 12, 1830.

*To the honorable the Senate and House of Representatives of the United States in Congress assembled :*

The memorial of the subscribers, who were appointed managers, by an act of the General Assembly of Virginia, incorporating Noah Zane, and his associates, a company to erect a toll-bridge across the Ohio river at or near the town of Wheeling,

RESPECTFULLY REPRESENTS :

That the great increase of travelling on the Cumberland road requires that the obstructions presented by the Ohio river be obviated by a bridge. That, with a view of testing the practicability of raising the stock necessary for the erection of such bridge, your memorialists have caused books to be opened, and are now receiving subscriptions. But such is the want of capital in this country, that but few men can spare any considerable sum from their business; and your memorialists are satisfied that, without the aid of the General Government, a sufficient sum for the erection of the proposed bridge cannot be raised, although it is believed that the stock will be productive. The capital stock of the company is fixed by the charter at two hundred thousand dollars. Your memorialists respectfully ask your honorable body to direct a subscription, under the charter of said company, of four thousand shares, which will be one-half of the capital stock of the company. Your memorialists are induced to name that number, from the belief that the balance will be as much as they will be able otherwise to dispose of. Besides expediting the transportation of the mail, and greatly facilitating the communication between the east and the west, your memorialists believe that such an investment on the part of the Government, as is above asked for, would be both safe and profitable stock: and, as in duty bound, your memorialists will ever pray.

NOAH ZANE,  
 ARCHIBALD WOODS,  
 MOSES SHEPHERD,  
 SAMUEL SPRIGG,  
 JAMES BARNES,  
 J. CALDWELL.

### ACT OF VIRGINIA.

AN ACT incorporating a company to erect a toll-bridge over the Ohio river at Wheeling.

[Passed February 17, 1816.]

1. *Be it enacted by the General Assembly,* That Noah Zane and his associates shall be, and are hereby, made a body politic and corporate, for the purpose of erecting a bridge across the Ohio river, at or near the town of Wheeling, and shall be called and known by the name and style of "The Wheeling and Belmont Bridge Company," and as such may sue and be sued, implead and be impleaded, with perpetual succession and a common seal, and generally to do and execute all matters, acts, and things, which a corporation or body corporate, in law, may or can do and lawfully execute.

2. The capital stock of the said company shall consist of two hundred

thousand dollars, which shall be divided into eight thousand shares of twenty-five dollars each, and disposed of in the manner herein provided, by the managers hereinafter named. Books shall be opened for the sale of shares at such times and places, and under the superintendence of such persons, as the managers may direct. Every person who shall subscribe for one or more shares shall thenceforth be deemed a member of the said company. The amount due upon each share shall be paid by the subscribers in gold or silver, or in bank notes circulating currently in the States of Virginia, Pennsylvania, and Ohio. The sum of one per cent. on each share shall be paid to the managers, or such person as they may direct, within thirty days after the time the whole amount of stock shall be subscribed; and the residue of the amount due on each share shall be paid in such instalments, at such times, and to such persons, as the managers for the time being may direct. No one instalment shall exceed two dollars and fifty cents on each share; nor shall any instalment be called for but upon thirty days' previous notice, published in some newspaper printed in St. Clairsville or Wheeling; and there shall be at least thirty days between the payment of each instalment. And on failure or non-payment of the instalments on any share, in the proportions, and at the periods, in which the said managers may require, the said share shall become forfeited to the use of the said company, together with such sum or quotas as may have been paid on account of such share.

3. *Be it further enacted*, That a general meeting of the stockholders shall annually be holden at Wheeling, on the first Monday in June, at which time there shall be elected, from among the stockholders, a board of managers, consisting of thirteen persons, for the purpose of conducting the affairs of the said company, who shall hold their office until their successors are appointed and organized into a board by the election of a president; and, on the first Saturday next succeeding their election, the said board of managers, or any nine of them, shall meet at their regular place of sitting, and elect one of their number as president, who shall preside in all their deliberations, and subscribe all their proceedings with his name, and shall, moreover, appoint a clerk, whose duty it shall be to attend all their meetings, and to keep a journal of all their acts and proceedings, which shall at all times be open to the inspection of any member of the company. Vacancies in the board of managers shall be filled by appointments to be made by the remaining managers, for the time being; and the person or persons elected shall act as manager or managers, until the next election.

4. If from any cause a general meeting shall not be held upon the day appointed therefor, it may be held upon any subsequent day which the board of managers, or any seven of them, may appoint. No person shall be eligible as a manager who is not a citizen of the United States, and a stockholder to the amount of at least ten shares; and the managers shall all reside within the counties of Ohio and Belmont.

5. The election of managers shall be by ballot; and, previous to every election, the board of managers shall appoint three stockholders, not being managers, to conduct the election, who shall receive and count the ballots, and declare, in writing, under their hand, the persons elected to serve as managers for the ensuing year.

Each stockholder holding not more than two shares, shall be entitled to two votes; for every two shares, and not exceeding ten shares, to one vote; for every three shares above ten, and not exceeding thirty, to one vote; for

every five shares above sixty, and not exceeding one hundred, one vote; for every six shares above one hundred, one vote. All votes may be given by proxy, but stockholders only shall serve as proxies.

7. The board of managers shall have power to appoint such officers as they may deem proper for conducting the business and concerns of the company, and may require such security for the performance of their duties, and allow them such compensation for their services, as they may deem reasonable.

8. Any seven of the managers (the president being one) shall form a board for the transaction of business; and, in the absence of the president, the board, consisting of at least nine members, shall appoint a president *pro tempore*, to act during such absence. In case of the death, resignation, or removal of the president, the board of managers may appoint a president to fill the vacancy; and the said board shall have power to remove the president, or other officer, or any member of the board, from office, for neglect or inattention to the affairs of the company, or any other misconduct in office. But no such removal shall be made but by the concurring votes of three-fourths of the whole number of members composing the board.

9. And for the purpose of carrying into effect the intentions and objects of the said company, Archibald Woods, Noah Zane, Samuel Sprigg, Joseph Caldwell, John White, Moses Shepherd, Notley Hays, Benjamin Ruggles, George Paull, James Barnes, and Elijah Wood, are hereby appointed managers of the same, who shall hold their offices until their successors are duly appointed and organized into a board.

10. No contract entered into by the board of managers shall be binding upon the company, unless signed by the president, and countersigned by the clerk. All obligations entered into on behalf of the company, shall bind their joint funds only, and shall contain an express reservation that the members are not held liable in their individual capacities.

11. The board of managers shall have full power and authority, in behalf of the company, to make all contracts, and employ all persons, necessary to effect the objects of the said company; and shall keep fair and accurate accounts of all their proceedings, which they shall exhibit to the stockholders at their general meeting, annually.

12. The funds of the company shall be kept by a treasurer, to be appointed for that purpose by the board of managers; and all moneys belonging to the company shall be paid over to the treasurer by the board of managers, for which his receipt shall be taken and filed, and the amount shall be charged to him in a book to be kept for that purpose by the board of managers; and all moneys due from the company shall be paid by the treasurer, upon the order of the board of managers, which order shall be signed by the president, and countersigned by the clerk. The books of the treasurer shall, at all times, be open to the inspection of any member of the company, and [once] at least [in] three months, and oftener if required, the said treasurer shall exhibit a statement of his account to the inspection of the board of managers.

13. So soon as the said bridge shall be completed, it shall be lawful for the said company to demand and receive the following tolls and rates for passing the same; that is to say: for a man, horse, mule, or work ox, twelve and a half cents; for all riding carriages, wagons, and carts, twenty-five cents per wheel; for every head of neat cattle, six and a quarter cents; and for every sheep, hog, goat, or lamb, two cents, and no more. If the

collector of the said tolls shall demand or receive from any person or persons, for passing the said bridge, more than is hereby allowed, he shall, for every such offence, forfeit and pay to the party aggrieved the tolls demanded and received, and five dollars, recoverable by warrant, before any justice of the peace within this Commonwealth; and in case of his inability to pay, the said company shall be liable to the like fines, recoverable and appropriated in like manner. And any person or persons attempting forcibly to pass the said bridge without paying tolls, or refusing to pay the same after having passed, shall be liable to the like fines, recoverable in the like manner, to the use of the said company.

14. When the said bridge is completed, the board of managers shall appoint a suitable person to collect and account for the tolls; and after defraying all necessary and proper expenses, the said board of managers shall, at the end of every six months, declare the dividend due to each shareholder, which shall be paid by the treasurer, upon the order of the board of managers.

15. The shares of stock in the said company shall be transferable, and transfer shall only be made in the manner which the board of managers may prescribe.

16. *Be it further enacted*, That, upon completing the said bridge from either bank of the said river to Zane's island therein, the said company, shall be entitled, and they are hereby authorized, to demand and receive half the tolls hereby granted.

17. *Be it further enacted*, That the said corporation, at every general meeting of the stockholders, shall have power to make and ordain all such by-laws, rules, and regulations, not contrary to the laws and constitutions of this State, or of the United States, as may be necessary for the well ordering of the business, officers, and servants thereof.

18. *And be it further enacted*, That the arches of the said bridge shall be erected so high above the usual high floods heretofore known in the said river, as at all times, during such high floods, to admit the safe passage under them of all flat-bottomed boats and rafts. And there shall be made, from the abutment next the Virginia shore, a drawbridge at least forty feet wide, which the said company shall at all times attend by their agents or servants, and raise the same free from expense to navigators, to permit the safe passage of all such craft or vessels as at any time cannot otherwise safely pass. And at all times during the night, good and sufficient lamps shall be lighted and suspended above each end of the said drawbridge, on the upper side thereof, for the information of such as may be passing up or down the river in the night season. And if the said company shall fail to comply with all the provisions and conditions in this section contained, so that any person or persons, bodies politic or corporate, shall sustain damage thereby, the said corporation shall be liable therefor, recoverable by action or actions upon the case.

