REPORT

OF THE

COMMITTEE ON CANALS

OF

NEW YORK STATE

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GEORGE E. GREEN, EDWARD A. BOND, State Engineer and Surveyor.
JOHN N. SCATCHERD, JOHN N. PARTRIDGE, Supt. of Public Works.
Major THOMAS W. SYMONS, U.S.A. Members.

JOHN A. FAIRLIE, Secretary.

NEW YORK, 1900.

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NEW YORK, January 15th, 1900.

Honorable THEODORE ROOSEVELT,

Governor of New York.

Sir:

The undersigned have carefully considered "the broad question of the proper policy which the State of New York should pursue in canal matters," as requested in your letter to us of March 8th, 1899, and have reached the following conclusions:

FIRST: That the canals connecting the Hudson River with Lakes Erie, Ontario and Champlain should not be abandoned, but should be maintained and enlarged; and that the Black River and the Cayuga and Seneca canals should be maintained as navigable feeders, but that they should not be enlarged at the present time.

SECOND: That the project of a ship canal to enable vessels to pass from the upper lakes to New York City (or beyond) without breaking bulk is a proper subject for consideration by the Federal Government, but not by the State of New York.

THIRD: That the project of 1895 for the enlargement of the Oswego and Champlain canals should be completed at a cost of $2,642,120.

That there are two projects for the enlargement of the Erie Canal which should be considered by the State of New York.

The first is to complete the project undertaken in 1895, with certain modifications, to wit:

The deepening of the prism to 9 feet throughout, and the lengthening of the locks on one tier so as to pass two boats, each 125 feet in length, 17½ feet in width and 8 feet in draft, with a cargo capacity of about 450 tons each, and the lengthening of the locks on the other tier so as to pass a single boat of the same size;

The use of pneumatic locks, or other mechanical lifts, at

Cohoes and Lockport, and new locks at Newark and Little Falls, by which 21 locks will be eliminated;

The construction of a new canal from near Clyde to near New London—about 81 miles in length—giving a wide waterway throughout the Seneca and Oneida Rivers and Oneida Lake, and avoiding the Montezuma marshes;

The abolition of the two aqueducts across the Mohawk River, and the substitution of the river for the canal from Cohoes to Rexford Flats near Schenectady, and possibly as far as Little Falls;

The construction of a new canal from the foot of the falls of the Mohawk, near Cohoes, to the Hudson River near the West Troy side cut.

The estimated cost of this project* is $21,161,645.

The second project is to construct a canal along the same route as above named, but of sufficient size to carry boats 150 feet in length, 25 feet in width, and 10 feet draft, with a cargo capacity of approximately 1,000 tons each. The prism of such canal to be not less than 12 feet deep throughout, with not less than 11 feet of water in the locks and over all structures, and the locks to be about 310 feet long and 28 feet wide, so as to pass two boats at one lockage. Such a canal will be capable of carrying a tonnage equal to the capacity of the St. Lawrence canals.

The estimated cost of this project† is $58,894,668.

In our judgment, arrived at after long consideration, and with some reluctance, the State should undertake the larger project on the ground that the smaller one is at best a temporary makeshift, and that the larger project will permanently secure the commercial supremacy of New York, and that this can be assured by no other means.

We believe our estimates of cost to be adequate for submitting this proposition to the voters at the election in November next, and in the meantime we advise that the Legislature make an appropriation of $20,000 to be immediately available for surveys, so that the detailed surveys, which are indispensable to the proper making of contracts, could be completed during the present year. If the proposition is approved by the people in

*See pages 71, 85.
†See pages 75, 90.

1900 the work can be completed, if properly managed, so as to be available for the season of 1905.

FOURTH: That the money to pay for these improvements should be raised by the issue of eighteen-year bonds in the manner prescribed by the State Constitution, and that the interest and principal of these bonds should be paid out of taxes specifically levied, for benefits received, in the counties bordering in whole or in part on the canals, the Hudson River and Lake Champlain; such taxes to be levied in proportion to the assessed valuation of the real and personal estate in such counties. These taxes will amount to about 10 cents per $100 of assessed valuation annually during the period of eighteen years.

FIFTH: That the efficiency of the canals depends upon their management quite as much as upon their physical size, and that no money should be spent for further enlargement unless accompanied by measures which will accomplish the following results:

(a) The removal of all restrictions as to the amount of capital of companies engaged in transportation on the canals, and the encouragement of large transportation lines for handling canal business, in place of hampering them, as has hitherto been the case.

(b) The use of mechanical means of traction, either steam or electricity, in place of draft animals; and the use of mechanical power in place of hand power for operating the gates and valves, and moving boats in locks.

(c) The organization of the force engaged on the public works of the State on a more permanent basis, so as to afford an attractive career to graduates of scientific institutions, with the assurance that their entry into the service, their tenure of office, and their promotion will depend solely on their fitness, as determined by proper and practical tests.

(d) A revision of the laws in regard to the letting of public contracts by the State, so as to make impossible a repetition of the unfortunate results of the $9,000,000 appropriation.

The reasons which have led us to these conclusions will be stated at length.

We have had an extended correspondence with civil engineers and others (including the principal commercial bodies of New York City and Buffalo) familiar with the transportation problem, and this correspondence, together with the minutes of our various meetings, is submitted in a separate volume. While this correspondence displays a considerable difference of opinion as to the proper plan for improving the canals, yet the bulk of it is favorable to their improvement.

I.

SHALL THE CANALS BE ABANDONED?

The inestimable benefits which have been derived from the Erie Canal in the past are not disputed by any one. To it, more than to any other cause, is due the phenomenal growth and commercial supremacy of the city and State of New York. It opened up the great West to settlement, and in turn attracted the products of the West to the low-grade line through the Appalachian chain, which exists only in the State of New York. The tolls on this water-way have more than repaid the cost of construction, maintenace and operation; in addition it has paid over $360,000,000 of freight money within the limits of the State, and the disbursement of this money along the line of the canal has built up the great interior cities from Buffalo to Albany, forming a continuous line of commercial centres, which has no counterpart in any other State. The growth of these cities in turn led to the construction of railroads paralleling the canal, and these by consolidation and scientific management have gradually reduced the cost of transportation during the last thirty years from an average of 2 cents per ton mile to about 6 mills per ton mile.*

No one disputes these evident facts; but the question which now confronts us is whether the railroads, with their large capital and scientific management, their durable roadbeds, powerful locomotives, larger cars, greater train loads, greater speed, and more certainty of delivery, will be able now or in the early future to reduce the cost of transportation below what is possible on the canals. If they can do this, then it is obviously unwise

*Changes in the rates of charges for Railway and other Transportation Services, by H. T. Newcomb. Published by the U. S. Department of Agriculture, 1898, page 19.

and improper to expend any more public money upon a method of transportation which, however important in the past, would no longer be able to compete with other and improved methods. The determination of this question seems to us to lie at the very foundation of the canal problem, and we have therefore given it the utmost attention.

The claim for the railroads has been put forward at great length, and with ability, by the Engineering News, whose editorial articles on the subject are printed at length in the volume of Minutes and Correspondence. In brief, they are to the effect that while the average railroad charges in recent years on the railroads of New York State have been about 6 mills per ton mile,* yet a lower rate has prevailed on grain, lumber and similar articles, which have hitherto formed the bulk of the goods transported over the canal. The grain rates fixed in April, 1899, from Buffalo to New York were as follows per bushel:

Wheat	3½ cts.
Rye	3¼ "
Corn	2¾ "
Oats	2½ "

The rate of 3½ cents per bushel on wheat is about $1.17 per ton, or 2½ mills per ton mile. It is further argued in these articles that the Chesapeake & Ohio R. R. is carrying coal at a profit on a rate of 2¼ mills per ton mile; and that on the completion of locomotives now under construction by the New York Central and other railroads, designed to haul trains with from 2,000 to 2,400 tons of paying freight, the rate on such articles as grain, coal, ore, etc., by rail will be reduced to about 1 mill per ton mile. In other words, the argument in favor of the railways is that private enterprise and private capital will at an early date produce on the railroads as low a freight rate as can be produced on the canal by the expenditure of large sums of public money.

If this argument were correct, it is needless to say that no further money should be spent on the enlargement of the canals, but that they should remain in their present condition until plans

*See Page 191.

could be carefully matured for the disposal of them. In our judgment, the argument is not correct. It would carry more weight if it were advanced or approved by practical railway managers; and we therefore sent the articles to the presidents of the New York Central Railroad, of the Illinois Central Railroad, and of the Pittsburg, Bessemer and Lake Erie Railroad, the last of which was specially built under the most favorable circumstances for the express purpose of carrying ores and low-grade freight at a minimum cost from Conneaut on the lakes to Pittsburg. The reply of Mr. Fish is explicit that there is no probability of a rate of 1 mill per ton mile by rail in the near future. The reply of Mr. Callaway, while not so positive, leaves no doubt in the mind of the reader that the New York Central Railroad has no expectation of quoting any such rate. The reply of Mr. Reed states that during the past summer nearly a million tons of ore were hauled from Conneaut to Pittsburg at an actual cost for transportation alone of 1½ mills per ton mile; the freight rate being 3.65 mills per ton mile.

It is evident, therefore, that the views expressed in the Engineering News are not sustained by practical railway managers, responsible to their stockholders for the profitable management of their roads.

The keeping of railway accounts is an intricate science; the system is not entirely uniform among different roads, and it is very difficult for any one to be able to state whether the carrying of grain at a rate equivalent to 2¼ or 2½ mills per ton mile is done at a loss or a profit. It is more than probable that it has been done at a loss, the corporate wealth of the railroads enabling them to carry this loss, provided they were making a profit on other classes of goods, and they considered it desirable to hold the business until on the return of more prosperous times they would be able to secure a profitable rate. It is to be noticed that these extremely low rates have prevailed during the hard times from 1893 to 1898, during which many manufacturers thought it better to keep their factories in operation at a loss rather than to close them entirely. With the return of prosperity during the two years just ending, the price of manufactured goods has increased from 30 to 60 per cent. (and more in some cases), and the railroads are already claiming that they have not shared in this prosperity, and that the time has come for an advance in railroad rates. Already the rate on grain across the State of New York has advanced from 3½ to 4 cents per bushel. The price of rails, cars, locomotives and labor during the year 1900 will be very much in excess of what the railroads have been paying during the last few years, and this must inevitably be reflected in a considerable advance in freight rates. We believe, therefore, that the reduction in railroad rates, which has been almost constant for the last thirty years, has received a check, and that an increase may be looked for until the present prosperity shall be succeeded by depression, when it is probable that they will again decline; but it is very doubtful if they will go any lower, if as low, as the rates recently prevailing.

In our judgment, water transportation is inherently cheaper than rail transportation. It varies slightly with the size of the vessel and the restriction of the waterway. On the ocean, where the waterway is entirely unrestricted and the size of the vessel is the maximum, it averages about half a mill per ton mile;* on the lakes, where the vessels are not so large, and occasional restrictions are encountered on the waterway, it is about six-tenths of a mill per ton mile;† on the canals of New York, where the boats are very small, the waterway greatly restricted, and obsolete methods are employed for handling the business, it is about 2 mills per ton mile. By the enlargement of the canal which we recommend, and the introduction of improved methods of management, we believe that the canal rate can be reduced to two-thirds of one mill per ton mile, or very nearly as low as the lake rates. All of these rates have varied in the past and will vary in the future to correspond with prosperity or depression in general business. But there is every reason to believe that they will maintain a corresponding ratio, the ocean, lake, and canal rates being from one-third to one-fourth of those by rail. The reductions which may be made hereafter in the railroad rate can be met by similar reductions in all three classes of the water rates, provided the same methods of skilled management are applied to all.

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*It is stated by Mr. E. L. Corthell (Minutes and Correspondence, page 89), that wheat has been carried from California to England for 3-10 mill per ton mile, and coal on the return trip for 1-5 mill.

†On the lakes return cargoes of coal are carried from Lake Erie to Lake Superior ports, about 1,000 miles, for 25 cents, or ¼ mill per ton-mile; see table, page 195.

Moreover, the canals have been largely limited in the past to the lower grades of freight, and this is equally true of the transportation on the lakes. The canal has thus been in competition with the classes of freight which pay only between 2 and 3 mills per ton mile, and which the railroads will carry at a loss rather than lose the business, whereas, the railroads carry other classes of freight, some of which brings as high as 15 to 20 mills per ton mile, and the average freight, including the low grades, as we have seen, being about 6 mills. There is no reason why the canals, if enlarged and properly managed, should not compete for the higher grades of freight, which, at prices far below those charged by the railroad, would bring very profitable returns on the lakes and canal.

The local tonnage on the canals has for many years exceeded the through tonnage, just as it does on the railroads, although not to the same extent, and an enterprising transportation line, skilfully managed, could give an enormous development to this local traffic at profitable prices, and thus be in position, just as the railroads are, to carry through freight of low grade at cost or less in case of necessity. With the canal enlarged so as to carry boats of 1,000 tons each, and these boats assembled in fleets of four or six, with a total capacity of 4,000 or 6,000 tons, each fleet having detached mechanical motive power—the system of handling being analogous to that of a train composed of cars and a detached locomotive—it will be possible to send a boatload of freight of the highest or the lowest class through from any point on the lakes to any point on the Atlantic coast from Boston to Philadelphia. Experience will then prove whether it is more economical to send freight of different classes either all the way without breaking bulk, or to use the lake steamers to Buffalo and there transfer to the canal boat, which, of the size we have mentioned, can be safely taken to any point on the route between Buffalo and New York, or on the coast within the limits above named.

The system of using barges with detached motive power in the coast-wise traffic between New York and New England has been in operation for many years, and has reached enormous proportions. It has hitherto been confined to low-grade articles, such as coal and oil, whereas the high-grade package goods have gone by steamboat. It is possible that this division may continue to be economical, and in that event a trans-shipment at New York between the steamboat and the canal boat would be necessary. But we feel certain that if the water-way across the State of New York is enlarged so as to afford facilities for boats of 1,000 tons, and is so managed as to produce safety and certainty of delivery by responsible transportation lines, and at a rate far below that now prevailing on the railroads, a very large business will develop along such route in all classes of goods, and at enormous benefit to the State of New York, and particularly to the two great cities at its eastern and western ends.

In considering this question of the relative advantages and cost of rail and water transportation, we have given much study to what is being done on the Continent of Europe; and one of our committee, Mr. F. S. Witherbee, has visited Europe for the purpose of gaining information on this point. His report is transmitted herewith, and a large number of documents, plans and photographs which he brought back have been deposited in the office of the State Engineer. It is found that on the continent of Europe so far from the canals being decadent during the last thirty years, they have been constantly enlarged and improved, enormous sums having been spent for this purpose, and the result has been an extraordinary increase in this class of transportation. It is well known that the railroad rates in Europe are much higher than in America. There are several reasons for this. In Europe there is none of the long-haul traffic, which is so much less expensive to carry, and accounts for so large a part of the lower ton mile rate in America. The management of the railroads is also less efficient. On the other hand, the management of the canals has been more efficient than with us. The result has been a far greater development in water traffic than in rail traffic during recent years in France, Belgium, Germany and Russia.

In France, since the war with Prussia, over 400 miles of new canals, and nearly 500 miles of new river navigation have been constructed, making nearly 7,000 miles of internal water-ways; the water traffic has increased from 1872 to 1897 by 140 per cent., whereas the rail traffic has increased by but 75 per cent. The little State of Belgium has expended since 1860 not less than $50,000,000 for enlarging its canals, and the water traffic increased from 1888 to 1896 by nearly 40 per cent., and it is significant that the increase in the transportation of miscellaneous package commodities during the same period was 54 per cent.

In Germany, the same process of betterment and extension of canals and water routes is continued. During the past year the new canal from Dortmund to Emden has been completed, and opened for traffic; this canal being especially noteworthy for the famous pneumatic lock at Henrichenburg, where vessels are lifted 45 feet from one canal level to another at one operation. The modern type of canal boat in use on this canal is a barge of 1,000 tons carrying capacity, built of steel, about 230 feet long, 30 feet wide, and 7½ feet draught, and costing only $5,000 each. The propulsion is entirely mechanical—either by steam or electricity. It is well known that the German government is planning a trunk route between the rivers Rhine and Elbe, and is strongly in favor of a large extension of its canal system; and that its plans would now be in process of being carried out but for the opposition of the agricultural interest, which fears the effects upon its own property of the reduction in rates which would certainly follow the execution of these plans.

In Russia, even greater efforts have been devoted to the development of the water routes on canals and rivers, the sum of $30,000,000 having been expended from 1891 to 1896 for this purpose, and in the same period the internal water traffic has increased by 70 per cent. This traffic on Russian internal waters accommodates 1,500 steamers, and 60,000 canal boats, with crews numbering 300,000 men. Vessels 200 feet long can traverse the whole length of the country from the Caspian Sea to St. Petersburg or Archangel (2,500 miles).

We do not think that these facts can be overlooked in the consideration of this problem. They show that in countries where the keenest competition exists not only within each country, but between each and its neighbor, effort is being made to gain an advantage, or, at least, keep on an equality, in the competition, by reducing the rates of transportation, and that to accomplish this large sums of public money are being spent to enlarge and improve the water routes; thus confirming the general proposition that under equal conditions of management the water route, even in a restricted way like a canal, is cheaper than the rail route.

New York has certain topographical advantages which it would be folly not to utilize. Through the valleys of the Hudson and the Mohawk and the comparatively low and level lands west of Oneida Lake, it is possible to construct a water route connecting the Great Lakes and the Atlantic coast, and no such water route can be constructed through any other State. It has no rival except in the St. Lawrence route. This State will inevitably have to compete with the routes by rail, and possibly by water, from the grain fields of the West to ports on the Gulf of Mexico. But in the transportation from the lakes to the Atlantic it has a great advantage, provided it is properly utilized. If the water route is abandoned, then New York must take its chances in the railroad competition with Portland, Boston, Philadelphia, Baltimore, Newport News and Savannah. In this competition it is hardly on an equality even, but is subject to many disadvantages; the distance to the Southern points is less than to New York; the other cities have harbors, which, while not so capacious and deep as that of New York, are still sufficient for the purpose, and the price of real estate and dockage at these several cities is very much less than in New York. If the city and State of New York are to take their chances in open railroad competition, then we must inevitably look to see the relative proportion of exports through New York constantly decreasing, as it has been for the last ten years.* While New York may possibly hold its own in the actual volume of business, yet the increase will go to other cities, which, as railroad termini, offer greater advantages for through business; and the relative volume of the business coming to New York will steadily decrease. On the other hand, if the State of New York enlarges its water-way to the utmost limit, then it can be sure that it will offer the lowest transportation rate, and will secure an increasing share of the business, notwithstanding the disadvantages it labors under in the matter of cost of terminals and handling.

The State of New York must be prepared to face from this time on a serious competition in the export trade over the St. Lawrence route. The Soulanges Canal, which was the last link in the improvements around the rapids of the St. Lawrence River, has been completed during the year 1899 and nominally opened for business. It will be actually opened for business with the spring of 1900. This chain of improvements gives a water-way from Lake Erie through the Welland Canal, Lake Ontario, the St. Lawrence River and its canals capable of carrying boats or barges of about 2,200 tons capacity; the size of the locks is

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*See Table 58, p. 223.

270 x 45 x 14, admitting vesels 255 feet long, and 12 to 14 feet draft, depending on the stage of Lake Erie. The expenditures for construction and enlargement of this route during the last fifty years have been over $56,000,000,* a sum which bears the same ratio to the wealth of Canada as $100,000,000 would bear to the wealth of the State of New York. The distance from Lake Erie to Liverpool by the St. Lawrence route is about 450 miles shorter than by any route across the State of New York.† It is certain that the Canadian government will do everything in its power to realize every possible advantage from this enormous expenditure. Already propositions have been submitted by a group of Chicago and Buffalo capitalists to the Harbor Commissioners of Montreal and accepted by the latter, the result of which will be to divert about 35,000,000 bushels of grain from the New York route. These propositions involve the immediate construction of at least 15 barges of the maximum size which can be used on the canal, and costing $100,000 each, in addition to elevators, warehouses and other structures in the harbor of Montreal, costing more than $4,000,000. These propositions contain no exclusive privileges, and it is open to another group of capitalists to make similar arrangements for the diversion of other large amounts of the grain which now passes through New York.

It is evident that the water route via the St. Lawrence on the one hand, and the short rail lines to Gulf ports on the other, will inevitably prove serious competitors in the future to the export trade of New York. If it desires to retain its export grain trade, it must improve its own water route to the utmost limit of which it is capable; it cannot retain this trade by taking its chances in the railroad competition of half a dozen routes from the lakes to the Atlantic.

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*Annual Report, Department of Railways and Canals of Canada 1898, I, p. 43.

†Port Colbourn to Montreal	375	miles
Montreal to Liverpool	3,220	"
Total	3,595	"
Port Colbourn to New York	500	"
New York to Liverpool	3,540	"
Total	4,040	"

Proceedings of Deep Waterways Association 1895, p. 168.

It is not alone, however, the export grain trade which requires the enlargement of the Erie Canal. The chief argument for its construction eighty years ago was to have a cheap transportation route for grain and lumber, and this has continued to be its most important function down to the present time. But the changes which are now taking place in the iron trade give reason to believe that if an adequate waterway can be secured between Lake Erie and the Hudson River the centre of the iron industry can be brought within the State of New York. This has hitherto been within the State of Pennsylvania on account of its own resources in ores, coal and limestone. But the discovery within a comparatively recent period of almost inexhaustible beds of iron ore in the upper lake region, combined with cheap water transportation on the lakes, has led to the abandonment of its own ore and the substitution of those from the lakes. These ores can be laid down at any point on a water route between Buffalo and New York at less cost than they can be laid down in Pittsburg; there is also a great abundance of suitable limestone within the State of New York and adjacent to the water route; and the improvements which we recommend will make available the Lake Champlain iron ores as well as those of Cuba for a very economical mixture.* The only advantage which Pittsburg would have over Buffalo or New York in the manufacture of iron and steel is in its greater proximity to the coking coals. It is believed that this advantage can be overcome by the saving in the cost of ore and limestone and the great saving in cost of transportation of the finished product. Between Pittsburg and tidewater the finished product must be transported a distance of 350 miles over a range of mountains, whereas from either Buffalo or New York, or any intermediate point on the water route, the enormous market for steel and iron in New York and New England, as well as abroad, can be supplied at greatly reduced charges for transportation. We believe that a suitable enlargement of the Erie Canal at the present time is justified by the prospect of its use in connection with manufacture of steel and iron and shipbuilding, fully as much as its original construction was justified by the prospect of transporting breadstuffs. In-

*A mammoth steel and iron plant, involving an outlay of more than $20,000,000, is now in process of construction at Buffalo, and plans are projected for another large plant at Tonawanda.

deed it is not too much to expect that with a canal which can carry manufactured steel from Conneaut to New York for 50 cents a ton, and distribute this from New York to points on the New England coast without breaking bulk, the vast steel and allied industries centering at Pittsburg, which support a population greater than that of Chicago, will seek an outlet for their products by rail to Conneaut and thence by the Erie Canal, rather than across the Alleghenies to Philadelphia.

Within the last ten years the United States have wrested from Great Britain the supremacy in the iron trade, and during that period the imports of iron and steel have diminished from $51,000,000 to $11,800,000 in value,* and the exports have increased from $21,000,000 to $93,700,000 in value.† There is every reason to believe that the iron and steel trade, and the manufactures depending on it, in the United States will continue to increase during the next twenty years in enormous amounts, and it is of the utmost importance that the State of New York shall promptly take steps to bring this industry within its borders, and to provide a cheap transportation route for the finished product both for export and for consumption on the Atlantic coast. Such a route can be provided by the Erie Canal, enlarged as we recommend.

The possibilities of manufacturing development along the banks of the Niagara River between the Falls and Buffalo should not be overlooked in considering the transportation problem. Factories are already established in the vicinity of Niagara Falls utilizing the cheap power obtained from the Falls to an extent of about 75,000 horse-power, and these will be doubled within a very few years. The problem of transmission of power has been so far solved as to permit the lighting of Buffalo and the operation of its street-car system at a distance of 22 miles from the power house. It is probable that in less than ten years the transmission of power, at least as far as Rochester, will be commercially practicable. These advantages, if properly utilized, will make Western New York the centre of such a manufacturing district as the world has never seen. The lakes give cheap transportation to the West, and it only needs a suitable water route to the Hudson in order to give cheap transportation eastward, which will enable

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*Statistical Abstract of U. S., 1898, page 252.

†Ibid, page 175; Monthly Summary of Commerce and Finance, Sept., 1899, pp. 675, 820.

these manufactured products to compete in every market in the world.

The late Mr. Albert Fink, than whom there was no higher authority on the transportation question, made a statement before the Windom Committee some 20 years ago that the Erie Canal regulated the rates not only on the railroads of New York State, but on every trunk line connecting the lakes with the Atlantic. This statement has never been successfully disputed, and it will continue to be true if the canals continue to keep pace with the railroads in enlargement and in management. If the canals are left stagnant, both in size and management, as they have been for a whole generation, while the railroads are improving year by year, then the time will come, and at a very early day, when this statement will cease to be true. To leave the canals in their present condition is virtually to abandon them. The Constitution of New York distinctly forbids this. For more than 80 years public money has been spent on the water-ways connecting the Hudson with the lakes, and during 50 years these water-ways were enlarged and improved to keep pace with the increase in the traffic, and to decrease the rates. The State has made this expenditure for the purpose of utilizing its natural advantages and keeping within its own limits the route which should produce the minimum freight rate. We believe that the policy which has prevailed in the past, and which has been the chief factor in the commercial prosperity of this State, should be continued in the future. If these views are wrong, then it is in order to stop spending money on the canal and to propose an amendment to the Constitution which will permit of their abandonment and disposal by sale or otherwise. In our judgment, such an amendment to the Constitution would not receive even a respectable minority of votes.

In the southern portion of the State there is a sentiment in favor of turning the management of the canals over to the Federal Government, but this idea is entertained by such a relatively small portion of the people of the State of New York, and its adoption seems to us in every respect so unwise, that we do not deem it necessary to discuss the matter at length. The proposition was brought before the Chamber of Commerce in New York during the year 1898, and a committee reported in favor of it; but on a thorough discussion in the Chamber the arguments in opposition to such a course, and especially those brought forward by Mr.

A. S. Hewitt, were so strong that the Chamber unanimously adopted a resolution disapproving of any such course. These arguments, published in the Report of the Chamber of Commerce for 1898,* seem to us unanswerable.

What has been said in the foregoing refers especially to the Erie Canal, but it applies equally to the Oswego Canal, which gives access to Lake Ontario, and to the Champlain Canal, which connects the Hudson River with Lake Champlain. We recommend that the project of 1895 be completed, which would provide for boats of 320 tons on the Oswego and 240 tons on the Champlain Canal.

In reference to the minor canals, namely, the Black River, and the Cayuga and Seneca, they were originally intended to be branches or commercial feeders, and in this light we think that they will no longer prove to have much value; but they are of great value as water feeders, and must be maintained for this purpose; and the additional expense of maintaining them in a state suitable for navigation is so slight that we think they should be maintained in that condition. We see no necessity, however, for their enlargement.

II.

THE SHIP CANAL PROJECT.

The enormous interest of the great West in the raising of food products, of which one-fifth is exported for foreign consumption, naturally leads the people of that section to seek the cheapest possible freight line for conveying such products to their final destination. They believe that an all-water route from the upper lakes to Europe will be of great benefit to them in enabling them to compete on more favorable terms with the grain producers of India, Russia and the Argentine Republic. For many years this sentiment has been growing, and it has resulted in Deep Waterway conventions, at which much interesting statistical information has been brought forward, and much accomplished in the way of interchange of ideas. The sentiment of these conventions has been practically unanimous in favor of a water route of either 21 or 28 feet depth from Lake Erie to the Atlantic Ocean. In response to this sentiment Congress has made appropriations† amounting

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*Pages 118-125.
†See page 145.

in all to $465,000 for the purpose of making the necessary detailed surveys in order that an intelligent opinion could be formed as to the probable cost of such a project. The surveys are being made under the direction of a Board of Engineers on Deep Waterways, and it is anticipated that their report and the result of their surveys will be laid before Congress at the present session. Such a waterway necessarily involves a deep canal across the State of New York, or some portion of it. Two routes have been under consideration, each of which involves a canal around Niagara Falls. The first route leaves Lake Ontario at Oswego, and goes by way of Oneida Lake to the Valley of the Mohawk, and thence to the Hudson. The second route connects the St. Lawrence River with Lake Champlain either through the upper part of the State of New York or through the adjacent portion of the Province of Ontario under some convention with Canada.

It seems to us that there are certain insuperable difficulties in the way of such a canal ever being a success, no matter by whom constructed. It is intended to be used by a vessel which can navigate the ocean, the canal and the lakes. We do not believe that such a vessel can be constructed so as to be economically and commercially successful. The ocean steamer is built to withstand the fierce storms of the Atlantic, and costs in its most modern type about $71 per net ton of carrying capacity.*

The vessel to navigate the lakes is built to withstand less frequent and dangerous storms; it has less draft, on account of the smaller depth of the harbors on the lakes, and it is built much less substantially; its cost is about $36 per net ton of carrying capacity.†

The cost of a canal fleet, consisting of a steamer and three consorts, with a total cargo capacity of 3,900 tons, according to figures furnished us by boat builders, would be $28,500,‡ or $7.31 per ton.

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*Report of Major T. W. Symons, in Report of Chief of Engineers U. S. Army for 1897, p. 3174.

†Ibid, p. 3176. These figures were based on the actual cost of vessels constructed between 1893 and 1896. At the present time, owing to the increased price of steel, the cost of each would be largely increased.

‡See page 64.

The Cleveland Steel Canal Boat Company estimates that steel canal boats of the above capacity (150 feet long, 25 feet wide and 10 feet draft) will cost $15,000 for each consort and $25,000 for a steamer, which is $18 per ton of cargo capacity for a fleet of four boats.

We have, then, the difference in first cost between $71, $36 and $8 per ton of carrying capacity for the three types of vessels which, in the evolution of business, have been produced as the most economical for the particular class of work each has to do. We do not believe that it is possible to combine these three types into one vessel, which will be as economical for the through trip as to use the three existing types with two changes of cargo, one at Buffalo and one at New York, or to use the boat of 1,000 tons capacity going through from the lakes to New York and there transferring its cargo to the ocean steamer.

