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COMMERCE AND DEEPWATERWAYS.*

BY PROF. LEWIS M. HAUPT, Consulting Engineer.

The lecturer was introduced by the Secretary of the Institute, and spoke as follows:

MEMBERS OF THE INSTITUTE, LADIES AND GENTLEMEN:

In attempting to present a subject having so many phases, I shall endeavor to direct attention first, to the great economies and practical utilities resulting from a liberal public policy towards our river and harbor improvements; second, to the wonderful developments and benefits which have followed the successful deepening of some of the "highways of commerce," and third, to the methods which may be applied to secure the rapid and economical removal of the bars obstructing our waterways; touching incidentally upon the relations of coastwise to foreign commerce, the limita

* A lecture delivered before the Franklin Institute, December 13, 1895.
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tions of draft to tonnage, the importance of shorter and deeper links connecting our great water systems, the incalculable losses due to insufficient water in natural channels, and the lessons furnished by experience, both at home and abroad, resulting from increased commercial facilities.

It has taken many years to impress the fact that the cheapest known method of transportation is by water, and that on the ocean the greatest economy is effected by the use of vessels of largest capacity. From this it follows that the price of every commodity imported or exported is affected by the size of the ship, and this in turn by the depth of water in the channels along her course. Hence the question of suitable depth becomes one of momentous importance to the commerce of the world, and often determines the supremacy of nations as of cities.

A few inches of sand across the ship's path imposes an effectual barrier to her progress, and may at times cause her entire destruction.

This question of the capacity of vessels is but another phase of the transportation problem, to secure the largest paying load at least cost for moving it, or, as it is more technically termed, the greatest ratio of live to dead load.

In rail transportation, the roadbed, rolling stock, stations, fuel, terminals and a host of employes constitute a large factor in the fixed charges (usually over 60 per cent.), while in water transportation, in natural channels, the roadbed is the free gift of God, the weight of the cargo and vessel is balanced by the buoyancy of the water, the fixed charges are relatively small, and the motor has merely to overcome the resistances of the air and water to the ship's passage through them. In many cases, as in rivers flowing to the sea, gravity provides the motor, and the cost of movement is hopelessly beyond reach of any figures possible in overland routes. For instance, the cost of transporting coal from Pittsburgh to New Orleans (2,000 miles) by the Ohio and Mississippi Rivers, including the return of empty barges, is accomplished at a profit to the carriers at 65 cents per ton, or $\frac{1}{3}$ mill per ton-mile, while the rate for the same coal from Pittsburgh to Lake Erie, with

millions of tons in transit annually, is 8 mills with transfer, or 6·93 mills without; this is 20·8 times as much as by the river. If the uncertainty of delivery by water, in consequence of the "tie-ups" occasioned by droughts, were removed, the cost of fuel on the river banks would give to the manufacturers of the valley a very great advantage over other competitors not so favorably situated.

The penalties paid for this uncertainty are enormous, as will presently be shown.

This rate of $\frac{1}{3}$ mill per ton mile is, however, exceptionally low for an interior waterway in an unimproved condition throughout most of its course; yet the rate on the Great Lakes and on the ocean is even lower. Ocean freights are sometimes carried at $\frac{1}{3}$ mill per ton mile, while the lowest paying rail rates are about 4 mills, the average charges being very nearly 9. So far as rail and ocean commerce are concerned, therefore, it is manifest that these two systems can never encroach the one upon the territory of the other, nor can they ever hope to compete in rates; but it must follow that the freight will remain aboard vessel and penetrate the inmost recesses of the land unless special inducements or rates are made by rail, or excessive pilotage or port charges cause an earlier transfer of cargo to the more expensive carrier.

It is this principle which has established, with few exceptions, all the great maritime cities of the world at the head of navigation of bays, rivers and estuaries. It has built Tyre, Venice, Marseilles, Amsterdam, Hamburg, Libau, London, Liverpool, Glasgow, Boston, New York, Philadelphia, Baltimore, Savannah, New Orleans, Galveston, Chicago, Duluth and many other terminals.