19. *And be it further enacted*, That if the said bridge shall be so constructed as to injure the navigation of the said river, the said bridge shall be treated as a public nuisance, and shall be liable to abatement, upon the same principles and in the same manner that other public nuisances are.

20. This act shall be in force as soon as the assent of the Legislature of the State of Ohio to its provisions shall have been obtained.

## ACT OF OHIO.

AN ACT giving the assent of this State to the erection of a toll-bridge across the Ohio river at Wheeling.

*Whereas*, the General Assembly of the Commonwealth of Virginia did, on the seventeenth day of February, Anno Domini one thousand eight hundred and sixteen, pass an act entitled "An act incorporating a company to erect a toll-bridge over the Ohio river at Wheeling," by which act it is provided and declared that the same should be in force so soon as the assent of the Legislature of the State of Ohio to its provisions should be obtained: Therefore,

*Be it enacted by the General Assembly of the State of Ohio*, That the Wheeling and Belmont Bridge Company be, and they are hereby, recognised and declared to be a body corporate and politic within this State, with all the powers and privileges, and subject to all the restrictions, of the act of the General Assembly of the Commonwealth of Virginia, entitled "An act incorporating a company to erect a toll-bridge over the Ohio river at Wheeling," to the provisions of which act the General Assembly of the State of Ohio do hereby assent, as fully and completely as if the same were herein particularly recited: *Provided*, The same shall be completed within ten years from and after the passage of this act: *Provided, also*, That it shall at no time be lawful for said company to use their funds for the purpose of banking; and if the said company shall at any time apply any of their funds to the use or purpose of banking, they shall forfeit all the benefit and privileges conferred by this act.

THOMAS KIRKER,

*Speaker of the House of Representatives.*

ABRAHAM SHEPHERD,

*Speaker of the Senate.*

December 30, 1816.

By an act of the Legislature of Ohio, passed at the late session, the foregoing is revived and continued in force for the term of ten years longer.

In pursuance of an act of the Legislature of Virginia, passed on the 17th day of February, 1816, incorporating Noah Zane and his associates a company to erect a toll-bridge across the Ohio river, at or near the town of Wheeling, we, Archibald Woods, Noah Zane, James Barnes, Joseph Caldwell, Notley Hays, Moses Shepherd, and Samuel Sprigg, managers named in said act, having convened in the town of Wheeling, this 26th day of February, 1830, and organized ourselves into a board of managers, for the purpose of carrying into effect the objects of the said act of incorporation, and having appointed Noah Zane chairman, and Morgan Nelson secretary of the board: On motion,

*Resolved*, That it is expedient forthwith to offer for sale the stock of the said Bridge Company.

*Resolved*, That M. Nelson, John Goshorn, Thomas Woods, John McLure, and T. P. Robinson, act as agents to receive subscriptions for said stock in the town of Wheeling;

That James Caldwell, Steel Smith, William B. Hubbard, and John Patterson, act in like manner at St. Clairsville;

That James Barnes, John Davenport, and B. H. Meckle, act in like manner at Barnesville;

That Joseph Gill, Robert Patterson, William Hamilton, and James Updegraff, act in like manner at Mount Pleasant ;

And that Walter B. Beebe, Thomas Bingham, and John Pritchard, act in like manner at Cadiz.

*Resolved*, That it is expedient to apply by memorial to Congress to take a portion of the stock of said company ; and that Samuel Sprigg, Archibald Woods, and Joseph Caldwell be a committee to prepare such memorial, and that the same be subscribed by the managers present, and forwarded to our representatives in Congress.

*Resolved*, That Philip E. Thomas, Luke Tiernan, John Patterson, Thomas Ellicott, and Talbott Jones, act as agents to receive subscriptions to the stock of the said company in the city of Baltimore ;

Moses Moorehead, Willis Siliman, and E. Buckingham, at Zanesville ;

And Gustavus Swan, Lincoln Goodale, William Nail, Ralph Osborne, and William Dougherty, at Columbus.

*Resolved*, That the proceedings of this meeting be signed by the managers present, and countersigned by the secretary.

NOAH ZANE,  
SAM. SPRIGG,  
JAS. BARNES,  
J. CALDWELL,  
A. WOODS,  
M. SHEPHERD,  
NOTLEY HAYS.

M. NELSON, *Secretary*.

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WASHINGTON, *January 30, 1836.*

SIR : The present application to Congress, to erect a bridge over the Ohio river at Wheeling, induces me to present to the consideration of your committee the following statement.

In 1816 the Legislatures of Virginia and Ohio incorporated a company to erect a bridge over the Ohio river, and appointed commissioners to carry the act into effect. Being the owner of one-half of "Zane's island," and the ferry privileges attached thereto, and supposing that the Government did not intend to connect the national road by a bridge across the Ohio, and further delay would prevent a majority of the commissioners from acting, books of subscription were opened, and the \$200,000 required by the charter was subscribed in shares of \$25 ; one-half of which was taken by myself and family, and the residue, with the exception of 130 shares, taken by my late brother Noah's family.

A contract has been made with Mr. Lebaron, for the bridge over the stream, on the west side of the island, at \$68,000 ; its length (the whole width of the stream) 670 feet ; breadth 40 feet, with two carriage-ways, two spaces for rail-ways, and foot-way ; of stone abutments (solid masonry) and piers, and wooden superstructure, with spans of 223½ feet ; the arches to be 60 feet above low-water mark : this branch seldom used by boats.

The eastern branch is 770 feet, presenting, on the eastern side, a steep bank of 100 feet in height, on which the town was first built ; the bank on the island on which it is supposed the bridge would abut, is 47 feet above low-water mark, and the arches would be made 75 or 80 feet above

the same mark, leaving sufficient room for boats of the largest class to pass at the highest stages of water. Both streams present a rock, very little below the gravel, that will only require the necessary levelling to erect foundations upon, and at a very small expense in making coffer-dams. The usual high flood is about 40 feet; that of 1832, the highest known to the present inhabitants, 49 feet 6 inches.

From my knowledge of the wish of the present stockholders, and the owners of the realty affected by this improvement, I have no doubt that they will surrender to the Government all their rights under the charter, upon being allowed for materials already procured for the western branch bridge, and such sum as may be agreed upon to the proprietors for the release of ferry privileges, to be determined in such manner as Congress may prescribe.

If the Government shall elect to only build a bridge over the eastern branch, I am authorized to say all rights under the charter will be surrendered, as well as all ferry privileges attached to that branch; and if, hereafter, it choose to purchase the right of the company to the western bridge, (which by contract is to be finished by 15th December,) the same will be transferred upon equitable terms.

I am, with much esteem and respect,

Your obedient servant,

DANIEL ZANE.

HON. CHARLES F. MERCER,

*Chairman of Committee on Roads and Canals.*

BRIDGE ACROSS THE POTOMAC AT WASHINGTON.

*Estimate of the cost of constructing a wire suspension bridge across the Potomac at Washington.*

The following estimate of the quantity and value of the wood and iron is referred to in the unity of length of the floor and of the cables of support ; so that the quantity of wood, given in the second column, is the number of feet, in board measure, reduced to a length of one foot, measured along the floor ; and, in like manner, the quantity of iron is reduced to the unity of length, or lineal foot measured along the cables.

Wood work.	Cost of timber per thousand feet.	No. of feet in board measure.	Cost per lineal foot, including labor of framing, raising, &c.
There will be 144 transversal beams, of which the dimensions should be such as to offer the necessary force, without loading the cables with a useless weight of materials; in the centre they may measure 7 by 16 inches -	\$18 00	69	\$1 25
These transversal pieces are covered along the carriage-way, first, with a course of planking three inches thick, of oak, laid longitudinally, or parallel with the direction of the bridge	17 00	81	1 38
And this planking is covered with an outer course one inch thick, laid parallel with the transversal beams -	17 00	27	46
The foot-ways to be formed of oaken plank, two inches thick -	17 00	18	30
Eight string pieces, placed above and below the transversal beams	18 00	36	65
Railing, or parapet - - - - -	-	-	40
			\$4 44
Iron.	Cost per pound of iron, including work, &c.	No. of pounds per lineal foot.	Cost of iron per lineal foot, including labor, &c.
Great cables of suspension. In estimating the cost of this important article, every expense is included: the value of the wire, freight, commissions, labor, paint, oil, and varnish, are all carefully considered. They offer a section of 70 inches -	\$0 12	230.0	\$27 60
Mean length of the wire cords of suspension, by which the floor is attached to the cables, 2 feet, area 1½ inch	12	30.0	3 60
284 bolts, 5 feet long, and 1 inch in diameter, of which the weight will be 12½ pounds - - - - -	7	6.3	44
Burr and shields - - - - -	8	.5	4
284 bolts, 2 feet long, 5-8 diameter, with burrs and shields -	8	1.0	8
94 bars, 4 feet long, 1 inch square, to support the railing -	6	2.0	12
Bars to prevent the slipping of the cables over the heads of the piers, reduced to the unity of length - - - - -	7	11.0	77
Nails and spikes - - - - -	7	2.0	14
			\$32 79

## MASONRY.

From the plinth of the impost, supporting the arch of the carriage-way, to the summit of the entablature, 2,400 perches, at \$4 50	\$10,800
From low-water mark to the level of the flooring, 2,380 perches, at \$3	7,140
	<u>\$17,940</u>
In the abutments there are 900 perches, at \$5	\$4,500
And 3,600 perches, at \$2 75	9,900
	<u>\$14,400</u>

## WING WALLS.

800 perches, at \$2	<u>\$1,600</u>
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## POINTS D'ATTACHE.