The average speed on the Suez Canal is only six miles per hour, and this on a canal with a total length of about 90 miles, of which fully two-thirds is a large lake. In a restricted waterway 350 to 400 miles long we do not believe that ocean steamers or lake steamers could attain an average speed exceeding five miles an hour. They are built to run from 15 to 20 miles an hour, and if they were run at only five miles an hour we think that in order to be profitable the now existing rates on the ocean and lakes of about one-half of a mill per ton mile would have to be very largely increased.

Finally, we think that this project is not one for serious consideration by the State of New York, because there are as yet no data which would enable any one to give even an approximate estimate of its cost. We have seen various statements placing the cost of a ship canal at figures ranging from $125,000,000 to twice or even three times that sum. None of them are founded on data sufficiently accurate to justify careful examination. The Board of Engineers on Deep Waterways is now preparing its estimates, and these will be the first based on adequate surveys. Until their figures are known, all that we can say is that a ship canal will cost very much in excess of the project which we recommend. On the other hand, it will not, in our judgment, produce a freight rate, or other advantages, commensurate with this increased cost.

While, therefore, it seems eminently a proper subject for consideration by the Federal Government, even though, as is probable, the result of such an examination shall be the abandonment of the project, we do not think it is a subject which should receive any serious consideration from the State of New York.

III.

PROJECT RECOMMENDED.

In the foregoing we have given reasons which have led us to the conclusion that it is not wise for the State to abandon its waterway, and that the ship canal will involve an enormous expenditure without producing a satisfactory result. It then remains for us to consider to what extent the waterway across the State should be enlarged. A number of projects have been under consideration, involving plans for a canal of different depths, from 9 to 14 feet, carrying boats with capacities of from 320 to 1,500 tons, and involving an expenditure of from $13,000,000 to $80,000,000. In order to arrive at an intelligent decision, it is necessary to determine with reasonable accuracy what each of the proposed projects will produce in the way of freight rate, and what it will cost.

In regard to the latter, the information and data which have become available within the last few months are far more extensive than were at the disposal of the State Engineer when the project of 1895 was prepared, or at the disposal of Major Symons when he made his report to the War Department in 1897 on the barge canal project, or at our own disposal when we sent out our circular letter of May 1st, 1899. The surveys of the Board of Engineers on Deep Waterways have been of the most thorough and complete character, and covered every possible route for a waterway through this State east of Oswego and Syracuse. The results of these surveys will not be available to the public until after the report shall be presented to Congress, which it is anticipated will be done during the present season, but through the extreme courtesy of the members of the Board their records and surveys have been placed at the disposal of engineers employed by us. The engineers of the State while the project of 1895 was being carried out made very complete surveys in the immediate vicinity of the canal, including cross sections at intervals of 100 feet. In order to obtain the data for estimates on the portion of the route west of Syracuse and Oswego we have employed our own engineers, who have made their own surveys. Finally, we have had the advantage of the maps of certain portions of the State recently published by the United States Geological Survey on a scale of 1-62500, or about 1 inch to the mile, with contours at 20 feet interval. With all of this data it has been possible to prepare estimates of cost which we feel justified in relying upon as sufficiently accurate to form a basis for recommendations to yourself and the Legislature. These estimates will be found on pages 81 to 107. They were prepared by Messrs. G. W. Rafter, D. J. Howell and F. M. Sylvester, all of whom have had long experience in engineering work connected with the canals. They were made under the personal direction of Major Symons, and have been carefully examined and approved by him. They have been further examined by Messrs. William H. Burr and William Barclay Parsons, whose statements as to their adequacy will be found on page 109. The original estimates of Messrs. Rafter, Howell and Sylvester, covering nearly 300 pages of typewritten manuscript, are considered too voluminous to be published *in extenso* with this report, and have therefore been deposited in the office of the State Engineer. They contain data of great value on the canal question, and we recommend their publication by the State.

It should be further noted that our estimates provide for the construction of mechanical lift locks at Cohoes at the risk and expense of the State. Chapter 519 of the Laws of 1899 provides a method by which these locks can be constructed by private capital at its risk, the State paying a rental in case of success. Should this method be put into practical operation, our estimates will be reduced by $1,200,000 for the smaller project, and $1,700,000 for the larger project.

We fully realize the responsibility attached to the making of these estimates, and we feel that we have taken every precaution within our power to avoid the error of estimating below actual cost. While further surveys are necessary in order to make working plans and prepare contracts (and we recommend that such surveys be made immediately), yet we feel reasonably confident that the figures we now present are sufficiently accurate as a basis for legislation and a vote of the people, and we think the result of further surveys will be to decrease to some extent the estimates we now present.

The other factor in the problem is to determine the probable freight rate; or, more exactly, the actual cost of transportation, which will result from carrying out each particular project under consideration. Major Symons has made a most careful study of this feature, and has procured from boat builders, canal boatmen, and from every other available source the data bearing upon the actual cost of running boats of different sizes. The result of his investigations is printed in full in the memorandum beginning on page 56. It is believed that every item of cost, expense and depreciation has been fully taken into consideration. As a check upon the figures obtained in this manner, we have had the actual freight rates in force upon the Lakes and upon the canals under existing circumstances.

The foregoing explanations are given so that every one can determine just how much weight to attach to our figures.

The Erie Canal was originally built with locks 90 feet long, 15 feet wide and 4 feet deep, and with a prism of corresponding depth. The boats first used carried 30 tons. It has been successively enlarged at different times, as shown on the accompanying diagram. At the end of 1862 it had double locks, 104 feet long, 18 feet wide and 7 feet deep, and carried boats of 240 tons. No improvements have been made during the last thirty-seven years, except to lengthen the locks on one tier so as to pass two boats at one lockage. This work had been completed on all the locks except at the four flights of Cohoes, Little Falls, Newark and Lockport. It was anticipated that at these points modern lift locks would be desirable, and that it was unwise to expend any money in lengthening the locks of the old pattern. This was the condition of the canal at the time of the adoption of the project of 1895 (Chapter 79 of the Laws of 1895). This law described the project in the following language: "The said improvement to the Erie and Oswego canals shall consist of deepening the same to a depth of not less than nine feet of water, except over and across aqueducts, mitre sills, culverts and other permanent structures, where the depth of water shall be at least eight feet, but the deepening may be performed by raising the banks wherever the same may be practicable; also the lengthening or improving of the locks which now remain to be lengthened, and providing the necessary machinery for drawing boats into the improved locks, and for building vertical stone walls where, in the opinion of the State Engineer and Surveyor and Superintendent of Public Works, it may be necessary. The improvement upon the Champlain Canal shall consist in deepening the said canal to seven feet of water, and the building of such vertical stone walls as in the opinion of the State Engineer and Surveyor and Superintendent of Public Works shall be necessary. The work called for by this act shall be done in accordance with plans, specifications and estimates prepared and approved by the State Engineer and Surveyor."

The contracts let under this project were all upon the prism and none upon the locks (except at locks 21 and 22). The plans and estimates, so far as we can learn, contemplated locks which would provide for the passage of two boats, each 104 feet long, 17½ feet wide and about 7½ feet draft. It was estimated that this would increase the carrying capacity of the boats about one-third, namely, from 240 tons to 320 tons.

This is what we understand to have been the project of 1895.

In his report for 1897, State Engineer Adams recommended the lengthening and deepening of the locks by the use of a different type of gate, so as to provide for boats of 115 feet in length, 17½ feet wide and 8 feet draft. This would increase the carrying capacity of the boats to 400 tons.

In the report of Messrs. North and Cooley, the Engineers of the Investigating Committee of 1898, it was pointed out that many items had been omitted in the project of 1895, such as "the strengthening of banks and repairing or renewing of locks, aqueducts, waste weirs, etc. * * * all locks deepened and lengthened or replaced with pneumatic lifts as at Lockport and Cohoes, * * * and pneumatic lifts at Newark and Little Falls." The carrying out of this additional work necessarily increased the estimates of the engineers of the Investigating Commission beyond those of the State Engineer.

We have considered the cost and value of the original project of 1895 when completed, as well as that including the modifications suggested by Messrs. North and Cooley, and we have also considered the cost of a similar project with locks sufficient to take two boats, each 125 feet in length, 17½ feet in width, 8 feet in draft, with a cargo capacity of 450 tons. We also considered the cost of widening one tier of locks so as to pass boats 125 x 25 x 10 feet with the idea that these boats might be temporarily used on a six foot draft, and thus derive a partial advantage in the increased cargo and decreased freight rate, pending the final completion of the project. This plan was very favorably received by boatmen and others interested in canal transportation, and this led us to make a very careful examination and test of the accuracy of the estimates of cost which we had used in our circular letter of May 1st as a basis for discussion, and which had been obtained from such published data as was then available. The result of such examination showed that the figures which we had been considering were erroneous. We also caused plans to be made of the sharp bends and other points of the canal where the navigation by boats 25 feet wide pending the enlargement would be difficult, and the result of such examination clearly convinced us that such boats could not be used to advantage until the final completion of the entire project. We also learned that a similar plan of temporarily navigating the canal on a single track basis with turnouts had been tried during the enlargement of 1855 and found to be impracticable. We were therefore compelled to abandon further consideration of the project designated as "Plan 2" in our circular letter of May 1st.

We have also considered with some care the project of a barge canal for barges of 12 to 14 feet draft, and capacity of 1,200 to 1,500 tons; but we became convinced that a barge of this size would cost very much more than a barge of 1,000 tons capacity; that the corresponding canal would cost very much more than the canal suitable for the 1,000 ton barge, and that the cost of transportation, or freight rate, would be substantially the same in both cases. We therefore have not made any detailed estimates of the cost of a barge canal for 1,500 ton barges.

The result of the investigation, therefore, reduced the number of projects to four, and the cost and economic value of each have been very carefully considered. The results are given in tabular form on page 67. In considering the three smaller projects, we became convinced that the completion of the project of 1895, as originally designed, and producing a waterway to be used by boats of 320 tons, would produce so slight an improvement over existing conditions as not to justify the expenditure of public money. As between the projects for boats 115 feet or 125 feet in length, each having 17½ feet width and 8 feet draft, we concluded that the increased saving in transportation cost by the larger boat was sufficient to justify the increased expenditure.

We thus eliminated from consideration all of the various projects except two, and the relative advantages of these will be stated in some detail in order to explain fully why we have finally decided to recommend the larger project.

Each of the projects contemplates that the first work to be done will be that upon the locks so as to fix the size of the boats, enable builders to resume the building of boats, and pending the completion of the prism to pass three of the present boats at one lockage. There are two points on the canal where an entirely different system of locks should be introduced; one at Cohoes, where a double pneumatic or other mechanical lift should replace the existing sixteen locks; and the other at Lockport, where a similar lift should replace the existing five locks. There are two other points, namely, Little Falls, where the four existing locks should be replaced by three new locks; and Newark, where the three existing locks should be replaced by one new lock. At other points the existing locks are to be rebuilt with greater length and greater depth. Each plan also contemplates the use of quadrant gates in place of the present gates, and of mechanical power, either steam or electricity, for operating the gates and for working the boats into and out of the locks.

Each plan also contemplates a new canal for about 100 miles, or 30 per cent. of the entire length. One diversion is from Clyde to New London, following the line of the Seneca and Oneida Rivers and Oneida Lake, avoiding the treacherous foundation which is such a fruitful source of expense across the Montezuma marshes, and giving a wide waterway through the rivers and lake above mentioned, so as largely to increase the speed of the boats. The other diversion is to begin at the West Troy side cut (cutting out two locks and seven miles of canal between that point and Albany), and construct a new canal leaving the Hudson River at the West Troy side cut and following the line of the existing Champlain Canal, and the bed of the Mohawk River to the Cohoes Falls; to canalize the Mohawk River from the falls to Rexford Flats, near Schenectady, and possibly as far up as Little Falls, if the result of further surveys shall show that this is cheaper than to follow the present route. The canalization of the Mohawk River between Cohoes and Rexford Flats will do away with the two aqueducts, the expense of rebuilding which on either of the plans for enlargement would be very great.

The aqueduct at Rochester, and the line of the canal through that city are so located that the expense of enlargement will be almost prohibitive, and we therefore advise the adoption of a new line to the south of Rochester, as is fully set forth in the estimates of the engineers. The adoption of the new line between Clyde and New London would carry the main canal about six miles north of Syracuse, but an outlet is provided for into Onondaga Lake, where large and satisfactory terminal facilities can be provided for the benefit of the Syracuse trade at comparatively small expense.

Our estimates provide for carrying the enlarged canal through the city of Utica on the present route, but further surveys are necessary to show whether it would be cheaper to carry it around the city of Utica.

For many years it has been suggested by engineers that it would be desirable to carry the canal between Clyde and some point in the vicinity of Rome by a southern route which should give a constantly descending canal from Lake Erie to the Hudson River. It has also been suggested that the Syracuse level might be extended east and west so as to provide a constantly descending canal. These projects were so attractive that we employed Mr. George W. Rafter to ascertain definitely what they would cost. His complete report has been filed with the State Engineer, and we recommend its publication. He surveyed one route to the south of the present line, one to the north, and one intermediate for extending the Syracuse level east and wst. His surveys showed that the cost of the southern route, 58 miles in length, would be $29,000,000; the northern route, 58 miles, would cost $22,400,000, and to extend the Syracuse level east and west, 113 miles, would cost fully $32,500,000. These estimates are based on a canal of 12 feet depth, sufficient to carry boats 25 feet wide and 10 feet draft. The adoption of either of these routes would involve a cost of from $17,000,000 to $25,000,000 in excess of the route which we recommend by the Seneca and Oneida rivers and Oneida Lake. In our judgment, no advantage would be gained corresponding with such an increased cost, and we therefore advise the adoption of the route via the Seneca and Oneida rivers, and Oneida Lake.

The route to be followed by either of the two projects which we now submit is therefore the same, and the difference in cost is that which arises from the difference in the size of boats and the difference in the size of locks and prism to carry them. The smaller project is for boats 125 feet in length, 17½ feet in width and 8 feet draft, and a capacity of 450 tons; and the larger project is for boats 150 feet in length, 25 feet in width and 10 feet in draft, with a capacity of 1,000 tons. The cost of transportation in one case will be 0.88 of a mill per ton mile, or 1 1-3 cents per bushel of wheat from Buffalo to New York; and in the other case 0.52 of a mill per ton mile, or 8-10 of a cent per bushel of wheat from Buffalo to New York. The cost of transporting a ton of freight from Buffalo to New York by the smaller project will be 44 cents, and by the larger project 26 cents. The smaller canal will have a capacity of 10,000,000 tons per annum, and on that tonnage the saving, as compared with the present canal, will be $4,300,000 per annum; on the same tonnage, the saving by the larger canal will be $6,100,00 per annum, but its capacity would be in excess of 20,000,000 tons per annum, and on that tonnage the saving as compared with the present canal would be $12,200,000 per annum. As compared with the lowest rail rate ever quoted across the State of New York, the saving on a tonnage of 20,000,000 tons per annum would be nearly $18,000,000 per annum.

As between these two projects, the undersigned are unanimously of the opinion that it is best for the State to adopt the larger project. Whether these views will meet the approval of the Legislature and the people it is not for us to say. We confine ourselves solely to advising you what in our judgment is the proper policy for the State to pursue in regard to its canals, leaving to those on whom the responsibility rests to decide whether these views should be carried into effect. We feel confident that on mature reflection the Legislature and people of the State will ultimately adopt these views. We have hesitated to recommend the expenditure of a sum of money which, although small in proportion to the resources of the State, is still a very great sum; but after much deliberation we are unwilling to recommend any temporary or partial settlement of the canal question. We do not believe that the adoption of the smaller plan will result in *permanent* benefit to the State of New York, and as the money expended on the smaller project would be almost entirely wasted in case a larger project should be determined upon later on, we do not feel justified in recommending the expenditure of so large a sum as $21,000,000 for a temporary purpose. We feel confident that the larger project will result in a transportation cost across the State of New York as low as that by the St. Lawrence canals, which constitute their chief rival at present, far less than any rate which is possible by railroad at any time within the immediate future, equal substantially to the results which could be obtained by a large barge canal or a ship canal, and, in short, would be a complete and permanent solution of the canal problem. It would give New York advantages in the low cost of transportation, and the commerce resulting therefrom which would be possessed by no other State on the Atlantic Coast.

We believe it is unwise to spend large sums of money in a mere betterment of the existing canal; what the present situation requires is a radical change, both in size and management, and what we recommend is practically the construction of a new canal from Lake Erie to the Hudson River, following the present canal for something over two-thirds of the distance, and new routes for the remaining distance of a little less than one-third, and utilizing the existing structures and prism so far as they can be made use of. We are firmly of the opinion that any less complete solution of the problem will in the end prove to be unsatisfactory; and that while the sum of money required to put this into execution is large, yet the resources of the State of New York are so enormous that the financial burden will be slight.

In regard to the Oswego and Champlain canals, we think the project of 1895 will afford an adequate solution, and that this project should be completed. The State has already expended on these two canals since 1895 $2,841,600. The cost of completing them now, owing to the Eight Hour Law and the increased price of materials, will be as follows:

For the Oswego Canal*..................	$ 818,120
For the Champlain Canal..................	1,824,000
Total	$2,642,120

We have carefully considered the substitution of the Hudson River for the Champlain Canal between Fort Edward and West Troy, but we find that this will add about $2,000,000 to the cost, and we do not think that the benefits will justify this additional expense. Subsequent surveys may show that for a portion of the distance it may be possible to utilize the Hudson River at a smaller expense than the estimates we submit for the corresponding portion of the canal.

*The work on the Oswego Canal between Syracuse and Phoenix is provided for as part of the Erie Canal enlargement.

The completion of this project will give a prism of nine feet depth and structures with eight feet depth of water on the Oswego Canal, making it suitable for boats of 320 tons capacity; and on the Champlain Canal will provide a prism of seven feet in depth, with six feet of water over structures, capable of transporting boats of 240 tons.

IV.

FINANCES.

Much has been said at various times about "the burden of taxation" for canal improvements and canal expenses, which, in our judgment, is not warranted by the facts; and it seems to us desirable that there should be a clear understanding of the matter. On pages 151-153 we have given itemized statements, compiled from the records of the public offices at Albany, showing for each of the canals in this State the revenues received, and the cost of construction, enlargement, operation and management from their inception to the close of the year 1898. This statement shows that the minor canals have resulted in financial loss, and several of them have not even paid any appreciable return upon the sum expended in their construction. Several of the latter, such as the Genesee Valley, Chenango and Chemung canals, were abandoned some years since, and it must be frankly admitted that their construction proved to be a mistake, and the sums expended on them were a total loss.

As to the Erie, however, the reverse is the case. Down to the close of the year 1882, at which time the tolls were abolished, the revenues collected on this canal exceeded all sums paid out upon it for any purpose whatsoever by the sum of $42,599,718. This profit has been reduced in subsequent years by the expenses for ordinary and extraordinary repairs, maintenance and operation, and for enlargement under the Nine Million Dollar Act, and against this outgo for expenses there has been no income from tolls; so that the net balance to the credit of the Erie canal is now a little more than $20,000,000.

It is important that this fact should always be borne in mind, that the Erie canal has paid into the State more money by many millions of dollars than has been spent upon it in the aggregate for any and all purposes whatsoever. Were this not the fact we should not advise its enlargement.

In considering the question of how the canal enlargement should be paid for, we have made a careful study of the assessed valuation of the different counties in the State; the results are shown in a map and tables on pages 158 and 159. A glance at these statistics shows that the wealth of the State lies contiguous to its water routes, the river and canal counties containing 90 per cent. of the total valuation. Statistics are not available which would enable us to make a comparison of the relative wealth of the different counties 80 years ago, prior to the construction of the canals; but we feel confident that these would not show any such great difference as now exists. While the canals have benefited the entire State, and every part of it, yet in those counties lying remote from the water routes the benefit has been less evident than in those adjacent to these routes. It has, therefore, seemed to us that it would be equitable that the expenses of completing the enlargement of the water routes should be borne by those counties through which these routes pass, instead of being paid by the entire State, as has been usually the custom hitherto. We sought the advice of counsel as to the legality of such a proceeding, and were somewhat surprised to find that it is in no sense novel, but was proposed and adopted for the earlier canal expenditures of 1817, and that there is an almost unbroken line of decisions by the Court of Appeals confirming in the most positive terms the right of the Legislature to levy taxes in this manner, if in its wisdom it sees fit to do so. The opinion of Avery D. Andrews, Esq., attorney-at-law, quoting these various decisions, is published on page 110. We trust that this opinion will be read in full, and we only quote here an extract from the most recent decision, in 1897, which, however, seems to us at once the broadest, most concise and most comprehensive statement of the case. The language of the Court of Appeals is as follows: *"The power of taxation includes the power to apportion the public burdens in such manner as may seem best to the Legislature."*

It has seemed to us that this method of paying the cost of enlargement is not only in every respect equitable, as well as legal, but that the adoption of it will in large measure remove any opposition to canal improvements which may exist in those counties which are not contiguous to the water routes. The great cities in the State will undoubtedly be the first beneficiaries of the trade which will result from such enlargement, and while other portions of the State will also derive benefit from it, yet this will be indirect, remote and contingent, whereas, to the cities and canal counties the benefit will be direct, immediate and positive. Such a method of assessment, while relieving the farmer in the purely agricultural counties from paying any part whatever of the cost of these improvements, will not, on the other hand, increase the cost to the water route counties by more than 10 per cent., and this they should be readily willing to pay in return for the benefits derived. If the voters in the canal counties do not believe that they will derive benefits justifying the expenditures necessary for the enlargement, then they will not engage in the enterprise; and, on the other hand, if they do believe that they will receive such benefits, then they will willingly vote for raising the necessary money to bring them about.

The financial burden, in any case, will not be a large one, for while the sum of $62,000,000, which is the cost of the plans we advocate, is a very great sum of money, yet it is less than 1½ per cent. of the assessed valuation of the canal counties, and a still smaller proportion of their actual value. The assessed valuation of those counties in 1898 was $4,412,772,343.* The normal increase in valuation during the last 60 years has been at the rate of a little more than 4 per cent. per annum, or doubling every 23 years. Should this rate continue until 1920, when the bonds would mature, the valuation of the canal counties would then be almost $9,000,000,000.

The population in the canal counties is about 80 per cent of the entire population of the State; the vote cast in such counties in 1898 was 80.5 per cent. of the total vote. The question of authorizing canal improvements and issuing bonds to defray the cost must be submitted to all the voters in the State; but if the act which is submitted for their adoption or rejection distinctly provides that the taxes to pay interest and principal of these bonds shall be levied in the canal counties only, then it is fair to assume that in the non-canal counties the voters will be indifferent to the question and the vote will be small; so that the canal counties will virtually decide the question for themselves. The Constitution requires money for canal improvements to be raised

*See Table 7, page 158.

by bonds maturing in 18 years. They could probably be placed at par, or at a premium, with 3 per cent. interest. The interest and sinking fund to redeem the bonds in eighteen years amount together to $7,271 for each $100,000 of bonds. For $62,000,000 of bonds this would amount to $4,508,020 per annum, which, levied on $4,412,772,343 of assessed valuation in the canal counties would amount to a little more than 10 cents per $100 of present assessed value, and this would decrease year by year as the valuation increases. The aggregate State, county and municipal taxes in the canal counties now average about $2 per $100 valuation. To increase this from $2 to $2.10 will certainly not prove a serious burden to any taxpayer. To the person or corporation paying taxes on $1,000,000 of assessed valuation it would increase his tax bill from $20,000 to $21,022 per annum; to the man owning a $50,000 house in New York City or Buffalo it would increase his taxes from $1,000 to $1,051 per annum; and to the farmer with a farm valued at $5,000 it would increase his taxes from $100 to $105.11.

If the enlargement of the Erie canal will restore to New York its former proportion of the grain trade, and in addition will develop the iron and steel industry within its own borders; in a word, will permanently establish the commercial supremacy of New York, which is now not only threatened but partially lost, the foregoing sums are a small amount to pay to bring about such results. They are small as compared with what New York has done in the past for the same purpose. On pages 154-155, Table 5 will be found a complete history, year by year, of the valuation of the State, the canal debt and the canal taxes. The canal debt reached its maximum in 1844, and was then 3.8 per cent. of the entire valuation of the State. A corresponding percentage at the present time would amount to nearly $190,000,000. While the canal debt was in process of extinction the taxes for canal purposes alone frequently rose as high as 20 cents per $100, and for all State purposes to 70 cents per $100. Such taxes at present would produce annual sums of $10,000,000 and $35,000,000, respectively. The original cost of construction of the Erie Canal was 3 per cent. of the valuation of the State at the time the work was undertaken. When the first enlargement was completed, the total cost of construction had risen to 3 7-10 per cent. of the valuation of 1850; when the second enlargement was completed the total cost of construction and enlargement had risen to 4 per cent. of the valuation of 1860.

In other words, the State adopted and pursued for over 45 years the policy of expending as much as 3 to 4 per cent. of its total wealth on the canals. Such a policy at the present time would involve an expenditure of $150,000,000 to $200,000,000. No such sums, in our judgment, are now proper or necessary, but we cite these figures to show what financial responsibilities have been assumed by the State in reference to its canals in the past, and how small, comparatively, is the responsibility which we now recommend the canal counties to assume. In the past, the outlay, so far as it related to the Erie canal, was more than repaid in tolls, without taking into account the enormous incidental advantages derived from that canal. If it should ever be thought wise to restore the tolls similar results can be produced in the future; but if the constitutional prohibition of tolls continues in force, then the burden on the taxpayers in the canal counties will still be comparatively slight in proportion to the enormous aggregation of their wealth.

The heaviest part of the cost must in any event fall on the city of New York as now constituted. This pays about 62 per cent. of all the taxes in the State, and would pay 69 per cent. of the assessment on the canal counties. In other words, New York City would have to pay about $3,250,000 per annum from say, 1902 to 1920, in order to establish its commerce on a basis where it would be secure for a full generation, if not for all time, from the injury which has been done to it by its rivals during the last few years. New York City is now considering the propriety of expending between $70,000,000 and $80,000,000 for railroads, bridges and tunnels designed to facilitate the movement of passengers within its limits. It may well consider the propriety of making a sufficient expenditure to secure its commerce, in order to be sure that it will have the passengers to transport.

V.

MANAGEMENT.

As stated in the beginning of this report, in our judgment the efficiency of the canals depends quite as much upon the way the business is handled on them as upon their physical size, and we advise against the expenditure of any more money for their enlargement unless it shall be accompanied with measures which will lead to the adoption of more modern methods in conducting the business of water transportation across the State. The policy of the State hitherto has been to discourage the adoption of modern business methods and to foster the handling of the traffic by canal boatmen owning each a single boat, or small companies owning a few boats. This prevents the State from taking advantage of those improvements in business management which have brought about such enormous economies in other lines. Canal legislation has been largely in the interest of the comparatively small number of canal boatmen, but it has resulted in failure so far as they are concerned, for experience has shown that they are unable to cope with the methods employed through corporate action.

The statistics which accompany this report* show that in 1868 the canals carried 44 per cent. of the tonnage across the State, and in 1898 only 5 per cent. In the matter of grain (including flour)† in 1868 the canals carried 76 per cent., and in 1898 10 per cent. Yet during all of these 30 years, the rail rate has always been in excess of the canal rate.‡ There must be a reason why shippers and merchants are willing to pay more for transporting grain and other articles by rail than by canal, and the reason is chiefly because the railroad conducts the business according to modern methods and the canals do not. There is, in our judgment, no reason why the same business methods cannot be applied to the canals as to the railroads; and if they are applied they will produce an equally satisfactory bill of lading, equal certainty in the time of delivery and equal responsibility on the part of the carrier.

In order to accomplish this, so much of chapter 934 of the laws of 1896 as limits the amount of capital which shall be employed in the business of canal transportation should be repealed.

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*Table 27, pages 182-183.
†Table 22, pages 176-177.
‡Table 32, page 190.

This law reads as follows: "No corporation organized under this act, and designed to navigate any of the canals of the State, shall have a capital stock exceeding $50,000." It has been charged on the one hand that this law was passed at the instance of the railroads in order to destroy the usefulness of the canals; and, on the other hand, it is asserted that it was passed for the benefit of the boatmen in order to prevent the formation of large corporations, which, by greater economy, could first drive the small boatmen out of the business, and then by some alliance or understanding with the railroads, increase the rates. Whatever the origin of the law may have been, it has proved in practice to be of no benefit to the boatmen. Their business has continued to diminish and to grow still less profitable year by year since this law was passed. They do not make living wages under existing conditions, and they cannot. They are attempting to maintain an antiquated method of business in competition with the modern methods which have brought about the extraordinary increase of wealth during the last 30 years. They cannot possibly succeed, and the State is not justified in expending any more public money unless the conditions are so changed as to derive the full benefit from its investment.

We therefore recommend in the most positive terms that the above quoted law of 1896 be repealed.

The next step is the reduction of terminal charges at Buffalo and New York. The improvements which we recommend are designed to produce a freight rate not to exceed one cent per bushel from Buffalo to New York. The prevailing rate on the lakes from Chicago to Buffalo during the last few years has been $1\frac{1}{2}$ cents, making a total of $2\frac{1}{2}$ cents for transportation alone for a distance of 1,500 miles. The cost of handling at Buffalo and New York is 2 1-10 cents, made up as follows:

		Cents.
Elevator charges at Buffalo		.625
Receiving, weighing and discharging at New York	$6.25 per 1,000 bu.	
Canal boat trimming	1.50 " " "	
Ocean vessel trimming	2.00 " " "	
Floating elevator	5.00 " " "	
	$14.75	1.475
Total for rehandling		2.100

We think that the cost of rehandling is out of proportion to the cost of transportation. It is equivalent to 78 cents per ton. Ore and coal are handled at terminal points on the lakes, in large quantities, at a cost of 8 to 10 cents per ton. We believe that the grain can be handled at a cost per ton little, if any, in excess of ore and coal.