It is, in general terms, therefore, an error to carry export freights by rail beyond the first port at which they may be conveniently shipped, for with the difference in rates of 20 to 1 the short cut to tidewater is undoubtedly the cheapest for all parties. To carry the freight in cars beyond this point and to use so expensive a plant for storage purpose is, to say the least, an extravagant policy.

But it may happen that no suitable harbor or place of

transfer exists at the nearest point on tidal water, or that there are physical obstructions which render shipment both dangerous and expensive. At one of the Gulf ports, for instance, the cost of lighterage is stated to be \$1.50 per ton, so that the charge for lading a 3,000 ton vessel in the "offing" would be \$4,500. At the average rate of 9 mills per ton mile this freight could be hauled 166 miles further, provided it could then be shipped without lightering. In point of fact, much of it is carried over 300 miles further to New Orleans on the Mississippi, 113 miles from the sea, with towage and pilotage charges almost as great, doubtless to retain control of the freight and utilise the company's own terminals at this point. The cost of lighterage alone, at ocean rates, would carry the freight by sea 3,900 miles. Any port, therefore, that can secure a deep water channel over the bar, and thus eliminate these terminal expenses, and which is at the same time located near the centers of production, occupies a strategic commercial position, and hence it is that so much attention has been given by the Government to the Gulf coast, as being that which furnishes the shortest haul from the great grain fields of the West to the markets of the world as well as to our Eastern seaboard, and why money has been so lavishly spent at South Pass, Sabine Pass, Galveston and other places, to remove the bars obstructing commerce at these ports. Although \$7,500,000 were spent by Capt. Jas. B. Eads and his associates in successfully deepening the South Pass to 30 feet, still the port and river charges constitute a barrier which limits the commercial movement of the Mississippi River, while at Galveston the struggle has been maintained with the sea for about a quarter of a century with the result that after spending probably \$6,000,000, with more to follow, on jetties and dredging, a depth of only 19½ feet was reported as having been secured last October. The original depth over the outer bar was 12 to 12½ feet.

Here also the terminal charges for lightering over the bar have so restricted commerce as to have fully justified the lavish expenditure made in the effort to remove this persistent and difficult obstruction. But as the desired ultimate

depth of 30 feet has not yet been attained, Congress has granted special concessions to private parties to improve the mouth of the Brazos River and Aransas Pass, that, if possible, the people of the South and West might work out their own salvation contemporaneously with the Government effort. Under these Acts, contracts are now being executed at both of these ports, which will be referred to later, our attention being confined at present to the benefits and economies of deep water in general.

The more deeply this phase of the subject is investigated, the more impressive becomes the conviction that the stimulus given to commerce by the deepening of her waterways is the basis of national prosperity. This conclusion gives to the appropriation for this purpose a pre-eminence over all others, and justifies, to the fullest extent, the levying of special taxes if necessary for this purpose. This policy is pursued by foreign countries with the most beneficial results, and it is carried so far as to subsidise steamship lines to develop new avenues of trade without opposition.

In 1892, the chairman of the Senate Committee on Commerce reported that "the total expenditure for water improvements on the lakes has amounted to about \$30,000,000, approximately one-fifth of the annual saving effected in transportation. By the improvement of these great waterways freights have decreased from 15 $\frac{3}{4}$ cents a bushel for corn between Chicago and Buffalo in 1859, to 19 cents in 1890. Since then it has been carried for 1 cent per bushel for these 1,000 miles, and the tendencies are still lower.

In this country, a narrow partisanship condemns such propositions as unjustifiable prodigality, while conflicting transportation companies oppose the enlargement of our waterways on principle, erroneously assuming that they are injurious competitors.

