The World's Columbian Water Commerce Congress

CHICAGO, 1893

THE PROJECTED

LAKE ERIE AND OHIO RIVER

SHIP CANAL

BY

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The Old Corner Bookstore
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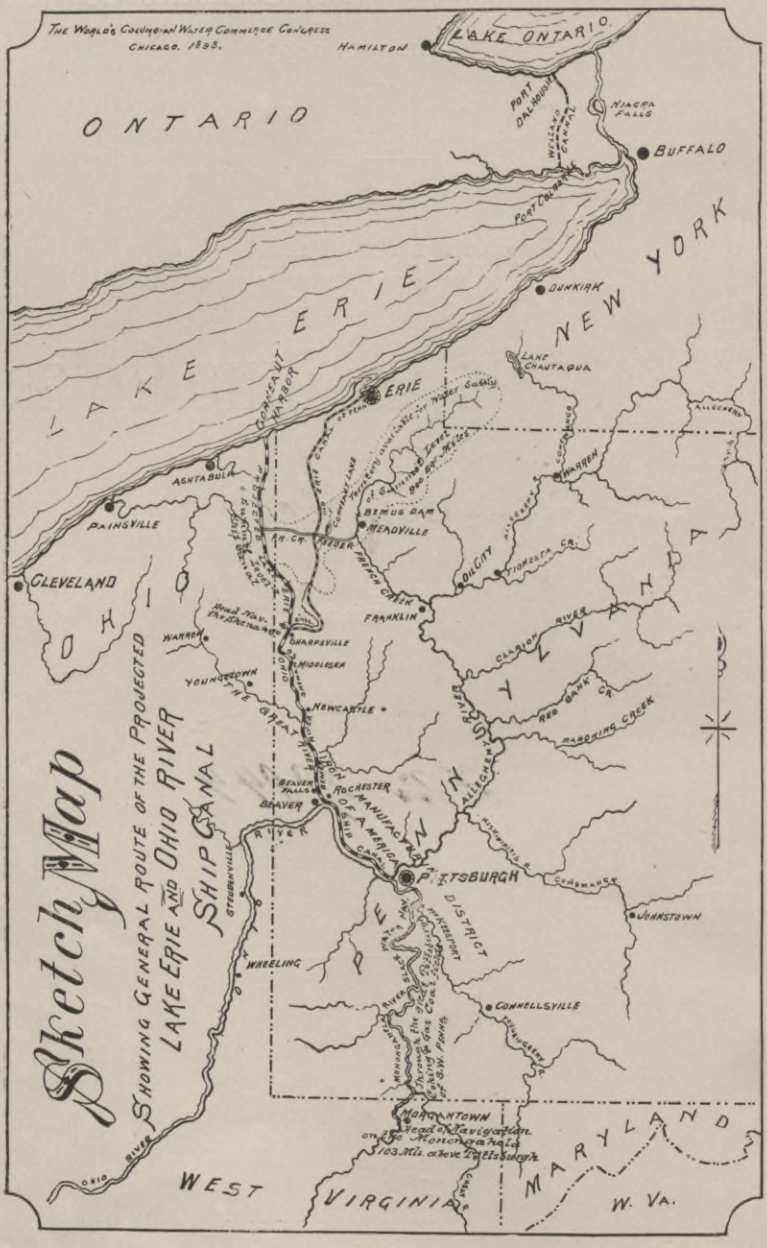

THE PROJECTED LAKE ERIE AND OHIO RIVER SHIP CANAL.

In 1889 the Legislature of Pennsylvania authorized the appointment of a Commission to determine the feasibility of connecting the waters of Lake Erie and the Ohio River by a ship canal, and, in the language of the Act, "To lay out a route for the same, if feasible, and to estimate the expense of its construction, etc.;" the sum of $10,000 being appropriated to cover the necessary expenses.

The Commission made its report to the Legislature in 1891, and three thousand (3,000) copies of the report, with duplicates from the plates,—which had been prepared,—were ordered to be printed; but as no money was appropriated to cover the expense of printing, the report of the Commission was never officially published.