Within the limits of the present city of New York and within the new harbor of Buffalo, there are miles of unoccupied and cheap water front where suitable structures and appliances for handling the grain out of the lake steamer into the canal boat at Buffalo and out of the canal boat into the seagoing vessel at New York can be erected, the result of which will produce a reduction in the grain rate fully equal to that which can be produced by an enlargement of the canal. If the elevator charges are not voluntarily reduced, then, with a waterway enlarged and made free as we recommend, the grain will be sent through from Chicago to New York in a fleet of four or six barges (133,000 or 200,000 bushels) without breaking bulk. This, combined with the Montreal competition, will soon force the adoption of improved and cheaper methods of rehandling.

We do not believe that it is necessary to attempt to bring about these results by legislation. If the use of the canal is made free, without restriction as to amount of capital employed, these results will be brought about in the natural course of trade and competition.

Again referring to the iron trade and the marvelously cheap cost of transporting ore, we find that this business is managed by large concerns owning their own mines, their own lake vessels, and their own railroad from the lake port to Pittsburg. At the points where bulk has to be broken, modern mechanical devices are installed for handling the material out of one carrier and into another in enormous quantities and at a minimum cost. We believe that, if the canal is enlarged and made free, analagous methods will be introduced in the grain trade under which responsible companies with adequate capital will take charge of the grain at Chicago or Duluth and deliver it in the hold of the seagoing vessel at New York, making use at all points of the line of their own property in lake steamers, elevators (both movable and floating), canal boats, and tow boats, and giving one through bill of lading. Such companies, it is hardly necessary to say, would not tolerate the antiquated method of hauling canal boats by horses or mules; self-interest would prompt and compel them in a very short time to find the best means of mechanical traction, whether by steam or electricity, whether to have the motive power in each boat, or to have a self-propelled boat which carries freight as well as tows other boats, or to have the motive power in a boat which carries no freight, but is used only for towing. The cost and methods of traction would be studied by such a transportation line with the same care that railroads now study improvements in locomotives, and the result would be constant improvements in the method of traction similar to those which have been in progress on the railroads for the last 30 years, and have resulted in the low rates which have practically driven the old-fashioned canal boat and methods out of the contest. Such a transportation line with such appliances would be able to run boats through the canals on schedule time, and with a more certain adherence to their schedule than the railroads make with their freight trains. It is well known that the schedule time of the lake steamers is far more certain than that of the freight trains on the railroads parallelling the lakes. The canal boats ought to be able to make at least 4 miles an hour, including lockage, night and day, which would bring the time from Buffalo to New York down to 126 hours, or $5\frac{1}{4}$ days, in place of about 12 days, as at present.

The other points where we think the canal management is open to great improvement relate to matters entirely within the control of the State, namely: the kind of locks, and the method of handling the locks; the efficiency of the force engaged in the engineering and management of the canals; and the method of carrying on public works by contract. On these points we think legislation is desirable, as well as a more business-like enforcement of the laws, than has hitherto prevailed.

In regard to the locks, we have explained on a previous page the modern arrangement which we think should be introduced at Cohoes, Little Falls, Newark and Lockport, which will reduce the total number of locks from 72 to 54; this will save at least 8 hours in the time of passage, and will dispense with the services of a great number of lock tenders. At the remaining locks it is possible to use an improved modern type of gate, occupying much less space than the old-fashioned gate, invented about 400 years ago, and to operate these gates by mechanical power at a still further reduction in the expense for management.

In regard to the force engaged upon the canals and other public works of the State, the State Constitution (article 5) provides for a State Engineer and a Superintendent of Public Works, and defines their duties. It is impossible to change the Constitution in this respect, if it were desired. In point of fact, the only serious objection we see to the system is that these officers have equal powers and responsibilities, and neither is subject to the other. So long as they work in harmony all goes well, but if they see fit to antagonize each other there is an opportunity for a deadlock, and delay and confusion in the transaction of public business. The system cannot, however, be changed in any reasonable time, and must be accepted. Except in the matter of their having co-ordinate powers, it is not different from the system pursued by railway, steamship or any other transportation lines, in every one of which there is a manager or superintendent at the head of the operating department, and a chief engineer to supervise the engineering work. The Constitution provides that the State Engineer shall be elected by the people for a term of two years, and the Superintendent of Public Works appointed by the Governor for the period of the latter's term. It is not possible to amend the Constitution in these respects, and it is therefore useless to discuss any other method. That prescribed by the Constitution must be followed, and the people or Governor must be relied upon to put competent men in these places.

The Constitution further provides that the Superintendent of Public Works shall appoint not more than three assistant superintendents, and that he shall appoint all persons employed in the care and management of the canals, except collectors of tolls and those in the Department of the State Engineer, and that all his appointees shall be subject to suspension or removal by him. The Legislature, however, has power to prescribe the duties of his assistants, and to fix their compensation. As to the employes under the State Engineer, the Constitution is silent.

If the Erie Canal is enlarged in the manner we recommend, and becomes again a large factor in the transportation question in this State, the work in its two departments of engineering and management, as well as the minor public works of the State, will afford a life career to the graduates of scientific institutions which they would gladly enter if they could feel sure that their tenure of office depended on good behavior, their promotion upon merit, and that they were not liable to be turned out at any moment for some political reason. While the Constitution places in the hands of the Superintendent of Public Works the power of appointment and removal in his department, yet the law has already restricted his absolute power in the matter of appointments by prescribing examinations and tests of fitness which must be passed before he can make the appointment; and similarly, the Legislature can restrict his power of removal so as to limit it to removal for cause. * It is also competent for the Legislature to classify and grade the permanent employes in both the public works and the engineering departments; to prescribe that appointments shall be made only in the lowest grade, and that promotion from one grade to the next higher shall be made after a suitable examination. We recommend that such legislation be passed; and we consider this essential in order to secure permanently an efficient, honest and economical administration of the canals and other public works of the State. If the State creates a service in which men will take pride in serving, and removal from which will constitute a stigma of disgrace, it will be able to secure for this class of work men of a higher order of ability, integrity and character for a comparatively small compensation. We believe that a unique opportunity now exists for establishing the service of the public works in this State on this basis, to have such legislation firmly planted in the statutes of this State, and to get the system fairly inaugurated and put into practical operation. Your own experience in these matters so far exceeds that of any member of the committee that it seems to us unnecessary that we should attempt to point out in detail the character of this legislation. We have only to call our attention to the matter, and to state that in our judgment the proper administration of the canals and other public works requires legislation which shall prescribe tenure of office during good behavior, appointment only to the lowest grade, promotion from one grade to the next by selection, both appointment and promotion to

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*See decision of Court of Appeals, People *ex rel* McClelland *vs.* Roberts, 148 N. Y., 360.

be determined by suitable tests, and no removals to be made except for cause.

Finally, we think that the laws in regard to the letting of public contracts by the State can and should be revised so as to make impossible a repetition of the unfortunate results under the nine million dollar appropriation. These results, under the present law, were unfortunate in the following respects: An unnecessary expenditure for advertising; a loss of public money through unbalanced bids; and an unnecessary expenditure through the use of force account. The report of the Investigating Committee appointed by Governor Black fully pointed out these facts, and it only remains for us to suggest such legislation as in our opinion would prevent them from occurring again.

In the matter of advertising, Chapter 794 of the Laws of 1896 required the work to be advertised in the State paper for ten successive days, *and in such other newspapers as the Superintendent of Public Works may select.* We recommend that this be repealed, and in place thereof a statute be enacted similar to the statute now in force in the city of New York (Section 66 of the Consolidation act), under which all advertising for the State shall be confined to the State paper, but allowing brief advertisements, calling attention to any contracts intended to be awarded and referring for full information to the said State paper, to be published in not exceeding two newspapers in each of the ten principal cities in the State.

In regard to the use of force account and extra work, we recommend that a statute be enacted providing that extra work shall be authorized only by the authority of the State Engineer and the Superintendent of Public Works, expressed in writing, and in no case shall such extra work (including force account) be authorized to an extent in the aggregate exceeding 10 per cent. of the value of the contract as determined by the bidding sheets.

We also recommend that the statute require that the bids shall not only be opened in the presence of bidders, but shall be publicly read in their presence; which, as stated in the report of the Investigating Committee appointed by Governor Black, was not done.

As to unbalanced bids, they have been used upon the Erie Canal for a great many years. They were brought out in the

Tilden investigation, and they were again shown up in the report of the Investigating Committee of 1898. The State has lost large sums of money from this cause, and there will probably be the same trouble in any future canal work unless some different system of bidding is adopted. We recommend for adoption, by statute, the following system, which is not novel, but is based upon methods which have been in use on large public works in other countries for more than a generation. The proposed method is as follows: Prior to the letting of any public contract the Division Engineer to prepare a schedule of prices for every unit of work to be used under the proposed contract. This schedule of prices to be submitted to the State Engineer and the Superintendent of Public Works for approval or revision, and when approved by them to be submitted to the Canal Board for final adoption. On the letting of the work each bidder will only be required to bid a discount or premium of a certain per cent. on the prices adopted by the Canal Board. The lowest bidder will be the one offering the greatest percentage of discount or the least percentage of premium on these prices. All questions of quantities will be eliminated from the bidding. It is fair to presume that prices which have been originally drawn up by the Division Engineer, familiar with all the local conditions, subsequently revised and approved by the State Engineer and the Superintendent of Public Works, and finally adopted by the Canal Board (which should have authority to call in outside expert advice, if it saw proper), would be fair and reasonable prices for the work to be done. It would then only remain for the bidder to use his own judgment as to increasing or diminishing these prices by a certain fixed percentage, which should apply to every item in the entire list.

The schedule of prices taken from a contract made on this plan is submitted herewith,* showing how fully every unit of possible work can be provided for. We believe that the adoption of such a plan as a part of the law of this State would make it impossible hereafter for contractors to take advantage of the State by means of unbalanced bids.

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*See page 117.

In closing this report we desire to put on record our appreciation of the ability shown by John A. Fairlie, Ph. D., secretary of the committee, in compiling and arranging under its supervision the statistical data which is hereto appended. In these tables will be found, we believe, the essential facts and figures which are necessary for any consideration and satisfactory solution of the canal problem, and which, so far as we know, have never before been brought together in a single volume.

Trusting that the result of our labors during the past year may be of some assistance in enabling you and the Legislature to "formulate definitely the canal policy of the State"—a matter which we consider of vital importance to its commercial and industrial welfare—we remain, very respectfully,

FRANCIS V. GREENE, *Chairman.*

GEORGE E. GREEN,

JOHN N. SCATCHERD,

THOMAS W. SYMONS,

FRANK S. WITHERBEE,

EDWARD A. BOND,
State Engineer and Surveyor.

JOHN N. PARTRIDGE,
Superintendent of Public Works.

APPENDICES.

I. LETTER OF APPOINTMENT.

STATE OF NEW YORK.

Executive Chamber.

ALBANY, March 8th, 1899.

My Dear Sir:

I am very desirous of seeing the canal policy of the State definitely formulated. As you know, the nine million dollars designated to deepen the canal to the depth of nine feet has been practically expended, and it is reported that sixteen millions additional will be needed to carry this scheme through, while, at the same time, certain experts have said that the scheme, when carried through, will not be satisfactory. In short, there is much conflict of opinion as to what policy should be followed with reference to the canals, and even as to the proper terminus of the canal on the lakes.

I desire the opinion of a body of experts, who shall include in their number not merely high-class engineers, but men of business, and especially men who have made a study of the problems of transportation, who know the relative advantages and disadvantages of ship canals, barge canals and ordinary shallow canals, who are acquainted with the history of canal transportation as affected by the competition of railroads, and who have the knowledge that will enable us to profit by the experience of other countries in these matters. I have decided to ask five of the citizens of New York, whose reputation in these respects stands highest, to act with the Superintendent of Public Works, Col. Partridge, and the State Engineer and Surveyor, Mr. Bond, to make the necessary investigations (and where necessary to call in the aid of special experts), to enable them to report to me, at as early a day as convenient, the proper course we should follow as regards this vital interest of the State of New York. I desire very much that you serve on this committee. The other four gentlemen will be Major T. W. Symons, Hon. John N. Scatcherd, Hon. George E. Green and Hon. Frank S. Witherbee.

Last year the questions which arose affecting the canals were really two-fold in character, namely: Those affecting the actual administration of the canal, and those affecting the general canal scheme of the State. As regards the former, the questions are now well on their way to solution. Three of the best qualified lawyers in the State have been retained to investigate and press home any charge of corruption against any canal official which in their judgment can be sustained, and Col. Partridge is so administering the office of Superintendent of Public Works as to guarantee the honest, efficient and economical management of the canals as they now are. The broad question of the proper policy which the State should pursue in canal matters remains unsolved, and I ask you to help me reach the proper solution.

Very sincerely yours,

THEODORE ROOSEVELT.

General Francis V. Greene.

II. REPORT ON EUROPEAN CANALS.

BY F. S. WITHERBEE.

General F. V. GREENE,

Chairman Committee on Canals, New York City.

DEAR SIR:

On your suggestion, I endeavored to make something of an investigation of the various canal systems in Europe this summer. I regret I had but little time at my disposal to cover so large a field, and that therefore the information I obtained is more or less fragmentary. It is also a matter of regret to me that some other member of the committee with more technical knowledge of the subject could not have had the excellent opportunities afforded me, for the subject of canal development is receiving much more serious attention abroad than with us.

I will not make a formal report to you, but will briefly describe what I was able to see of the various canals in the order in which I visited them.

LA LOUVIERE (BELGIUM) LIFT LOCK.

This lock is near La Louviere, and about two hours by train from Brussels. It is located on a canal tributary to a large coal district, and when completed will connect the Charleroi Canal with the Mons and Brussels Canal.

The lock was constructed to overcome an elevation of about 11½ metres (about 34 feet), and is a double one worked in balance. The tanks for holding the boats are 43 metres (about 140 feet) long, 5.8 metres (about 19 feet) wide, 2.5 metres (about 8¼ feet) deep, and have a capacity of locking 40 boats of 400 tons capacity per day of ten hours. It takes thirteen minutes to lock a boat through. Lift gates are used for admitting boats to the tanks, and the official in charge of the locks said he knew no reason why they could not be used on any ordinary lock, although he knew of none now in use in Belgium. This lock was constructed in 1888 at a cost of about $300,000. The contract work was done by the Cockerill Steel Company. The lock has been but little used, as the canal is not yet fully completed. Work, however, is now being vigorously pushed on it, and it is contemplated to build three more locks similar to the one at La Louviere.

BRUGES (BELGIUM) SHIP CANAL.

Bruges is situated about thirteen miles from the North Sea, and is at present the centre of six canals diverging to different parts of Belgium. A ship canal about the size of the Suez Canal is now being built from Bruges to the North Sea with the intention of making Bruges a seaport similar to Manchester in England. The idea is that coal and various manufactured products can be cheaply shipped by the present canal system to Bruges and there loaded on sea-going ships for the export trade. The work now going on at Zee-Bruges, the proposed seaport of Bruges, is on an extensive scale. A very large break-water is being built out into the sea to afford an ample harbor for the largest ships to enter, and the entire work will cost the Government about $8,000,000.

The only lock on the canal is the tidal one at its entrance, and it is said to be the largest and best in Europe. The gates of this lock are worked by electricity and slide into the side walls. The resident engineer, M. Cousins, told me he knew of no slide gates in use on the smaller canals of Europe, but he saw no reason why they could not be utilized, as they were used on some of the large tidal locks elsewhere. For further information and details regarding this very interesting work now going on at Zee-Bruges, I would refer you to an accompanying pamphlet, marked No. 1, by Charles Pieds, the State Engineer of Belgium.

Since visiting Zee-Bruges, I see by the papers they have discovered in their excavations there an old Roman ship lying about thirty feet below the surface, and supposed to be about two thousand years old.

PETROLEUM MOTOR BOATS ON LAKE LUCERNE (SWITZERLAND).

While stopping at Lucerne I was particularly impressed with the fact that a large number of the barges on the lake were propelled by petroleum motors, and learned that they had almost entirely displaced the sail-boats formerly used by the farmers and small manufacturers to convey their produce to the railroad at Lucerne.

The following figures as to the cost of operating these boats may be of interest, and were obtained by me from a reliable source. The boats are about 26 metres (about 85¼ feet) long, 5½ metres wide (about 18 feet), and carry about 50 tons each. The motors are 6 horse-power, and weigh 3,500 pounds, costing about $1,200. A two-bladed screw is used, and a speed of three and a half miles per hour is made by a loaded boat. Petroleum costs 11 cents per gallon, and about 85 cents' worth is consumed for a day of ten hours. The same man operates the engine and steers, and I noticed that very little wash was made when the boats were moving. The motors are made by the Demler Motor Company of Constance, Switzerland, and I understand similar boats are used on the canals in Amsterdam, Holland.

THE DORTMUND-EMS (GERMANY) CANAL.

This canal was undertaken by the Emperor to connect the large coal and steel making districts of Germany with the North Sea at Emden. It is designed eventually to connect with the Rhine near Oberhausen, and also by a lateral canal, to be built from a point near Munster, to connect the Rhine with the Elbe. The distance from Dortmund to Emden is about 170 miles, and at different points along the route the Ems River has been canalized. This canal has been constructed in four years, two of which were taken up in preliminary surveys. It was a very difficult canal to construct from the fact that it is located near large manufacturing and coal mining districts, with a perfect network of railroads to cross. The scheme of the canal has been to make it as straight as possible, with wide curves, so that long boats can be utilized. The work is of the most substantial character, and as it is the most recent large interior canal completed in Europe, it has all up-to-date improvements. I regret I was not able to ascertain its cost. It accommodates boats 68 metres (about 223 feet) long, 9 metres (about 29½ feet) wide, drawing 2.25 metres (about 7 1-3 feet) of water, with a cargo capacity of 1,000 tons. These boats are built of steel, and cost about $5,000 each. At present they are towed by small tugs, but experiments are being made for electric haulage.

There are twenty-one ordinary locks between Dortmund and Emden; two are operated by electricity and the others by hand. One large hydraulic lock known as the

HENRICHENBURG LIFT LOCK

is located about eight miles from Dortmund. This lock overcomes a difference in elevation of about 14 metres (about 46 feet), and cost about $750,000. It is a single lock, and the actual lifting of a boat of 1,000 tons capacity from one level to the other takes but two minutes. Lift gates for the tank are used similar to those at La Louviere. It takes thirteen men to operate this lock for two shifts. It is a magnificent steel structure, and for further details regarding it I would refer you to an accompanying publication by Messrs. Haniel & Lueg, of Dusseldorf, who had the contract for constructing the lock. I would also refer you to an accompanying supplement of the *Zeitschrift des Vereines Deutscher Ingenieure* for August 12, 1900. Both of these publications contain numerous illustrations of the lock when under construction. I also visited on this same canal

THE ELECTRIC LOCK AT MUNSTER.

This is one of the two ordinary locks on the Dortmund-Ems Canal operated by electricity. The lock is about 70 metres (229½ feet) long, 9 metres (about 29½ feet) wide, and overcomes an elevation of about 6.2 metres (about 20 1-3 feet). The difference in the level is utilized to run a 6 horse-power electric motor, by which the water valves and gates of the lock are operated. These gates are of the ordinary swing pattern, made of steel, and can be opened in thirty seconds. It takes about ten minutes to complete the locking of a boat from one level to the other. The snubbing-post at each end, to which the hawsers of the boats are attached, are made to revolve by electric power, and boats are thus drawn in and out of the lock. By the use of two reservoirs at each side of the lock a saving is made of about 60 per cent. of the water required for lockage. Only two men are required to lock a boat, and it could be done with one. The electrical and mechanical work of this lock cost about $37,000.

The Dortmund-Ems Canal will eventually have a very large traffic in the exportation of German products and the import through it of large quantities of grain and Swedish and Spanish iron ore. From Amsterdam and Rotterdam to Dortmund the present rail rate on iron ore is about $1 per ton, or say, seven mills per ton per mile, and it is expected that the canal will materially reduce this rate.

The canal question is a very absorbing one in Germany today. The Emperor, backed by the manufacturing interests, is anxious to increase and enlarge the canal systems, while the agrarian, or agricultural, interests are bitterly opposed to this policy, fearing the importation of foreign cereals will injure them. It is an interesting commentary on the present prosperity of Germany that, although this Dortmund-Ems Canal was built to develop the export trade of Germany, yet the first cargoes to pass through it will be English coal and pig iron to supply the actual shortage in these commodities now existing in Germany.

HYDRAULIC LOCKS, ST. DENIS CANAL (FRANCE).

This canal is a sort of junction canal located on the outskirts of Paris. The locks are of the ordinary type, but the gates and valves are worked by hydraulic power. There are two parallel locks, the larger one being about 44 metres (144 1-3 feet) long, 7.7 metres (about 25¼ feet) wide, and 3.25 metres (about 10 2-3 feet) deep. The larger one accommodates boats carrying 500 tons and overcomes a difference in level of 10½ metres (about 34½ feet). The traffic through these locks is very large, and it takes two men to operate them on each shift, and about ten minutes is required for lockage. As in Germany, steel boats are largely being substituted for wooden ones, and are built to carry about 10 per cent. more load. The gates of these locks open outward, so as to give the full length of the lock to the boat.

It is interesting to note that the climate of France is such that this canal was closed only about 40 days in the year 1898. The canals are always operated unless the ice exceeds five inches in thickness.

HYDRAULIC LIFT LOCK AT LES FONTINETTES (FRANCE).

This lock is located on the Neufosse Canal near St. Omer, which is part of the Northern Canal System of France, and is also part of an international system leading into Belgium and

Germany. A very large traffic passes through it. The Les Fontinettes Lock was constructed in 1888 to take the place of six ordinary connecting locks, and to overcome an elevation of about $13\frac{1}{2}$ metres (about $44\frac{1}{4}$ feet), and accommodates boats of 400 tons capacity. The lock is a double-balance one similar to the one I have described as being located near La Louviere in Belgium. Its two tanks are 39 metres (about 128 feet) long, 5 metres ($16\frac{1}{2}$ feet) wide, and 1.8 metres deep. It has the same lift gates as are used at La Louviere. Owing to poor foundations, the lock was not at first a success, and the ordinary locks adjoining it have always been kept in repair to be used in case of accident to the hydraulic locks, but during the last two years, since extensive repairs have been made, the lock has been in constant and successful operation.

Owing to the congested traffic on this canal, it used to take boats frequently three hours to pass through the old, ordinary, single locks; now, less than fifteen minutes is required through the new lock. It takes four men to operate the lock, though only one handles the valves. It took three years, and cost about $400,000, to construct the lock. The enclosed picture gives a very good idea of its proportions.

ELECTRIC HAULAGE NEAR BAUVIN, FRANCE.

A great deal has been done on the French canals in the past five years in the way of developing some sort of mechanical haulage.

Three systems have been tested—the cable system, running along the bank of the canal to which the boats can be attached, the use of electric motors on the boats themselves, and the use of locomotives running along tracks on the tow-paths. All these systems have proved more or less of a failure, but a new system consisting of a machine known as the "electric horse," a sort of an automobile which moves along the tow-paths without rails and drags the boat, has recently been tested at Bauvin on the Northern Canal System, not far from Lille, and it is hoped that this system will solve the problem of mechanical traction. The "electric horse" resembles very closely one of the small mechanical rollers used in making roads and pavements. The wheels are very broad so as to overcome any inequality or moisture of the tow-path.

Each machine weighs about two and a half tons, and is capable of drawing three boats with a load of, say, 750 tons at a speed of about two kilometres (about 1¼ miles) per hour. It is expected that the price of traction will be greatly reduced by this new system, as it has already fallen from two mills to one and one-tenth mills per ton per mile. The experiments that have been made at Bauvin and Bethune have been so satisfactory that a plant is soon to be constructed to handle all the traffic on this canal, which is one of the most important in France, as a large amount of coal is shipped through it to Paris. It is interesting to note that coal is transported to Paris, a distance of about 200 miles, for $1.10 per ton. Sufficient electric power is generated by a 150 horse-power engine at Bauvin to operate a trolley system consisting of ten "electric horses." These machines are built by Denefle & Company, No. 119 Boulevard Montemarte, Paris, and I understand they have a contract with the French government for a term of years to operate their system on this canal. The French government has always followed the policy of giving a franchise to a corporation for towing on their canals, but has reserved the right of fixing the tolls to be charged and the right to inspect the animals used. It is not too much to prophesy that within two or three years the horse will have entirely disappeared from the canals of France.

For further details on canal haulage and statistics regarding the canal traffic of France I would refer you to two accompanying reports by M. La Riviere, the Chief Engineer in charge of the Northern Canal System at Lille. I have marked these reports No. 5 and No. 6.

CONCLUSION.

France, Germany and Belgium are all much interested in the question of their canal improvements, and each seems to realize that in the struggle for the world's trade their canal systems are to play no unimportant part. Many schemes are now on foot for improving present, or building new, canals. Electricity is likely to be used very largely for haulage and the operation of their locks, but it was a matter of disappointment to me to learn that practically nothing had been done on their smaller canals to substitute lift or slide gates on their locks; but, as I have said above, the officials in charge of the large locks on which these improved gates are used told me they saw no reason why they could not be utilized on their smaller canals.

The tow-paths are vastly superior to ours, many of them being paved or macadamized, and most of the canals have rows of trees along each bank, not only as a protection to man and beast against storms, but also to protect the canal banks. Wherever practicable, rivers are canalized. In Germany they are working up to a standard of a boat with a capacity of 1,000 tons. They seek to obtain this capacity by the length and width rather than the depth of the boat; in other words, with longer locks and broader curves. They claim this is cheaper than a deeper canal. Russia, on the other hand, is planning to build a ship canal 1,000 miles long and 30 feet in depth to connect the Baltic and Black seas. Strategic as well as commercial reasons are doubtless behind the size of this proposed canal. I was impressed everywhere with the size of the rudders of the boats, and the claim was made that the boat was much easier handled around the curves in consequence. Another device which seems to be generally used in Europe is a movable mast, generally elevated at an angle of about forty-five degrees, to the end of which a hawser is attached. This enables the boats to pass each other easier, as, by dropping the mast, one boat can pass under the hawser of the other. These masts can also be utilized for hoisting the cargo out of the hold. There are also many other details in the operation of European canals which would repay a close inspection on our part.

A Congress of Navigation is held every few years in different parts of Europe, and matters of importance to the various canal systems are discussed, and a great deal of mutual information is thus exchanged. The next Congress is to be held in September, 1900, in Paris, and I sincerely hope our government will be well represented by competent authorities on our canal system.

In conclusion, I want to express my appreciation of the courtesies that were extended to me on all sides in Europe. Every opportunity was given me for my investigations, and especially are my thanks due to M. de Bruyn, Minister of Agriculture in Belgium; M. Geirard, Chief Engineer of Public Works in Belgium; and also to M. Cousins, Engineer in charge of the Harbor and Canal Improvements at Zee-Bruges; to Hon. J. G. A. Leishman, United States Minister at Switzerland, for information regarding petroleum motors on Lake Lucerne; to Hon. Andrew White, United States Ambassador to Germany, for introductions to the officials of the Dortmund-Ems Canal; to Mr. Henry Vignaud, Secretary of the United States Embassy at Paris, for letters to the proper French officials, and to M. La Riviere, Chief Canal Engineer at Lille, who was good enough to accompany me to Bauvin to inspect the electric haulage experiments now being conducted there. Yours truly,

F. S. WITHERBEE.

New York, November 1, 1899.

Maps of the principal European waterways, and the canal district of Europe are inserted at the end of this volume. Statistics of canal mileage and inland water traffic in European and other foreign countries will be found in Tables 60 to 69.

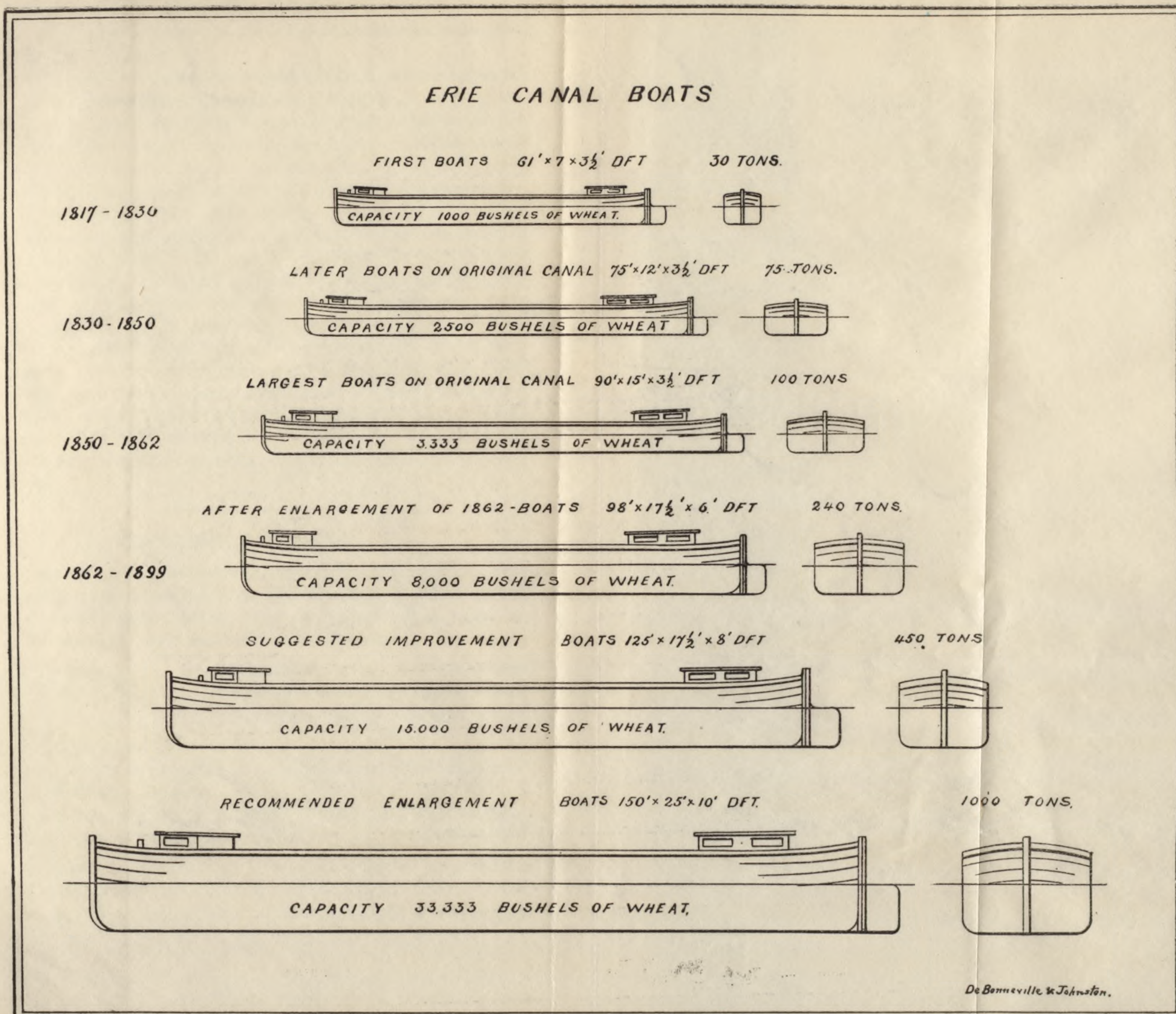
III. MEMORANDUM ON COST OF TRANSPORTATION AND VALUE OF CANALS.