600 perches, at \$2 50	\$1,500
1,200 perches, at 2 00	2,400
	<u>\$3,900</u>

## AGGREGATE.

4,940 lineal feet flooring, at \$4 44	\$21,933 60
5,400 lineal feet iron, at 32 79	177,066 00
8 piers, at \$17,940	143,520 00
Abutments	14,400 00
Wing walls	1,600 00
Points d'attache	3,900 00
	<u>\$362,419 60</u>

Such is the estimate of the cost of that portion of the bridge above the surface of the river at low water.

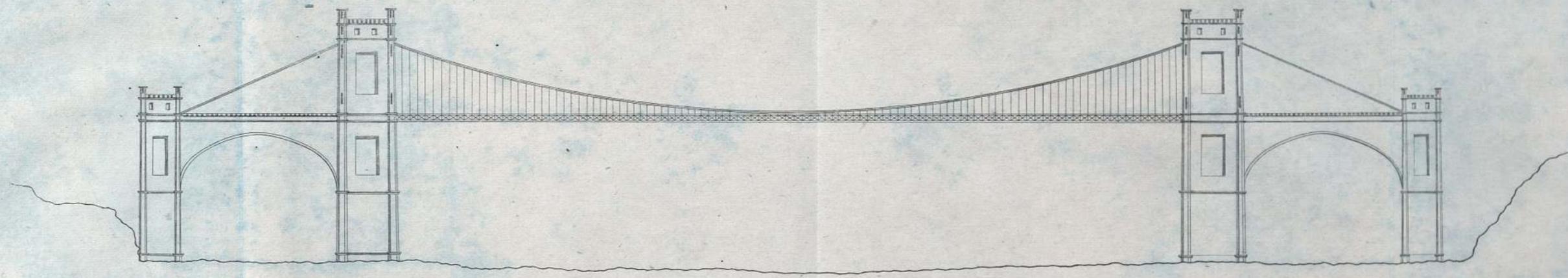
As we do not know the nature of the bottom, I will estimate the cost of laying the foundations, upon the supposition that, after removing a few feet of mud or sand, a soil will be found of sufficient consistence to permit the use of piling; whilst rock, clay, and gravel, or any substance which of itself would be a foundation sufficiently secure without piling, is too far below the bed of the river to justify the builder in penetrating to it.

For an estimate of this nature, we may assume nine feet as the average depth of water; and we shall require for each pier,

550 perches of masonry, at \$3 00	\$1,650
240 oaken or beech piles, at 2 50	600
1,400 lineal feet of oak for sleepers, at 12	168
480 bolts, weighing each 5 lbs. at 7	168
12,000 feet of oak or beech planking at 15 00	180
500 pounds spikes, at 7	35
Coffer-dam, banking, &c.	1,000
	<u>\$3,801</u>

Or, for the eight piers - - - \$30,408

**DESIGN**  
*OF A*  
**WIRE SUSPENSION BRIDGE**  
*ACROSS THE OHIO*  
**AT WHEELING**



Which estimate of the probable cost of establishing the foundations, added to the sum of \$362,419 60, gives, for the estimate of the cost of the entire bridge, \$392,827 60.

Respectfully submitted.

CHARLES ELLET, JR.

BRISTOL, *March 19, 1833.*

SIR: It is some months since I offered for your consideration a plan of a suspension bridge, proposed to be erected across the Potomac at Washington. As, in consequence of the recent appropriation made by Congress towards that object, the subject may again receive your attention, I am induced, by the importance of the question, the confidence I feel in the system I have proposed, and the hope that its adoption in so conspicuous a place may accelerate the introduction of the principles in bridge architecture on which it is founded, to address you again on that subject.

The peculiar plan before you is altogether novel in this country; and it is only on the rivers of France that the true principles of the system have been developed, and the advantages of its application fully witnessed. And, although it must be admitted that it might be perfectly adapted to the purposes of Europe, and yet be in every respect inadequate to the wants of America, I think it cannot but be conceded that the opinion entertained of the system in the country where it is best understood, is, at least, a fair commentary on its merits.

In France it has already superseded the use of every other description of bridges. In the years 1830-'31, I examined ten or twelve which had been recently thrown across the Rhone, besides a great number on the other principal rivers of that country, and found that the opinion of the people, of the mechanics and citizens, entirely coincides with that expressed in the reports and essays of the most distinguished architects and engineers. They view the introduction of this system with universal accord, as an effective means of ameliorating the internal communication of the country. It was regarded as such by the late Conseiller d'Etat and Directeur Général des Ponts et Chaussées, M. Becquey, when in 1821 he appointed an engineer to proceed to England, and examine the chain bridges which had already been constructed there, and afterwards authorized the erection of the "Pont des Invalides," on that principle, across the Seine, at Paris.

The merit of economy, and decided superiority in point of durability, have never been denied them, even by those whose interest in promoting the continuance of the wooden arch or lattice bridge has caused them to oppose their introduction.

The only objections I have ever heard advanced, are the danger that might result from the breaking of a link or bolt forming the chain, and the inconvenience arising from their supposed want of rigidity. The former objection, without examining its validity, is obviated in the plan I propose, by the substitution of wire cables in the place of the usual chains of bar iron; the peculiar advantages of which substitution I endeavor

ored to expose in the communication which was forwarded along with the design of the bridge. The latter objection—the want, or supposed want, of rigidity—is one that has in no instance been urged by any intelligent person who has witnessed such a structure, judiciously designed, on a large scale, or by any one who is capable of investigating the laws of their motion and equilibrium.

The fact that they have been, and are, employed with success and satisfaction in the heart of such a populous city as Paris, and in the vicinity of London, is sufficient to refute any idea of danger or inconvenience incident to their adoption. These bridges, as all others that have come under my observation during a long and laborious investigation of the subject, although not secured by any auxiliary means, in addition to what is due to the natural principles of their equilibrium, are sufficiently fixed and stable for every purpose to which they can be applied. In fact, it will be confidently affirmed by every engineer, whose experience will authorize him to express an opinion on the subject, that the oscillations and vibrations of a suspension bridge, compared with the motions of an ordinary wooden bridge of equal span, and produced by a disturbing force of equal intensity, are not only less considerable, but infinitely less dangerous; for, from whatever cause may proceed the quivering motion visible in a suspension bridge, or the slight changes of which the figure of the chains is susceptible, we are always assured that it will return to its natural position immediately on the removal of the disturbing force.

But a wooden bridge, whatever be the peculiarities of its construction, will, after a very short period, exhibit permanent changes in its disposition; the arches will bend, the roof will present alternate elevations and depressions, and the floor will exhibit the undulating appearance of most of the bridges on the Susquehannah. Nor are these symptoms of danger to be disregarded; for the cause which produced the first change of form will cause it to increase; and the *ratio* of its increase augments with the change that has been effected. And for this reason, there are few, even among the most approved bridges in this country, that could be occupied without danger by a body of troops closely drawn up.

As it is the duty of the architect always to look to the future, there is another consideration connected with the plan before us, which should not be disregarded. In the event of a war, the preservation of an army, or the success of a campaign, might depend on the destruction of the bridge communicating with the capital. And whether it were the interest of the enemy or the country that required its overthrow, the probability is, that the shortest and most effectual means would be resorted to, in order to render it impassable. In either case, if the structure were of wood, it would in all probability be destroyed by fire.

But, with the system of suspension, as fire would not be effectual, and the destruction of the cables would be laborious, and as an arch might be dropped in the space of fifteen minutes, the bridge might be preserved when nothing else would be respected.

Although, in cases of this nature, the opinion should not be influenced by considerations of beauty or appearance, it may be observed that there is no design which could create a deeper impression of strength, security, and grandeur, or, in short, more worthy of the situation and the presence of the capital, than a design predicated on similar principles.

Though the peculiar dispositions and arrangement of the parts of the plan before you may require many and various modifications to adapt it

better to the locality and the preservation of the navigation of the river, which may not be evident at this distance from the site, yet I believe that no difficulty can occur which may not be surmounted without any material deviation from the original design.

Apologizing for the liberty I have taken in again urging this subject on your attention,

I have the honor to be,

With great respect,

Your obedient servant,

CHAS. ELLET, Jr.

Hon. LOUIS McLANE,

*Secretary of the Treasury.*

BRISTOL, PA., April 25, 1833.

SIR: It is some months since I forwarded to you a plan of a wire suspension bridge, designed to be erected across the Potomac. As the plan of that structure has been decided on, I presume the design of which I speak will no longer be required. I would, therefore, thank you to have it transmitted to my address as soon as convenient.

It was sent rolled upon a cylinder of wood, so that the drawing might be preserved from injury; if returned in the same manner, I would appreciate the favor.

I have the honor to be, respectfully,

Your obedient servant,

CHAS. ELLET, Jr.

Hon. LOUIS McLANE,

*Secretary of the Treasury.*

BRISTOL, PA., May 2, 1833.

SIR: Circumstances oblige me again to trouble you with a letter, and request that the design of a suspension bridge, which I forwarded to you in compliance with the Treasury advertisement of last October, be transmitted to me as soon as convenient. I expect to sail for Europe in a very short time, and am desirous to collect my drawings previous to my departure.

I addressed a letter to you on this subject about two weeks since, and not having received either the plan or an answer, I presume the letter has miscarried.

Respectfully, sir,

Your obedient servant,

CHAS. ELLET, Jr.

Hon. LOUIS McLANE,

*Secretary of the Treasury.*

## DOCUMENTS

*Laid before the House by the Chairman of the Committee on Roads and Canals, and ordered to be printed in connexion with Doc. No. 374.*

NEW YORK, April 3, 1834.

DEAR SIR: It is with the sincerest thanks for the kind manner in which you have expressed your willingness to examine the subject which I introduced to your attention, as well as your disposition to be of service to me in my professional pursuits, that I acknowledge my obligations, and forward to you the design of which I spoke.