These opposing forces will account for the comparatively undeveloped condition of our internal waterways. A few extracts from the testimony, taken by the Cullom Committee on Interstate Commerce, will serve to reveal some of the actual causes obstructing our commerce.

Mr. F. B. Thurber, of the New York Board of Trade, said:

"Canals should be modernised. For twenty-five or thirty years they have remained just as they were. * * * The water lines are, I may say, the salvation of this country, and should be developed and extended in every possible way. * * * The railroads have improved enormously, while little or no improvements have been made in our system of American waterways. * * * This is doubtless largely to be attributed to the adverse influence of railroad corporations in legislation. In Pennsylvania and other States they have bought up the canals and abolished them. Whenever a river and harbor bill is pending in Congress, the railroad representatives will vote millions for improvements which do not materially affect them ; but when it comes to an item like the Hennepin Canal, which promises to be of benefit in extending our system of waterways, they are found voting solidly against it," etc.

Mr. Chas. Ridgely, President of the Springfield Iron Company, said, in regard to the importance of developing water-routes: "The cost of such improvements would come back to the people many times over, in the reduced rates of freight which they would secure, even if all the freight went, as now, by rail, and the canals were unused."

Hon. Thos. Updegraff, of Iowa: "I have more faith in water routes as cheapeners of transportation on interstate commerce than in all suggested means."

This is the general purport of some 90 witnesses, of whom 80 per cent. was in favor of improving our internal waterways, 17 per cent. was opposed, and 3 per cent. undecided. Of the 15 persons opposed, 10 were railroad officials, 3 farmers, 1 merchant and 1 machinist.

But the opinion entertained by some railroad managers as to the injurious effects of parallel waterways is giving place to the more enlightened belief that such competition is beneficial. This is evinced by many of the most prosperous railroad managers in this and other countries. While it is a very important factor in the commercial development of our resources, it is too broad to be considered at this time, and must be dismissed with the suggestion that the stock quotations taken in connection with the geographical position of the roads will serve to illustrate its truth.

RATES BY COUNTRY ROADS.

In strong contrast with the rates by water, as previously mentioned, it may be well to observe, in passing, the semi-official results recently reported by General Roy Stone, special agent of the Road Inquiry Office, concerning the cost of freight movements over our road system in various sections of the country. "The average cost of haulage over the roads in the United States is 25 cents per ton mile; in New England it is 32 cents; in the Middle and Southern States, 31 cents; in the Northern States, 27, and in the prairie country, 22 cents. The average length of haul in the Northern States is 6.9 miles, so that the total cost of the haul is \$1.86 for each ton."

The total cost of the movement of our farm products reaches nearly \$1,000,000,000, of which nearly two-thirds might be saved by merely improving the roads. There are many places where the rehabilitation of our canals would reduce this tax upon commerce still further, and, by increasing the ratio of water to land carriage, lower the through rate, while still giving the railroad a larger percentage of the tariff than it can now secure, and at the same time increase its tonnage and shorten its haul. Mr. Stone says: "We are handicapped in all the markets of the world by the enormous waste of labor in the primary transportation of our products and manufactures, while our home markets are restricted by difficulties in rural distribution which not infrequently clog all the channels of transportation, trade and finance."

Another benefit resulting from deeper internal waterways would be the increase in the amount and value of our exports, thus converting a deficit into a surplus, and making us a creditor instead of a debtor, paying our balances in goods and products instead of in gold, and stimulating our manufactures by the lower price of raw material provided from the home market. It thus extends its beneficent influences beyond the limits of the nation and assumes an international importance. These generalities are abundantly illustrated in the case of France, Germany and other countries.

RELATION OF DOMESTIC TO FOREIGN COMMERCE.

The internal commerce of a country is the basis of the external, and as its relative importance does not appear to be generally recognised, a few words in relation thereto may not be amiss. It is commonly believed that the foreign tonnage is the largest and most valuable adjunct to a seaport.