By Major T. W. Symons.

In making a recommendation to the State of New York to enlarge and improve the Erie Canal, it is necessary to know not only the cost of the improvement, but to show as plainly and clearly as practicable the advantages that would accrue from it in cheapening the cost of transportation.

The following study has been made of the cost of transportation by the present Erie Canal and by the canal improved in the various ways that have been under discussion by the Committee on Canals. No effort has been made to ascertain or estimate the cost of transportation by the Champlain or Oswego canals. These are recognized as of minor importance to the Erie Canal, but it is assumed that these canals will be benefitted by improvements proportionally with the benefits accruing to the Erie Canal from similar improvements.

The basis of the computations and estimates of the cost of transportation are the ascertained figures of cost by the present Erie Canal navigated by fleets of four boats hitched together tandem, two by two, the forward pair consisting of a steamboat and an ordinary boat, and the rear pair of two ordinary boats, the steamboat pushing one and towing two ordinary boats, this being the method now in common use. No consideration is given to the system, still largely prevalent on the canal, of towing ordinary boats by horses or mules. This is more expensive than steam canal transportation, and can have no place in any improved canal of the future. It is recognized that it is quite within the bounds of probability that something better than steam propulsion may be devised for the canals, but up to the present time there are no tangible results in this direction. If a system or systems of propulsion by the use of electricity, compressed air, gasoline, or anything else can be devised to replace economically steam, as at


ERIE CANAL BOATS
FIRST BOATS 61'×7×3½' DFT
30 TONS.
1817 - 1830
CAPACITY 1000 BUSHELS OF WHEAT.
LATER BOATS ON ORIGINAL CANAL 75'×12'×3½' DFT
75 TONS.
1830 - 1850
CAPACITY 2500 BUSHELS OF WHEAT
LARGEST BOATS ON ORIGINAL CANAL 90'×15'×3½' DFT
100 TONS
1850 - 1862
CAPACITY 3.333 BUSHELS OF WHEAT
AFTER ENLARGEMENT OF 1862 - BOATS 98'×17½'×6' DFT
240 TONS.
1862 - 1899
CAPACITY 8,000 BUSHELS OF WHEAT.
SUGGESTED IMPROVEMENT BOATS 125'×17½'×8' DFT
450 TONS
CAPACITY 15.000 BUSHELS OF WHEAT.
RECOMMENDED ENLARGEMENT BOATS 150'×25'×10' DFT.
1000 TONS.
CAPACITY 33.333 BUSHELS OF WHEAT.
De Bonneville & Johnston.

present used, they will lower the cost of transportation below the figures given in this paper.

The following tables give the estimated data concerning loads and costs of steamers and ordinary boats (all built of wood), expenses for running the same, and the cost of transportation on the canal in its present condition and as improved in various ways. In all cases it is estimated that the principal business will be *down* the canal toward the sea, and that the *up* loads will amount in the aggregate to one-third of the down loads.

As a basis of comparison, the estimated cost of transportation is computed first by the ton, and second, by the bushel of wheat (assuming all freight reduced to wheat), and third, by the ton mile. This estimated cost includes all ordinary expenses for labor, material, fuel and engine supplies, repairs, insurance on fleet and down cargo, 5 per cent. on investment, and 5 per cent. deterioration. It is expected that most of the boats of a canal fleet would get a considerable revenue for storage during the winter, which would help to pay some of the fixed charges, but this is not taken into account in the following estimates, all expenses being charged against the revenues from transportation simply.

PRESENT ERIE CANAL.

The present poor condition of the Erie Canal with its antiquated locks and liability to accidents permit boats to make but about seven trips per year. The dimensions of the boats in use are 98 feet long, 17½ feet wide and 6 feet draft.

Load of steamer...........	150 tons or	5,000 bushels of wheat
Load of ordinary boat......	240 tons or	8,000 bushels of wheat
Load of fleet..............	870 tons or	29,000 bushels of wheat

Seven trips annually.

Total down freight per annum......	6,090 tons or 203,000 bushels
Total up freight per annum....................	2,030 tons
Total up and down freight per annum...........	8,120 tons
Total up and down freight, in wheat............	270,667 bushels

Value of steamer....................................	$8,500
Value of three consorts.............................	9,000
Value of fleet......................................	$17,500

SEASON'S EXPENSES.

Wages and subsistence	$2,982.00
Fuel, oil, waste, etc	1,400.00
Ordinary repairs	196.00
Insurance on fleet	217.50
Insurance on down cargo	456.75
Miscellaneous small expenses	100.00
Interest on investment at 5 per cent	875.00
Deterioration, etc., at 5 per cent	875.00
	$7,102.25

Cost per ton $\frac{\$7,102.25}{8,120}$ equals 87 cents.

Cost per bushel $\frac{\$7,102.25}{270,667}$ equals 2.62 cents.

Cost per ton mile equals 1.75 mills.

ERIE CANAL COMPLETED UNDER ACT OF 1895.

SEYMOUR PLAN.

The State of New York has entered upon an improvement of its canals and has expended some $9,000,000 thereon.

The "Nine Millions" act provided as follows:

"The said improvement to the Erie and Oswego Canals shall consist of deepening the same to a depth of not less than nine feet of water except over and across aqueducts, mitre sills, culverts and other permanent structures, where the depth of water shall be at least eight feet."

Under this plan the Erie and Oswego Canals would be provided with such a depth of water as would enable boats to draw barely seven and one-half feet. The length of boats provided for under this improvement is limited to the capacity of the lengthened locks of the canals. These locks as lengthened have a chamber length betwen hollow quoins of 221½ feet, suitable for two boats, each 104 feet long.

The work if completed under the $9,000,000 act will, therefore, have a capacity suitable for boats of the present width, 17½ feet, draft of 7½ feet and length of 104 feet. An ordinary boat would carry 320 tons and a steamer 230 tons, and in considering the transportation value of such a canal it is assumed that nine trips per season are practicable.

On the same basis as before, the transportation value of such a canal is shown in the following table:

Load of steamer..........	230 tons, or 7,667 bushels of wheat
Load of ordinary boat.....	320 tons, or 10,667 bushels of wheat
Load of fleet.............	1,190 tons, or 39,667 bushels of wheat

Nine trips annually.

Total down freight per annum.................. or 357,000 bushels of wheat.	10,710 tons
Total up freight per annum.....................	3,570 tons
Total up and down freight per annum...........	14,280 tons
Total up and down freight, in wheat............	476,000 bushels
Value of steamer..................................	$9,000
Value of 3 consorts..............................	10,500
Value of fleet......................................	$19,500

SEASON'S EXPENSES

Wages and subsistence..............................	$3,200.00
Fuel, oil, waste, etc..................................	1,800.00
Ordinary repairs......................................	200.00
Insurance on fleet....................................	240.00
Insurance on down cargo...........................	803.25
Miscellaneous small expenses.....................	150.00
Interest on investment, 5 per cent...............	975.00
Deterioration, etc., 5 per cent.....................	975.00
	$8,343.25

Cost per ton $\frac{\$8,343.25}{14,280}$ equals 58 cents.

Cost per bushel $\frac{\$8,343.25}{476,000}$ equals 1.75 cents.

Cost per ton per mile equals 1.16 mills.

ERIE CANAL ENLARGED TO PROVIDE FOR BOATS 115 FEET LONG AND 8 FEET DRAFT.

SEYMOUR-ADAMS PLAN.

There is another plan, not sanctioned by law, but which has been proposed by the former State Engineer and Surveyor, which looks to so enlarging all locks that they will each admit two boats of 115 feet in length and of the present width, and to so deepening all structures that a boat draft of 8 feet will be available. This involves much work not covered by the estimates under the $9,000,000 act. Under this plan the already lengthened locks would be slightly lengthened and provided with a different kind of gates, and all the locks not yet lengthened would have their dimensions made to correspond.

Assuming that on such a canal business is done in four-boat steam fleets, which can make nine trips per season, the transportation value of such a canal on the basis before given would be as follows:

Load of steamer..........	300 tons, or 10,000 bushels of wheat
Load of ordinary boat.....	400 tons, or 13,333 bushels of wheat
Load of fleet.............	1,500 tons, or 50,000 bushels of wheat
Nine trips annually.	
Total down freight per annum................ or 450,000 bushels of wheat.	13,500 tons
Total up freight............................	4,500 tons
Total up and down freight..................	18,000 tons
Total up and down freight, in wheat...........	600,000 bushels
Value of steamer..............................	$10,000
Value of three consorts.......................	12,000
Value of fleet................................	$22,000

SEASON'S EXPENSES

Wages and subsistence........................	$3,200.00
Fuel, oil, waste, etc.........................	2,000.00
Ordinary repairs	225.00
Insurance on fleet............................	270.00
Insurance on down cargo......................	1,012.50
Miscellaneous small expenses.................	150.00
Interest on investment, 5 per cent............	1,100.00
Deterioration, etc., 5 per cent...............	1,100.00
	$9,057.50

Cost per ton, $\frac{9057.50}{18,000}$ equals 50 1-3 cents.

Cost per bushel, $\frac{9057.50}{600,000}$ equals 1.51 cents.

Cost per ton per mile, equals 1 mill.

NEW ERIE CANAL PROPOSED AND CONSIDERED BY CANAL COMMITTEE.

The essential and underlying idea of the new Erie Canal, as proposed and considered by the Canal Committee, is to adapt it for use by the largest practicable boat of the width of the present boats, to utilize to the greatest degree possible the work that has already been done under the $9,000,000 appropriation, to make such changes in the route of the canal as seem dictated by sound engineering and business reasons, and to make such changes in the locks as will make them accord with the very best modern practice.

The principal features of the new Erie Canal as proposed by the committee, are as follows:

1. The prism of the canal to be left at its present width generally, but to be deepened to 9 feet throughout, at aqueducts and structures as well as in the canal levels, and to be put into condition for use by boats of the present width and drawing 8 feet.

2. Three important changes in the route of the canal to be adopted. The first and greatest change is to deflect the canal from a point just east of Clyde into the Seneca River, follow down the river to its junction with the Oneida River, thence follow up the Oneida River to Oneida Lake, through Oneida Lake, and thence by canal up the valley of Wood Creek and to the present Erie Canal near New London, making several river cut-offs to shorten distance and give better alignment.

The second change is to do away with the two aqueducts across the Mohawk River and the portion of the canal in Saratoga County. This is to be done by throwing the canal into the Mohawk at Rexford Flats, and following down the river to the vicinity of Cohoes Falls.

The third change is at the West Troy side cut where, instead of the awkward right angle turn requiring even small boats to uncouple, a diagonal deflection is made which will enable fleets to pass directly and conveniently into the Hudson without breaking up.

3. Pneumatic or other mechanical locks or appliances for the passage of boats to be provided at Cohoes and Lockport, and possibly at Newark. All other locks (one of each pair) to be lengthened and enlarged to take in two boats of 125 feet length, 8 feet draft, and of the present width. The locks to be provided with water power generating apparatus wherever necessary, with steel quick-acting quadrant gates, equipped with spring buffers, or other gates equally good, with power capstans at each end of the lock for pulling the boats in and out, and generally with everything of the most modern and up-to-date character. The other small lock of each pair of locks to be lengthened to take in one boat 125 feet long.

On such a canal, with its greatly improved route, its less liability to detention from accident, and its quick-acting locks, it is believed that four-boat steam fleets can make ten round trips per year if the business is properly managed, and the boats are given reasonably quick dispatch at terminals.

The following is the estimated cost of transportation by such a canal:

Load of steamer..........	350 tons, or 11,667 bushels of wheat
Load of ordinary boat.....	450 tons, or 15,000 bushels of wheat
Load of fleet.............	1,700 tons, or 56,667 bushels of wheat

Ten trips annually.

Total down freight per annum.................. or 566,667 bushels of wheat.	17,000 tons
Total up freight per annum....................	5,667 tons
Total up and down freight.....................	22,667 tons
Total up and down freight, in wheat............	755,555 bushels

Value of steamer..................................	$10,500
Value of three consorts............................	13,000
Value of fleet....................................	$23,500

SEASON'S EXPENSES.

Wages and subsistence	$3,200.00
Fuel, oil, waste, etc	2,500.00
Ordinary repairs	250.00
Insurance on fleet	287.50
Insurance on down cargo	1,275.00
Miscellaneous small expenses	150.00
Interest on investment, 5 per cent	1,175.00
Deterioration, etc., 5 per cent	1,175.00
	$10,012.50

Cost per ton, $\frac{10,012.50}{22,667}$ equals 44 cents.

Cost per bushel $\frac{10,012.50}{755,555}$ equals 1.32 cents.

Cost ton per mile, equals .88 of a mill.

ENLARGED ERIE CANAL.

The great demand on the part of many people in the State for a much larger canal with widened and deepened locks, and a prism to correspond which would furnish transportation at a minimum cost, influenced the Canal Committee to make as thorough an examination as possible into the cost of such an improvement and the benefits derivable therefrom.

After giving due consideration to every feature of the problem, the Canal Committee decided that if the canal be materially enlarged its new dimensions should be such as would fit it for use by barges of 150 feet length, 25 feet width, and 10 feet draft of water, with all locks arranged to take in two boats coupled together tandem.

The route deemed most desirable for such a canal from Lake Erie to the Hudson River is to follow the present line of the Erie Canal with minor diversions from Buffalo to just east of Clyde, then to deflect into Seneca River, and follow down this river and up Oneida River through Oneida Lake, and by the valley of Wood Creek to the line of the Erie Canal near New London. The two aqueducts across the Mohawk would also be done away with and the canal thrown into the river, and at the West Troy side cut the location would be changed to better the debouchment into the Hudson. This canal would require the rebuilding of all the locks on the portion of the Erie Canal retained, substituting at Cohoes, Lockport and possibly at Newark, pneumatic or other mechanical locks for those now existing, building new locks on the Seneca-Oneida and lower Mohawk portions of the route, and deepening and widening the prism of the canal to give a waterway of not less than 1,000 square feet cross section.

The following is the estimated cost of transportation by such an enlarged Erie Canal:

Load of steamer..........	900 tons or	30,000 bushels of wheat
Load of ordinary barges...	1,000 tons or	33,333 bushels of wheat
Load of fleet.............	3,900 tons or	130,000 bushels of wheat

Ten trips annually.

Total down freight per annum........................39,000 tons
or 1,300,000 bushels of wheat.

Total up frieght per annum........................13,000 tons

Total up and down freight per annum..............52,000,tons

Total up and down freight, in wheat..........1,733,333 bushels

Value of steamer	$13,500
Value of three barges	15,000
Value of fleet	$28,500

SEASON'S EXPENSES.

Wages and subsistence............................	$4,000.00
Fuel, oil, waste, etc..............................	3,300.00
Ordinary repairs	300.00
Insurance on fleet...............................	352.50
Insurance on down cargo..........................	2,925.00
Miscellaneous small expenses.....................	200.00
Interest on investment, 5 per cent...............	1,425.00
Deterioration, etc., 5 per cent..................	1,425.00
	$13,927.50

Cost per ton $\frac{\$13{,}927.50}{52{,}000}$ equals 26 cents.

Cost per bushel $\frac{\$13{,}927.50}{1{,}733{,}333}$ equals 8-10 of a cent.

Cost per ton per mile equals .52 of a mill.

These figures as to the cost of transportation by canals of various capacities, etc., are based upon using four-boat steam fleets, making an estimated number of trips each year, which number is dependent upon the rapidity of transit through the canal and open waterways, the time consumed in lockage, the dispatch at terminals, and the liability to accidents and detentions.

There are various possibilities which may enable the cost of transportation to be still further reduced. Six-boat fleets may be used instead of four-boat fleets; the motor boats may be run independently of the ordinary motorless consorts and all the components of the fleet used to better advantage; and some other better and more economical method of supplying propulsive power may be devised and put into operation.

The figures as to cost of transportation are also based upon the idea that the canal transportation will be carried on in a business-like manner, as nearly as practicable in accordance with modern railroad practice. As the reduction in the cost of transportation would affect not only the canal freight, but rail freight as well, it is certain that the gross tonnage benefited would vastly exceed 10,000,000 per annum, and the benefits to the producing, manufacturing and business interests of the State and country would be several times the largest amount stated in the appended table.

The Canal Committee has also considered the proposition advocated by many simply to widen and enlarge the locks of the Erie Canal to permit passage by boats 125 to 150 feet long and 25 feet wide. The Committee does not endorse this proposal as a work by itself, but insists that if the locks are enlarged to accommodate boats of greater width and draft, the prism of the canal shall be correspondingly enlarged and that the ultimate necessity for the enlargement of the prism should not be lost sight of in considering the enlargement of the locks solely. The prism of the present Erie Canal is properly proportioned for boats of the width of those now using it, *i. e.*, 17½ feet, but is not suited for boats of 25 feet width, and if the locks should be widened, the running thereon of 25-foot boats would be attended with great difficulty and delay, and would be most unsatisfactory, and the demand would inevitably and immediately be made for the enlargement of the prism. Such being the case, it is deemed proper to consider the cost of all the work required at the outset.

For purposes of comparison the following table has been prepared, giving the estimated cost of transportation by the present Erie Canal, and by the canal improved to the different sizes and capacities as specified herein. In stating the cost of the different canals, the amount required in each case for the passage of the Cohoes Falls is included. In case a private contract is made for the locks required for this passage, as authorized by Chapter 519 of the Laws of 1899, which permits them to be built and operated on a rental basis, the estimated amount which the State would require to raise would be reduced by from $1,200,000 to $1,700,000.

COST OF TRANSPORTATION BY PRESENT ERIE CANAL AND SAME CANAL IMPROVED TO DIFFERENT CAPACITIES.

	Present Erie Canal.	Erie Canal Completed under \$9,000,000 Project.	Erie Canal Completed under \$9,000,000 project, and same farther extended to allow use by boats 115 ft. x 17½ ft. x 8 ft. draft.	Erie Canal Completed in accordance with project of *Canal Committee*, for use by boats 125ft. x 17½ ft. x 8 ft. draft.	Recommended Canal for barges 150 ft. long, 25 ft. wide and 10 t. draft.
Cost of transporting a ton of freight between Buffalo and New York..........	87 cents.	58 cents.	50 cents.	44 cents.	26 cents.
Cost of transporting a bushel of Wheat between Buffalo and New York..........	2.62 cents.	1.75 cents.	1.51 cents.	1.32 cents.	.80 cents.
Cost per ton per mile..........	1.75 mills.	1.16 mills	1 mill.	.88 mills.	.52 mills.
Assuming a tonnage of 10,000,000 tons annually the cost of transporting it between Buffalo and New York would be..........	\$8,700,000	\$5,800,000	\$5,000,000	\$4,400,000	\$2,600,000
Under above assumption, the annual saving in cost over present Erie Canal would be	0	\$2,900,000	\$3,700,000	\$4,300,000	\$6,100,000
Relative cost of transportation, assuming that by present Erie Canal as unity..........	1.00	.67	.57	.50	.30
Relative value of canals considering cost of transportation simply. Present Erie Canal as unity..........	1	1.50	1.74	1.98	3.34
Assuming a tonnage of 10,000,000 tons annually with the saving in cost of transportation as indicated in this table, and money at 5%, the economic value of the different size canals over the present Erie Canal would be..........	0	\$58,000,000	\$74,000,000	\$86,000,000	\$122,000,000
Estimated cost of completing the Erie Canal to the extent indicated..........	0	\$12,923,639	\$15,068,048	\$21,161,645	\$58,894,668

IV. ESTIMATES OF COST.

By Major T. W. Symons.

SEYMOUR PLAN.

The estimated cost of completing the improvement of the Erie Canal undertaken in 1896 in accordance with the law of 1895, is stated by Messrs. North & Cooley to be $10,700,000. This estimate includes generally the work required to deepen the prism of the canal to 9 feet, and to give not less than 8 feet across aqueducts, mitre sills, culverts, and other permanent structures, and for lengthening and improving the locks remaining to be lengthened.

The estimate was made before the passage of the State eight-hour law and before the recent great rise in the cost of supplies and materials. To bring it up to date and make proper allowance for existing conditions, it must be largely increased.

From the best data available to the Committee the estimated cost of the work still required to carry out this project can now be stated as follows:

ESTIMATE.

For deepening the prism	$9,432,684
Aqueducts, waste weirs and culverts	304,855
Locks	3,045,952
Bridges	140,148
Total	$12,923,639

This includes the improvement of the canal at Cohoes Falls, "the sixteens." If the arrangement sanctioned by the State is entered into, which permits a private company to build pneumatic locks and operate them on a rental basis, the above named sum can be reduced by about $1,200,000, leaving the sum of $11,700,000 to be provided by the State. These estimates have been revised and increased to cover the additional cost to the State due to the eight-hour law and the increase in cost of labor and materials, and for engineering and inspection.

With this work completed, the canal would have a capacity for boats 104 feet long, 17½ feet wide, drawing 7½ feet and carrying about 320 tons of freight. A four-boat steam fleet would carry about 1,200 tons at a load, or about 40,000 bushels of wheat.

SEYMOUR-ADAMS PLAN.

In his report for 1896, State Engineer Adams proposed an extension or modification of the original project authorized for the Erie Canal under the "$9,000,000 act." His proposition was to obtain a depth of 9 feet throughout the canal, over aqueducts, structures, etc., as well as in the canal reaches, and to lengthen the locks by changing the gates so as to allow their use by boats 115 feet long, of the present width, and drawing 8 feet of water. This follows the present route of the canal.

This would enable ordinary boats to carry 400 tons of freight, and a four-boat steam fleet would carry 1,500 tons of freight, or about 50,000 bushels of wheat. As far as known, no definite estimate was made by Mr. Adams of the cost of the additional work proposed.

The estimated cost of carrying out the work proposed by Mr. Adams is herewith. It is based upon the preceding estimates with the necessary allowances for deepening the canal at structures, lengthening the locks, and flattening curves.

ESTIMATE.

For deepening the prism	$9,537,824
Aqueducts, waste weirs, culverts, etc.	1,040,076
Locks	4,350,000
Bridges	140,148
	$15,068,048

This includes two new quadrant buffer steel gates with the necessary masonry at each lengthened lock, and the unlengthened locks to be improved to correspond, and all structures to be given such depth as will admit their use by boats drawing 8 feet of water.

As in the previous case, if the arrangement sanctioned by the State is entered into at Cohoes, this sum can be reduced by about $1,200,000, leaving $13,800,000 to be provided by the State.

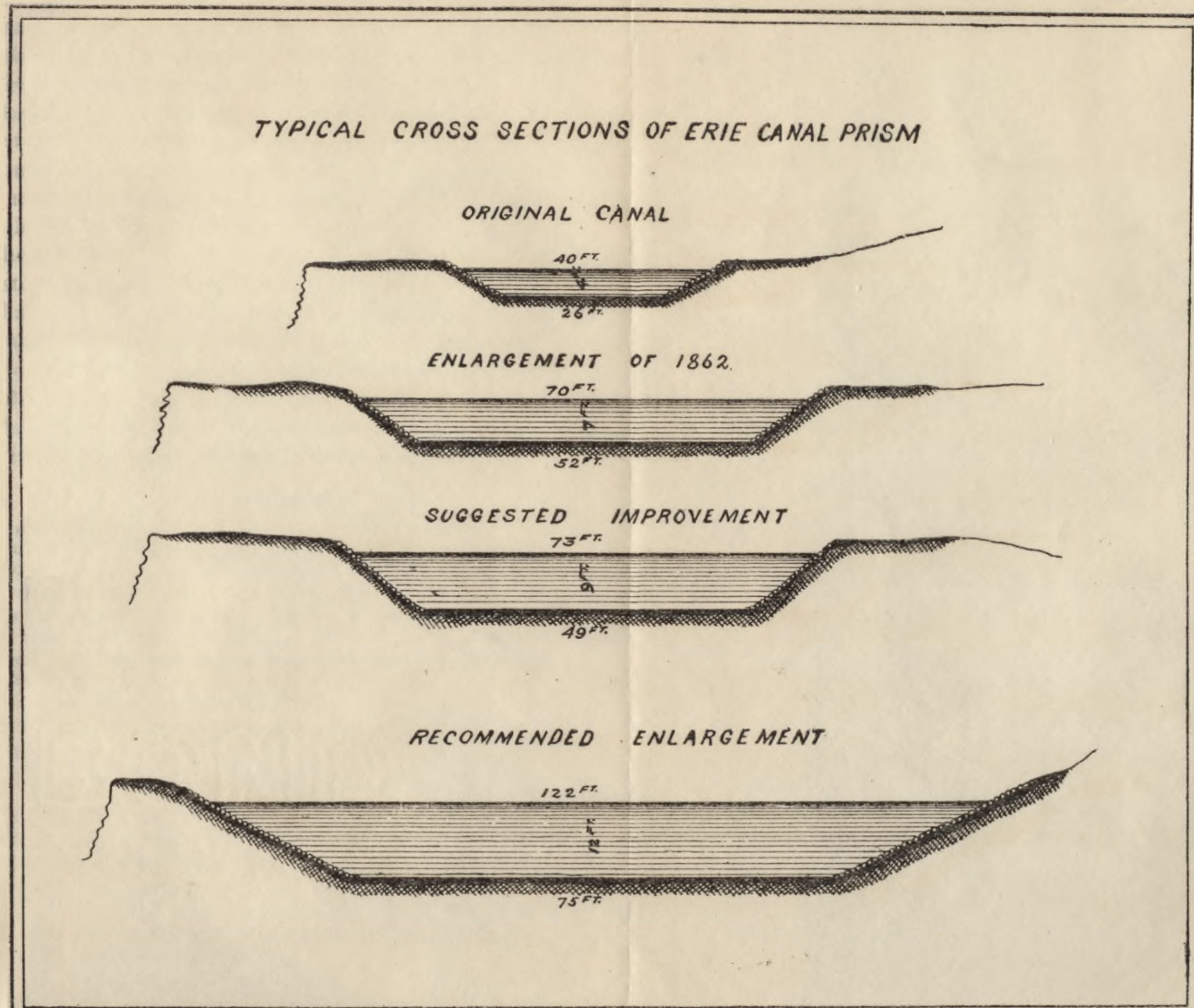
PLAN CONSIDERED BY THE CANAL COMMITTEE.

The plan suggested by the Canal Committee and favorably considered by it in preference to either of the two plans just mentioned, is a further extension and modification of the Seymour-Adams plan and provides for using on the canal boats of the largest practicable size suited to the existing width of prism and locks, with a draft of 8 feet.

In this plan all the locks in one tier of the existing locks which are utilized, and all new locks, are to be provided with steel buffer quadrant gates at each end of the lock, and are to be made 260 feet long in the clear, sufficient to accommodate two boats each 125 feet in length. The locks in the other tier of the existing locks to be made of a size suitable for one boat 125 feet in length. The locks, it is proposed, shall be provided with either water or electric power for operating gates, valves, and capstans, the latter for drawing boats into and out of the lock.

If the same route were followed as in the Seymour-Adams plan, previously mentioned, i. e., the present route of the Erie Canal, the additional cost due to the enlargement of the locks would be about $1,500,000, while it would add about 12½ per cent. to the carrying capacity of boats. But in order to get the canal in its best location, where the cost of maintenance will be the least, and the chances of accident and detention be minimized, and on which boats can make the best time and greatest number of trips per year at the least expense, the Canal Committee believe that several important changes in the route of the canal should be made, which changes involve an added expense.

The principal changes in the route are to deflect the canal from its present line at a point just east of Clyde, and reach and follow down the Seneca River, up the Oneida River, through Oneida Lake, and up the valley of Wood Creek and over to the


TYPICAL CROSS SECTIONS OF ERIE CANAL PRISM
ORIGINAL CANAL
40 FT.
26 FT.
ENLARGEMENT OF 1862.
70 FT.
52 FT.
SUGGESTED IMPROVEMENT
73 FT.
49 FT.
RECOMMENDED ENLARGEMENT
122 FT.
75 FT.

existing line of the canal near New London. This is the first and greatest change.

The second is somewhat like unto it, and consists in throwing the canal into the Mohawk River from Rexford Flats to Cohoes, thus doing away with the two aqueducts across the Mohawk, with their deficient waterway and bad approaches.

The third is to improve the debouchment into the Hudson at West Troy by building a new canal and locks on a diagonal line from the existing line, and it in turn depends upon the building of mechanical lift locks at Cohoes Falls and the canalization of the Mohawk River below these Falls.

There would also be necessary changes at Newark and Rochester and at other points along the line. With the canal improved as outlined, the locks would be suitable for passage by two boats each 125 feet long, 8 feet draft and the present width. Each would carry about 450 tons, and a four-boat steam fleet would carry about 1,700 tons, or 56,667 bushels of wheat.

The estimated cost of the improvements to the Erie Canal to carry out to completion the plan outlined above is as follows:

ESTIMATE.

Deepening the prism of canal in those portions retained, i. e., Buffalo to Clyde, and New London to Upper Mohawk Aqueduct		$6,484,527
Improvement of locks in those portions of canal retained		3,494,050
Changes in structures on those portions of the canal retained, to give 8 feet draft of water		747,638
Telephone line (not included in estimates, except in Seneca-Oneida route)		93,000
Seneca-Oneida Rivers deflection—		
Prism, lake and river channels	$1,983,950	
Dams, etc	741,150	
Locks	1,162,000	
		3,887,100
Mohawk River deflection—		
Prism and river channel	1,596,500	
Dams and other structures	1,092,830	
Locks	727,000	
		3,416,330
From head of Cohoes Falls to entrance into Champlain Canal at State Dam, Cohoes—		
Prism, including protecting wall	600,000	
Mechanical lift, Cohoes Falls, including approaches	1,200,000	1,800,000
Carried forward		$19,922,645

Amount forward.......................		$19,922,645
Mohawk-Hudson debouchment, from Mohawk River to Hudson River, at West Troy—		
Prism	607,000	
Locks	632,000	
		1,239,000
		$21,161,645

In round numbers, $21,200,000.