No route having been specified in the act of the Legislature, the Commission felt justified in recommending the shortest practicable route to connect the Ohio River with the Lakes, and finally reported in favor of a route leaving the Ohio River at a point twenty-eight (28) miles below the city of Pittsburgh, and thence *via* the Beaver and Shenango Rivers to the head of the last-named stream, near the Ohio State line; and thence passing into Ohio, and for a distance of twenty (20) miles in that State to Conneaut Harbor, Lake Erie,—a point located about one mile west of the Pennsylvania State line.

GENERAL DESCRIPTION OF ROUTE, ETC.

The length of the canal from the mouth of the Beaver, on the Ohio, to Conneaut Harbor, Lake Erie, on the line

adopted, was found to be one hundred and three (103) miles; or only 7 miles more than an air line connecting the two points. In order to reach the harbor of Pittsburgh, however, and to accommodate the vast coal, coke, and iron interests of that city, the Commission recommended the extension of the canal paralleling the Ohio River to the United States dam at Davis Island, situated four miles below the city of Pittsburgh, and which dam makes the "permanent harbor" of the city. This extension from the lowermost dam on the Beaver is about twenty-four (24) miles in length, and forms one continuous pool, or level, having an exit lock at the Pittsburgh end, dropping 6 feet into the pool of the city harbor, formed by the aforesaid Davis Island dam. The water supply of this long level would be furnished from the Beaver River. Three locks of an aggregate lift of forty-one (41) feet would be required to reach low-water surface in the Ohio River at Beaver, or Rochester, and are provided for in the estimate; the said connection with the Ohio being chiefly for the benefit of vessels trading from Wheeling, Cincinnati, and other ports on the Ohio, located below the mouth of the Beaver River. It was not deemed expedient, or advisable, to terminate the canal at the mouth of the Beaver, for the reason that the improvement of the Ohio River below the Davis Island dam, now being undertaken by the United States Government, provides for a minimum depth in the river of only 6 feet, while the ship canal is designed with a depth in the canal prism of 15 feet, and with the same depth on the miter sills of its locks.

As designed, the canal will have at the bottom a width of 100 feet, and at the surface, one of 152½. The dimensions of the locks, as elsewhere referred to, are 300 feet available length by forty-five (45) feet width. For convenient reference the following table of distances and elevations of the most important places along the route of the canal are herewith presented:—

	Miles.	Elevation of water in Canal above Sea Level.	No. of Locks from Pittsburgh.
Pittsburgh	0.0	699.29	0
Rochester	27.4	705.3	1
New Brighton	30.4	705.3	2
Beaver Falls	32.4	715.6	3
Rock Point	40.1	739.0	4
Wampum	42.9	755.0	5
New Castle	51.4	790.0	8
Middlesex	66.4	823.5	12
Sharon	72.4	856.5	14
Sharpsville	75.9	866.0	16
Head of Shenango Navigation	79.6	876.0	17
Transfer	81.9	976.0	22
Greenville	86.7	984.0	23
South End of Summit	98.5	1,016.0	25
North End of Summit	118.5	1,016.0	26
Conneaut Harbor	130.4	572.89	51

As early as 1824, the General Government executed surveys for a canal from the mouth of the Beaver River to Lake Erie at the Harbor of Erie, Penn., and between 1837–40, a canal of sixty-five (65) ton boat capacity was completed, and continued in operation until 1872, when it was sold to private parties, and a portion of the old abandoned canal is now used as a roadbed for a railroad.

Although terminating twenty-eight (28) miles below the city of Pittsburgh, and small as it was, the old canal accommodated a very considerable business; there being carried over it in some years as much as 400,000 tons of coal, and its net toll receipts were more than $100,000 per annum.