This fallacy doubtless arises from the fact that every ton of imports or exports is recorded, as most of it is taxed for

revenues, and its value is carefully appraised, while the domestic tonnage is not generally reported, and the difficulty of securing statistics of this movement from official and reliable sources is very great; yet a careful examination of the reports of the various Boards of Trade, Census Reports, and other documents, leads to the conclusion that the domestic tonnage is not far from 75 per cent. of the entire tonnage of most of our ports. Taking our own case for example, we find that in 1892 the gross tonnage of Philadelphia was 14,572,292 tons, of which 3,788,781 only was foreign, or 25 per cent. In 1893 the total was 13,326,484 tons, of which 2,971,111, or only 22 per cent., was foreign. The rest, or 78 per cent., was coastwise. Of this traffic over 5,000,000 tons was coal, and about 1,000,000 petroleum.

In 1870 it was stated that the domestic commerce through the limited Delaware and Raritan Canal exceeded all the foreign tonnage to and from New York for that year.* Since then the foreign commerce of New York has expanded enormously, while the canals have been contracted by the failure to recognise their utilities and economies, and to enlarge their capacities to keep pace with the demands of modern vessels.

Another question of considerable importance, viz.:

THE RELATION OF DRAFT TO TONNAGE,

arises in connection with the projects to enlarge existing waterways. It is one which is almost indeterminate, since it grows with the additional facilities afforded. The tendency to cheapen transportation by carriage in bulk causes ship-owners to build larger vessels in anticipation of deeper drafts. On this point the late General O. M. Poe said :

“For thirty-five years I have watched the increase of the Great Lakes’ commerce, but neither I nor any one else has been able to expand in ideas at the same rate. The wildest expectations of one year seem absurdly tame by the side of the actual facts of the next.”

This statement is fully confirmed by the fact that in 1840

* Testimony of Gen. I. Wister before Interstate Commerce Committee.

Henry Clay denounced the Sault Canal project as "a work beyond the remotest settlement in the United States, if not in the moon," and yet the locks have since been enlarged thrice to accommodate the rapid strides in the traffic.

Last year the tonnage exceeded 13,000,000, yet the opening of the Canadian locks, by affording increased facilities, has enabled about 15,000,000 tons to be passed during the current year, which merely proves the old adage that *facilities create traffic*. By "facilities" is to be understood any economy resulting from reduced distances or time in transit, or at terminals, or from reduced rates.

The relation between draft and tonnage is more fully set forth in the annexed communication to the Board of Engineers appointed to select the best route from Baltimore to the sea.

UNITED STATES CUSTOM HOUSE,
BALTIMORE, November 26, 1894.

Thos. L. Casey, Brigadier-General, Chairman, Chesapeake and Delaware Canal Board, Washington, D. C.:

* * * The draft of vessels is not made a matter of record in this office, and I have, after consulting with competent persons, arranged the number of vessels embraced in the foregoing statement into four groups under certain respective drafts, which will probably serve as a guide to your deliberations.

I will also state that there is a large number of vessels engaged in the coasting trade, between this and other domestic ports, that are not obliged to enter or clear at the Custom House, representing as much as 2,000,000 tons, about 75 per cent. of which go North and bear the same relative proportion as to draft.

[SIGNED] JAS. A. DIFFENBAUGH,
Special Deputy Collector.

This is followed by a tabular statement of tonnage, foreign and coastwise, for several years, from which the following data are collated:

COASTWISE MOVEMENT FOR 1893 FOR PORT OF BALTIMORE.

	Under 10' Draft.	10' to 15' Draft.	15' to 20'.	Over 20'.	Total Report- ed at Custom House.
To and from Northern cities	Tons. 29,911	Tons. 145,641	Tons. 487,754	Tons. 205,237	868,543
Percentage	3%	17%	56%	24%	100%

It will be seen that *only 3 per cent.* is carried in vessels drawing 10 feet of water, while by far the greater portion

requires from 15 to 20 feet, and that a depth of 20 feet would pass 75 per cent. of the tonnage. If the nondescript tonnage is 2,000,000, as stated for Baltimore alone, and we take 75 per cent. of it, or 1,500,000, and add it to the recorded tonnage alone, it gives a total movement from this one port for the year of 2,368,543 tons to and from *Northern* cities.