In this estimate the sum of $1,200,000 is included for the work required for the passage of Cohoes Falls. If the arrangement already sanctioned by the State is carried out, this amount can be deducted from the estimate, leaving a net total in round numbers of $20,000,000.

This provides, it is believed, the best canal practicable with the existing width of prism, and attention is invited to the fact that at each of the existing lock locations two locks are provided, one capable of passing two boats and one capable of passing a single boat of the maximum dimensions. This is important as minimizing the chances of detention at the locks due to accidents of any kind, and economizing in the use of water.

ENLARGED ERIE CANAL.

The Canal Committee in its desire to find the best solution of the canal problem was early impressed with the advantages of enlarging the Erie Canal to the greatest extent which seemed practicable, and finally decided that if a marked enlargement were to be made it should be to a size that would admit its use by boats 150 feet long, 25 feet wide and drawing 10 feet of water. Such boats would carry each about 1,000 tons, and a four-boat steam fleet would carry 3,900 tons, or 130,000 bushels of wheat.

The Committee set earnestly to work with the limited means at its disposal to find out the cost of such a canal.

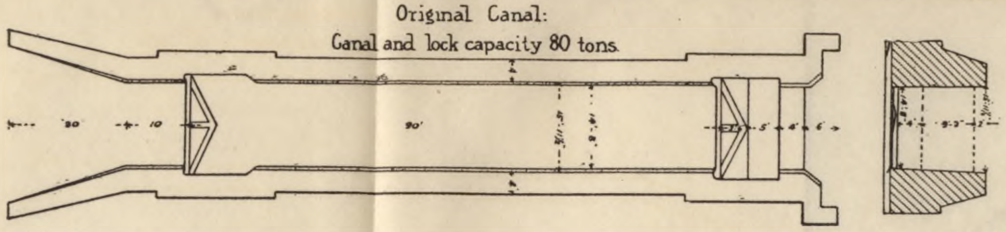
The detailed estimates given in the reports of Messrs. Rafter, Howell and Sylvester are based on a canal to be used by boats 125 feet long, 25 feet wide, and 10 feet draft, each carrying over 800 tons of freight.

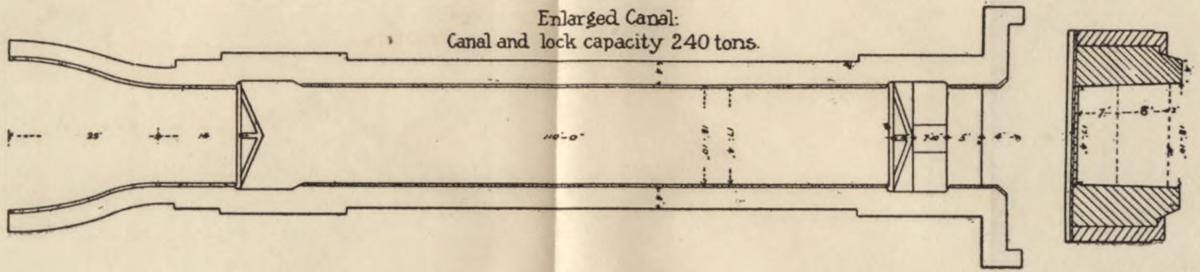
The only difference between such a canal and the one finally decided upon is in the length of the locks, each being 260 feet in one case and 310 feet in the other, and in the permissible curvature in the alignment. Due allowances for these differences are made in this memorandum and summary of the estimates, and in

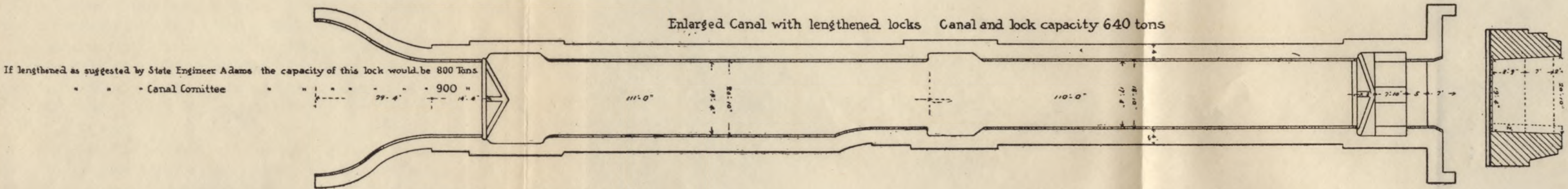
PLANS AND CROSS SECTIONS ORIGINAL, PRESENT, AND PROPOSED ERIE CANAL LOCKS.

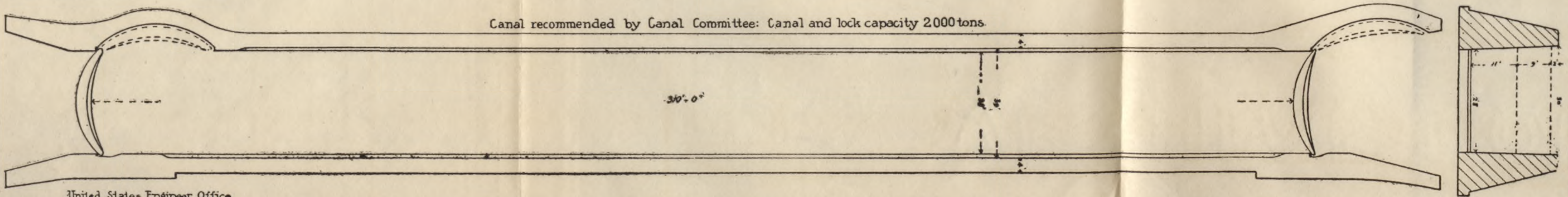
To accompany report of Canal Committee, January 1900.

0 20 40 60 80 100
Scale of Feet.









United States Engineer Office.
Buffalo. New York.
January 1900.

the combined estimates submitted by the three gentlemen above named.

It was decided for the final estimates that the proposed canal should have the following characteristics:

LOCKS.

The locks to be 310 feet long in the clear, 28 feet wide and with 11 feet depth of water on sills. To be filled and emptied through the bottom.

To be provided with steel quadrant buffer gates, or some other type of quick acting gate of modern design.

To have power capstans for pulling boats into and out of the locks.

To be supplied with water pipes, flumes, wheels, etc., for generating the water power required for operating gates, valves and capstans.

All entirely new locks to be built of concrete.

At Lockport, Cohoes, and possibly at Newark, pneumatic or other mechanical lift locks to be provided with the lock basin of the size above specified.

PRISM.

The prism of the canal to have a depth of at least 12 feet, with a minimum depth of 11 feet on structures.

To be about 75 feet wide at the bottom and ordinarily with side slopes of 1 on 2. When different slopes are used the cross section to be about 4½ times the area of the immersed cross section of the loaded boat, which is 250 square feet.

The river and lake channels to be 200 feet wide, and the same to be properly buoyed and lighted. In such a canal with ample cross section and two feet of water under the boats, it is believed and expected that high canal rates of speed can be developed without any great additional expenditure of power over what would be required in open water.

ROUTE.

In carrying on their investigations it became apparent that some marked deviations from the present route of the canal were desirable and necessary, and this is in full accord with the opinion of engineers who have previously investigated the subject.

The route which for purposes of estimate was adopted is thus described:

Beginning at Buffalo, the present line of the canal is generally followed to near Rochester. At Medina the conditions will necessitate the construction of about $\frac{3}{4}$ of a mile of new canal, and a new aqueduct across Oak Orchard Creek. Three and a half miles west of Rochester 1,800 feet of new canal, cutting off a sharp bend. At Rochester it will be necessary to adopt a new route for the canal, passing either to the north or south of the city. It is believed this will be better than to attempt to enlarge and improve the present route through the heart of the city.

The adopted route then follows the present canal until Newark is reached; here the location is changed for the purpose of getting a better alignment and combining locks.

There are also some other changes at South Greece, Lyons, Brighton, and Macedon. At about a mile and a half east of Clyde the present route is abandoned and the adopted route passes almost due east through the valley of Crusoe Creek to the Seneca River. This it follows down to the junction with the Oneida River, passes up through the valley of Oneida River, cutting off the bends, and into Oneida Lake; through the lake and by the valley of Wood Creek to the present line of the canal near New London. Syracuse is provided for by a harbor at Onondaga Lake, and a protected harbor is provided at the eastern end of Oneida Lake.

The adopted route then follows the route of the present Erie Canal to a point above the upper Mohawk aqueduct, a little east of Schenectady, where it enters the Mohawk River and follows down this river properly canalized to the head of Cohoes Falls, thus doing away with the two aqueducts across the Mohawk and the crooked stretch of canal between them.

The passage of Cohoes Falls to be made by pneumatic locks to be built by the State. This will include the necessary improvement of the Mohawk to permit boats to pass from the foot of the Falls to the Champlain Canal.

If the arrangement already sanctioned by the law of the State, whereby the State is authorized to contract with private parties for building and operating the Cohoes locks on a rental basis be carried into effect, it will reduce the amount named in these estimates as required to be advanced by the State by $1,700,000.

The Champlain Canal, between the Mohawk and the Hudson, at the West Troy side cut to be enlarged and rectified and supplied with the proper locks.

It is only proposed in this report to canalize the Mohawk from Cohoes Falls to the upper aqueduct, just east of Schenectady, thus doing away with the two aqueducts over the river and the bad stretch of canal in Saratoga County. The estimate includes the requisite enlargement of the existing canal from Rexford Flats to Rome. It is quite possible, and in fact probable, that when the work of enlargement is seriously undertaken it will be found in the interest of economy and efficiency to extend the canalization of the Mohawk over almost the entire distance from Rome to Troy, and this should be carefully studied in detail. Time has not enabled a careful examination of this subject to be made by the Canal Committee. The details of the different portions of the route and work estimated on are found in the reports of Messrs. Rafter, Howell and Sylvester.

ESTIMATES OF COST.

The work of making the estimates of the cost of building the proposed canal was divided up. Mr. Geo. W. Rafter made the estimates for the Seneca-Oneida diversion and the Mohawk-Hudson debouchment. Mr. F. M. Sylvester made estimates of the cost of locks, and Mr. D. J. Howell made the estimates for the enlargement of the prism and the canalization of the Mohawk. The summaries herein are obtained by combining these estimates so as to obtain the cost of enlarging the Erie Canal and reconstructing it upon the route proposed by the Canal Committee, with the Seneca-Oneida and Mohawk deflections, with single locks each capable of passing two boats each of 1,000 tons capacity and each 150 feet long, 25 feet wide and 10 feet draft. The estimates are based upon prices obtained in 1896-7, with a liberal percentage added for the 8-hour law and advance in prices of materials. They also include about 12½ per cent. for engineering, advertising, contingencies, etc.

Mohawk-Hudson debouchment.		
Right of way, excavation, lining, puddling vertical and slope walls, culverts, wiers, bridges, etc.	$963,990	
Five locks	595,000	
Carried forward		$1,558,990

Amount forward		$1,558,990
Champlain Canal to head of Cohoes Falls.		
Canalization of lower Mohawk	875,000	
Mechanical lift at Cohoes Falls	1,700,000	
		2,575,000
Mohawk River diversion, Cohoes Falls to Rexford Flats.		
Land damages, excavation, walls, slope paving, etc	2,680,223	
Four concrete dams	803,000	
Four locks	915,000	
		4,398,223
Rexford Flats to New London.		
Excavation, slope walls, wash walls, vertical walls, puddling, etc	15,265,898	
Extra right of way	259,400	
Bridges, culverts, aqueducts, etc	3,995,888	
Twenty-three locks	2,476,000	
		21,997,186
Seneca and Oneida Rivers diversion, New London to Clyde.		
Right of way, clearing, excavation, riprap, lining, puddling, dredges, lights, breakwater, telephone line, slope, wash and vertical walls, bridges, movable dams, etc	$3,951,387	
Seven locks	1,163,000	
Cut-offs, Seneca and Oneida Rivers	500,000	
		5,614,387
Clyde to Buffalo.		
Excavation, slope walls, wash walls, vertical walls, puddling, channeling, etc	$14,045,107	
Bridges, culverts, aqueducts, etc	5,387,175	
Extra right of way and damages	646,600	
Nine enlarged locks	909,000	
Three new locks	540,000	
Mechanical lift at Lockport	1,100,000	
Removing old structures at Locks 53 and 61	30,000	
		22,657,882
Telephone line (not included except in Seneca-Oneida Rivers diversion)		93,000
Total		$58,894,668

In round numbers, $59,000,000

In this estimate the sum of $1,700,000 is included for the work required for the passage of the Cohoes Falls. If the arrangement already sanctioned by the State is carried out, this amount can be deducted from the estimate, leaving a net total in round numbers of $57,200,000.

OSWEGO CANAL.

No surveys or examinations of the Oswego Canal have been made by the Canal Committee or under its direction. The Committee believes that the work on this canal, between Phoenix and Oswego, undertaken in 1896, should be completed, and so recommends. The cost of this work was estimated by the engineers of the Clinton Commission in 1898 to be $681,600. This should be increased by about 20 per cent. to allow for the new eight-hour law and the general advance in the price of materials.

It is, therefore, estimated that to complete the improvement of the Oswego Canal to the extent necessary and authorized by Chapter 79 of the Laws of 1895, there will be required the sum of $818,120. The portion of the canal between Syracuse and Phoenix will not need to be improved if the new Seneca-Oneida River route for the Erie Canal be adopted.

CHAMPLAIN CANAL.

The Canal Committee recommends that the Champlain Canal be improved to the full extent authorized by law of 1895. This will provide a waterway suitable for boats 98 feet long, 17½ feet wide and 6 feet draft.

The cost of the work on the Champlain Canal to complete the improvement was estimated in 1898 by the engineers of the Clinton Commission at $1,520,000. To this must be added about 20 per cent. to provide for the extra cost under the eight-hour law and rise in prices of materials. This makes the estimated cost of the improvement $1,824,000.

The Canal Committee was impressed with the desirability of utilizing the broad waters of the Hudson River for a waterway from Fort Edward down to West Troy in place of the canal which parallels the river. Studies made indicate that it is entirely practicable to do so. Estimates of the cost of doing this have been made, and show that to canalize the river from Troy to Fort Edward will cost about $3,200,000. This, added to the necessary improvements of the canal between Fort Edward and Whitehall, makes a total for the Champlain Canal, improved as stated, of $3,700,000. This is nearly $2,000,000 more than the estimated cost of improving the canal in its present location.

The Canal Committee believes that whenever the Hudson River from Troy to Fort Edward is canalized it would be well to consider a material enlargement of the capacity of the Champlain Canal, and therefore the Committee recommends that for the present the work of improvement undertaken under the act of 1895 be carried out, at an estimated cost of $1,824,000.

SUMMARY.

The total estimated cost of carrying into effect the canal policy outlined and recommended by the Canal Committee, namely, to improve the Erie Canal to a size suitable for barges of 1,000 tons capacity, and to complete the improvements on the Oswego and Champlain Canals, authorized by the law of 1895, is as follows:

Erie Canal	$58,894,668
Oswego Canal	818,120
Champlain Canal	1,824,000
Total	$61,536,788

In round numbers, $62,000,000.

WIDENED LOCKS, SIMPLY.

To widen and lengthen one tier of the locks on the Erie Canal to accommodate boats 150 feet long and 25 feet wide, with the work on the prism of the canal absolutely necessary for allowing such boats to use the canal with the present available draft of six feet, would cost about $8,000,000.

This estimate includes building the locks with a least draft of eleven feet, so that they would be suitable for boats drawing ten feet should the prism of the canal afterward be enlarged. As stated elsewhere, it is not believed that any practical good can come from this work, considered solely by itself. It relates to the existing location of the Erie Canal, and does not include any diversion of the route deemed desirable and necessary by the Committee.

CONTINUOUSLY DESCENDING CANAL, LAKE ERIE TO HUDSON RIVER.

For many years the opinion has prevailed that it is practicable to relocate the Erie Canal so as to eliminate the depression in the profile between Newark and Syracuse, and thus have a canal with a continuous fall all the way from Lake Erie to the Hudson.

To Mr. George W. Rafter was assigned the task of investigating this matter, and his report gives full information relating thereto.

From this report it is seen that there are two routes which the canal could follow which would eliminate the depression, and which are possible, but not practicable, on account of the enormous cost involved. One of these routes lies to the south and one to the north of the existing canal.

SOUTHERN ROUTE.

The possible southern route leaves the present canal just east of Newark, follows down the valley of the Clyde, and crosses the Montezuma Marshes and Seneca River just north of Cayuga Lake. It passes through the southern part of Syracuse, and joins the present line of the canal about two miles east of Syracuse.

The cost of this canal of a size suitable for boats 25 feet wide and ten feet draft is summarized from Mr. Rafter's report as follows:

Right of way and land damages	$5,180,000
Excavation, etc.	9,600,000
Vertical and retaining walls	825,000
Rip-rap, gravel lining and puddling	2,695,000
Concrete core walls	2,500,000
Bridges and crossings	3,030,000
Aqueducts, culverts, etc.	5,000,000
Miscellaneous	170,000
	$29,000,000

One of the most serious objections to this southern route, aside from its great cost, is that it takes the canal from the business section of Syracuse and puts it in the residence portion. This accounts for the enormous land damages in the estimate.

NORTHERN ROUTE.

The northern route examined by Mr. Rafter also leaves the Erie Canal just east of Newark, keeps well to the north of Crusoe Creek, passes to the north of Baldwinsville, crosses the Seneca River just north of Onondaga Lake, and connects with the existing canal about two miles east of Syracuse.

The cost of this canal of the same size as in the southern route is summarized from Mr. Rafter's report as follows:

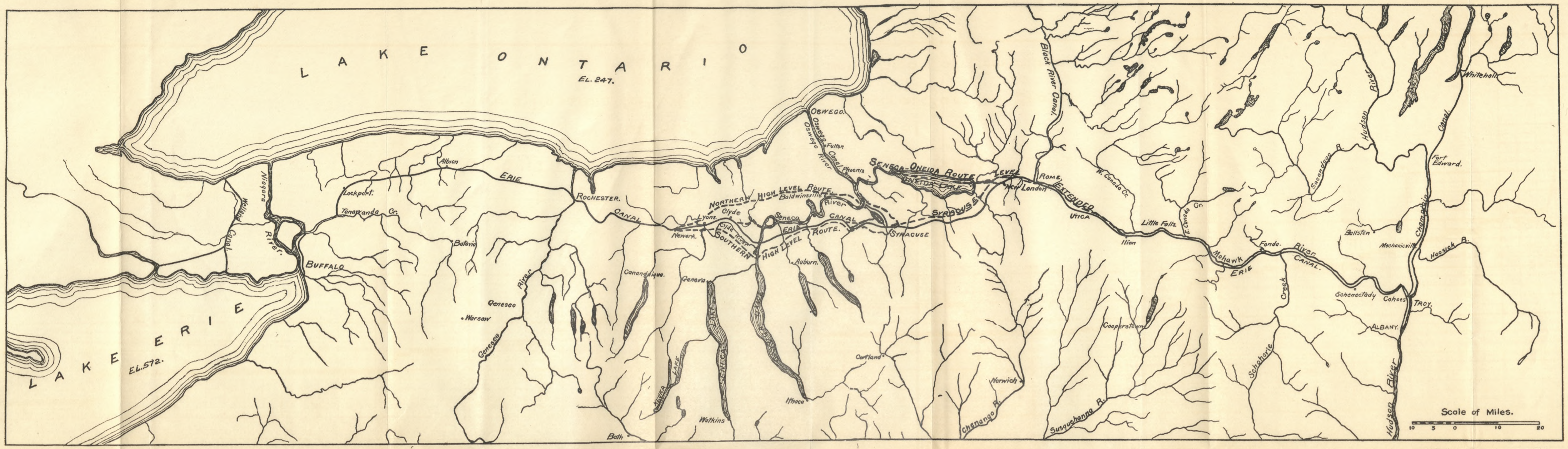
Land damages and right of way	$380,000
Excavations, etc.	8,800,000
Vertical and retaining walls	268,000
Rip-rap, gravel lining and puddling	3,200,000
Concrete core walls	5,000,000
Bridges and crossings	1,700,000
Aqueducts, culverts, etc	1,220,000
Side cut to Onondaga Lake, etc	1,200,000
Miscellaneous	632,000
	$22,400,000

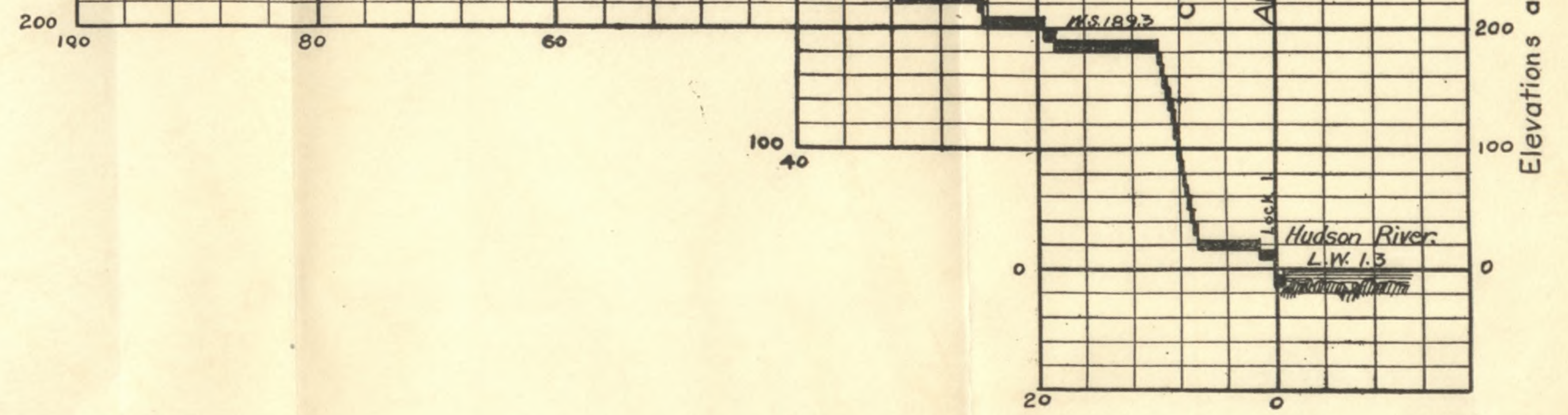
EXTENSION OF SYRACUSE LEVEL.

Messrs. Cooley and North suggest in their report to the Clinton Canal Commission that the proposed rectification just discussed might be more cheaply and safely worked out by extending the Syracuse level westward near the present canal location, and eastward through the flat country south of Oneida Lake, cutting down the Rome Summit to correspond.

This was examined into by Mr. Rafter, who reports great difficulties in the way of doing it, and gives a detailed estimate of its cost, which amounts to $32,500,000.

It is considered by the Canal Commission to be an impracticable proposition.



1899

ERIE CANAL ENLARGEMENT.

COMMITTEE ON CANALS OF STATE OF NEW YORK.

Map and Profile of Erie Canal

Showing Possible New Routes Through Central Part of State.

To accompany Report of Committee.

1899

ERIE CANAL ENLARGEMENT.

COMMITTEE ON CANALS OF STATE OF NEW YORK.

Map and Profile of Erie Canal

Showing Possible New Routes Through Central Part of State.

To accompany Report of Committee.

V. ENGINEERING REPORTS WITH ESTIMATES OF COST.

BY GEO. W. RAFTER D. J. HOWELL AND F. M. SYLVESTER.

COMMITTEE ON CANALS OF NEW YORK STATE.

New York, December 22, 1899.

Messrs. GEORGE W. RAFTER,
D. J. HOWELL,
F. M. SYLVESTER.

Gentlemen:

I hand you herewith the reports signed by Mr. Rafter under date of December 1st and 20th, by Mr. Howell under date of December 15th, and by Mr. Sylvester under date of November 20th, containing estimates of various projects for the enlargement of the Erie Canal.

The substance of these reports has been considered by the members of the Committee, all being present, with great care during the last two days, and the Committee is unanimously of the opinion that there are only three projects for consideration.

The first is the completion of the project authorized by the law of 1895, with the following modifications:

The deepening of the prism to 9 feet throughout, and the lengthening of the locks on one tier, so as to pass two boats, each 125 feet in length, 17½ feet in width and 8 feet draft, with a cargo capacity of about 450 tons; and the lengthening of the locks on the other tier, so as to pass a single boat of the same size.

The use of pneumatic locks, or other mechanical lifts, at Cohoes, Lockport, and, possibly, Newark and Little Falls.

The construction of a new canal from near Clyde to near New London, about 81 miles in length, giving a wide waterway through the Seneca and Oneida Rivers and Oneida Lake, and avoiding the Montezuma marshes.

The abolition of the two aqueducts across the Mohawk River, and the substitution of the river for the canal from Rexford Flats to Cohoes.

The construction of a new canal from the foot of the falls of the Mohawk, near Cohoes, to the Hudson River, near the West Troy side cut.

The second project is for a canal to accommodate boats of the same dimensions as above given, but which shall follow the route of the present Erie Canal, except from Albany to Lock 18, in place of which the diversion by a mechanical lift over the Cohoes Falls and a canal from the foot of the Falls to the Hudson River at West Troy side cut shall be substituted.

The third project is for a canal following the same route as the first project, but of sufficient size to carry boats 150 feet in length, 25 feet in width, and 10 feet draft, with a cargo capacity of approximately 1,000 tons each, with locks capable of passing two boats at one time.

The preliminary reports and estimates prepared by each of you for certain parts of these projects are now submitted to you jointly, in order that you may prepare a joint report, as brief as possible, but accompanied with the estimates for each of the projects in full detail, showing the quantities and unit prices. It is expected that this joint report will be printed with our own report when submitted to the Governor, and that the final figures thus furnished by you will be the basis of such recommendations as the Committee may take.

It is desired that the report and estimates should be handed to us not later than December 30th.

Yours truly,

F. V. GREENE, *Chairman.*

New York, January 1, 1900.

To the Committee on Canals of New York State,

General F. V. GREENE, Chairman.

Gentlemen:

Immediately after receipt of General Greene's letter of December 22d, 1899, the undersigned met at the Committee's office in New York for the purpose of preparing complete estimates on projects which had received the Committee's final approval, as defined by General Greene in his letter.

In accordance with General Greene's request, we have revised, and, so far as necessary to meet the final conclusions of the Committee as to preferable routes, have modified our several previous estimates, and herewith present details on three propositions. These three propositions are so thoroughly defined under their respective headings as to make any description of just what they cover unnecessary in this place.

A few words are desirable by way of explaining the relations of each of the undersigned engineers to the complete estimates herewith submitted. None of us has been able in the time available to study every project in all its details. A division of labor was therefore imperative, the ground actually gone over by each being substantially as follows:

Mr. Rafter has made special studies of the proposed rectifications between New London and Clyde as given in detail in his report presented to you under date of December 1st, 1899. The same report also contains his study as to difficulties, on account of curvature and lack of width, in the way of using boats 25 feet wide and 125 feet in length on the canal with its present prism and structures, exclusive of locks. It further contains an estimate of the cost of enlarging Champlain Canal from a point where it crosses the Mohawk River to the West Troy side cut in order to accommodate boats of 8 feet draft and 18 feet in width, together with an estimate of the cost of reconstructing the West Troy side cut on new lines.

In his report of December 20th, 1899, Mr. Rafter has presented a series of estimates relating to the completion of the $9,000,000 project on several different plans, as follows:

(1) To complete $9,000,000 improvement on present route as originally provided by act, Chapter 79, Laws of 1895, and amendments, and as designed by State Engineer and Surveyor, carrying boats 98 to 104 feet long, and drawing about 7½ feet of water.

(2) To complete $9,000,000 improvement on present route, and providing for boats 115 feet long and at least 8 feet draft.

(3) To complete $9,000,000 improvement on present route, and providing for boats 125 feet long and 8 feet draft.

(4) To complete $9,000,000 improvement with Seneca-Oneida rivers, lower Mohawk and West Troy side cut deflections, providing for boats 125 feet long and 8 feet draft.

For the fourth proposition, the figures as to canalization of Mohawk River were prepared by Mr. Howell.

Under date of December 15th, 1899, Mr. Howell has submitted to your Committee a report covering an estimate of cost, and report for the enlarged prism with a depth of 12 feet, for the Erie Canal from upper Mohawk aqueduct at Rexford Flats to Buffalo, following line of present canal, with the exception of such short diversions as are made in his report.

Also an estimate of cost of the utilization of the lower Mohawk River by canalizing the same from upper Mohawk aqueduct at Rexford Flats to Cohoes Falls.

Under date of November 20th, 1899, Mr. Sylvester submitted a report covering the enlargement of the present old locks by lengthening the same to 260 feet, preserving the present width, and deepening the chambers in every case to nine feet. For constructing new locks at the several points noted in the report with chambers of the size mentioned below; also for enlarging one side to 260 feet with the present width, and deepening to nine feet. For the construction of new locks on the proposed diversion via Seneca and Oneida rivers and Oneida Lake; also locks Numbers 1, 2 and 3 on the Champlain Canal, and the canal lock and river lock for the proposed new West Troy side cut. In addition to the foregoing, several other propositions are covered in the summary of this report.

The foregoing brief statements fairly define the personal responsibility of each of the undersigned engineers for the complete estimates herewith submitted. We do not deem it necessary to go further into the detail of exactly what each individual has done, the more especially because we understand that it is the intention of your Committee to recommend the publication of our detailed reports. If we may be permitted the suggestion, we would say that it seems quite desirable that the detailed reports should be published, chiefly in order to preserve the considerable amount of new matter relating to New York canals which we have gathered. For such publication we think the report of the Honorable State Engineer and Surveyor would be the preferable medium, because it is to that report that one naturally looks for information about the canals.

While we have thus limited our individual responsibility, it is nevertheless proper to state that the final propositions on which estimates are herewith submitted are in some particulars different from several of the propositions covered by our individual reports. It has been necessary, therefore, in some degree to prepare new estimates, which have been checked by each of us, and which we are all responsible for as regards the final form in which they are herewith presented.