On re-examining the plan and the communication to the Secretary of the Treasury, with which it was accompanied, it appears to me that it would be better to send you a copy of that letter, which contains the principal arguments in favor of the system, than, by abridging it, to diminish the force of the facts which it contains. Another reason for sending it in its original state, (with the exception of some trifling modifications I have thought it well to make,) is the adaptation of the remarks to the plan in question; for it is right to observe, that I had not all the information which I now possess, at the time the plan was drawn; and I have very little doubt it could be much improved by various alterations, if I had any inducement again to devote my whole attention to the subject.

Though I have exhibited some anxiety for the success of this design, I have very little expectation that it will meet the approbation of Congress; for, although the step in the progress of improvement from the stone arch to the suspension bridge is not less than that from the huge Egyptian lintel to the boldest bridges constructed by Rennie and Perronnet, we have not before us, in this country, the examples which are requisite to render the proof of the fact incontrovertible. We have no stone arches on a grand scale, to serve as a warning to those who would undertake to build 43 piers in such a soil as the mud and sand which here constitute the bottom of the Potomac, and show the cost of forming the centering and turning the arches of cut stone between them; nor have we a single suspension bridge judiciously designed, and well executed, to furnish us with palpable evidence of the facility with which the same difficulty might be surmounted, by a resort to the proper means. While to adopt the design which has been agitated, of a bridge in masonry is going back to the days when the labor of thousands and the wealth of a nation could be commanded to supply the void created by the absence of science and skill, it is not in my power to adduce facts sufficiently strong to force conviction upon the minds of those whose pursuits have not made them familiar with the subject.

I do not send you a copy of the estimate which accompanied the following communication, because I had not all the data for making one, at the time it was written, which I now possess. And when I glance at the array of pages which you will have before you, I really hesitate to increase it by the addition of even so important a part as that of the information necessary in drawing a comparison between the various projects you may have to consider. If, however, an estimate in detail be desirable, I will furnish it with pleasure in the course of a few days after the receipt of your expressing a wish to have one. The cost will be (and I consider the estimate liberal) about five hundred thousand dollars.

It is possible there may be many objections to my design, which, at this

distance from the only point where interest is felt on the subject, it is impossible for me to anticipate. Yet I do not doubt that the plan might be modified to accommodate any really necessary object, without materially increasing the expense, or diminishing the utility or convenience of the work.

I know not what these objections may be, and will not attempt to combat imaginary difficulties that may never occur.

The impressions which most persons with whom I converse have received on this subject, appear to be drawn from the chain bridges they have been accustomed to see in various parts of the country; and, consequently, they ascribe to the system the imperfections which are to be attributed only to the weak and unskilful manner in which it is applied.

We must bear in mind the fact that a suspension bridge owes its stability to its weight; and that, notwithstanding a light structure may bend like a reed, a heavier one, submitted to the same disturbing force, may be motionless.

There is no cause to apprehend danger in consequence of the great span of the arches; for, though the stress upon the cables will be great, we must make their strength proportionate.

Mr. Brunel has recently constructed an arch on this principle across the Avon, of 700 feet span; and Mr. Telford, after erecting the Menai bridge, offered a plan for an arch of 1,200 feet opening, across the Mersey at Run-corn; and, if the object of the work were sufficient to authorize it, no engineer should hesitate throwing an arch for a suspension bridge over a space of 2,000 feet.

Without fatiguing you longer with my opinions on a subject in which I may feel, perhaps, sufficiently interested to be liable to prejudice, I submit the plan and description to your inspection; confident that your opinion will be the result of a candid investigation, and that you will not, as too many have done, condemn it because of its novelty.

I have, sir, the honor to be,

Very respectfully,

Your obedient servant,

CHAS. ELLET, Jr.

Hon. C. F. MERCER, M. C.

BRISTOL, PA., October 6, 1832.

To the Hon. LOUIS McLANE,  
*Secretary of the Treasury.*

SIR: I transmit, by to-day's mail, a design of a bridge across the Potomac, at Washington, prepared from the data contained in the Treasury advertisement of 21st August. The time I have had at my disposal since I received that paper and a profile of the bottom of the river, which were politely furnished me by Colonel Kearney, has not been sufficient to permit me to represent on the plan many very important parts of the structure.

I have been obliged to confine myself to those objects which are essentially necessary to convey an idea of what would be the appearance of the bridge when finished, leaving those of minor importance, or what relate to practical detail and the execution of the work, to be communicated, in my plan should be adopted, at a future period.

Yet I believe there is nothing neglected which would be requisite in determining the comparative merit of the bridge I propose ; or, if any, I shall endeavor to supply it in the observations I shall hereafter make on the peculiarities and general properties of the system.

In general, when an architect is called upon to furnish a design for a construction, he is to be governed by the purposes the edifice is intended to subserve, the materials which are at his disposal, and the funds that are to be applied to the object. But in the case before us, the dimensions of the bridge, and certain other conditions, are prescribed ; while the limit of the cost, and the character of the structure, are submitted to his discretion. It becomes, then, necessary for him to pass in review the various approved methods of construction, and ascertain in what respects they are well adapted, and in what inapplicable, to the present purpose. Having thus satisfied myself of the inadequacy, from various causes, of the bridges usually constructed over the rivers of this country, I have concluded to offer for your consideration a design of a suspension bridge—a system which has recently acquired the highest degree of popularity in Europe, by the facility with which it may be erected, the symmetry of its proportions, and its decided eventual superiority, with respect to economy, over bridges of every other description. I have not adopted the suspension bridge because of its imposing appearance, the grandeur and beauty of its nine successive arches, (properties inherent in the system,) or the apparent triumph of the arts over the obstacles of nature, visible in its execution ; though these are considerations to which we might attach some importance in designing a bridge to facilitate the entrance to the capital ; but it has been my endeavor to keep constantly in view, as objects of paramount importance, the preservation of the navigation of the river, the durability of the structure, and general facilities of intercommunication.

The subjects which, in this state of the case, naturally present themselves for our consideration, are to determine :

- The height to be given to the flooring or archway ;
- The span of the arches ;
- The stability of the structure ;
- The durability of the chains ;
- And the comparative advantages of wire cables.

And the better to investigate the peculiarities and merit of the accompanying plan, I shall proceed to examine respectively these several questions, and offer such arguments as it seems proper to adduce in defence of the principles of its construction, and its fitness for the site upon which it is proposed to be erected.

### 1. *Height of the flooring or archway.*

In determining the proper height of the floor of the bridge above the surface of the water, we must be guided by the condition assigned in the words of the law, which requires that it be “of sufficient elevation to admit the passage under it of an ordinary steamboat.” It does not seem, then, that a strict compliance with the letter of the law demands the altitude of the flooring to be sufficient to admit the passage under it of the *largest* steamboats at present used on the Potomac. Nor does it appear necessary that it should ; for, independently of the fact that great latitude is taken by the constructors of steam engines in proportioning the parts of

their machinery, there are practical formulæ, deduced from scientific principles, by which to determine the proper dimensions of a chimney, which show that the height and area, and quantity of air with which the fire must be supplied, are reciprocally dependant on each other. Hence it is very easy, when the altitude is restricted within certain limits, so to proportion the area to the height, that it may afford the requisite supply of air. I mention this fact merely to show that, when circumstances would otherwise require the funnel to be of greater altitude than the height of the floor will admit, there is a remedy. Yet, doubtless, the limits within which discretion is restricted should not be too confined; for there are other inconveniences, besides the diminution of draught, attached to the adoption of chimneys that have not sufficient height. And it appears to me that the engineer should be governed, in planning a structure of such magnitude as this, by more important considerations than the excessive height which taste, caprice, or even necessity, should cause the projector of a steamboat to adopt for his smoke stack.

If, however, the chimneys of some few boats must necessarily exceed the altitude of the flooring of the bridge, they may be made moveable, (as they are on most of the boats used on the Rhone, and some other rivers of Europe,) either by rotating in a vertical plane, by striking, as the mast of a vessel, or by having eight or ten feet at the extremity made to slide upon the portion which is stationary.

These considerations are deemed sufficient to justify me in putting the floor of the bridge in my design forty-six feet above low water. This will be "sufficient to admit the passage under it of an ordinary steamboat," for the top of the funnels of steamboats generally is considerably less than forty feet above water line; and, as the rise of the tide at Washington is usually about three feet, there will be a space at common high water of more than three feet between the floor and the top of the chimney.

## 2. *Span of the arches.*

This system of construction is peculiarly adapted to those situations where a great number of piers would be inconvenient, and where the force of water and danger from ice, at the time of freshets, would render it impolitic to diminish the water-way and obstruct the channel of the river. It is no less valuable where the altitude of the flooring, and the nature of the soil at the bottom, are such that the construction of piers would be expensive.

I have never seen the Potomac at Washington, when swollen to an unusual height, or when obstructed by ice; but I can easily conceive, from my knowledge of the river above tide water, and the great quantity of ice that is formed and discharged into it, that it must sometimes drive, and even pile to a considerable height, at the position which will be occupied by this bridge. And the damage done to the finest structures in every part of the Union, at the breaking up of the ice during the last spring, should be attended to as instructive lessons by those who shall in future be charged with the erection of bridges.

Although the current of the Potomac at Washington may not be so rapid as that of the Susquehannah at Columbia, Northumberland, or Wilkesbarre,\*

\*It is well known that the damage sustained by the Columbia bridge, during the great freshet the last winter, and which is to be attributed solely to the obstruction of the water-

yet the nature of the soil upon which the piers are to be built is much worse; and the natural effect of obstructing the channel will be to cause the ice to form a dam, and enable the increased velocity of the current, by undermining the piers, to overthrow the edifice. The expense of establishing the foundations of this bridge, and raising the masonry to the level of the water, notwithstanding the many facilities which will be afforded by the old bridge, will assuredly be great; for, although the precise depth of the sand and alluvial deposit does not appear to have been determined, it is highly probable that a firm and solid foundation will be found to be many feet below the present bed of the river. If such be the case, we have sufficient inducement to endeavor to diminish the number of piers as much as is consistent with the economical construction of the superstructure.