The domestic commerce of Delaware Bay and tributary waters, as reported by the various custom districts, after deducting 25 per cent. for foreign commerce, is 14,250,000 tons, while that of the Chesapeake Bay is 11,250,000 tons, making a total of 25,500,000 tons.

If 3 per cent. represents the limit of the present 10-foot canal it would equal 765,000 tons, which will be found to be about the average tonnage of the Chesapeake and Delaware Canal in the past ten years.

Were this canal deepened to 15 feet, it would then be able to pass 20 per cent., or 5,100,000 tons, and 20 feet would give it a capacity of 75 per cent., or 18,125,000 tons.

With this amount of commerce in sight at present, it is manifest that a very great reduction in rates could be allowed, and still leave a handsome profit to the owners.

Fifteen feet draft, or 5,000,000 tons at 20 cents, would yield a revenue of \$1,000,000, and for an open waterway at tide level it would cost but little more to handle 5,000,000 than one-tenth this amount, so that the excess would be profit, and the rates could be reduced to a minimum, to great advantage to the commercial interests of this populous section. At 1 cent per ton mile, or 14 cents for the trip (which is still a high rate for canals) the revenue would be \$700,000, the interest at 6 per cent. on \$11,666,566, whereas the cost of the work with modern devices should not exceed \$2,000,000.

An open waterway once built requires the minimum of expenditure for maintenance and operation, and the fixed charges are practically independent of the tonnage.

This work of enlargement, if undertaken, with the co-operation of the Government, would prove to be one of the most beneficent and profitable enterprises of our times, and would commend itself to all enterprising and public-spirited

citizens. It would restore in great measure the declining commerce of this port, and increase the profitable tonnage of all railroads having terminals in these waters, by stimulating manufactures and increasing the ratio of growth.

Stevenson says the commercial value of a waterway increases as the cube of the depth, so that if the depth be doubled its value will be eightfold greater. This law must be restricted, however, within practical limits.

THE TYNE, ENGLAND.

Let us now note a few special instances of the benefits resulting from the deepening of waterways, and their results upon the adjacent territory, taking first one of the many valuable and instructive foreign precedents.

A case which is often cited, but which will bear repetition because of its moral, is that of the River Tyne, on the east coast of England. It is but a short stream extending from New Castle to the sea, about 19 miles of which are in tidal waters. In its original condition it was little better than a creek, and vessels were often stranded on the bars in 3 feet depths at low water. Frequently vessels drawing 17 or 18 feet were obliged to wait two or three months for favorable spring tides and winds to enable them to cross the bar; yet now the largest ships afloat can safely navigate this stream without detention at any stage of the tide. To secure this result, the sum of \$20,000,000 has been spent by the Tyne Commission in dredging, building training-walls, piers and dry docks, and in providing warehouses and terminals. From 1860 to 1887 over 80,000,000 yards were dredged. At the beginning of the work the revenues derived from tolls and tonnage dues were far from sufficient to provide for the annual expense, and it became necessary either to borrow the money or permit the shipping to seek other ports having better facilities.