The following are the estimates referred to:

First Proposition.—Estimated cost of completing Erie Canal improvement, originally authorized by Chapter 79, Laws of 1895, between Hudson River at West Troy (now Watervliet) and Buffalo, with the following modifications of the present line:

Diversion at West Troy (Watervliet), thence by line of Erie and Champlain canals to Cohoes, with mechanical lifts at Cohoes Falls, and with canalized Mohawk River from head of Cohoes Falls to Rexford Flats.

From Rexford Flats, line of present canal to be followed to one mile west of New London.

Diversion from line of present canal, 1 mile west of New London to 1½ miles east of Clyde, via Wood Creek, Oneida Lake, Oneida and Seneca rivers, etc., known as Seneca-Oneida route.

From 1½ miles east of Clyde to Buffalo, canal line to remain as at present.

This proposition proposes nine feet of water over all structures with double chamber locks of the present width, 260 feet long on one side, and 130 feet long on the other. All locks to be fitted with quadrant gates and power capstans, together with the necessary waterwheels, shafting, and rope drives, etc., for operating said gates and capstans.

ESTIMATE.

New work at West Troy side cut—		
Right of way, earthwork, vertical wall, etc..	$125,000	
Two new locks at West Troy............	246,000	
		*$371,000
Improvement of Erie and Champlain Canals from West Troy side cut to Mohawk River, as per original estimate of 1898, plus 28 per cent., exclusive of locks....................	482,000	
Three locks, West Troy to Mohawk River..	*386,000	868,000
Total, carried forward....................		$1,239,000

* These items include necessary percentage for engineering and contingencies.

Amount forward			$1,239,000
Canalization of Mohawk River, from Cohoes Guard Lock to foot of Cohoes Falls, including protection wall			*600,000
Mechanical lifts at Cohoes Falls, with approaches, and including two tandem locks, each with single chamber 260 feet long			*1,200,000
From head of Cohoes Falls to Rexford Flats. Channel 9 feet deep, 200 feet wide—			
480,000 c. y. Rock excavation for prism (submerged), at $2.00		$960,000	
180,000 c. y. Earth excavation for locks and approaches, at 30c		54,000	
237,000 c.y. Rock excavation for lock and approaches, at $1.00		237,000	
28,000 c. y. Walls for lock approaches, at $6.00		168,000	
67,500 c. y. Earth for dike, at 30c		20,250	
4,000 c. y. Slope paving, at $3.00		12,000	
		$1,451,250	
Engineering and contingencies, 10% about		145,250	
		$1,596,500	
Removing two spans each of upper and lower aqueduct: 1,360 c. y. Excavation old masonry, at $2.00		*2,720	
Removing present dam (Cohoes Power Co.), 3,555 c. y. Excavation old masonry, at $2.00		*7,110	
Land damages, 1,400 acres, at $200		*280,000	
Four concrete dams	$730,000		
Engineering and contingencies, 10%	73,000	803,000	2,689,330
Four new locks, between head of Cohoes Falls and Rexford Flats			*727,000
Prism, as per original estimates made by State Engineer's Department and Messrs. Cooley and North, in 1898, from Rexford Flats to one mile west of New London		$1,558,814	
Aqueducts, etc., as per original estimates of 1898, Rexford Flats to one mile west of New London		34,328	
Bridges, as per original estimates of 1898, Rexford Flats to one mile west of New London		37,405	
		1,630,547	
Add 28%		456,553	
			2,087,100
Twenty-three locks (Nos. 23 to 46, inclusive, less 1 at Little Falls), Rexford Flats to one mile west of New London			*1,583,050
Totals, carried forward			$10,125,480

Amount forward.........		$10,125,480
Seneca-Oneida route, from one mile west of New London to 1½ miles east of Clyde—		
Right of way and land damages............	$53,000	
Clearing, grubbing and burning............	16,000	
1,500,000 c. y. Earth excavation, at 25c......	375,000	
600,000 c. y. Hard material to be dredged, at 25c.......................	150,000	
3,800,000 c. y. Soft material to be dredged, at 12c.......................	456,000	
150,000 c. y. Soft shale to be dredged, at 70c.	105,000	
100,000 c. y. Hard rock to be dredged, at $1.30	130,000	
Deepening Onondaga outlet and lake.......	15,000	
Dockage at Onondaga Lake...............	15,000	
Riprap, lining and puddle..................	130,000	
Navigation lights, houses and buoys........	48,000	
Telephone line............................	23,000	
Two dredges..............................	64.000	
Four highway bridges to be raised, at $500..	2,000	
Fourteen new highway bridges, at $11,000...	154,000	
Three railway bridges to be raised, at $5,000.	15,000	
Two wasteways, at $12,000.................	24,000	
Forty snubbing posts, at $10...............	400	
Breakwater at Sylvan Beach................	120,000	
Movable dams at Jack's Reef and Oak Orchard	160,000	
Miscellaneous items.......................	8,000	
Contingencies, inspection, engineering, etc., about 11%...............................	261,600	
	$2,325,100	
Seven new concrete locks..................	*1,162,000	
	$3,487,100	
Add for cut-offs, Seneca and Oneida Rivers.	*400,000	
		3,887,100
Prism, as per original estimates, from 1½ miles east of Clyde, to Buffalo..............	$3,453,265	
Aqueducts, as per original estimates........	95,600	
Bridges, as per original estimates...........	22,000	
	$3,570,865	
Add 30%.................................	1,071,260	
		4,642,125
Fifteen locks, from 1½ miles east of Clyde to Buffalo, exclusive of Lockport................................		*1,311,000
Carried forward.....................		$19,965,705

* These items include necessary percentage for engineering and contingencies.

Amount forward..................		$19,965,705
Mechanical lift, at Lockport, including necessary retaining walls, approaches, regulating weirs, etc........		*600,000
Telephone line not included, except in Seneca-Oneida route		*93,000

To the foregoing should be added a sum of money to cover lowering and widening certain aqueducts and lowering culverts not included to be lowered to 9 feet, and widened by the estimates of 1898, as well as for flattening curves, in order to better accommodate boats 125 feet in length, as follows:

Additional lowering and widening of aqueducts, and lowering culverts and flattening curves on Eastern and part of Middle divisions	$158,540	
On part of Middle and Western divisions...	344,400	
		*502,940
Final amount......................		$21,161,645

The foregoing estimate includes mechanical lifts at Cohoes and Lockport, but not at Little Falls and Newark. For the two latter places the estimate includes re-locations and new work as follows:

At Little Falls, locks 37 and 38 are combined in one lock. At Newark, locks 57, 58 and 59 are combined into two locks, with a change of location between. At Brighton, locks 63 and 64 are also combined in one lock.

Second Proposition.—Estimated cost of completing the Erie Canal improvement from Hudson River at West Troy (now Watervliet) to Buffalo, with the section from West Troy to head of Cohoes Falls as defined in First Proposition, otherwise to follow line of present canal. Everything on same basis as in First Proposition.

From West Troy to head of Cohoes Falls—		
Total, as per First Proposition........................		$3,039,000
Prism, as per original estimates made by State Engineer's Department and Messrs. North and Cooley, in 1898, from present Lock No. 18 to east line of Oneida County..	$1,309,633	
Aqueducts, etc., as per original estimates of 1898	81,852	
Bridges, as per original estimates of 1898....	31,419	
	$1,422,904	
Add 28%..................................	398,413	1,821,317
Carried forward......................		$4,860,317

* These items include necessary percentage for engineering and contingencies.

Amount forward		$4,860,317
Twenty-six locks to be changed, from present Lock No. 19 to Lock No. 45		*1,769,300
Additional lowering of aqueducts and culverts and flattening of curves on Eastern division, not included in original estimates of 1898		*253,541
From Oneida County line to Wayne County line—		
Prism, as per original estimates of 1898	$1,276,500	
Aqueducts, etc., as per original estimates	53,900	
Bridges, as per original estimates	55,600	
	$1,386,000	
Add 23%	318,780	
		1,704,780
Seven locks to be changed, Nos. 46 to 52 inclusive		*447,000
Additional lowering of aqueducts and culverts and flattening of curves on Middle division, not included in original estimates of 1898		*300,220
From Wayne County line to Buffalo—		
Prism, as per original estimates of 1898	$3,663,365	
Aqueducts, etc., as per original estimates	95,600	
Bridges, as per original estimates	22,000	
	$3,780,965	
Add 30%	1,134,290	
		4,915,255
Fifteen locks, No. 53 to Black Rock Guard lock, not including Lockport		*1,311,000
Mechanical lift, at Lockport, including necessary retaining walls, approaches, regulating weirs, etc.		*600,000
Additional lowering of aqueducts and culverts, on Western division, not included to be lowered to depth of 9 feet in estimates of 1898, and for flattening curves		*344,400
Telephone line		*114,000
Final amount		$16,619,813

THIRD PROPOSITION.—Estimated cost of enlarged Erie Canal to 12 feet depth, with single chamber locks 310 feet long by 28 feet wide, to carry two boats, each 150 feet long, 25 feet wide, and 10 feet draft, from the Hudson River at West Troy (now Watervliet) to Buffalo by the following route:

Diversion at West Troy, thence by line of present Erie and Champlain canals to Mohawk River at Cohoes. Along west bank of Mohawk River by separate canal with protecting wall to near foot of Cohoes Falls, with mechanical lift at Cohoes Falls.

* These items include the necessary percentage for engineering and contingencies.

From head of Cohoes Falls to Rexford Flats via canalized Mohawk River.

From Rexford Flats to about one mile west of New London along the line of the present canal, with the following modifications: At crossing of Schoharie Creek, about one-half mile of new canal, with new aqueduct and new location for Lock No. 30. At Little Falls, the combining of Locks. Nos. 37 and 38 in one lock, and about 1,000 feet of new canal, with necessary flattening of curves. At Lock No. 41, about 2,000 feet of new canal and new location for this lock.

From about 1 mile west of New London to about 1½ miles east of Clyde, new location via Wood Creek, Oneida Lake, Oneida and Seneca rivers, etc.

From about 1½ miles east of Clyde to Buffalo along the line of the present canal with the following modifications:

At Lyons about 3,500 feet of new canal below Lock No. 55. At Brighton about 2,500 feet of new canal, and new location for Lock No. 63, and the combining of Lock No. 64 with this lock. At Rochester, construction of a new aqueduct, and general readjustment to meet new conditions.

At about 3½ miles west of Rochester, about 1,800 feet of new canal, cutting off a sharp bend in the present canal. At South Greece, about the same length of new canal is estimated for, to better the alignment. At Medina, the cost of about three-quarters of a mile of new canal, together with a new aqueduct, is included.

At Newark, the estimate includes a change of location and the combining of Locks. Nos. 57, 58 and 59 in two locks. This proposition also includes the omission of Lock. No. 61 at Macedon, and the combining of ths lock with Lock 60 just east of Macedon.

From Hudson River, at West Troy, to Mohawk River, at Cohoes—

Right of way and land damages...........	$87,500
Bailing and draining......................	5,000
470,000 c. y. earth excavation, at 25c........	117,500
180,000 c. y. rock excavation, at $1.00.......	180,000
10,000 c. y. lining, at $1.00................	10,000
5,000 c. y. puddle, at $1.00................	5,000
38,000 c. y. vertical wall, at $6.00..........	228,000
15,000 c. y. slope wall, at $3.00............	45,000
6 highway bridges, at $13,000..............	78,000
Carried forward......................	$756,000

Amount forward		$756,000	
1 lift bridge, Mohawk Basin		6,000	
3 culverts, at $9,000		27,000	
1 waste weir		10,000	
700,000 ft. B. M. Hemlock, at $16		11,200	
Readjustment of highways		30,000	
Readjustment of railway		10,000	
5,000 sq. yards soiling and sodding, at 40c.		2,000	
20 snubbing posts, at $10		200	
Contingencies, inspection and engineering, about 13%		111,590	
			$963,990
Five single-chamber concrete locks, 310 feet long by 28 feet wide			*595,000
Canalization of Mohawk River, from Cohoes Guard lock to foot of Cohoes Falls, including protecting wall.			*875,000
Mechanical lifts at Cohoes Falls, with approaches, and including two tandem locks each, with single chamber 310 feet long			*1,700,000
Canalized Mohawk River, from head of Cohoes Falls to Rexford Flats—			
781,479 c. y. rock excavation for prism, at $2.00		$1,562,958	
180,324 c. y. earth excavation for locks and approaches, at 30c		54,097	
336,806 c. y. rock excavation for locks and approaches, at $1.00		336,806	
23,132 c. y. walls for lock approaches, at $6.00		168,792	
67,500 c. y. earth dike (2700x15'x45'), at 30c.		20,250	
4,000 c. y. slope paving (2700x20x2'), at $3.00		12,000	
		$2,154,903	
Engineering and contingencies, 10%		215,490	
		$2,370,393	
Removing two spans upper aqueduct, 680 c. y. at $2.00	$1,360		
Removing two spans lower aqueduct, 680 c. y. at $2.00	1,360		
Removing present dam (Cohoes Power Co.), 3,555 c. y., at $2.00,	7,110		
		*9,830	
One swing or lift bridge at upper aqueduct		*20,000	
Land damages and overflow area, 1,400 acres, at $200		*280,000	
Carried forward		$2,680,223	$4,133,990

* These items include the necessary percentage for engineering and contingencies.

Amount forward.........		$2,680,223	$4,133,990
Four dams of concrete..............	$730,000		
Engineering and contingencies, 10%	73,000	803,000	3,483,223
Four new single-chamber concrete locks each 310 ft. by 28 ft. wide..........................			915,000
From Rexford Flats to about one mile west of New London, along route of present canal, with modifications as noted.			
9,973,513 c. y. excavation, earth and hard pan, at 35c..................		$3,490,730	
100,000 c. y. excavation for 2,500 ft. new canal, Schohaire Creek, at 30c.		30,000	
1,569,394 c. y. excavation rock, at $1.00......		1,569,394	
48,880 lin. ft. excavation of old cement masonry, at $2.00......		97,760	
77,700 lin. ft. slope wall at $6.60..........		512,820	
112,600 lin. ft. river slope wall, at $9.00...		1,013,400	
863,400 lin. ft. wash wall, at $1.50.........		1,295,100	
64,785 lin. ft. vertical wall, natural foundation, at $20.00...............		1,295,700	
277,900 lin. ft. bottom puddle, at $4.00.....		1,111,600	
120,100 lin. ft. vertical wall, timber foundation, at $28.00...............		3,362,800	
161,000 lin ft. slope puddle, at $1.70......		273,700	
19,400 lin ft. vertical wall, underpinning, $7.00		135,800	
		$14,188,804	
Deduct value of $9,000,000 work.			
1,040,768 c. y. excavation earth and hard pan, at 35c......	$364,269		
90,148 c. y. excavation rock, at $1.	90,148		
82,350 c. y. slope wall, at $2.00...	164,700	619,117	
New total		$13,569,687	
Engineering and contingencies, 12½%......		1,696,211	
		$15,265,898	
Special construction...............	$11,300		
Bridges	2,688,500		
Culverts	353,100		
Aqueducts	499,000		
	$3,551,900		
Engineering and contingencies...	443,988	3,995,888	
		$19,261,786	
Extra right of way, 100 ft. wide, for 107 miles, 1,297 acres, at $200......		*259,400	$19,521,186
Carried forward......................			$28,053,399

* These items include the necessary percentage for engineering and contingencies.

Amount forward....................		$28,053,399
23 single chamber lengthened locks, each 310 ft. long by 28 ft. wide, including 1 new concrete lock of above dimensions at Little Falls..................................		*2,476,000

From about 1 mile west of New London to about 1½ miles east of Clyde. New location via Wood Creek, Oneida Lake, Oneida and Seneca rivers, etc.—

Right of way and land damages..............	$92,750	
800 acres clearing and burning at $15........	12,000	
200 acres clearing and grubbing at $60.......	12,000	
2,000,000 c. y. earth excavation at 25c......	500,000	
6,000,000 c. y. soft material—mud, marl, soft clay, sand, etc. (to be dredged), at 12c	720,000	
1,500,000 c. y. hard material—sand, clay and boulders (to be dredged), at 25c...	375,000	
350,000 c. y. soft shale rock (to be dredged) at 70c..................	245,000	
400,000 c. y. hard limestone or sandstone (to be dredged) at $1.30..........	520,000	
200,000 c. y. soft material (to be dredged) in Onondaga outlet and Onondaga Lake at 10c......................	20,000	
2,000 lin. ft. dockage, Onondaga Lake, $10	20,000	
60,000 c. y. riprap at $1.10................	66,000	
60,000 c. y. gravel lining at 80c...........	48,000	
100,000 c. y. puddle, at $1................	100,000	
25 navigation lights, houses, etc., at $2,000	50,000	
200 buoys at $30........................	6,000	
70 miles telephone line at $330...........	23,100	
2 dredges at $40,000....................	80,000	
10 highway bridges to be raised, etc., at $3,000	30,000	
14 new highway bridges, at average of $16,000	224,000	
6 railway bridges to be raised at $15,000.	90,000	
2 wasteways at $20,000.................	40,000	
40 snubbing posts at $10.................	400	
3,000 lin. ft. of breakwater at Sylvan beach at $40	120,000	
Planting willows for bank protection.......	5,000	
Readjustment of highways..................	5,000	
1 movable dam at Jack's Reef.............	70,000	
1 movable dam at Oak Orchard...........	90,000	
Carried forward..........	$3,564,250	$30,529,399

Amounts forward		$3,564,250	$30,529,399
Contingencies, inspection and engineering, about 11%		387,137	3,951,387
7 new single chamber concrete locks, each 310 ft. long by 28 ft. wide			*1,163,000
Add for cut-offs, Seneca and Oneida rivers			*500,000

From about 1½ miles east of Clyde to Buffalo along the line of the present canal, with modifications noted—

411,000 c. y. dredging, Tonawanda Creek, at 30c		$123,300	
11,269,200 c. y. excavation earth at 30c		3,380,760	
2,932,000 c. y. excavation hard pan at 60c		1,759,200	
1,513,000 c. y. excavation rock at $1		1,513,000	
23,500 lin. ft. excavation cement masonry at $2		47,000	
1,238,000 lin. ft. wash wall at $1.50		1,857,000	
141,600 lin. ft. vertical wall, natural foundation, at $20		2,832,000	
27,000 lin. ft. vertical wall, timber foundation, at $28		756,000	
142,000 lin. ft. bottom puddle at $4		568,000	
73,000 lin. ft. slope puddle at $1.70		124,100	
177,800 sq. ft. rock channeling at 30c		53,340	
		$13,013,700	
Deduct value of $9,000,000 work.			
898,000 c. y. excavation earth, at 30c	$269,400		
69,100 c. y. excavation hard pan, at 60c	41,460		
218,300 c. y. excavation rock, at $1.	218,300	529,160	
Net total		$12,484,540	
Engineering and contingencies, 12½%		1,560,567	
		$14,045,107	
Bridges	$2,980,000		
Culverts	583,600		
Aqueducts	1,225,000		
	$4,788,600		
Engineering and contingencies,	598,575	5,387,175	
		$19,432,282	
Extra right of way, 100 ft. wide, for 143.5 miles, 1,733 acres, at $200		*346,600	
Carried forward		$19,778,882	$36,143,786

* These items include the necessary percentage for engineering and contingencies.

Amounts forward	$19,778,882	$36,143,786
Damages, Rochester and Lyons	*300,000	
Total		$20,078,882
9 single chamber lengthened locks, each 310 ft. long by 28 ft. wide		*909,000
3 new single chamber concrete locks, same dimensions		*540,000
Mechanical lift locks at Lockport		*1,100,000
Removing old lock structures at Locks 53 and 61		30,000
Telephone line not included except in Seneca-Oneida route		*93,000
Final amount		$58,894,668

ESTIMATES ON LOCKS.

Estimate on enlarging the present lengthened locks to 260 feet long, 19 feet wide and 9 feet deep, on the lengthened side, and 130 feet long, 19 feet wide and 9 feet deep on the unlengthened side.

Detail estimate of typical lock—

Bailing and draining	$1,000
Moving old crib lower end and rebuilding same	800
Moving old crib upper end and rebuilding same with recesses for gates	2,533
1,650 c. y earth excavation at $1.50	2,475
800 c. y. excavation old masonry at $1.50	1,200
500 piles, 26 feet long, equals 13,000 lin. ft., at 28c	3,640
115,000 feet, b. m., Hemlock timber at $20	2,300
12,000 feet, b. m., Oak underpinning at $100	1,200
5,000 feet, b. m., White Pine underpinning at $100	500
15,000 feet, b. m., White Pine used in recesses at $35	525
15,000 feet, b. m., White Oak used in sills at $50	750
10,000 lbs. bolts, spikes, etc., at 4c	400
575 c. y. new masonry at $15	8,625
650 c. y. concrete at $12	7,800
1,200 c. y. puddling at $1.25	1,500
500 c. y. lining at $1	500
500 c. y. vertical wall at $6	3,000
Repairing and re-pointing old walls, etc	750
1 conduit with valves, etc., for power	4,000
1 water wheel with shafting clutches, rope drives, etc	2,000
2 power capstans, complete	2,500
2 head gates at $1,800	3,600
2 tail gates at $2,200	4,400
	$55,998
12%	6,720
	$62,718

* These items include the necessary percentage for engineering and contingencies.

Estimate on cost of enlarging old locks on the lengthened side to 310 feet by 28 feet by 11 feet. Eliminating old locks and constructing new locks with the above size chamber.

Estimate of typical lock—

Bailing and draining	$1,000
Moving old crib at lower end and rebuilding same	800
Moving old crib at upper end and rebuilding same	2,500
4,500 c. y. in bottom earth excavation at 75c	3,375
6,000 c. y. in side earth excavation at 40c	2,400
2,100 c. y. of old masonry excavation at $1.50	3,150
1,000 c. y. of embankment at 25c	250
40,000 lin. ft. of piles at 30c	12,000
185,000 feet, b. m., Hemlock at $20	3,700
5,000 lbs. bolts and spikes at 4c	200
1,000 c. y. puddling at $1.25	1,250
500 c. y. lining at $1	500
500 c. y. new lock masonry at $14	7,000
5,000 c. y. new concrete at $6	30,000
2,100 c. y. vertical wall masonry at $5	10,500
10,000 feet, b. m., White Oak and Pine underpining at $100	1,000
15,000 feet, b. m., White Oak for sills at $50	750
8,000 feet, b. m., White Pine in recesses at $35	280
Repairing and re-pointing old lock walls	750
1 conduit with valves, for power	4,000
1 water wheel with shafting, clutches, rope drives, etc	2,000
2 power capstans, complete	2,500
1 head gate	2,900
1 tail gate	3,800
	$96,605
12%	11,593
	$108,198

Estimate on new locks, 310 feet by 28 feet by 11 feet, single chamber.

Typical lock, 10 feet lift—

Bailing and draining	$3,000
9,000 c. y. excavation of earth at 40c	3,600
8,000 c. y. embankment at 25c	2,000
1,000 c. y. lining at $1	1,000
1,000 c. y. puddling at $1.25	1,250
60,000 lin. ft. piles at 30c	18,000
250,000 feet, b. m., Hemlock at $20	5,000
6,000 lbs. bolts and spikes at 4c	240
8,500 c. y. concrete at $6	51,000
4,200 c. y. vertical wall masonry at $5	21,000
15,000 feet, b. m., White Oak for sills at $50	750
1 conduit with valves, for power	4,000
Carried forward	$110,840

Amount forward	$110,840
1 water wheel with shafting, clutches, rope drives, etc.	2,000
2 power capstans, complete	2,500
1 head gate	2,900
1 tail gate	3,800
	$122,040
12%	14,645
	$136,685

New locks on the Mohawk River, from Upper Aqueduct to Cohoes Falls. Estimate of typical lock with walls 38 feet high, one chamber 260 feet by 20 feet by 9 feet and one chamber 130 feet by 20 feet by 9 feet—

	Bailing and draining	$3,000
	Earth and rock excavations are included in estimates for prism.	
8,000	c. y. embankment at 25c	2,000
1,000	c. y. lining at $1	1,000
500	c. y. puddling at $1.25	625
20,000	c. y. Portland cement concrete at $6.50	130,000
	Vertical approaches included in estimates for prism.	
130	lin. ft. dock extension of short lock at $10	1,300
20,000	feet, b. m., White Oak for sills at $50	1,000
1	lock and tool house	1,500
150	tons C. I. pipe culvert at $45	6,750
4,500	lbs. lead for joints at 10c	450
2	valves, above line	1,000
2	valves for feed culverts	2,500
4	valves for discharge	3,000
7,500	lbs. steel rods in concrete at 2.5c	187
120	vitrified tile elbows, 12 inches, at $1.75	210
400	lin. ft. tile pipe lining at 50c	200
8	c. i. bollards at 25c	200
25,000	lbs. c. i. coffer dam checks in walls at 5c	1,250
2	head gates at $3,500	7,000
2	tail gates at $4,500	9,000
2	power capstans	2,500
1	water wheel with shafting, clutches, rope drives, etc.	2,000
		$176,672
	12%	21,200
		$197,872

Estimate on cost of enlarging one side of present locks and constructing new locks with single chambers, 310 feet long, 28 feet wide, 12 feet deep—

West Troy side cut Riverlock, new, lift 7.6....	$119,000	
West Troy side cut canal, new, lift 10.8........	130,000	
Champlain Canal at Cohoes, lock No. 1, new, lift 10.4	140,000	
Champlain Canal at Cohoes, lock No. 2, new, lift 11.2	140,000	
Champlain Canal at Cohoes, lock No. 3, new, guard lock	66,000	
		$595,000
Pneumatic locks, lift 111 feet..................		$1,700,000
Lower Mohawk River diversion, from Cohoes to Upper Aqueduct—		
Upper Aqueduct, or No. 1, new, lift 21 feet....	$220,000	
2 miles below aqueduct, or No. 2, new, lift 10 feet	203,000	
1 mile above Vischer Ferry, or No. 3, new, lift 20 feet	243,000	
West Troy County Dam, or No. 4, new, lift 20 feet	249,000	915,000
Note.—The above lifts are for low water stages.		
Erie Canal, first west of Schenectady, lock No. 23, lift 10.3..............................	108,000	
Erie Canal, lock No. 24, lift 8.2.............	93,500	
Erie Canal, lock No. 25, lift 7.7.............	97,000	
Erie Canal, lock No. 26, lift 7.4.............	102,000	
Erie Canal, lock No. 27, lift 8.9.............	103,000	
Erie Canal, lock No. 28, lift 6.7.............	96,000	
Erie Canal, at Schoharie Creek, lock No. 29, lift 9.4	106,000	
Erie Canal, at Schoharie Creek, lock No. 30, new, lift 11.2..........................	142,000	
Erie Canal, at Sprakers, lock No. 31, lift 5.8..	92,000	
Erie Canal, at Fort Plain, East, lock No. 32, lift 6.1	94,000	
Erie Canal, at St. Johnsville, lock No. 33, lift 3.7	86,500	
Erie Canal, at Mindenville, West, lock No. 34, lift 11.5	102,000	
Erie Canal, lock No. 35, lift 7.8..............	101,000	
Erie Canal, at Little Falls, lock No. 36, lift 7.0.	116,000	
Erie Canal, at Little Falls, lock No. 37a, lift 19.	185,000	
Erie Canal, Little Falls, lock No. 39, lift 12.5..	130,000	
Erie Canal, lock No. 40, lift 8.5..............	93,500	
Erie Canal, new lock No. 41, lift 8.3 feet.......	120,000	
Erie Canal, lock No. 42, lift 6.9..............	97,000	
Carried forward...........	$2,064,500	$3,210,000

Amounts forward	$2,064,500	$3,210,000
Erie Canal, lock No. 43, lift 7.0	102,000	
Erie Canal, at Ilion, East, lock No. 44, lift 11.7	106,000	
Erie Canal, at Ilion, West, lock No. 45, lift 10.2	110,000	
Erie Canal, at Utica, lock No. 46, lift 4.0	93,500	2,476,000
Cost of locks from West Troy Side Cut to New London		$5,686,000

Seneca-Oneida rivers and Oneida Lake diversion, from New London to Clyde—

Wood Creek, upper level lock, lift 20.2	$198,000	
Wood Creek, middle level lock, lift 20.2	215,000	
Wood Creek, lower level lock, lift 20.2	215,000	
Oak Orchard, lock, lift 6.0	116,000	
Baldwinsville, lock, lift 11	127,000	
Jack's Reef, lock, lift 4.0	114,000	
Clyde, lock, lift 15	178,000	
Total		$1,163,000

From Clyde to Buffalo—

Erie Canal, at Lock Berlin, lock No. 54, lift 8.1	$110,000	
Erie Canal, at Lyons, lock No. 55, lift 9.3	100,000	
Erie Canal, lock No. 56, lift 6.8	100,000	
Erie Canal, at Newark, lock No. 57, Erie Canal, at Newark, lock No. 58, Erie Canal, at Newark, lock No. 59, new, lift 26.0	280,000	
Erie Canal, at Macedon, East, lock No. 60, lift 14.5	120,000	
Erie Canal, at Pittsford, lock No. 62, lift 10.8.	102,000	
Erie Canal, at Rochester, East, new, lock No. 63, lift 16.8	185,000	
Erie Canal, at Rochester, East, new, lock No. 65, lift 10.0	102,000	
Erie Canal, at Rochester, East, new, lock No. 66, lift 8.9	102,000	
Erie Canal, at Lockport, pneumatic, new, lock No. 67-71, lift 58	1,100,000	
Erie Canal, at Sulphur Springs Lock, guard lock	86,500	
Erie Canal, at Riverlock Tonawanda, new single lock No. 4	75,000	
Erie Canal, at Black Rock Lock, guard lock	86,500	
Cost of locks from Clyde to Buffalo		$2,549,000

SUMMARY.