But it may appear, at the first blush, that, in endeavoring to avoid what I deem the popular error, (that of placing too many obstructions in the channel,) I have, by fixing the span of the arches in my design at 600 feet, fallen into the opposite extreme. I will not now enter into a detail of all the reasons which have induced me to fix upon that particular limit; their exposition would require the introduction of frequent mathematical formulæ, which would afford no interest to any but the architect or engineer. Among the advantages derived from this arrangement, may, however, be mentioned the little obstruction it presents to the navigation of the river, as well by offering an uninterrupted space of 572 feet between the piers, for the passage of steamboats, as by allowing a greater space from the line of the chains to the surface of the water, enabling us to elevate a portion of the floor, and admit the passage of vessels beneath the cables.

### 3. *Stability of suspension bridges.*

The investigation of the conditions of equilibrium and the laws of the vertical oscillations of these structures, is a subject involving considerations which require the aid of a profound mathematical analysis. And, fortunately, there is no part of the edifice of which the strength, stability, or rigidity, may not be tested by the most unquestionable theory. The strain and the tension to which every piece of timber, bar of iron, or strand of wire, is to be submitted, as well as the extent and the duration of every motion produced by the passage of vehicles, or any concussive force, are all predicted by the calculus: so that it is easy for us to assure ourselves of the practicability of any project, as well as to anticipate the difficulties to be encountered in putting it in execution. One of the peculiar properties of the suspension bridge, and that against which a superficial observer generally urges a doubt or an objection, is its flexibility. But so far from being objectionable, it may, I think, be advanced as an argument in favor of the system. It enables a light and weak structure to yield repeatedly way by the piers, which prevented the free passage of the ice, was such that the cost of repairing it will exceed one hundred thousand dollars. It is also well known that the Wilkesbarre bridge has been two or three times, and from the same cause, literally swept from its site, and carried down the stream; though in a situation presenting every advantage for the construction of a firm and durable edifice. The span, or opening, of the Northumberland bridge, is much greater than is usual in similar structures; and the consequence is, a disgraceful bending of the whole edifice; which, in the course of a very few years, (if not previously destroyed by fire, or prostrated by the ice,) will be crushed by its own weight. It is, perhaps, useless to pursue the histories of the remaining bridges, on that, or the other great rivers of this State; they would, with few exceptions, lead to the same result. Wherever one of our wooden bridges has preserved its form and situation for any length of time, the cost of its construction has been enormous.

to a heavy body passing over it, to acquire a new state of equilibrium, and return to its former situation so soon as the disturbing force is withdrawn. Whereas, if the structure were of wood, and more particularly if it were of any of those systems, of which some peculiarity of the framing is intended to supply the place of curved ribs, after once yielding, or once bending, it would never return. But this objection (supposing it to be one) cannot operate against the particular design I present; for the theory of these structures teaches us that, *cæteris paribus*, the greater the span of the arch, the less will be the motion produced by an equal shock occasioned by a falling body; that the depression produced in the centre of an arch of a suspension bridge, by a weight being placed upon it, is *equal in all arches*, whatever be their opening, if the weights of their unit of length are equal, and the curve of their chains similar. But, as the floors of bridges of a greater span are generally composed of stronger and heavier materials than those of less span, and the area of the sections of the chains of the former is much greater than of the latter, it is evident that both the motion and depression produced by a given weight or shock will be much less in larger bridges than in smaller ones. These facts are indicated by theory; but existing bridges offer ample proof in corroboration of them. Whilst bridges of 100 or 150 feet, (if not strengthened by auxiliary means,) may be shaken by the effort of a single individual, those of 300 or 400 feet (as the fine Pont de Beaucaise on the Rhone) are scarcely moved by the weight of a heavy laden wagon: and that of 560 feet, constructed by Telford, over the strait of Menai, is not felt to tremble under the heaviest teams that are ever driven over it. But, although it might be shown that, supposing the bridge represented in the accompanying design perfectly flexible, its own weight would be sufficient to preserve its figure, and prevent any dangerous movement; yet, even if such were not the case, it would be very easy, with the aid of a hand-railing, and a judicious framing of the floor, to render it so rigid and inflexible, that motion would be impossible. And, finally, I do not hesitate to assert, after a very extensive examination of the subject, that a bridge, constructed according to the design before you, would be less subject to vibrations and changes of figure, than any wooden bridge which it would be practicable to construct in this situation.

#### 4. *Durability of the chains.*

As one of the principal elements of the reasoning by which we are to determine the comparative merit of the system of suspension is the durability of the chains by which the structure is supported, it may be well to draw such conclusions, without the light which time only can shed upon the subject, as we are enabled to arrive at from analogy and the data in our possession. M. Navier, the engineer, whose researches on this subject are the most profound, and whose examination has been the most extensive, has expressed as his decided opinion, that "the duration of suspension bridges will be at least equal to that of any other edifices." And, indeed, there are many circumstances which militate in favor of the opinion; for while there are no well authenticated facts tending to prove the rapid deterioration of iron, even when exposed to the influence of the atmosphere, there are numerous circumstances of an opposite character. We are not to acknowledge the oxidation of iron bars when placed in situations so unfavorable as the feet of iron railings or balustrades, as instances

of the rapid destruction of the metal; for we know that the nature of the solder is often that which would produce immediate oxidation; and also that the decomposition of water, caused by the electricity which is developed on the contact of two metals of different natures, may likewise produce such a result.

But there are numerous facts which prove that if iron be preserved from humidity, it will remain without sensible deterioration for centuries. There is a remarkable fact, which has been noticed by several authors, as tending to establish the great durability of this material, even when not protected by any tegument, and exposed to the constant action of the atmosphere. It is a chain which is suspended between two peaks of rocks which command the tower of Moustiers, in the province of the Lower Alps; a monument which is supposed to have been erected by a chevalier of Rhodes in the thirteenth century.

Although the precise date of the erection of this chain cannot be determined with certainty, it is, nevertheless, known to have been there many hundred years, and at the present time evinces not the slightest traces of any alteration that can be attributed to the effect of oxidation. If, then, iron be susceptible of so long a duration, when thus unfavorably situated and entirely unprotected we have certainly, sufficient authority to justify the expectation that, with an occasional coat of paint, or by the use of any integument impervious to water, it may, under ordinary circumstances, be preserved almost indefinitely.

These are important facts; for, when we compare a structure capable of enduring unimpaired for ages, with one which, at most, we cannot expect to last above forty years, and the very existence of which may at any moment be destroyed by the fire of a cigar, or a spark from a steamboat pipe, we should, unless it be decidedly inferior in some other respect, give a preference to the former.

After proving the greater durability of the suspension bridge, it would seem that no other argument (excepting what may refer to their comparative costs) would be necessary to establish its superiority over the wooden bridge. But it does not appear from the "proposals," that an estimate of the cost of the construction is required; and, if it were required, it would not be in the power of the architect to furnish one, without many data that are not yet to be had. He might, however, estimate the quantity of masonry contained in the piers, &c. of the suspension bridge, and, by comparing it with the quantity contained in the piers and abutments supporting a wooden superstructure, show that the volume of the latter would be the greater.

He might, too, without estimating the cost of establishing the foundations, show that the coffer-dams, piling, &c. required for the 25 or 30 piers of a wooden bridge, would be far more expensive than those required for the eight piers of the suspension bridge. And it would be very easy, by estimating the cost of the chains and flooring of the suspension bridge, and by comparing it with the known cost of the wood and iron work of existing bridges, to prove that even here the prime cost would be in favor of the adoption of the suspension bridge. For the present, I shall do no more than state the facts; but, should it be deemed necessary, I will cheerfully communicate the proofs of them whenever it shall be required.

5. *Superiority of wire cables.*

I have endeavored, in the preceding observations, to establish the general superiority, in bridge architecture, of the system of suspension; it remains for me to expose the reasons for the preference I have given to the use of wire cables, instead of the usual wrought iron chains.

The circumstance which appears to have had the greatest effect in promoting the adoption of wire as a means of supporting the flooring of suspension bridges, is the remarkable degree of strength which iron acquires by the process of drawing it into wire. Though the discovery of this fact is by no means recent, the credit of conceiving the idea of applying it advantageously in the construction of bridges appears to be due to M. Seguin d'Annonay. From the valuable experiments of this engineer, we find that the strength of iron wire of a good quality is twice as great as that of bar iron; and that the strength of the worst quality of wire used in his numerous experiments was to the mean strength of wrought iron in the proportion of 5 to 4. Indeed, the tension which wire is obliged to resist in the act of being drawn is a sufficient proof of its tenacity.

In the construction of the bridge between the towns of Tain and Tournon, on the Rhone, there were many opportunities to observe the relative force of bar iron and iron wire. A wire cable used there in a machine for proving the strength of iron bars, was more than three hundred times loaded with a weight exceeding nineteen tons to the square inch, without evincing the smallest evidence of injury from such a repetition of the strain; whilst iron bars employed in the same manner, and in the same machine, broke after fifteen or twenty trials, though the load did not exceed seven, and sometimes was not more than six tons to the square inch, notwithstanding that the iron was of a good quality, and care was had to obtain specimens which were perfectly sound.

These facts, though sufficient, perhaps, of themselves, to justify an attempt to apply this material in the place of the chains usually employed in the construction of bridges, are far from being the only proofs of the superiority it possesses. In addition to their greater tenacity, wire cables enjoy the eminent advantage of being composed of a greater number of independent parts, the breaking of one or several of which would not sensibly affect its strength; the friction caused by the pressure of the adjacent strands, the ligatures, and the adhesion of the varnish, being sufficient to prevent those which may be broken from slipping.\*

The strength of every wire should be tested by experiment in manufacturing the cable; so that, if any strand have defects which are not discovered, its force will, at least, be equal to all it will ever be required to exert.