It was decided to borrow, and up to the end of 1882 the work was conducted on loans, which aggregated \$18,365,000. Only \$2,130,000 was expended out of revenue received from shipping. The result, however, has fully justified this policy, as the annual income has grown in 20 years from \$455,000

to over \$1,255,000. The results of these improvements, which have produced a depth of 30 feet, have been remarkable. In 1888 nearly 21,000 vessels entered and cleared, carrying 8,396,000 tons, which is about equal to the commerce of the Suez Canal. These improvements were not made by the Government, but under the admirable system of public works existing in Great Britain, which authorises local harbor commissions to levy a tonnage tax upon vessels, and to apply the revenues derived therefrom directly to the maintenance and improvement of the harbors. Thus, under the presidency of Sir Joseph Cowen and his Board, aided by their resident engineer, Mr. Philip J. Messent, to whom I am under obligation for many valuable data, these works have been successfully executed with so great benefit to the commerce and industries of that thrifty and popular center. A trip to Tynemouth reveals a succession of shipyards, warehouses, mills, factories, towns and cities skirting both banks of the river, which is almost unparalleled in the world, all due to the increase of depth in the river and on the bar to 30 feet mean low water.

THE OHIO, BELOW PITTSBURGH.

Per contra, as in art, so in engineering, it often requires negative to produce positive results. The sinking of a propeller in the channel below the locks at the Sault so obstructed commerce as to leave no doubt about the propriety of still further enlargements in that direction.

The blockade of our seaports in 1813-14, and the destruction and sacking of the National Capital impressed upon our forefathers the importance of connecting the Chesapeake, Delaware and Raritan Bays by canals; and in the event of a war to-day with any foreign power, the absence of a passage for our heaviest gunboats would seriously cripple our defences and expose our coastwise cities to destruction. If the mere edict to construct such waterways could bring them into existence in a moment, it would then be issued, be the cost what it might, "but it would then be too late."*

* Gen. Wm. P. Craighill, U.S.F.

NAVIGATION ON OHIO SUSPENDED BY DROUGHT FROM APRIL UNTIL DECEMBER, 1895.—1,200,000 TONS OF COAL.
VALUE OF PLANT OVER \$6,000,000. DAILY EXPENSE OF KEEPING IT Afloat, \$2,000.

COAL TOWS IN THE DAVIS ISLAND POOL, ON THE OHIO RIVER—AWAITING A “RISE” TO GO OUT.

One of the most impressive lessons to be derived from the absence of sufficient water for commerce is to be found in the experience of the communities on the upper Ohio River during the past season of exceptional drought.

The harbor of Pittsburgh, which is made by the movable dam at Davis Island, and the fixed dams of the Monongahela slackwater system forms a convenient basis in which to make up the tows of coal boats and barges which supply the Mississippi and its tributaries.

It is the custom to assemble these tows above the dam and await the pleasure of Pluvius to provide a flood with sufficient depth of water to carry them out. Sometimes the river rises to within a few inches of the requisite height, and then provokingly subsides. During the past season there has been no coal shipped by river between the 18th of April and the 28th of November (over seven months), and the accumulation of the product had gone on until the tonnage tied up exceeded that of any harbor in the world. For miles on both banks of the river the steamers and their fleets lined the shores, and the danger of their being frozen in all winter was imminent, when a heavy rain released 200,000 tons; but a part of these met a watery grave on the shoals of Dead Man's Ripple, a short distance below Pittsburgh.*

* *Quantities of Fruit Going to Waste.*—The Ohio River lower than it has been since 1860, with one exception.—Distilleries in Kentucky affected.

CINCINNATI, O., Oct. 15.—Millions of bushels of fruit are going to waste along the Ohio River, because of the close of navigation. Between this city and Evansville, 150,000 barrels of apples, in addition to potatoes and other produce, will be lost by decay.

At the little port of Amsterdam, Ind., 2,000 barrels of apples have been lying on the wharf for two weeks awaiting shipment.

The river is lower now than it has been since 1860, with one exception.

The continued drought in Central Kentucky is interfering seriously with the distillers. Glen's Creek, which is the only source of water supply for several distilleries, has gone dry, and a large number of men are out of employment.—*Ledger, October 16, 1895.*

* *Mishaps to Barges.*—Fifteen that were carrying coal sunk, and eight more are aground.