The abandonment of this canal has left the too prevalent impression in Western Pennsylvania that it was a failure, and increases the difficulty in reviving interest in any kind of a canal. The old canal had 133 locks, and its summit level was 66 feet higher than the proposed ship canal, and, besides, it was 31 miles longer between the river and the lake than the contemplated project. Two years previous to its final abandonment, an attempt was made to have the State assist in enlarging it to the present capacity of the

New York and Erie Canal, viz., to a depth of 7 feet, and made available for boats of 250 tons; but the opposition of certain Eastern politicians defeated this project, and by the constitution adopted in 1873 the State can now take no part in this or any other similar enterprise, the State Canal Commission having been appointed in 1889 merely for the purpose of setting forth the facts regarding the feasibility of a Lake Erie and Ohio River Ship Canal.

The old canal, as it was maintained for a number of years, suffered greatly from the neglect to deepen its summit level; and in consequence, while there was an ample supply of water to be had by natural means, pumping from Conneaut Lake into the feeder—two miles long—had to be resorted to to keep up the supply; and frequently the inefficiency of the pumps resulted in insufficient depth being provided, so that ox teams were sometimes employed to drag the boats eight miles through the summit level. So again, at its Ohio River end, during the season of low water in the river, when no boats were moving, agricultural produce, for want of adequate means of transportation on the river to Pittsburgh, suffered deterioration in value. There can be no question, however, that had the old canal terminated at Pittsburgh instead of at Rochester and Beaver, 28 miles below, it never would have been abandoned; and it is from such miserable excuses for canals built for the most part on routes abounding with lockage, and where the water supply was generally insufficient, that the average American citizen draws his conclusions regarding inland water transportation in general.

The newly projected ship canal leaves the old canal route at the head of the proposed slack-water navigation of the Shenango River, the main prong of the Beaver River, and 55 miles above the mouth of that stream. This division, which forms rather more than one half the distance between the Ohio and Lake Erie, is remarkably direct, requiring but few changes to make it suitable for a ship canal of splendid proportions. The natural width of the

Beaver varies from 300 to 500 feet, and of the Shenango from 175 to 300 feet; and the thalweg of these streams, as shown by soundings indicated on the profiles, shows that with a comparatively small amount of dredging, a depth of 15 feet can be had without the necessity of erecting dams any higher than those constructed for the old canal, some of which are still in use, affording water-power for mills. The new dams might in some portions—as in the neighborhood of the city of New Castle—well be arranged with adjustable tops, or made so as to be entirely lowered to the bed of the stream, in order to pass floods which, at rare intervals, have overflowed the adjacent low lands.

In addition to the iron-manufacturing towns of Beaver Falls, New Brighton, New Castle, Middlesex, Sharon, and Sharpsville, located on this division, by means of a branch, about 17 miles in length, upon which an abundant water supply can be had, the city of Youngstown, Ohio, on the Mahoning River, could be reached. Youngstown and its neighborhood is the seat of 13 furnaces, each one of which is equivalent, as a freight producer, to an average city of thirty or forty thousand inhabitants. In addition to these 13, there are 16 more furnaces directly on the route of the canal in the Shenango Valley, with many rolling mills, etc., and at the Pittsburgh end 25 furnaces, most of them larger than can be found elsewhere in the world, besides iron and steel works in great numbers.

From the head of the Shenango navigation, 55 miles, as before stated, from the Ohio, and 16 from the southern end of the summit level, the canal proper would begin (referring now to the country between the Ohio and Lake Erie, and neglecting for the time being the 24-mile extension above the mouth of the Beaver to Pittsburgh).

In this distance of 16 miles eight locks, averaging not quite 18 feet lift each, are projected to reach the summit; which summit level, as at present designed, is 20 miles in length through a region of swamps for most of the distance,—the exact point of the divide being difficult to

determine by ordinary observation. The conformation of the country is such, however, that the summit level could be extended entirely to the "head of navigation," so called, on the Shenango, making it nearly 30 miles long; and thus it might be possible to dispense with the eight locks, substituting in their place a double lift of 140 feet. The canal, as projected, would be provided with single locks, measuring 315 by 45 feet, or with an available length of 300 feet; but in case lifts should be decided upon, in order to reduce the number of locks, it would probably be found necessary to make the lifts double. The time required to pass lifts, under the best circumstances (appears to the writer, who has, however, had no personal experience with them), would be considerably in excess of that required to make a lockage, say of 20 feet, which is the maximum proposed by the Pennsylvania Ship Canal Commission.