But it is different with regard to iron bars; these may have defects that are not only hidden, but which cannot be discovered until the breaking of the bar shall have revealed them. A bar which appears perfectly sound may sometimes be broken by a fall, a smart blow with a hammer, or even by slightly bending it; and many bars of which the absolute force, when free of defects, would not be less than twenty-eight tons to the square inch, break on being tested with an effort of fifteen or sixteen tons; while others yield, open, and show the points where most defective, and only require a

\* A case similar to that of a hempen rope, the friction of the component ligaments of which is superior to their tenacity.

small increase of tension to produce a rupture. And although it is not right so to establish bridges that a weight exceeding the third part of the absolute force of the iron can ever come upon them; and although every piece should be tested by experiment beyond the greatest strain it will ever be obliged to resist, still the possibility of fracture is not entirely removed. On a subsequent trial of its strength, iron sometimes breaks under a less weight than it had previously resisted, as in the case of the bars used in the machine for proving the force of the links employed in certain parts of the bridge at Tournon, where they should not have broken until the load amounted to twenty-eight tons; yet, after being successively charged fifteen or twenty times, they broke under six or seven tons.

And, frequently, a sudden change of the temperature of the air, by acting immediately on the surface of the metal, creates a tension in large bars, sufficient, of itself, to produce immediate rupture.

These are the most serious objections to the use of wrought iron for such purposes; from which, owing to their greater tenacity, the absence of serious flaws, the more certain means of testing, as well as the peculiar method of manufacturing them, the wire cables are entirely free.

But it was formerly supposed that, in consequence of the greater surface they exposed to the atmosphere, the effect of oxidation would be more rapid in the cables than in the chains. When this objection was originally urged against them, the advocates for the employ of wire, without attempting to deny the possibility of the fact, after taking the precaution to varnish the separate strands of wire before it was formed into cables, and protect the exterior with a coat of paint, left it to time to verify or controvert the supposition. I visited, in 1831, the first bridge which was constructed of this material in France; and though it was eight years after its erection that I examined it, I could not discover, on a very minute inspection of the cables, the smallest traces of oxidation. After the success of this first experiment, (for at the time it was only designed as such,) the system acquired immediate popularity. And the architect who now visits Europe, for the purpose of examining the public edifices constructed by the great masters of his profession, will find the suspension bridges of the Loire and the Rhone objects not the least worthy of his attention. There is nothing from which he can derive greater gratification and instruction, than by following the courses of the principal rivers of France and England, and observing the splendid bridges which the application to the arts of the discoveries in science has enabled them to construct in situations where, for centuries before, the anticipated difficulties and expense had prevented any attempt to form a communication.

Experiments have since been made by M. Vicat on the progress of the oxidation of wire; from which it appears that a bridge would not be rendered unfit for use a century after its construction, if the cables were left entirely unprotected, each separate strand being isolated, and exposed to all the vicissitudes and inclemency of the atmosphere. But during the time required for making the experiments from which this result was obtained, where the wire was done up in bundles similar to the cables into which it was to be manufactured, it was found that the humidity did not penetrate sufficiently to tarnish the surface of the central strands. If, then, properly varnished at first, and occasionally painted, we have no reason to believe that the term of their duration would be less distant than that of bar iron. ut every climate renders a peculiar method of treatment necessary; every

material requires for its preservation a protection adapted to its nature; and if we neglect the precautions required by the constitution and properties of the substance, there is no material and no system of construction that will not be frail and temporary.

These remarks are already become too elaborate; but it did not seem practicable to examine the prominent features of the subject, and establish the superiority of a new method of construction, in fewer words. I may not yet have succeeded; for it is impossible to show, in a few pages, the powers of a system, to demonstrate which others have filled volumes; it is impossible, by means of any geometrical projection, to exhibit the magnificence of a suspension bridge; and it is impossible, without an estimate in detail of the cost of every part, to prove (that which I confidently believe to be a fact) that the original cost of the bridge I propose, without reference to its comparative durability, will be considerably less than that of an ordinary wooden bridge.

I will venture no longer to occupy your attention. Though the subject of my communication is too extensive to be investigated in a few brief and popular observations, what I have said may appear sufficient to fulfil the object of the "proposals:" if it be not, I will be happy to furnish any information in my possession to elucidate the subject.

I have, sir, the honor to be,

Respectfully, your obedient servant,

CHAS. ELLET, Jr.

#### *Description of the drawings.*

Fig. A is a projection, on a small scale, of the entire bridge; which consists of seven arches of 600 feet span, and two arches of 483 feet span; the latter being portions of the same figure.

Fig. B is a plan of the same.

Fig. C is a projection, on a larger scale, of the two extreme arches, and half of each of the adjacent arches.

Fig. D is a plan of the same, representing the carriage-way and footways; the former being 27 feet wide, and the latter each  $4\frac{1}{2}$  feet.

Fig. E is a projection of the front of one of the piers, or, as they are sometimes called, triumphal arches. The carriage-way in the centre is 18 feet wide, which is sufficient space freely to admit the passage of two vehicles abreast. The two foot-ways through the pier are each 4 feet wide, and 7 feet 6 inches high.

The order of the architecture is Ionic, which I have chosen, because it appears best adapted to the site, and the materials: for I presume the piers above high-water mark would be built of the freestone which is procured from somewhere near the Potomac, in the neighborhood of Alexandria. The portion of the piers below the water line, which is liable to be injured by ice and floating bodies, should be built of the granite from the vicinity of the Little Falls.

Fig. H represents a section of the floor and cables of suspension.

Each arch is supported by six cables of wire.

The joists, strings, and planking in the floor should be of oak.

Fig. I is a projection of the floor and railing.

Figs. K and L represent the draws. This design offers peculiar facilities for the construction of the draws, and the machinery connected with

them. It will be observed, on an inspection of the drawing, that we elevate a portion of the floor, and admit vessels under the cables. To do this, all the larger class of vessels, as ships and brigs, will be constrained to strike their royal and top-gallant masts, before they pass the bridge. I do not consider this inconvenience of sufficient importance to merit a moment's comparison with the decided advantages to be gained by the arrangement. There are but few ships or brigs owned in Georgetown, and these come in but two or three times in the course of the year. The operation of striking the top-gallant masts of a merchantman does not require at sea more than an hour; and there will be ample time to do it while coming up the river from Alexandria, where those sails can always be dispensed with.

The greatest height of the chains above the surface of the river at low water is 107 feet; and their altitude at the outer end of the great draw is 84 feet; and the mean height, or that in the middle of the same draw, the line where the vessels will pass, is 95 feet, or, at common high water, 92 feet—a space, doubtless, sufficient for the largest vessels that sail from Georgetown.

The machinery for elevating the draws is very simple, and may be understood by a reference to figs. F and G on the plan. W and W are two weights connected by the chains  $v$  and  $v$  with the draw, at the distance of 45 feet from the face of the pier. They descend along the curves  $nn$ , and  $mm$ , of which the law is such that the difference between the force exerted by the weights, or the tensions of the chains  $v$   $v$ , and the resistance of the draw, may be constant, the excess being in favor of the draw. This difference will be overcome by the force of two men applied at the moveable cranks  $c$   $c$ . It will therefore descend by its own weight; which, when down, will prevent it from rising. But to render it still more secure, and prevent any unpleasant shaking, it will be fastened by keys and the peculiar form of the ends of the longitudinal pieces.

The two great counter-weights W W roll along curves built in the masonry, and near the centre of the pier. The strength of the pier will not be sensibly diminished by the vacant spaces or crescents left there for the action of the weights. The length of the lever, by which the pier acts to maintain its equilibrium, remains unaltered, whilst the weight of the pier is only diminished an amount equal to the weight of the quality of materials which those spaces would contain; and this quantity, being taken from the centre, does not affect its stability.

The construction of the draw is represented in figs. K and L. It is elevated by the chains  $c$  and  $g$ . A less weight would be required to raise it, if the force acted at the extremity; but as its own weight would then strain the longitudinal pieces, or require their weight to be excessive, the arrangement I have adopted is preferable.

When the draw is down, it is supported by the oblique chains represented in fig. F, at the points  $a$ ,  $b$ ,  $d$ , and  $e$ . The strength of these chains must, of course, be sufficient to support the weight of the draw, and the transitory loads it will have to sustain; taking into view their inclination to the vertical.

The forces applied at the cranks  $c$   $c$ , act at the extremity of the draw.

*Extract of a letter of subsequent date, from Charles Ellet, junior, to the Chairman of the Committee on Roads and Canals.*

The extensive applicability of these principles, not only as a substitute for the ordinary methods of bridge building, but for aqueducts for navigable canals, for feeders, and for portable bridges in military operations, would really appear to render it worthy the attention of Government.

A bridge of one hundred and fifty feet span, suitable for the purpose of an army in the field, and sufficient for the passage even of artillery and stores, could be transported in an ordinary baggage wagon, and might be erected, by an active officer and a well drilled corps, in less than an hour. A suspension aqueduct for the supplying of this city with water, could be thrown across the Harlaem river for the sum of \$150,000, which would be more durable, and not less stable, than that of stone, which the engineer has estimated at \$500,000.

We have in all quarters evidence of the necessity (or, at least, room) for a change in the present systems of construction: even the stone aqueducts on the Erie canal, which so often have been adverted to as little less than masterpieces, are already falling to the ground, and must necessarily be rebuilt before ever the wooden trunks on the same work will fail, and sooner than the cables of a suspension bridge would have required a fresh coat of varnish.

The enclosed estimate is not a copy of that which was submitted to the Secretary of the Treasury. The price of the cables varies from that originally given, in consequence of the false, and, perhaps, interested, statement of an importer of iron wire; an error which I have since been able to correct by the more authentic testimony of an agent for an English house at Philadelphia.