West Troy Side Cut to New London	$5,686,000
Seneca River and Oneida Lake diversion	1,163,000
Clyde to Buffalo	2,549,000
Eliminating locks Nos. 53 and 61	30,000
	$9,428,000

Estimates on cost of enlarging old locks and constructing new locks, with one chamber 260 feet by 19 feet by 9 feet, and one chamber 130 feet by 19 feet by 9 feet—

West Troy Side Cut Riverlock, new	$118,000	
West Troy Side Cut Canal Lock, new	128,000	
Champlain Canal, at Cohoes, lock No. 1	138,000	
Champlain Canal, at Cohoes, lock No. 2	138,000	
Champlain Canal, at Cohoes, lock No. 3	110,000	
Pneumatic Locks	1,200,000	
Erie Canal, lock No. 19	56,500	
Erie Canal, lock No. 20	52,750	
Erie Canal, near Upper Mohawk Aqueduct, lock No. 21	68,000	
Erie Canal, near upper Mohawk Aqueduct, lock No. 22	65,500	
Erie Canal, first west of Schenectady, lock No. 23	65,500	
Erie Canal, lock No. 24	56,500	
Erie Canal, lock No. 25	58,500	
Erie Canal, lock No. 26	61,000	
Erie Canal, lock No. 27	65,600	
Erie Canal, lock No. 28	58,500	
Erie Canal, at Schoharie Creek, lock No. 29	60,000	
Erie Canal, at Schoharie Creek, lock No. 30	67,500	
Erie Canal, at Sprakers, lock No. 31	55,500	
Erie Canal, at Fort Plain, East, lock No. 32	56,250	
Erie Canal, at St. Johnville, lock No. 33	52,500	
Erie Canal, at Midenville, West, lock No. 34	61,000	
Erie Canal, lock No. 35	61,000	
Erie Canal, at Little Falls, lock No. 36	88,200	
Erie Canal, at Little Falls, new lock in place of Nos. 37 and 38	194,000	
Erie Canal, at Little Falls, lock No. 39	98,500	
Erie Canal, lock No. 40	56,500	
Erie Canal, lock No. 41	61,000	
Erie Canal, lock No. 42	58,500	
Erie Canal, lock No. 43	61,000	
Erie Canal, at Ilion, East, lock No. 44	63,500	
Erie Canal, at Ilion, West, lock No. 45	66,000	
Erie Canal, at Utica, lock No. 46	56,500	
Cost of locks from West Troy Side Cut to New London		$3,657,800
Erie Canal, at Syracuse, lock No. 47	$73,500	
Erie Canal, at Syracuse, lock No. 48	67,600	
Erie Canal, at Syracuse, lock No. 49	54,600	
Erie Canal, lock No. 50	67,300	
Erie Canal, at Jordan, lock No. 51	61,700	
Erie Canal, at Port Byron, lock No. 52	65,800	
Cost of locks from New London to Clyde		$390,500

Clyde to Buffalo—

Erie Canal, lock No. 53	$60,000	
Erie Canal, at Lock Berlin, lock No. 54	66,000	
Erie Canal, at Lyons, lock No. 55	60,000	
.Erie Canal, lock No. 56	70,500	
Erie Canal, at Newark, lock No. 57 / Erie Canal, at Newark, lock No. 58 / Erie Canal, at Newark, lock No. 59 } double lock	341,000	
Erie Canal, at Macedon, East, lock No. 60	70,500	
Erie Canal, lock No. 61	70,500	
Erie Canal, at Pittsford, lock No. 62	61,000	
Erie Canal, at Rochester, East, lock No. 63	212,000	
Erie Canal, at Rochester, East, lock No. 65	61,000	
Erie Canal, at Rochester, East, lock No. 66	61,000	
Erie Canal, at Lockport, single lock, lock Nos. 67-71	600,000	
Erie Canal, at Sulphur Springs Lock, lock No. 72	57,500	
Erie Canal, at Riverlock Tonawanda, new	66,600	
Erie Canal, at Black Rock Lock	53,600	
Cost of locks from Clyde to Buffalo		$1,911,200

SUMMARY.

West Troy Side Cut to New London	$3,657,800
New London to Clyde	390,500
Clyde to Buffalo	1,911,200
	$5,959,500

Estimate on cost of new locks on route via Seneca River and Oneida Lake, one chamber 260 feet by 20 feet by 9 feet, and one chamber 130 feet by 20 feet by 9 feet—

Wood Creek, upper level	$197,000	
Wood Creek, middle level	215,000	
Wood Creek, lower level	215,000	
Oak Orchard	116,000	
Baldwinsville	127,000	
Jack's Reef	114,000	
Clyde Lock	178,000	
		$1,162,000

Locks on the Lower Mohawk River diversion, from Upper Aqueduct to Cohoes Falls, one chamber 260 feet by 20 feet by 9 feet, and one 130 feet by 19 feet by 9 feet—

Upper Aqueduct, or No. 1	$175,000	
Two miles below, or No. 2	161,000	
One mile below Vischer Ferry, or No. 3	193,000	
West Troy Co. Dam, or No. 4	198,000	
		$727,000

RECAPITULATION.

Cost of enlarging one side of present locks and constructing new locks with single chambers 310 feet long, 28 feet wide, 12 feet deep.................................$9,428,000

Cost of enlarging old locks and constructing new locks, with one chamber 260 feet long, 19 feet wide, and 9 feet deep, and one chamber 130 feet long, 19 feet wide and 9 feet deep, on the present route of canal except the diversion at Cohoes.................................. 5,959,500

Cost of new locks on the diversion via Seneca River and Oneida Lake, one chamber 260 feet by 20 feet by 9 feet, and one chamber 130 feet by 20 feet by 9 feet...... 1,162,000

Locks on Lower Mohawk River diversion, from Upper Aqueduct to Cohoes Falls, one chamber 260 feet by 20 feet by 9 feet, and one chamber 130 feet by 20 feet by 9 feet.. 727,000

Cost of enlarging old locks and constructing new locks, with one chamber 260 feet by 19 feet by 9 feet, and one chamber 130 feet by 19 feet by 9 feet, on the present route of canal, except diversions at Seneca River and Oneida Lake and the Lower Mohawk River, from the Upper Aqueduct to Cohoes, thence via the Champlain Canal and Erie Canal into the Hudson River at West Troy Side Cut.. 7,215,750

COMPARATIVE DISTANCES.

Distance via Erie Canal from Lock No. 1, at Albany, to Commercial Slip, at Buffalo................................ 351.9 miles.

Distance from Hudson River at West Troy (Watervliet) via Erie and Champlain canals and Mohawk River to head of Cohoes Falls, thence by way of line of present canal to Buffalo (second proposition)............................ 345.3 miles.

Distance from Hudson River at West Troy (Watervliet) side cut, via Erie and Champlain canals, and Mohawk River to Rexford Flats, thence via line of present canal to one mile west of New London, thence by Wood Creek, Oneida Lake, Oneida and Seneca rivers, etc., to 1½ miles east of Clyde, and thence by line of present canal to Commercial Slip, Buffalo, slight changes in alignment not being considered (first and third propositions)................................... 351.3 miles.

NOTES ON THE ESTIMATES.

The following embodies such concise explanations as are necessary to understand the estimates.

Prices are given in the estimates for each item separate from all other items. This does not mean that just these items would be embodied in specifications for work, but is rather in order to define for present purposes every item of cost. In Mr. Howell's estimates the unit price per linear foot for wash wall, slope wall and river slope revetment is based on slope paving laid dry two feet in thickness at a price of $3.00 per cubic yard; the wash wall being seven feet long, the slope wall 30 feet, and the river slope revetment 40 feet, which latter is assumed to be the average figure.

The unit price per linear foot for vertical wall for firm foundation is based on about 3 cubic yards to the running foot, at a price of $6.60 per cubic yard, including in part excavation for the wall. This price, it is considered, is equivalent to $6.00 per yard for the wall, the same as used in Mr. Rafter's estimate. The sum of $8.00 per linear foot is added for timber and grillage foundation for vertical walls. It is proposed to build all these walls of concrete. The price per linear foot for puddling is based on $1.00 per cubic yard, a thickness of 18 inches being provided for. Earth mixed with hardpan, where the quantities for each could not be separated, is estimated at 35 cents per cubic yard. In Mr. Howell's estimates dry-rock excavation is estimated at $1.00 per cubic yard, while in Mr. Rafter's estimates for Seneca-Oneida route a somewhat less price is used. It is believed that these prices are adequate for the particular cases in which they apply. In Mr. Howell's estimates submerged rock excavation is taken at $2.00 per cubic yard, while for the Seneca-Oneida route Mr. Rafter has taken it at from 70 cents to $1.30, the difference again arising on account of varying qualities of material to be handled. There are a few other variations in unit prices of earth and rock work.

As regards prices used, the estimates are generally self-explanatory. Should further explanations be needed, our several detailed reports, filed with the Honorable State Engineer and Surveyor, may be referred to.

The estimates for Seneca-Oneida route provide for a connection through Onondaga outlet into Onondaga Lake whereby that lake will become the harbor for Syracuse. It seems to us that the removal of Erie Canal from the business centre of Syracuse, substituting Onondaga Lake as a commodious harbor, will be of inestimable advantage to that city in this particular, that it will permit the development of harbor facilities adequate to a rapidly growing municipality. This view is based upon the supposition that the canal on its present location through the city of Syracuse is on the whole a detriment to the city. A similar statement may be made as regards the city of Rochester. At each place the canal passes through the heart of the town. When the original construction was completed in 1825 these now populous cities were country villages, and bridges over the canal were constructed with deep approaches, the same as still prevail for nearly the entire distance from Albany to Buffalo outside of cities. With the growth of the large towns there came a demand for cutting down the steep approaches and the substitution therefor of mechanical lift bridges. These bridges have now so multiplied in number, both at Syracuse and Rochester, that if the canal business is to ever again become anything like a maximum, the constant opening of the lifts would be an intolerable nuisance. For these and other reasons there is plainly a very strong sentiment at both Rochester and Syracuse in favor of new location outside. The proposed Seneca-Oneida route accomplishes for Syracuse everything on this line that could be desired, but no such simple solution is applicable at Rochester, where a long detour to one side of the city would be imperative. So far as can be determined by casual examination, the problem may be solved in two ways—either by passing to north of city, crossing Genesee River on an aqueduct about 200 feet high and 1,000 feet long, or by a detour to south, crossing Genesee River at water level above present feeder dam. This latter route would save about two miles distance, but entails a long cut for several miles in length, with guard locks at each side of the river. The northern route would be about the same length as the present canal. The new southern line would probably leave the present canal in the neighborhood of South Greece, entering it again about two miles south of Brighton, thus making a new location between 11 and 12 miles in length. It would avoid the present bad alignment through the city of Rochester, as well as obviate the necessity for change in alignment at Brighton and South Greece. As a broad statement, we may say the entire present alignment through the city of Rochester is, on account of a number of sharp curves, unadapted to successful navigation with the length of boat now proposed, and will involve very heavy expense for the necessary changes. It is our opinion that the line around the city of Rochester should be thoroughly studied before actually beginning any further new construction. The estimates herewith submitted include $4,800,000 for the work at Rochester and outside of that city between the points of this proposed change. Taking into account a saving of two miles in distance, it is our opinion that the new line can be constructed for about the same sum of money that is required to enlarge the present line, the advantages of such new construction being not only a far better line for navigation, but the relief of the city of Rochester from the burden of obstructed streets. An opportunity for a harbor at Rochester is afforded by the Johnson and Seymour Pond, with which connection can be made through the present feeder without great expense.

The foregoing diversions at Syracuse and Rochester are the more important ones; a number of others are discussed in our detailed reports.

The estimates herewith submitted include the cost of canalizing the Mohawk River from Cohoes guard lock to Rexford Flats. As the result of our casual study we cannot but think it would be from many points of view very desirable to utilize the Mohawk River, at any rate as far as Little Falls, and possibly to Rome. On this point anything we say must be considered general, because no detailed studies have been made. Some of the reasons why the further canalization of the Mohawk River would be desirable are as follows: In the first place, there would be a considerable saving in the annual expense of maintenance and repairs; again, it would solve the much vexed question of bridges; the clearance of the same and interruption to navigation therefrom; at the same time removing the many complications and conditions to be met and solved at culverts and aqueducts. It obviates the necessity for long stretches of expensive vertical walls through cities on the line of the present canal with the consequent risk in new constructions of injury to many buildings now lining the canal through the cities. It entirely eliminates the large estimate for slope walls and wash walls along the artificial channel. Moreover, the dams necessary for the slack water navigation would frequently be located above towns, and could be utilized for additional water power to manufactories now there.

Again, it would remove all questions of puddling and risks from breaks and interruptions to navigation. It would further mean that should future demands require an increased depth of channel and width of prism they could be obtained without interruption to navigation, and with but little loss to the value of work already accomplished and paid for under former improvements.

It is proper to point out that the proposed arrangement at Cohoes would interfere materially with The Cohoes Company's raceway and present head works. As an offset to this, the proposed arrangements would give an increased head at the Cohoes dam of 8 feet, which, however, they could only utilize by raising their head raceway wall. The estimates herewith submitted do not include any damages resulting to The Cohoes Company as the result of this new location, the inference being that some amicable arrangement could be entered into with this company regarding the changes contemplated, and the adapting of their head race to meet the new conditions proposed.

In the estimate for Seneca-Oneida route, the cost of cut-offs is placed at $500,000 additional to the main estimate, which is based upon following the meander of the river. The estimate of $500,000 for cut-offs assumes dredgable material across flats where cut-offs are located, and deposit of same at sides either by pumping or spouting.

In the first and second propositions we have referred to the original estimates of 1898 as made by the State Engineer's Department under the directions of Messrs. North and Cooley. These estimates are on file at the offices of the several Division Engineers in considerable detail. Their length precludes their reproduction, either here or in our detailed report. Since they were made the Eight Hour law has been passed, which has had the effect of materially increasing the cost of labor in New York State. The return of business prosperity has also considerably increased the cost of the chief materials to be used in such work. Within the last few months the cost of cement has increased from 15 to 20 per cent., and stone 10 to 20 per cent.; steel, which is, however, a relatively small item, is 35 per cent. higher than in 1898; transportation is perhaps 15 per cent. higher; labor has nominally increased 25 per cent.

The effect of these several increases in price upon the present work is discussed somewhat at length in Mr. Rafter's report to your Committee made under date of December 20th, 1899, and without going into detail in this place we may say that, taking into account all facts, as well as the original estimates themselves, we have concluded that the original estimates for the Eastern Division should carry an addition of 28 per cent. in order to meet the conditions at the present day; those of the Middle Division 23 per cent., and for the Western Division 30 per cent. Aside from these percentage additions we have assumed the adequacy of the original estimates as used in the first and second propositions. As a general contingency item, in our new estimates covering engineering, inspection, cost of advertising, etc., we have used from about 10 to 13 per cent. Ten per cent. is the figure ordinarily used, but a somewhat larger one appears necessary in New York State canal work because of the dual inspection. However, as regards completing the $9,000,000 improvement a large proportion of the engineering work is done, and there accordingly seems to be no good reason why 10 per cent. is not sufficient to cover these several items for such completion.

The estimates for the first and second propositions have been made on the supposition that bridges along the line of present canal will generally clear the slightly modified boats likely to result from deepening to 9 feet. It is considered that 12 feet clearance will be ample for such boats, and the few bridges below that figure not otherwise provided for can, if necessary, be raised at small expense.

Provision has been made for constructing bridges wherever needed to meet changed conditions, with the exception of railway and purely private interests. This has always been the policy of the State of New York, and we know of no reason for any variation now.

As to just how the present locks are to be made over into a single chamber lock 28 feet in width, as per third proposition, reference may be made to the detailed report of Mr. Sylvester.

The estimates propose the use of concrete for all new locks and for vertical walls on river work. Also the use of concrete for a portion of the work for enlarging and lengthening locks. Reasons for use of concrete may be obtained by reference to the detailed reports of Messrs. Rafter and Sylvester.

We are, gentlemen,

Very respectfully,

GEO. W. RAFTER,

D. J. HOWELL,

F. M. SYLVESTER.

COMMITTEE ON CANALS OF NEW YORK STATE.

NEW YORK, December 22, 1899.

Messrs. WILLIAM H. BURR,
GEORGE S. MORRISON, and
WM. BARCLAY PARSONS.

Gentlemen:

We have been giving a great deal of time of late to the consideration of the canal problem, and have finally obtained estimates of cost on three different propositions in relation to the enlargement of the Erie Canal which have never before been possible. They are now only possible by reason of the hearty co-operation of the Board of Engineers on Deep Waterways, which has placed at the disposal of engineers employed by us all of their valuable and extensive surveys east of Oswego and Syracuse. We have had surveys of our own made between Syracuse and Buffalo; and have also had the benefit of the surveys made by the State Engineer in connection with the nine-million dollar improvement, which are far more extensive than is generally known. For instance, you will probably be surprised to learn, as I was, that in connection with that improvement the canal was cross-sectioned at intervals of 100 feet all the way from Buffalo to Albany.

These estimates have been prepared for this Committee by Messrs. George W. Rafter, D. J. Howell and F. M. Sylvester, and are now being put in final form for consideration. It is of the utmost importance not only that the members of the Committee should feel assured that these estimates are adequate and sufficiently accurate to form the basis of recommendations to the Governor and Legislature, but also that the people of the State should be equally convinced of their adequacy and accuracy. The Committee therefore desires to have the figures finally passed upon by engineers of national reputation and especial experience in canal questions; and I write to ask if you will consent to examine the estimates which we will submit to you and give us your opinion as to their substantial accuracy and sufficiency as a basis for recommendation to the Governor and the Legislature.

In making this request, I am obliged to say that the Committee has no funds to pay for the services requested, and I can only appeal to each of you, as a citizen of New York, to give a portion of your time to the consideration of these estimates on the same basis of lack of compensation that the members of the Committee have given their time to the study of the problem during the greater part of the present year.

The estimates will be ready to submit to you on January 2d, and I trust that in the meantime I may hear from you saying that you will comply with my request to examine them.

Very truly yours,

F. V. GREENE, *Chairman.*

NEW YORK, January 3, 1900.

Committee on Canals,
11 Broadway, New York.

Gentlemen:

In reply to your letter of December 22, 1899, we beg leave to report that

We have examined the estimates submitted to you, under date of January 1, 1900, by Messrs. Rafter, Howell and Sylvester for a new canal from Lake Erie to the Hudson River, capable of carrying boats with 1,000 tons cargo—these estimates amounting, in the aggregate, to $58,894,668. As it would require several months to verify the quantities, we have made no attempt to do so. Our examination is limited by the necessities of the case, and by your instructions, to the general accuracy of unit prices, and to the methods which you and your engineers have followed in obtaining these estimates.

We are of the opinion that these methods are reasonable and sufficient. The reports in which they are pursued show very careful and thorough examination of the data involved, and we believe that the resulting estimates may be considered sufficiently accurate to form the basis of representations on your part to the Governor and Legislature in regard to the canal policy of the State, but that further surveys should be made in order to prepare working plans and make the detailed estimates, which should be completed before entering into contracts.

Respectfully yours,

WM. BARCLAY PARSONS,
WM. H. BURR,
Consulting Engineers.*

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*Owing to the absence from the city of Mr. George S. Morrison, he was unable to act with Messrs. Burr and Parsons.

VI. OPINION ON APPORTIONMENT OF COST.

By AVERY D. ANDREWS.

NEW YORK, October 2, 1899.

General F. V. GREENE,

Chairman Committee on Canals of New York State.

Dear Sir:

I have received your recent letter requesting my opinion whether it would be constitutional to provide funds for the enlargement of the State canals on the following basis, viz: the project to be passed by the Legislature, submitted to the people and approved by them; the money to be raised by the issue of bonds on the credit of the State of New York under Section 4 of Article VII. of the Constitution, the interest and principal of said bonds to be paid by assessment on the cities and towns of more than ten thousand inhabitants situated within the limits of counties bordering upon the Erie, Oswego and Champlain canals and the Hudson River, or upon the counties bordering thereon; such assessment to be in proportion to the assessed valuations of real and personal estate bordering upon such cities and towns, or counties.

It is universally conceded, as will appear from numerous authorities herein cited, that the power of a State, for purposes of taxation, over persons, property or business within its jurisdiction is practically unlimited except by the restrictions of the Federal and State constitutions. The answer to your inquiry depends, therefore, upon and requires a careful examination of the Constitution of the United States and that of the State of New York as interpreted and declared by the highest courts of the United States and the State.

Article X. of the Amendments to the Constitution of the United States declares:

"The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States, respectively, or to the people."

The only prohibition upon the States in respect to taxation is found in Section 10 of Article I., which forbids any State, without the consent of Congress, to lay any imposts, or duties on imports or exports, except what may be absolutely necessary for executing its inspection laws, nor any duty of tonnage.

In an early case, Providence Bank vs. Billings, 4 Peters 514, the Supreme Court of the United States, in passing upon the question of the power of a State to tax, said:

"The power of legislation and consequently of taxation operates on all the persons and property belonging to the body politic * * * * However absolute the right of an individual may be, it is still in the nature of that right that it must bear a portion of the public burdens, and that portion must be determined by the Legislature. This vital power may be abused, but the interest, wisdom, and justice of the representative body, and its relations with its constituents, furnish the only security against unjust and excessive taxation, as well as against unwise legislation."

And again, in the famous case of McColloch vs. Maryland, 4 Wheaton 428, Chief Justice Marshall, speaking for the Supreme Court of the United States, said:

"The people of the State, therefore, give to their government the right of taxing themselves and their property; and as the exigencies of the government cannot be limited, they prescribe no limits to the exercise of this right, resting confidently on the intent of the Legislature and the influence of the constituents over their representatives, to guard them against its abuse."

Turning now to the Constitution of the State of New York, we find that those of 1777 and 1821 contained no restrictions whatever upon the power of the State to incur debts or impose taxes. Under both of these constitutions, the State repeatedly incurred debts and imposed taxes for the construction and improvement of the State canals. In the Constitution of 1846, Section 12 of Article VII. was as follows:

"Except the debts specified in the tenth and eleventh sections of this article, no debt shall be hereafter contracted by or on behalf of this State, unless such debt shall be authorized by a law for some single work or object to be distinctly specified therein; and such law shall impose and provide for the collection of a direct annual tax, to pay and sufficient to pay the interest of such debts as it falls due, and also to pay and discharge the principal of such debt within eighteen years from the time of the contracting thereof.

"No such law shall take effect until it shall, at a general election, have been submitted to the people, and have received a majority of all the votes cast for and against it at such election.

* * * * * * * * * *

"No such law shall be submitted to be voted on within three months after its passage, or at any general election when any other law, or any bill, or any amendment to the Constitution shall be submitted to be voted for or against."

This section, without alteration or amendment, except a renumbering of the sections referred to, was adopted verbatim in the Constitution of 1894, and has not since been amended. Section 10 of Article VII. of the present Constitution refers to canal improvements, and is as follows:

"The canals may be improved in such manner as the Legislature may provide by law. A debt may be authorized for that purpose in the mode prescribed by section four of this article, or the cost of such improvement may be defrayed by the appropriation of funds from the State Treasury, or by equitable annual tax."

It is therefore apparent that the State has ample power to incur a debt for the improvement of the canals; but that this can be done only by imposing a *"direct annual tax"* sufficient to pay principal and interest, pursuant to the provisions of Section 4 of Article VII., above quoted. The real question is, therefore, whether it is within the power of the Legislature to impose the particular scheme of taxation suggested in your inquiry. There can, of course, be no doubt whatever as to the power of the Legislature to impose a direct annual tax for canal improvement upon all the persons or property within the State. The only novel or unusual part of the proposed scheme of taxation consists in the method of apportionment of the tax upon certain specified cities and towns, or counties. Upon this question of apportionment of taxation there have been numerous decisions by the Court of Appeals of this State, to the most important of which I will briefly refer. The earliest case, decided in 1851, and to which all subsequent cases refer, is that of People vs. Brooklyn, 4 New York 419, in which the Court, after referring to the decisions of the Supreme Court of the United States, quoted above, says:

"Assuming this, as we safely may, to be sound doctrine, it must be conceded that the power of taxation and of apportioning taxation, or of assigning to each individual his share of the burden, is vested exclusively in the Legislature, unless this power is limited or restrained by some constitutional provision. The power of taxing and the power of apportioning taxation are identical and inseparable. Taxes cannot be laid without apportionment, and the power of apportionment is therefore unlimited unless it be restrained as a part of the power of taxation. There is not and since the original organization of the State Government, there has not been any such constitutional limitation or restraint.

"The people have never ordained that taxation must be limited or regulated by any or either of the rules laid down by the Supreme Court in People vs. Brooklyn, 6 Barbour 209, or in the case now under consideration. They have not ordained that taxation shall be general so as to embrace all persons or taxable persons within the State or within any district or territorial division of the State; nor that it shall or shall not be numerically equal, as in the case of the capitation tax; nor that it must be in the ratio of each man's land, or of his goods, or of both combined; nor that a tax must be co-extensive with the district, or upon all the property in a district, which has the character of and is known to the law as a local sovereignty; nor have they ordained or forbidden that a tax shall be apportioned according to the benefit which each taxpayer is supposed to receive from the object on which the tax is expended. In all these particulars, the power of taxation is unrestrained."

An even stronger statement of the power of the Legislature in respect to taxation is found in Town of Guilford vs. Supervisors, 13 New York 146:

"Whenever these formalities are observed, the Legislature has the right to appropriate the public moneys for local or private purposes, and to impose a tax upon the property of the whole State, or any portion of the State, or any particular and specific kind of property."

This decision has been criticised by eminent authorities, but solely upon the right of the State to appropriate public moneys for private and personal purposes. It was cited and distinguished by the Court of Appeals in Weismar vs. Douglass, 64 N. Y. 100, but not in such a manner as to impair its value upon the question here at issue, that of the apportionment of taxes.

The next important case was that of Brewster vs. Syracuse, 19 N. Y. 117:

"The sewer was constructed under authority conferred by the Legislature upon the city of Syracuse, and the expense was imposed on that part of the citizens interested in the improvement, by virtue of the discretionary power of the Legislature to impose public burdens on those who, in its judgment, ought to bear them. The nature of this power was fully examined in Brooklyn vs. the Mayor, 4 New York 419, and it was then declared to be a part of the legislative exercise of the State power of taxation to ascertain, subject to no judicial review, the burdens to be borne and the persons or classes of persons who were to bear them * * * The taxation of the individuals interested in regard to this sewer stands on the same footing as all other taxation by the Legislature. * * * Besides, it is a well settled principle that where any particular county, district or neighborhood is exclusively benefited by a public improvement, the inhabitants of that district may be taxed for the whole expense of the improvement in proportion to the supposed benefits received by each."

In Gordon vs. Cornes, 47 N. Y. 611, a tax was authorized upon the city of Brockport for the erection of a State Normal School. The tax was opposed on the ground that the institution for which the money was to be raised was not a local one, but was for the equal benefit of the whole State, and that the assessment ought to be imposed with equality upon all the property in the State. The Court of Appeals said:

"The power of apportionment is included in the power to impose taxes, and is vested in the Legislature, and in the absence of any constitutional restraint, the exercise by it of such apportionment cannot be reviewed by the courts. The constitution of some States contains certain special provisions designed to guard against an unequitable exercise of this power and to secure equality in the distribution of public burdens. A violation of any such provisions would undoubtedly be cognizable by the courts, but in this State such restraints have not been deemed necessary, and the people have been content to leave to the wisdom and justice of the Legislature, unrestricted by specific regulations, the subject of determining how the public burdens shall be apportioned among them.

"To undertake to review the action of the Legislature in this respect, and to enforce by judicial power absolute equality of taxation, or to declare a law unconstitutional on the ground that the locality is taxed for what might seem to the court to be more than its just proportion of an expenditure for a public purpose, would be usurpation of the provisions of the Legislature."

And again, upon the question of freedom from judicial supervision, the Court says, in People vs. Home Insurance Co., 92 N. Y. 347:

"In the consideration of the effect and meaning of laws imposing taxes, it would undoubtedly be the duty of the court to so construe them if possible as to avoid unequal and double taxation; but in determining the question of legislative power we are precluded from entertaining such considerations, and must be governed by the constitutional authority conferred upon the legislative body. In performing the duty of levying taxes for the support of the government, State legislators may, in the exercise of their undoubted power, impose double taxes or lay burdens beyond the financial capacity of the classes taxed; and however unwise or impolitic such a course may be, the courts have no right to interfere with the exercise of the legislative discretion."

And again in Genet vs. Brooklyn, 99 N. Y. 306:

"The power of taxation is vested in the Legislature and is practically absolute, except as restrained by constitutional provisions. The power of taxation being legislative, all the incidents are within the control of the Legislature. The purposes for which the tax shall be levied, the extent of taxation, the apportionment of the tax, upon what property or class of persons the tax shall operate, whether the tax shall be general or limited to a particular locality, and in the latter case the fixing of the assessment, the method of collection, and whether the tax shall be a charge upon both persons and property, or only on land, are matters left with the discretion of the Legislature and in respect of which its determination is final."

This case was cited and approved in State vs. Kings County, 125 N. Y. 320. A very late case, decided in June, 1897, is that of Cayuga County vs. State, 159 N. Y. 286, where the Court said:

"The power of taxation includes the power to apportion the public burdens in such manner as may seem best to the Legislature; and while the power of taxation is to be exercised for public purposes, its scope is not to be narrowed by refinement, but it exists in unconfined vigor except where, by express language or necessary implication, its exercise is restricted by the Constitution."

The numerous cases here cited have arisen chiefly in respect to taxes for local improvements in various parts of the State, levied pursuant to special acts of the Legislature. The case of Gordon vs. Cornes, 47 N. Y. 611, *ante*, is a very interesting and important one. The Legislature there levied, and the courts sustained, a special tax upon the city of Brockport for the erection of a State Normal School. The school was to be under the jurisdiction and control of the State authorities, and in a measure benefited the whole State. The taxation of a single city for the erection of a State school is identical in principle with the taxation of a class of cities for the construction or improvement of a State canal.

While none of the foregoing leading cases refer specifically to the canals, it is interesting to note that the method of taxation herein proposed has, in one case at least, been adopted by the Legislature for canal improvements and sustained by the courts. The act of April 15, 1817, based upon the report of the original Canal Commission, of which De Witt Clinton was president, directed the raising of $250,000 by taxation upon the lands and real estate lying along the route of the canals and within 25 miles thereof. This special tax was suspended by Chapter 105 of the Laws of 1819; but in so doing the Legislature specifically declared its right to levy and assess a tax upon the principle therein involved.