The elevation of the summit level above mean tide is 1,016 feet, and 443.11 feet above the mean level of Lake Erie; and this descent of 443.11 feet from the summit is provided for in 25 locks, with an average lift of 17.7 feet, all in a distance of about 12 miles. The Commission made no serious study of the possibilities of lifts for this division, though it is manifest that there is here afforded an opportunity by their employment to dispense with quite a number of these locks, and, as well, to economize in the use of water necessary for the maintenance of the supply in the summit level, etc. Auxiliary reservoirs were provided for to maintain an equable supply at several of the intermediate levels between the summit and Lake Erie, but it must remain for further study to determine which of several practicable expedients would be best for actual construction in this situation.

The lake terminus in the mouth of Conneaut Creek was specially surveyed, and numerous borings made to determine the depth to the rock, etc. It was found that a dredged channel, of about 250 feet width, passing

straight inward from the proposed breakwater of 17 feet in depth, and one mile in length to the first lock, was entirely practicable at a moderate cost. Examinations of the mouth of Elk Creek Harbor, in Pennsylvania, seven miles east of Conneaut, were also made; but Conneaut Harbor was found to furnish more favorable natural conditions, and proved to be the terminus for the shortest and least expensive route which could be found for the canal.

On the entire route between the lake and the river there are no engineering difficulties worthy of much notice, the most important being two arched spans of 40 feet each in an embankment 50 feet high for the passage of Conneaut Creek beneath the canal, at a distance of about 5 miles from the lake terminus; and besides this an aqueduct embankment over the valley of Big Run, about 14 miles south of the terminus of the summit level,—the said embankment averaging about 30 feet from the top of the berm to the ground for a distance of about 6,000 feet; the material for this embankment comes from the adjacent canal cuts. At no point does it appear necessary to excavate more than 35 feet to secure the full depth of the canal prism; and this kind of location may be secured with an alignment, save at one or two bends in the Shenango River, where the hills come down on both sides to the stream, requiring a curvature of a less radius than 2,000 feet. It may be said in general that the contours of the country between the Shenango and the lake are quite gentle, and never broken by sharp ravines. It is a region, for the most part, which permits of considerable latitude on the part of the engineer in the arrangement of his levels, so as to reduce the excavations necessary for the canal to a minimum, and with but little material to waste. The slope toward the lake, which presents such a formidable appearance on the profile, would, with the exception of the Conneaut Creek crossing, afford almost a natural bed for a railway, on one mile of which, however, the descent would be rather more than 100 feet, but in all it averages less than 40 feet fall per mile.

From the territory directly tributary to the summit, the Commission found that 13,000,000 cubic feet of water *per diem* could be obtained for the 214 days of lake and canal navigation allowed by the underwriters. The basis of this calculation is a conservative one. With a rainfall of, say 40 inches, the first assumption is that 40 per cent is available flowage, which in this case is 16 inches, and these 16 inches are distributed as follows:—

Compensation to riparian owners . . .	6.72 inches.
Evaporation from surface of reservoirs, 4.1 per cent of rainfall	1.64 "
Percolation from reservoirs and conduits .	1.64 "
Available storage water	6.00 "
Total	16.00 "

It would be practicable, in my opinion, to supply the few riparian owners who live in that sparsely settled region, and from whom necessary streams are diverted, by pipe lines from the reservoirs, and thus largely increase the available supply to be had from the country immediately adjacent to the summit level.