The masonry I have set down at a higher price in the present estimate than in that which was formerly presented. If this is higher, it is only because it provides for the construction of a better bridge; not that the former was not sufficiently high to pay liberally for a work of such a character as would be necessary to compete in utility, economy, and durability, with a wooden bridge. The estimated cost of the foundations presented to the Secretary of the Treasury was made upon an hypothesis explained in the letter accompanying it; and if the data I assumed were wrong, the fault is attributable to him whose duty it was to have provided better.

The present estimate, you will observe, amounts to \$518,528, which I consider sufficient to cover every expense. If it should be found deficient in any part, it will be in the cost of the foundations; for, on this subject, where experience is not sufficient to furnish a certain guide, and theory is inapplicable, the estimate must necessarily be, in a great measure, empirical.

*Estimate of the cost of a wire suspension bridge, proposed to be constructed across the Potomac, at Washington.*

In the following estimate, the quantity and value of the wood and iron are referred to the unit of length of the floor and the supporting cables; so that the quantity of timber, given in the first column, is the number of feet in board measure, reduced to a length of one foot measured along the floor; and, in like manner, the quantity of iron is reduced to the lineal foot, measured along the cables.

Timber.			
	Cost of timber per thousand, board meas.	No. of feet, per lineal foot.	Cost per lineal foot, labor of raising, &c. included.
There will be in each arch 144 transversal beams or joists, which will measure, in the centre, 7 by 16 inches	\$18 00	69	\$1 25
These transversal beams are covered along the carriage-way, first by a course of three inch oak planking, laid parallel with the direction of the bridge	17 00	81	1 38
And this planking is covered with another course, one inch thick, laid parallel with the direction of the joists	17 00	27	46
The footways to be of oak plank two inches thick	17 00	18	30
Eight string pieces placed above and below the transversal joists	18 00	36	65
Railing or parapet	-	-	40
Cost of timber per lineal foot	-	-	\$4 44
5,200 lineal feet of timber, at \$4 44	-	-	\$23,088
Iron.			
	Estimated cost per pound of iron.	No. of pounds per lineal foot.	Estimated cost of iron per lineal foot.
In estimating the cost of this important item, every expense is included; as the value of the wire, manufacturing it into cables, paints, oil, varnish, freight, raising, &c.: the section of the cables will measure 70 inches	\$0 10	230	\$23 00
Area of the section of the wire suspenders, by means of which the floor is connected with the cables, 1½ inch; mean length 24 feet	10	30	3 00
Bolts, burrs, and shields in flooring	9	10	90
Bars to prevent the slipping of the cables	9	8	72
Nails and spikes	7	2	14
Cost of iron per lineal foot	-	-	\$27 76
5,500 lineal feet, cables, iron, &c., at \$27 76	-	-	\$152,680

## STATEMENT—Continued.

Masonry.	Perches of masonry in each pier.	Price of masonry per perch.	Estimated cost of masonry in each pier.
From low-water mark to the level of the flooring -	2,380	\$4 00	\$9,520
From the plinth of the impost supporting the arch over the carriage-way, to the summit of the entablature -	2,400	5 50	13,200
Cost of each pier - - - - -	-	-	\$22,720
Timber work - - - - -	-	-	\$23,088
Iron work - - - - -	-	-	152,680
Eight piers, at \$22,720 - - - - -	-	-	181,760
Eight foundations for piers, at \$17,000 - - - - -	-	-	136,000
Abutments, wings, fastenings, &c., \$25,000 - - - - -	-	-	25,000
Estimated cost of bridge - - - - -	-	-	<u>\$518,528</u>

LYNCHBURG, *March 13, 1836.*

DEAR SIR: Your favor of March 4th, relative to the suspension bridge which it is proposed to erect across the Ohio, at Wheeling, was not received until yesterday. I have since then employed the facts which you have furnished me in developing a plan for that structure, with a view to the preparation of an estimate of the probable cost of its execution. Not being familiar with the proposed site of the bridge, and having no information with regard to the nature and elevation of the banks of the river, I know not what natural advantages may exist to cause a modification of the plan upon which the estimate is predicated. In the absence of authentic information, I have deemed it safest to assume the most unfavorable case, namely, that in which the points of support are to be raised to the full height you have named from the bed of the river, and the ends of the cables must be secured by an artificial construction raised from the same level.

These conditions being added to the data which you have furnished me, seemed to designate an arrangement similar to that in the accompanying sketch, as at once the most suitable and the most economical.

The span of the arch, measured between the inner faces of the columns of support, is 500 feet; and between each column and the shore is a stone arch of 100 feet, the extreme or littoral abutments of which arches are constituted of the mass of masonry in which are anchored the cables of suspension.

The object of these arches is apparent; while, added to the opening over the channel, they give us a clear water-way of 700 feet, they evidently counteract by their thrust the horizontal component of the tension of the great cable; and, of course, if built with a due regard to the equilibrium of the structure, neutralize the effort to overturn the abutment.

If we had a high and abrupt bank on either shore, the design would be

modified so as to take advantage of it; the span of the arch might be increased, and the height of the columns of support diminished; perhaps one of the stone arches would be rejected, and the ends of the cables secured in the rock, without erecting an abutment for that purpose.

The width of the opening, which I have assumed as sufficient, is not dictated by any difficulty of overcoming the whole breadth of the stream without the aid of intermediate piers; but has been selected altogether with a view to economy, on the supposition that an artificial support must be formed at the level of the river.

There are no facts in physical science better established than the possibility of safely suspending a wire cable over a space of six thousand feet, where points of support can be obtained at an elevation of one tenth that distance. But a chain suspended under such circumstances sustains a tension equal to one-third the absolute force of the material of which it is composed, and therefore would not be capable of supporting any additional weight for a great length of time. As we recede within this limit, still preserving the same ratio between the width of the opening and the height of the supports, the load which the cable is capable of sustaining, in addition to its own weight, increases; and at any point within three thousand feet the possibility of applying the system to the construction of a bridge is unquestionable.

Though the cost of erecting the supports and executing the work on so magnificent a scale will perhaps forever prevent its accomplishment, we may expect to witness a much nearer approach to the limit than has yet been attempted.

There are several very important structures in Europe of this character, of which the dimensions greatly exceed those of the design before you. The Menai bridge, on the great road from London to Dublin, is too well known not to have occurred to your recollection; it measures 560 feet between the abutments, and is elevated 128 feet above low water.

In a recent memoir read to the French Academy by M. Arago, are given the principal dimensions of the Freybourg bridge; from which it appears that the edifice, which is on the road from Basle to Strasburg, measures 880 English feet between the points of support, and that the flooring is elevated 167 feet above the bed of the Saone.

These examples are quite sufficient to establish the practicability of the plan proposed; and though the cost will be great, you will perceive, by the following estimate, that it is chiefly due to the excessive height of the abutments.

In forming the estimate, I have supposed the width of each carriage-way to be twelve feet, and that of the footway six feet; making the whole width of the platform thirty feet. The dimensions of the joist and planking were calculated on the supposition that they may have to sustain the jolting of the heaviest teams and trains of artillery; and the estimate for the dimensions, and consequent cost of the cables, is made, as usual, on the presumption that the platform may sometimes be covered by a dense crowd of people, occupying the whole distance between the abutments. This weight exceeds, by many tons, that which would be produced by droves of cattle, or even a troop of horse.

Supposing each individual to occupy three square feet, we shall find, for the weight to be resisted, that due to the pressure of five thousand men; and estimating the average weight of the individuals composing a crowd

at 155 lbs., we shall obtain, for the greatest transitory load, 346 tons. This, added to the constant weight of the structure, 384 tons, gives for the maximum load, against which we are to provide, 730 tons. The tension due to this weight, uniformly distributed along the platform, is 1,062 tons; and this furnishes the data for determining the dimensions of the cables.

The platform and its load would be supported by eight iron-wire cables, presenting an actual section of eighty square inches; each of these would measure ten inches in circumference, and would be capable of supporting a weight of 420 tons, which is equivalent to an aggregate force of 3,360 tons, or more than three times the extreme tension which they can be required to resist.

This may appear to be providing a superfluous excess of force; but it is to be observed, that the elasticity of iron is affected before the load which it sustains amounts to one-half the limit of its tenacity; and though the limit of elasticity of iron wire approaches nearer the limit of tenacity than is found to be true in bar iron, still, perfect security, and a proper regard to the durability of the material, seem to point to one-third the absolute force as the nearest approach which is consistent with the perfect preservation of the nature of the metal.

The weight of the cables and suspenders will be 240,000 pounds; and, being imported free of duty, may be manufactured and delivered at 11 cents per pound. They will be manufactured in five distinct pieces, of which the principal, extending from one point of support to the other, will be 530 feet in length.

The thickness of the abutments or columns of support will be 36 feet; breadth, 48 feet; height, from the foundation to the coping of the parapet, 165 feet. They will contain, each, 7,980 cubic yards of masonry, and should be built with two vacant spaces in the interior.

The whole amount of masonry in the structure, according to the plan, including the arches, abutments, &c., is 29,800 cubic yards.

The following may be regarded as an approximate estimate of the cost; it is certainly a very liberal one for the superstructure, and there can be little doubt that the massive masonry required can be built for the price at which it is set down.

29,800 cubic yards of masonry, at \$6	-	-	-	\$178,800
240,000 lbs. wire cables, (cost of raising included,) at 11 cts.	-	-	-	26,400
500 lineal feet of platform	-	-	-	2,500
				207,700

As the width of the other channel is ninety feet less than that to which this estimate applies, its cost would be proportionably diminished, and I should, therefore, consider \$400,000 a liberal estimate for the two.