PITTSBURGH, November 28.—Nearly 5,000,000 bushels of coal was started down the river to-day, making a total going out on this rise of about 15,000,000 bushels. The river is now receding rapidly, and as there is no present

The extent of this congestion cannot be appreciated by one who has not seen it, and it is far-reaching in its effects, as it directly concerns the industries of millions of people. The actual value of the plant tied up in the harbor of Pittsburgh alone, as stated by Hon. John F. Dravo, Secretary of the Coal Exchange, on November 7th, 1895, was \$6,310,000, as follows: "There are at the present time in Pittsburgh harbor about 1,200,000 tons of coal loaded on about 2,500 vessels :

2,500 vessels, average cost \$900	\$2,250,000
Cost of coal in Pittsburgh harbor	1,260,000
There are registered in this port about 80 towing steamers,	
average value, \$30,000	2,400,000
Twenty passenger and other steamers, average value,	
\$20,000	400,000
	<hr/>
	\$6,310,000

"At the present time it is costing about \$2,000 per day to keep this tonnage afloat, besides interest on the investment."

Two thousand dollars per day is the interest on \$40,000 at 5 per cent. In one month it represents \$1,200,000—merely to keep the tows afloat, which is done by sprinkling sawdust over the surface of the river around the boats and pumping out the seepage from the interior. This "tie-up" of Nature has seriously crippled the entire valley, as the railroads cannot do more than maintain a partial supply, and the price of fuel has risen in some of the larger cities \$1.00 a ton.

These are but a few of the consequent evils resulting

prospect of more water, the tows with 7-foot boats will, of necessity, have to tie up along the route before reaching Cincinnati.

A wreck at Dead Man's Island, near Sewickley, last night, caused a loss of about 250,000 bushels, involving the sinking of fifteen barges. The *Relief* grounded a barge, and the four other tugs, with barges following close in their wake, were piled up one after another in a confused mass. The channel, however, was cleared sufficiently to permit the tows leaving to-day to pass through safely.

The *Iron Age*, towing eight barges of iron and steel for Cairo, is aground at Freedom, and up to a late hour to-night had not succeeded in getting off. Her cargo represents about \$240,000.—*Times*, November 29, 1895.

from the unimproved condition of the upper Ohio, which has been crying for relief for half a century.

As yet only the one dam is completed, at Davis' Island, $5\frac{1}{2}$ miles below Pittsburgh, although another is now under contract at Beaver, some 23 miles below the first, leaving between the two a long stretch of unimproved navigation. These dams cost about \$1,000,000 apiece. In contrast with this state of affairs, reference may be made to the work of improving the Great Kanawha by a similar system of movable dams, under the continuous supervision of General Wm. P. Craighill, now Chief of Engineers. Here the system will soon be completed, and will furnish a 6-foot navigation to Brownsville, with the result that, while the commerce of the river has greatly increased, that of the railroads has, contrary to their expectation, been expanded in like ratio. Nor is this an isolated instance where the improvement of the waterways has proven beneficial to railway traffic. In fact, the experience is general, and it is no uncommon thing to find railroads hauling crude products at a loss to maintain the traffic resulting from their use in manufactures.

Between the lowest profitable rate by rail and by water, there is a large margin for movement of raw materials by canals, which cannot be profitably handled otherwise, and which, but for the cheaper water rates, must lie dormant in the earth at the expense of their dependent industries.

For example, by a suitable waterway from the coal regions of western Pennsylvania to Lake Erie, which is now felt to be a necessity, it is found that "bituminous coal can be delivered in Chicago at \$1.61 $\frac{1}{2}$ per ton; in Duluth, at \$1.50 $\frac{1}{2}$; Detroit, at \$1.38; to Canadian vessels at the head of the Welland Canal, at \$1.20; and in New York City, via the Erie Canal, at \$1.98; and the secretary of the Pittsburgh Canal Committee, Mr. John E. Shaw, adds that the economy on coal alone in six leading cities of the lake region would amount to \$12,000,000 annually, representing, at 4 per cent., the interest on \$300,000,000."