The canal can obtain 40,000,000 cubic feet *per diem* by uniting these reservoirs with the surplus flow of French Creek, supplemented by storage reservoirs constructed in the valleys of Cussewago and French Creeks. At the Bemus dam in French Creek, above Meadville, from whence the old canal feeder ran to Conneaut Lake 23 miles, Mr. W. Millnor Roberts (late Chief Engineer of Pennsylvania) states that the lowest discharge is 19,000,000 cubic feet per diem, and of this 15,000,000 cubic feet was considered available for canal purposes, leaving 4,000,000 cubic feet daily for the use of landowners below. The mean discharge of French Creek for ten months yearly is much greater than the figures reported by Mr. W. M. Roberts.

We have to sum up, an area of country about the heads of the Conneaut and Shenango Rivers, Cussewago and

French Creeks, embracing an area of more than 800 square miles; a region—and the late Colonel Merrill, of the United States Corps of Engineers, agreed with me in the opinion—most favorably disposed for the location of shallow reservoirs, the kind harmless even should they burst, yet, in some instances, of enormous area and storage capacity. One dam of this sort, shown by the surveys of the Commission only 14 feet high, would make a pond of 8,000 acres on ground now mostly a worthless swamp. This pond would lie alongside the summit level for a number of miles, but its water surface would be 26 feet lower than canal level. Pumps could be resorted to to lift water into the canal from it, but its principal use would be to keep up a brisk supply in the canal south of the summit.

With 40,000,000 cubic feet daily, and making the liberal allowance of 5,000,000 cubic feet daily loss in the hot months by evaporation, infiltration, and gate leakage from the summit, we should still have 190 locks full daily, which is rather more than could theoretically be used in the lockage of vessels through single locks over the summit. One and a half locks full will pass a vessel into and out of the summit level. The supply, therefore, is shown to be enough for 125 vessels, or 62 passages each way daily.

Should the time ever come when a duplicate ship canal upon this chosen route should become a necessity,—something, however, not within the bounds of reasonable probability,—the Alleghany River, with its 4,000 square miles of drainage area, could be tapped in the neighborhood of Tidioute, and made to flow to Conneaut Lake through a feeder branching from the French Creek feeder, and possibly not more than 60 miles long. I know from my own gauging of French Creek, and other tributaries of the Alleghany River, that its low-water discharge from its 1,100 square miles, which is the area of its entire basin, is more than equal to the Kiskiminetas of 1,300 square miles, the Clarion River, Redbank Creek, and the Mahoning River, all united. Evaporation is much more excessive,

for some reason, in the valleys last named, in the summer and fall months, than is observed on French Creek. French Creek originates in a cool, elevated region, traversed by moisture-laden winds fresh from the Great Lakes; and this is probably the explanation of the marked atmospheric and hygrometrical differences in the valleys named. It was my fortune to have referred to these facts, which now have so much significance, in a report to Colonel Merrill, when I made a survey of the Alleghany River in 1878, under his direction, for the United States Government.

COMPARISON WITH OTHER PROPOSED ROUTES.

A comparison between this route and those which have been surveyed by State and United States engineers, upon some of which small canals are now in operation, connecting the waters of Lake Erie with the Ohio River, will show most conclusively the superiority of the Beaver route over them all in the following prime considerations: 1st, length of route; 2d, aggregate of lockage, with one exception; 3d, cost; 4th, prospective business.

Ohio River to Lake Erie.	Length, Miles.	Lockage, Feet.
Miami, or Cincinnati-Toledo Route . .	238	882
Maumee, or Wabash Route	500	648
Portmouth-Cleveland Route	312	1130
Beaver-Conneaut Route	103	759.81

Upon none of the routes named west of the Beaver route is it possible to find a water supply for a canal of the dimensions proposed for the Beaver route; viz., 15 feet depth of water, with a canal prism 100 feet wide at the bottom, 152 feet at the surface, having locks 300 feet available length by 45 feet actual breadth.

ESTIMATE OF COST.