The value of masonry, of course, depends on its quality; and, as the dimensions of this bridge are on a grand scale, and the character of the superstructure is designed for a work of the first class, I have deemed it essential to raise it on a permanent foundation. Such a structure should only be adopted on an important occasion; and, when adopted, it should be monumental.

I have only to add, that the accompanying plan is to be regarded merely as the result of a half hour's reflection, and not as the disposition which

would actually be adopted after an examination of the site, and mature deliberation on the subject. Indeed, when we observe the quantity of masonry (nearly 14,000 cubic yards) provided in the estimate for the purpose of securing the cables, there can scarcely remain a doubt that a much more advantageous arrangement might be selected.

I remain, dear sir,

Very respectfully,

Your obedient servant,

CHARLES ELLET, JUN.

Hon. C. F. MERCER, M. C.

The Committee on Roads and Canals have received, during the present session of Congress, the annexed statements, which are believed to be entitled to full credit, respecting the interruption of the necessary intercourse between the opposite shores of the Ohio river, in the direction of the Cumberland road. They have, also, had submitted to them the accompanying memorial, subscribed by more than 450 citizens of Wheeling, and the citizens of Virginia in its vicinity.

George W. Thompson states that he has resided, since his birth, within ten miles of the river, in Belmont county, Ohio, which county borders on the Ohio river, opposite Wheeling, in Virginia; that he knows that the ferrying across the Ohio river is obstructed by ice more or less every year, and frequently amounting to a total obstruction of the passengers, travellers, and drovers, and imminent danger to the transportation of the mail. He further states, that more than once he has been detained, on this side of the river, a week, by the impracticability of crossing the river. He further states, that there are two other ferries—one above, and one below the island; that when the river breaks up, in the spring, it is extremely difficult (sometimes dangerous) to approach these two ferries, and that the principal point of crossing is at the island ferry; and that in all times of difficulty, when he has crossed this river, he has found Mr. Daniel Zane giving his personal attention, and affording every facility. Besides the immense travelling, this ferry accommodates a very extensive portion of Ohio.

GEO. W. THOMPSON.

WASHINGTON, *January 12, 1837.*

By the request of the friends of a free bridge across the Ohio river, at Wheeling, Va., Daniel Zane states that for twenty years, or more, he has had the care and superintendence, either in part or altogether, of the ferry across the Ohio river, at Wheeling. That the navigation is frequently interrupted during the winter season. Light wagons, carriages, and horsemen, are detained from two to three days at a time; heavy teams, from two to seven days, frequently.

This detention does not arise from any defect in the boats, or inattention or unskilfulness in the hands; for it is well known that persons come

as much as thirty, and the subscriber has known persons to come eighty miles up, to get over at Wheeling, on account of its being known said ferry was kept open when practicable.

Great difficulty is encountered, every winter, in transporting the mails across the river; they are frequently taken over by laying plank upon the ice, (before it is safe to cross upon it without them,) and drawing the mail-bags along. This operation is attended with much danger to the lives of those concerned, as well as great risk in regard to the contents of the mails. He recollects but one instance, however, of the mail being lost.

DANIEL ZANE.

As it regards the steamboat ferry below the island, it has not, nor cannot, accommodate the public as well as we can with our common mode of ferrying, as we crossed at least ten days longer through the ice this season than the steamboat ran.

DANIEL ZANE.

Peter Yarnall states that he has resided for twenty-five years at Wheeling, and knows that great difficulty and danger have existed, at various times during that period, in regard to crossing the river; and that persons are often detained there, in considerable numbers, and for several days, on account of the difficulties in the navigation up and down the Ohio river.

PETER YARNALL.

Daniel Steenrod states that he has lived near Wheeling; his farm adjoins the town, and he has been keeping a public-house for nearly twenty-five years—his entire residence there being forty years, or more; and knows that persons have frequently been detained for several days, in great numbers, at his house, on account of the interruptions to the navigation rendering it impossible to cross the Ohio. Such detentions last for a week at a time, during which period unsuccessful attempts are often made to get across.

DANIEL STEENROD.

*To the Senate and House of Representatives of the United States in Congress assembled:*

The memorial of the subscribers, citizens of Wheeling, and its vicinity, in the State of Virginia,

RESPECTFULLY REPRESENTS:

That the public travel is obstructed, and the mail often hindered and delayed, by reason of the difficulty experienced in crossing the Ohio river at Wheeling. During the winter season, the crossing at this point is always precarious, often difficult and dangerous, and sometimes it is entirely interrupted for several days together. The only remedy for this great

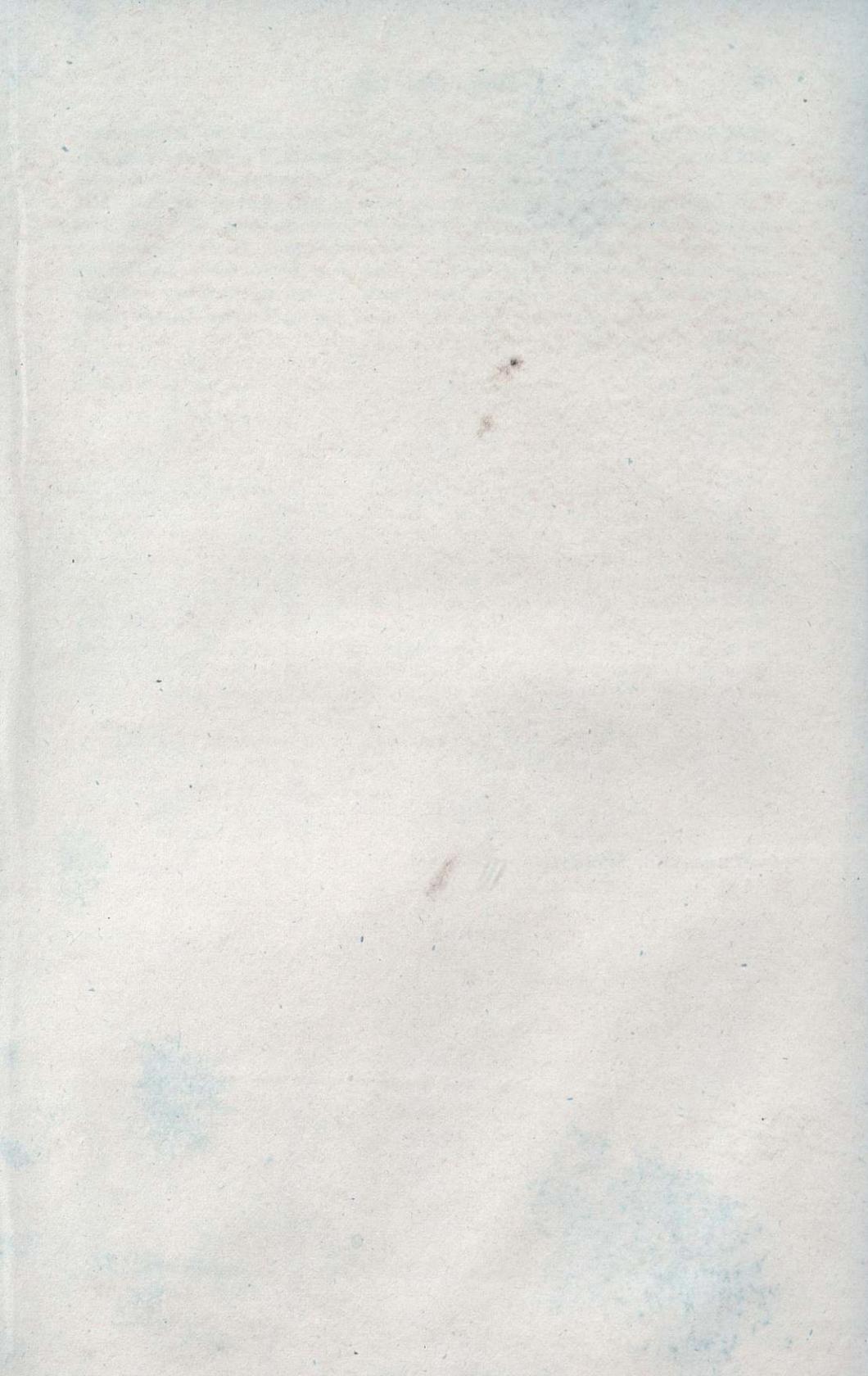
public inconvenience is the erection of a bridge across the Ohio river; such bridge, in fact, seems to be a necessary part of the national road, for the river is often found to be a more serious obstruction to the travel and to the progress of the mail than many miles of bad road would be. And when it is considered that as many as six or eight western, and nearly as many eastern States, are interested in the regular and speedy transmission of the mails crossing the Ohio here, your memorialists conceive such bridge may well be regarded as a national object. Your memorialists therefore pray for the appropriation of such sum of money as shall be deemed sufficient for the erection of a bridge across the Ohio river, from the city of Wheeling to Bridgeport, Ohio, in order to supply the link which is wanting to connect the eastern section of the national road with that part of it which lies west of the Ohio river.

The undersigned, understanding that fears are entertained by some that the erection of a bridge across the Ohio river, at Wheeling, may obstruct the navigation thereof, beg leave to express their belief that there is no reasonable ground for such fears, believing as they do that a bridge may be so constructed as not to impede the navigation thereof, except on occasions of extraordinary freshets, (but three of which have occurred within the last fifty years,) and would not, even then, but for a short period. And they would further state, that the crossing of the river, at Wheeling, is often rendered difficult and highly dangerous in the winter season, for many successive days, by masses of floating ice, and oftentimes entirely interrupted.

McKee, Harding & Co.  
Redick McKee,  
W. T. Selby,  
Richard McClure, P. M.  
John Fawcett,

Forsyth & Atterbury,  
J. Leit,  
Wm. Beymer,  
Moore & Clarke,  
William Paxton.

WHEELING, January 17, 1837.



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John Doe	John Doe
John Doe	John Doe