"A comparison of the selling price of bituminous coal in the lake and Canadian cities and New York harbor, will

make apparent the commercial benefit from these proposed deep waterways.

"That the present or any proposed railroad system of overland carriage by rail can never bring about this enormous saving to commerce is also apparent.

"There are nine railroads operating wholly or in part between Pittsburgh and the Great Lakes. The total cost of road and equipment of these lines is \$172,141,738.82. The average ton mile rate on all freight on said lines is about 6½ mills, which is below the ton mile rate on the ore and coal to and from the Pittsburgh district, and yet the financial statements of four of these roads has recently shown a net loss on their business; and as the lowest class of traffic has required a ton mile rate below the average of total freight carried, it is not hard to see that it would have been business economy for these railroads to have put a sufficient amount of the enormous cost of their roads into a canal and had it relieve them of this low-class freight."

Some idea of the economies resulting from this proposed deep water canal, as based upon existing tonnage, may be obtained from the following statistics compiled by Mr. Shaw:

A saving of 77 cents per ton on the ore required for	
Allegheny County would be	\$3,196,093 60
For Mahoning and Shenango Valleys it would be . .	1,382,875 14
Making a total of	<u>\$4,578,968 74</u>
While the amount earned by the canal in carrying	
this ore at 35 and 15 cents, respectively, would	
aggregate	\$1,455,998 85
The coal now shipped from western Pennsylvania to	
lake ports amounts to 7,761,891 tons, on which, at	
72 cents per ton saved, the economy would be . .	5,588,861 58
At 30 cents per ton for transportation, the canal re-	
turns from this amount of coal would be	1,553,378 20
Or a total saved on the price of ore and coal at the	
points of consumption of	
	10,167,530 32
And a total earned for the canal of	
	3,009,379 05
Being 6 per cent. on \$50,000,000 from coal and ore alone.	

A conservative estimate of the tonnage which would traverse this canal, if opened to-day to a depth of 15 feet, would be:

PORTION OF PITTSBURGH HARBOR WITH COAL FLEETS, LINING BOTH BANKS OF THE MONONGAHELA RIVER.

	<i>Tons.</i>
Ore	6,000,000
Coal	7,000,000
Limestone and miscellaneous	1,000,000
Coke and lumber	1,000,000
	<hr/> 15,000,000

At an average rate of 30 cents per ton, therefore, the revenue would be \$4,500,000, while the economy effected each year in transportation would exceed \$10,000,000. As there are many persons whose interests in other securities make them skeptical concerning such estimates as these on paper, it may be advisable to refer to the experience of the Suez Canal, which was so bitterly opposed by British diplomats, engineers and the press while in French hands. Now, however, since the control has crossed the English Channel, we find, in 1894, the gross receipts of the company were \$15,390,230.60, as compared with \$14,764,906.80 in 1893, and if the revenue from the tramway from Port Said to Ismalia and the lands and water company are eliminated, it will be found that the actual receipts from the vessels that used the canal were \$650,800 higher than in the previous year. Expenses were \$65,958.60 smaller than in 1893. Taking the whole of the charges of every kind, including the interest and sinking fund on the bonds, the 5 per cent. interest which is paid on the whole of the capital, and a sum of \$90,000 for renewals and improvements, we get a total of \$7,165,834.20, which, deducted from the gross revenue of \$15,390,230.60, leaves \$8,224,396.40. Out of this sum the council recommended the placing of \$150,931.60 to the reserve, thus bringing it up to \$1,150,931.60. Thus there remained for distribution among the shareholders \$8,073,464.60, and each share, in addition to the 5 per cent., which is first paid, will receive for 1894 a dividend of \$14.20. The gross yield on Suez Canal shares for last year consequently comes to \$19.20, or 18 per cent., or, after deducting the tax, to \$18 net. Tolls are now \$1.85 per ton for the 100 miles.*

[*To be concluded.*]

* Consular Reports.