Regarding the estimated cost of the canal, I can say that while the surveys were only of a preliminary nature, sufficient data was secured to make a reasonably close approx-

imation of what the actual cost would be. Some of the more important items were made purposely large, and in some instances the prices attached are lower than responsible dredging companies both in this country and England, who had been communicated with by Mr. Goodwin, my associate, advised. The report of the Commission and memoranda printed separately from the report, may be referred to for further details as to the cost. The total estimated cost of the work is $27,000,000. I can conceive of no reasonable additions or improvements which would make it cost more than $30,000,000. The Beaver sandstone is noted for its durability and the ease with which it can be worked. Clay for brick slope revetment; cement, equal to the best made in America, manufactured in its valley; sand, gravel, timber, and everything else needed by contractors, is at hand, or conveniently accessible by railroads.

PROSPECTIVE BUSINESS OF THE PROPOSED CANAL.

The coal region of Western Pennsylvania and the Pittsburgh, Shenango, and Mahoning iron-manufacturing districts presents more business prospectively for a canal than any equal area of the country can possibly exhibit; but to make the exhibit as it should be made would require much more time than I can devote to it in this place.

The following table, compiled from the records of the "American Manufacturer and Iron World,"—a recognized authority,—exhibits the number, condition, and capacity of the furnaces in the "canal district," as I shall beg leave to term it, on February 1st of the present year:—

Furnaces.	Total No.	In Blast Feb. 1st	Weekly Cap. Furnaces in Blast Tons.	Total Cap. Weekly Tons.
Pittsburgh Region,	24	21	34,214	39,616
Shenango Valley,	16	9	9,869	15,793
Mahoning Valley,	13	10	110,072	14,432
West Virginia,	4	2	2,154	3,340
Totals,	57	42	59,309	73,181
Total U. S.,	528			281,865

The 57 monster furnaces of our canal district, which by their output so astonished the visiting members of the British Iron and Steel Institute, have alone a capacity equal to one quarter of the entire furnace production of the whole United States.

The present production of furnaces of this dictrict is, no doubt, greatly in excess of 3,000,000 tons per annum. Their production actually was 2,593,719 tons in 1889, as shown by reports of the American Iron and Steel Association.

Of the iron ore to supply these furnaces, including a few thousand tons shipped through Pittsburgh to Johnstown, etc., there was received in 1889, 4,627,049 tons—all of which had been transferred from lake vessels to railroads at Pittsburgh's five lake ports; viz., Cleveland, Ashtabula, Fairport, Loraine, and Erie. The ore receipts at these ports have largely increased since 1889, and it may fairly be assumed that from 5,500,000 to 6,000,000 tons are now annually consumed in our canal district.

It is reasonable to think that within a few years after its completion the canal would do an enormous business in the transportation of coal, ore, lumber, grain, and miscellaneous freight; and such was the conclusion of Hon. John Dalzell in the report prepared by him, and favorably recommended to Congress by the Committee on Railways and Commerce last winter. On the assumption that a toll was to be levied to provide for interest on cost and for maintenance of way, I think it can be shown the canal would be profitable in operation with tolls of no more than 10 cents per ton on coal, 15 cents on iron ore, and with somewhat higher rates upon more valuable articles of merchandise. The interest account on, say $30,000,000 at 5 per cent would be $1,500,000. The cost of maintenance of way on 2,431 miles of canals in France, summing up accounts for the 5 years 1883–1888, was only $390 per mile per annum. It seems to me scarcely probable that a rate in excess of $1,000 per mile per annum for actual mainte-

nance of way would be required upon this canal; this, with $70,000 for office and contingent expenses, should be ample for maintaining the work in the highest state of efficiency. We might, therefore, have to provide for a revenue of $1,700,000. As the canal district now pays to the railroads perhaps as much as $7,000,000 for the transportation of its direct lake business, it may be seen that there is a safe margin to meet canal expenses, provide a profit to vessel owners, and still effect a large annual saving to shippers. I will not undertake to refer to the indirect advantages this canal would be to the people of the Ohio Valley, and to the possibilities of the future.

THE PITTSBURGH TERMINUS.

Pittsburgh with its environs now forms a compact manufacturing and mercantile community of 575,000 population, employing in 1892, in her various establishments, 134,097 persons, the annual product of their labor being for the year mentioned $350,201,925, as reported in the statistics printed by the Chamber of Commerce. But population alone affords no criterion of the extent of the commerce of this great community. The commerce originating in Pittsburgh is vastly greater than that originating in any other city in the Union, and including that which passes through, forms an aggregate of 40,000,000 tons per annum, a tonnage in excess of the united volume of traffic of the Great Lakes annually passing the city of Detroit; and it has been well said that Pittsburgh's financial and material interests in lake navigation is equaled only by Chicago and Buffalo of all the cities directly on the lakes.

Her tonnage of vessels on the Ohio River, engaged chiefly in the transportation of coal to the Mississippi Valley, from her inexhaustible coal mines, is greater than that of any lake or ocean port in America.

Twenty-two firms and individuals in Pittsburgh, engaged chiefly in the coal trade in 1889, reported the numbers and tonnage of vessels owned by them as follows:—

	Number.	Tonnage.
Coal boats	1,467	1,174,600
Coal barges	1,776	958,100
Coal flats	648	120,800
Total	3,891	2,253,500

The steamers registered at the port of Pittsburgh, exclusive of small propellers and dredging vessels, number 154, with an aggregate tonnage of 32,438; of these, fully 125 are coal-towing steamers. These are universally stern-wheel vessels, and are used to *push*, and not tow, the fleets of barges, etc. A fleet leaving Pittsburgh generally conveys 10,000 tons of coal, and at Louisville, the larger class of towboats combine not infrequently three of these fleets, making up a tow of 30,000 tons. In addition to the high power of the engines, with which these towboats are equipped, they are provided with a number of balanced rudders, against which the current is thrown by reversing the wheel when making sharp bends, which produces a leverage that enables the most intricate channels among bridge piers, and in the face of violent currents to be steered in safety. This is a system of towing, of course, not possible to be put in practice on the lakes or the ocean, but the inventive skill of Pittsburgh boatbuilders, which has enabled her to present the cheapest means of transportation on difficult waters known to the world, may be relied upon to furnish vessels well adapted to ply upon the canal and lakes in the iron ore, coal, coke, lumber, and grain trade.

With an outlet to the Lakes, her unrivaled facilities for steel-vessel construction would promise soon to result in a decrease of their cost. The facts regarding this so-called "inland city" should be better known to the world than they are; and when such a place is ready to grasp hands with the Lake people in their efforts to improve lake navigation, and to extend it to tide water, it argues well for the early consummation of these truly national enterprises. Pittsburgh's situation is much the same as that of

Manchester, England,—though happily for Manchester, a situation which will shortly be relieved, thanks to her own energy,—a large contributor to, but a small receiver of the benefits accruing from deep-water navigation. But in favor of Pittsburgh, it may be said that for less than one half the expenditure of that incurred by Manchester, she can, by means of a ship canal to the Lakes, benefit a tonnage, not so valuable per ton, but nearly three times as great in volume as the most hopeful friends of the Manchester Ship Canal anticipate for their project, now so nearly completed.

The Davis Island dam affords 14 feet of water for two miles above in the Ohio over a width of more than 1,000 feet, and about 10 feet water, thence to the wharves of Pittsburgh, and to the lowermost dam of the Monongahela Slack-water Navigation, which unlocks the territory of the coal fields of Southwestern Pennsylvania. The existing conditions of Pittsburgh's Harbor as a canal terminus are susceptible of great improvements, and it can be made in every respect suitable for the commerce which would naturally be developed in case of the construction of the Ship Canal.

THE LONGITUDINAL PROFILE OF THE PROPOSED SHIP CANAL BETWEEN LAKE ERIE AND THE OHIO RIVER.

From Surveys made by the Pennsylvania Ship Canal Commission in 1890.