A very similar case arose in 1834. By Chapter 46 of the laws of that year, the terminus of the Chenango Canal was changed from Whitesborough to Utica. Chapter 307 of the laws of 1835 directed that the cost thereof be assessed upon the owners of all the real estate in the city of Utica, in proportion to the benefits deemed to have been received. The tax was opposed on the ground that the act was unconstitutional, as a taking of private property for public use without compensation. The Supreme Court of the State in the case of Thomas vs. Leland, 26 Wendell 65, sustained the validity of the tax in an opinion of which the following is an extract:

> "To sustain this argument, it must be denied that the general profit of the community to which we belong will warrant a tax affecting our property. Our answer in the case at bar is that the improvement in question was in itself a compensation to plaintiff. Such at least was the view taken by the Legislature, and they must be left to judge of compensation. * * * If the power to impose a tax for a lunatic asylum, for instance, were to be rested on the ground of individual pecuniary benefit to each one who should be called upon to contribute, it is quite obvious that it would not be maintained for a moment. Yet who would doubt that such might be imposed on a local community, a county or even a town? I admit that this power of taxation may be abused, but its exercise cannot be judicially restrained so long as it is referable to the taxing power."

The facts in this case are almost identical with those in the scheme of taxation herein proposed. In one case a single city is taxed for the cost of a single canal improvement. In the other a class of cities or counties is taxed for the cost of a general canal improvement.

Since this case was decided there has been the long and unbroken line of decisions by the Court of Appeals heretofore cited, sustaining the principle therein announced, and declaring in the strongest terms the right of the Legislature to apportion taxes as it shall see fit without judicial supervision. It is therefore fully established that there is in this State no limitation or restriction upon the power of the Legislature to apportion taxes, provided the subject matter is, as in this case, within the jurisdiction of the State.

I am therefore of the opinion that either of the methods suggested by you for providing funds for the enlargement of the State canals, would, when adopted pursuant to the provisions of Section 4 of Article VII. of the Constitution, be a constitutional and valid exercise of legislative power, and would be so declared by the courts.

Respectfully,

AVERY D. ANDREWS.

VII. MEMORANDUM ON METHOD OF BIDDING TO PREVENT UNBALANCED BIDS.

By adopting a schedule of prices and testing the bids by the discount offered on such prices, unbalanced bids are impossible. This system has been used on all public works in France for many years. All such contracts contain:

First—General specifications and conditions applicable to all public work.

Second—A description of the work to be done; an approximate statement of quantities, and special specifications for the particular piece of work to be done.

Third—A schedule of prices, drawn up by the Engineers, and giving in great detail the unit price for every kind of material, crude or prepared, and for every kind of labor which can possibly be used on the work.

The bidder names a discount of a certain percentage, applicable to every unit price, at which he offers to do the work; and the work is awarded to the bidder who offers the largest discount.

The contract from which the following schedule of prices is taken was for work under the Department of Parks, consisting of excavation and embankment, furnishing and planting trees, sodding, paving, etc.

The lowest bidder for this work was at a discount of 28 2-10 per cent.

The translation of the schedule of prices from the original contract was made by J. W. Howard, C. E., the metres being converted into yards, and the francs into cents.

Nature of the Work.	Nos of the Prices.	Designation of the Undertakings.	Units.	Price per Unit.
		CHAPTER I. DAY LABOR.		
Workman's days, including incidentals and cost of tools......	1	Foreman of pavers and laborers...	hour	$ 0.15
	2	Journeyman paver................	"	.14
	3	Laborer, handler, apprentice paver or yard assistant, sand shoveller, roller man, spreader, rammer, grouter..................	"	.09
	4	Shoveller, picker or spader, sorter of paving stones ......,..........	"	.10
	5	Dresser or shaper of stones..	"	.14
	6	Day watchman..................	day	.50
	7	Day workman..................	night	.60
	8	Gardener, pruners, wood cutters...	hour	.10
	9	Drivers.........	"	.10
	10	Drivers who work by the month...	day	.80
	11	Drainers (12 hours of work)......	"	1.10
Horses and Vehicles...	12	Wagons for one or more horses....	hour	.04
	13	R.R. truck for one or more horses..	"	.08
	14	Harnessed horse, thill horse or other without driver............	"	.14
	15	A harnessed horse with his driver by the month, including holidays and Sundays..................	month	64.00
	16	The same each extra hour...... ..	hour	.50
	17	One-horse carriage with driver...	"	.28
	18	Two-horse " " " ...	"	.42
	19	Three-horse wagon with driver....	"	.56
	20	Trip of a one-horse carriage with driver in the limits of the area of the work awarded, including loading, unloading, incidentals.	trip	1.00
	21	Trip of a carriage or truck with two horses under same conditions....	"	1.40
	22	Livery stable carriage drawn by one horse with coachman..........	day	4.00
		CHAPTER II. SUPPLIES OF MATERIALS.		
Sand and Mortar...	23	Bank sand......................	cubic yd.	.85
	24	River sand...........	"	1.08
	25	River sand, screened......... ...	"	1.24
	26	Fine sand from Belleville and Romainville..........	"	.70
	27	Mortar, 2 parts cement, 5 parts river sand..............	"	3.10
	28	Cement, powdered...............	"	4.34

Nature of the Work.	Nos. of the Prices.	Designation of the Undertakings.	Units.	Price per Unit.
Signals or Lanterns..	29	Signal or lantern with oil..........	night	$ .13
Raw Stone.	30	Broken stone including unloading in the first sixteen wards and outside the city limits................	cubic yd.	3.20
	31	Same in four last wards...........	"	3.36
	32	Rough quarry stone.............	"	1.92
Natural and Broken Gravel. ...	33	Raw gravel unloaded in yards or at place of work in the ten first wards.	"	1.28
	34	In last ten wards.................	"	1.12
	35	Crushed gravel in first ten wards...	"	1.76
	36	In last ten wards, and outside city limits.........	"	1.60
	37	Excess value for selected gravel, ¾ inch or half gravel.............	"	.24
Earth and Soil.......	38	Fertile soil in trenches or holes for trees, etc., delivered in place.....	"	.72
	39	Earth for the gardener delivered where needed....	"	.96
	40	Manure delivered in place...... ...	"	1.20
	41	Straw and strong manure delivered in place.........	"	.96
Props.....	42	Posts for props, from 2 to 4 yds. long	each	.18
	43	The same, 4 to 5 yds. long........	"	.25
	44	" 5 to 6 "	"	.40
	45	" 6 to 8 "	"	.50
	46	The same, length 1½ yds., circumference 3 inches....	100	3.00
	47	The same, length 1⅓ yds. circumference 2½ inches............	100	2.40
	48	Same, of willow or buckthorn from 2 to 2½ yds. long..............	50	.25
	49	Tree boxes...............	each	2.00
	50	Corset tree boxes, 2⅔ yards high, carbonized by the Lapparent method and painted...................	"	.95
	51	Same, not carbonized	"	.90
	52	Same, neither set nor painted......	"	.80
	53	Grillage tree boxes of iron, polished, primed and weighing 30 lbs......	"	1.80
	54	Each 2.2 lbs. more or less of above.	"	.12
	55	Straw buffers about 2 in. thick and wide and 5 in. long, like those employed by the city, per thousand..	1000	3.60

Nature of the Work.	Nos. of the Prices.	Designation of the Undertakings.	Units.	Price per Unit.
Props.....	56	Platted straw about 2 in. and 1 in. thick like those employed per linear meter (39 inches)		$.03
		CHAPTER III. HAND WORK AND LABOR. (Tools, etc.. included.) *1st—Earth and gravel work.*		
Cracking stone.....	57	Breaking of crushed stone, quartz, porphyry to 2 inch..............	cubic yd.	.96
	58	Same, sandstone and granite.......	"	.48
	59	" soft stone.................	"	.16
	60	Breaking gravel..................	"	.48
Excavation, Tearing away and breaking up	61	Excavating all kinds of earth, loose measurement..................	"	.08
	62	Breaking up old masonary, limestone or rock without blasting....	"	.32
	63	Supplementary for blasting when ordered....	"	.40
	64	Breaking up gravel roadway to 8 in. depth........................	sq. yd.	.17
	65	Same, beyond previous depth.... .	cubic yd.	.56
	66	Breaking up of asphalt mastic surfaces, including concrete foundation........................	sq. yd.	.03
	67	Excavation by ploughing	cubic yd.	.01
	68	Breaking up ground including breaking of lumps, to 1 ft. depth......	sq. yd.	.03
	69	Supplementary for each 4in. additional depth......................	"	.01
	70	Spading land planted or under culture, including raking and burying the refuse growth, for the first spading of the year............	"	.005
	71	The same for other spading or hoeing in same year	"	.003
	72	Spading from 4 to 8 inches deep, for establishing lawns, borders, including smoothing the ground and piling up roots and small stones..	"	.01
	73	Ploughing 4 to 8 inch depth including furnishing the outfit needed.	acre	8.00
	74	The same, but for land under culture.........	"	4.80
	75	Harrowing with one horse including outfit needed..............	"	1.20
	76	The same, by hand labor, including outfit needed..................	"	4.80

Nature of the Work.	Nos of the Prices.	Designation of the Undertakings.	Units	Price per Unit.
Square or round holes for Trees..	77	Holes for trees, made square or circular, 10 x 10 x 20 in. deep......	hole	$ .01
	78	Same, 26 x 26 x 24 "	"	.05
	79	" 26 x 26 x 32 "	"	.06
	80	" 39 x 39 x 31 "	"	.09
	81	" 39 x 39 x 39 "	"	.12
	82	" 88 x 88 x 39 "	"	.27
	83	" 150x150 x 39 "	"	.53
Shaping...	84	Shaping slopes forming, including, shovelling of a less depth than 8 inch average	sq. yd.	.01
Shovelling and Loading.......	85	Shovelling earth measured in loose lumps and other materials of the same kind into barrels and carts..	cubic yd.	.04
	86	Raising with a hod or bucket by rope, ladder or stairway, excavated material of every kind for each yard of height................	"	.04
	87	Picking loose material upon staging, whatever the material...........	"	.02
		N. B. This price will not be allowed unless the material has been left by orders at least 8 days in place.		
Collecting.	88	Gathering together small stones from the places hoed and distribution of the same on the roadway.	"	.48
Raking....	89	Raking earth surfaces and piling the refuse stones....	sq. yd.	.004
	90	Raking simple sand walks or land to take off seeds.....	"	.001
Levelling and Ramming......	91	Debris levelling	cubic yd.	.01
	92	Ramming layers, each 4 in., of excavated or embanked sand.......	"	.03
	93	Spreading and levelling material for gravel or macadam roadway, by layers, less than 2 in............	sq. yd.	.003
	94	Same, from 2 in. to 5 in...........	"	.004
	95	" " 5 in. to 8 in...........	"	.006
	96	" deeper than 8 in............	"	.009
Spreading.	97	Spreading sand on sidewalks and paths, including wheelbarrow work.........................	cubic yd.	.04
	98	Spreading gravel and broken stone on roadways, including wheelbarrow work.................	"	.04

Nature of the Work.	Nos. of the Prices.	Designation of the Undertakings.	Units.	Price per Unit.
Sowing and Rolling. . .	99	Sowing lawns, raking and rolling. . .	acre	$16.00
	100	Rolling after sowing, using one horse.	"	.45
	101	Hand rolling after sowing.	"	4.80
	102	Cutting earth or grass borders, per yard.	yard	.005
Transportation in Limits of Contract. .	103	Transporting in wheelbarrows excavated material, clods and similar materials, each 98 ft. on a level, and more than 62 ft. on a 6% grade or steeper.	cubic yd.	.03
	104	Loading wagons, transporting and unloading excavated material, place measurement, each 325 ft. transported.	"	.12
	105	Same, measured in wagon.	"	.10
	106	Each additional 325 ft. transportation.	"	.02
Transportation to Public Dumps. . . .	107	The same, measure in wagon.	"	.10
	108	Loading and transportation to public dumps and unloading, incidental expenses included, of excavated material, measured in place; in first ten wards.	"	.72
	109	Same, in last ten wards and outside of (fortifications) inner city limits.		
	110	The same, including excavation, in first ten wards.	"	.64
	111	Same, in last ten wards and outside of (fortifications) inner city limits.	"	.80
		N. B. For the materials of 108, 109, 110, 111, $\frac{1}{6}$ will be deducted when measured in the wagon.	"	.72
	112	Loading, transportation, to public dumps, stone chips, cuttings, earth from working yards, measured in wagon, in first ten wards.	"	.56
	113	Same, in last ten wards, and outside of inner city limits	"	.48
	114	Transportation of leaves to the horticultural establishments.	"	.16

Nature of the Work.	Nos. of the Prices.	Designation of the Undertakings.	Units.	Price per Unit.
Piling, Sifting and Sorting....	115	Unloading and placing sand, gravel, broken stone..................	cubic yd.	$ .03
	116	Unloading and arranging in rectangular piles, rocks and natural stone..................... ..	"	.05
	117	Sifting sand and detritous from stone taken from gravel and macadam roadways..............	"	.06
	118	Sorting out broken stone to size of 2½ inches....................	"	.24
		2d Paving.		
Labor Paving.......	119	Taking up pavements........... .	sq. yd.	.02
	120	Cleaning paving blocks.	"	.02
	121	New paving raised to its proper level for all labor	"	.13
	122	Picking over less than 2½ sq. yds. of surface, including taking up pavement......................	"	.18
		N. B. Picking over with pick more than 2½ sq. yds. will be counted as adjustment (121).............		
	123	Supplementary pay for more than forty paving stones per square meter (33⅓ stones per sq. yd.)....	"	.03
	124	Supplmentary pay for paving over trenches for sewer, water or gas, and over filling of 39 in. or more.	"	.12
	125	Taking up each sand layer.......	"	.002
	126	Repaving over trenches opened for sewers, tunnels, water and gas pipes and for all necessary work, and sand required for a depth of 8 in., labor or taking up and repairing the required shape of the surface, filling the joints, etc., taking away and dumping the earth, sand, stone chips, etc. resulting from grinding, using original blocks, relaying them, transporting to the paving yards superfluous blocks and bringing needed extra blocks from the yards, including all that is necessary to maintain the work until it is officially received.	"	.51

Nature of the Work.	Nos. of the Pieces.	Designation of the Undertakings.	Units.	Price per Unit.
Labor Paving......	127	Ramming each layer of sand 4 to 6 in....	sq. yd.	$ .004
	128	Filling in with old paving stones...	"	.05
	129	New paving on a better mortar including a foundation of 1.5 in. sand foundation................	"	.26
	130	Supplementary pay for new paving adjusted within the horse-car belts or zones, when the line is not in use......................	"	.04
	131	Same, when the horse-car line is in use; on lines of the first class under the maintenance prices agreed to by the street railway companies.....................	"	.12
	132	Same, lines of second class........	"	.11
	133	" " third "	"	.09
Setting and Resetting Curbstones	134	Taking up curbs of sandstone, chateau landon stone of sidewalks and laying them along the side of a road...	yard.	.02
	135	Setting or resetting the same.	"	.07
Recutting Paving Blocks....	136	Breaking up into large paving stones	1000	11.00
	137	Redressing old blocks to standard, width 3 to 4 or 5 to 6, length 6, depth 6 in....................	"	12.00
	138	Same, to standard, width 3 to 4 or 5 to 6, length 8, depth 6 in........	"	16.00
	139	Same, to standard, width 3 to 4 or to 5 and 6 in. in depth........ .	"	18.00
	140	Recutting old paving blocks to model for carriage entrances, cross walks of macadam roads...	"	15.00
Dressing and cutting curbstones.	141	Dressing sandstone or C. Landon stone, curbs of sidewalks including joints	yard.	.14
	142	Cutting raised portion between, chiselling of same..............	"	.20
Moving old and new Paving stones. 1, in barrows......	143	Transporting in wheelbarrow paving stones, 32 yds. on a level or 21 yds. of at least a 6% grade including time for loading and unloading, for stones containing more than ¼ cu. ft. each........	1000	1.00

Nature of the Work.	Nos. of the Prices.	Designation of the Undertakings.	Units.	Price per Unit.
Moving old and new Paving stones. 1, in barrows......	144	Same, stones from $\frac{1}{8}$ to $\frac{1}{4}$ cu. ft......	1000	$ .60
	145	" " less than $\frac{1}{8}$ "	1000	.40
	146	" each space of 32 yds. additional transportation for stone of *143*.	1000	.50
	147	Same, stone of 144..............	1000	.30
	148	" " 145	1000	.20
		N. B. A distance of 16 yds short will not be counted, but full 16 yds. and above will be counted as a relay................		
Moving old and new Paving stones. 2, in wagons.......	149	Transportation in wagons an initial distance of 108 yds., including time and labor of loading and unloading, gathering them from any height, for paving stones of size in *143*...................	1000	3.20
	150	Same, " *144*...................	1000	1.80
	151	" " *145*...	1000	1.20
	152	Supplementary pay for each 108 yds. for stone, size *143*.............	1000	.22
	153	Same, " *144*...............	1000	.11
	154	" " *145*...............	1000	.06
Moving old and new Paving stones from Storage places to place of work and inversely..	155	Transportation of paving blocks from storage yards in relation to the area of the contract to the place of work, including time and labor of loading and unloading for stones of and above size in *143*.	1000	8.40
	156	Same, for sizes of *144*...........	1000	4.40
	157	" " " 145...........	1000	2.60
		N. B. End blocks will be counted as ordinary paving blocks, according to their several cubic sizes		
Removal of chips and pieces of Stone.....	158	In the first ten wards.............	cubic yd.	.56
	159	" last ten wards, inner city limits.	"	.48
Moving and Handling stone curbs	160	A linear meter (39 in.) of curbstone, of sandstone, or C. Landon stone, for transportation will be equivalent to seven paving stones, 9 in. cube, this includes loading, unloading and all other handling......		
		N. B. For the prices for work not covered by the present schedule, the prices of the schedule for curbstones in force for the maintenance of works under the administration of the Public Works of Paris. These prices will be subject to the same discount as the prices of this schedule (article No 40 of the specifications)		

The present Schedule is drawn up by the Chief Engineers undersigned.

PARIS, the 30th of Oct. 1879.

Chief Engineer of Public Highways (1st Division), (Signed) ALLARD.	Chief Engineer of Public Highways (2d Division), (Signed) DE FONTANGES.

Chief Engineer of Avenues, Carriages and Concessions on Public Highways.

(Signed) E. HUET.

Registered at Paris, Bureau of Acts of the Administration the 15th of January, 1880. Folio 39, Volume c–e 8.

Received (tax) three francs, seventy-five centimes, decimes included.

(Signed) VILLETTE.

($0.75.)

VIII. ABSTRACT OF CORRESPONDENCE WITH COMMITTEE.

RESOLUTIONS OF COMMERCIAL ORGANIZATIONS.

BUFFALO MERCHANTS' EXCHANGE
favors immediate lock enlargement, to be followed by deepening of prism to nine feet.

CANAL ENLARGEMENT ASSOCIATION
recommends second proposition for lock enlargement and deepening prism to nine feet.

CHAMBER OF COMMERCE OF THE STATE OF NEW YORK
favors enlargement of the locks as the first step, to be followed by further improvements.

NEW YORK BOARD OF TRADE AND TRANSPORTATION
favors lock enlargement and deepening of Erie and Oswego canals to nine feet, and Champlain canal to seven feet.

NEW YORK PRODUCE EXCHANGE
favors a canal not less than fourteen feet in depth.

STATE COMMERCE CONVENTION
favors improvement of the Erie, Oswego and Champlain canals on a progressive policy, securing the greatest benefits in the shortest time.

REPLIES TO CIRCULAR OF MAY 1ST.

ABBOTT, LYMAN, NEW YORK CITY,
considers that State action should be limited to first or second propositions; abandonment a hazardous experiment.

BABCOCK, STEPHEN E., LITTLE FALLS, N. Y.,
favors second proposition, and makes suggestions as to method of enlarging locks, elimination of lockage and relocation of Erie Canal from Lyons to Syracuse.

Bowers, L. M., Cleveland, O.,
favors the construction of a ship canal by the general government.

Buffalo Freie Presse, Buffalo, N. Y.,
advocates canal improvement and favors first proposition.

Burr, Wm. H., New York City,
favors first proposition for Champlain and Oswego canals; and, if not too costly, the 1,500-ton barge canal for the Erie route.

Callaway, S. R., New York City,
N. Y. C. & H. R. R. R., is preparing its roadway and equipment for 2,400-ton train loads of grain, which will make possible very low railroad rates.

Canal Enlargement Association, Buffalo, N. Y.,
favors lock enlargement and deepening of prism to nine feet.

Chamberlin, John, Buffalo, N. Y.,
favors enlargement of locks, and opposes a ship canal.

Clark, Capt. W. C., Buffalo, N. Y.,
presents advantages of water over rail transportation.

Clarke, Thomas Curtis, New York City,
favors a fourteen foot canal to Lake Champlain and St. Lawrence River to connect with proposed Georgian Bay Canal.

Clarkson, E. M., New York City,
urges completion of project of 1895 first; lock enlargement to follow.

Cleary, Wm. E., New York City,
favors improvement; first and second propositions alone are practicable; doubtful if twenty-five feet wide boats can navigate present canal.

Clinton, George, Buffalo, N. Y.,
urges completion of project of 1895, as the largest improvement possible without extensive relocation of Erie Canal.

Collingwood, F., New York City,
considers proposition 2 (b) most likely to be both possible of accomplishment and successful in its results.

Cooley, Lyman E., Chicago, Ill.,

submits programme of improvements pending construction by U. S. Government of ship canal via Lake Champlain, the State work to include a permanent barge route from Lyons to the Hudson.

Corthell, E. L., New York City,

advises against the further expenditure of large sums for canal enlargement and argues in favor of railroad transportation.

Coykendall, S. D., Rondout, N. Y.,

favors a canal suitable for barges of 2,000 tons capacity.

Dutton, Chauncey N., New York City,

argues in general terms for a capacious water route on the main transportation axis from Buffalo to New York.

Edson, Franklin, New York City,

favors the completion of the project of 1895, but with main locks on Erie Canal enlarged to provide for a future barge canal.

Elmira Advertiser, Elmira, N. Y.,

favors the surrender of the canals to the general government or their abandonment.

Engineering News, New York City,

urges the probability of lower railroad rates in the future which will make the canal route unnecessary.

Evans, E. T., Buffalo, N. Y.,

favors immediate enlargement of Erie Canal locks.

Fish, Stuyvesant, New York City,

thinks railroads cannot make a rate of one mill per ton-mile but that rail rates must be materially raised in the near future because of the increased cost of rendering the service.

Greene, George S., Jr., New York City,

propositions one and two in the right direction; but considers 12 ft. barge canal the best plan.

Hall, Gordon W., Lockport, N. Y.,

outlines plan for electric propulsion on canals.

Haupt, Lewis M., Philadelphia, Pa.,

advocates improvement of the canals.

HEFFORD, R. R., BUFFALO, N. Y.,
advises the enlargement of locks first, followed by deepening of prism for boats of 8 ft. draught.

HEWITT, A. S., NEW YORK CITY,
discusses reductions in railroad rates, and does not favor further expenditure for improving the canals at the present time.

HILL, JAMES J., ST. PAUL, MINN.,
suggests a depth of ten feet for Erie Canal.

JOHNSON, EMORY R., PHILADELPHIA, PA.,
favors a canal suitable for barges of 1,500 tons capacity; improvements to begin with enlargement of the locks.

JONES, EDWARD F., GEN., BINGHAMTON, N. Y.,
favors control and enlargement of canals by the federal government.

JOURNAL OF COMMERCE, NEW YORK CITY.
editorial article discussing *Engineering News* articles on railroad rates, and urging the importance of the canal as a regulator of railroad rates.

KNIGHTS OF LABOR, NEW YORK CITY
Resolution favoring enlargement of the locks as a first step in canal improvement.

MCECHRON, WM. M., GLENS FALLS, N. Y.,
favors the completion of project of 1895, and urges especially the immediate completion of improvement on Champlain Canal north of Ft. Edward.

MARINE RECORD, CLEVELAND, O.,
favors canal suitable for barges of 1,500 tons capacity.

MORISON, GEORGE S., NEW YORK CITY,
favors continuously descending barge canal; locks should be enlarged, first using temporary construction on sections of present canal to be abandoned in barge canal.

NILES, HENRY T., TOLEDO, O.,
opposes a ship canal, and considers a canal suitable for 1,500-ton barges will be a complete and final solution of the question.

NIMMO, JOSEPH, JR., HUNTINGTON, L. I.,
suggests lines of investigation in reference to railway competition, through shipments and commercial statistics.

NOBLE, ALFRED P., CHICAGO, ILL.
data not at hand for a definite conclusion between barge and ship canal; suggests the possibilities of Canadian route via the St. Lawrence River.

NORTH, EDWARD P., NEW YORK CITY,
favors a ship canal on Erie route, and pending construction suggests deepening of present prism to facilitate navigation and encourage boat construction.

NOTT, GORDON H., CHICAGO, ILL.,
favors enlargement of locks to accommodate 2,000-ton boats to be followed by deepening prism to 9 ft.

RAFTER, GEORGE W., ROCHESTER, N. Y.,
discusses surveys by Deep Waterways Commission, relocation of Erie Canal from Newark to Syracuse, and importance of large transportation companies.

REED, J. H., PITTSBURG, PA.,
The cost of transportation on the P., B. & L. E. R. R. averages 1.5 mills per ton-mile, and the freight earnings 3.65 mills per ton-mile.

ROGERS, WM. A., BUFFALO, N. Y.,
favors the immediate enlargement of locks as mentioned in second proposition.

RYAN, THOMAS M., BUFFALO, N. Y.,
favors enlargement of locks and deepening of prism to nine feet.

SCHENCK, MARTIN, TROY, N. Y.,
favors construction of a barge canal, if possible one suitable for boats of 1,200 to 1,500 tons capacity.

SCHWAB, GUSTAV H., NEW YORK CITY,
favors construction of barge canal for barges of 1,200 to 1,500 tons capacity.

SLOAN, GEORGE B., OSWEGO, N. Y.,
favors completion by the State of project of 1895, hoping for construction of ship canal by federal government.

SPALDING, H. C., NEW YORK CITY,
discusses construction of 11 ft. canal, and favors eliminating many locks by combining neighboring locks into single large lifts.

STANWIX ENGINEERING CO., ROME, N. Y.,
favors enlargement of locks to accommodate barges of 1,200 to 1,500 tons, with ultimate enlargement of prism.

TAUSSIG, F. W., CAMBRIDGE, MASS.,
considers that enlargement of Erie Canal will not meet railway competition; uncertain as to success of a large barge canal; ship canal would not benefit New York.

TOURGEE, ALBION W., BORDEAUX, FRANCE (U. S. CONSUL.)
favors construction of double-track freight railway on canal right of way.

TUBBS, J. NELSON, ROCHESTER, N. Y.,
favors completion of project of 1895; and urges that 25 ft. wide boats cannot navigate present canal.

VAN BUREN, JOHN D., NEWBURG, N. Y.,
favors completion of the project of 1895, presenting statistical estimates of cost of construction and transportation for the various propositions.

WINDMUELLER, LOUIS, NEW YORK CITY,
favors construction of a canal suitable for barges of 1,500 tons capacity.

WRIGHT, JOHN A. C., ROCHESTER, N. Y.,
considers a nine foot depth the utmost possible on present route of Erie Canal; locks should be enlarged first.

IX. ABSTRACT OF PUBLIC HEARINGS.

BUFFALO MERCHANTS' EXCHANGE, JUNE 14, 1899.

C. Hallam Keep, Secretary of the Buffalo Merchants' Exchange, read various resolutions adopted by the Harbor and Canal Committee of the Buffalo Merchants' Exchange, the Canal men of Buffalo, and the Canal Enlargement Association; also letters from J. J. Albright and John Laughlin, of Buffalo—all in favor of canal improvement.

Captain Thomas Ryan spoke in favor of the proposal to enlarge the locks on the Erie Canal for boats 125 feet long and 25 feet wide, stating that such boats could navigate the present canal, and that with enlarged locks he would agree to build large boats at once.

L. P. Smith said it was practical to run boats 125 by 25 feet on the present canal provided the silt was taken from the bottom of the canal and a few of the worst bends were straightened.

Gordon W. Hall thought there would be no trouble in navigating the present canal with boats 25 feet wide. He said that during the former enlargement the large boats 17½ feet wide were built as soon as the large locks were built and were used before the prism was enlarged, when the canal width was but 45 feet. He considered steamboats the best method of traction thus far developed.

George T. Gilson agreed with the plan for enlarging the locks, said the expenditure of the nine million dollars had improved the canals and made navigation easier, and considered steamboats cheaper than hauling by animals.

Niles Case opposed the plan for enlarging the locks first, and favored completing the project which had been begun of deepening the canal.

Edward McConnell favored the plan for enlarging the locks.

George H. Raymond urged the enlargement of the locks, and presented the possibilities of an enlarged canal in connection with the development of the iron and steel trade in New York State. In reference to the limit on capital of canal transportation companies, he said that would not apply to a company incorporated in another state, and mentioned the Cleveland Steel Canal Boat Company, with a capital of $150,000, now operating on the canals. He said it was not practicable to move grain from Chicago or Duluth to New York without the transfer at Buffalo.

William A. Rogers said that the business community favored the improvement of the Erie Canal, and spoke of the importance of the iron trade which could be secured by the canal.

Hon. Henry Hill spoke in favor of improving the canals, and of their importance to the State of New York.

NEW YORK PRODUCE EXCHANGE, OCTOBER 20, 1899.

G. Waldo Smith spoke in favor of improving the canals, mentioning some points discussed in the recent Commerce Convention at Utica, especially the usefulness of the canal for transporting iron to the seaboard.

Stephen Hoye presented the papers in the law suit of the canal boatmen against the Dock Board of the City of New York for depriving them of the use of the canal piers on the East River.

F. B. Thurber stated that the Chamber of Commerce felt that the canals should be maintained, and that the consensus of opinion favored the project for the immediate enlargement of the locks. In reference to Mr. Hewitt's recent position, the feeling among the members of the Chamber of Commerce Committee on Internal Improvement was that he had not given sufficient consideration to what the canals might be if they had a fair chance under reasonable improvement.

Arthur F. Corwin said that the Merchants' Association believed the canals should be maintained and enlarged; that the recent reductions in railroad rates had been in those commodities for which the canals were competitors.

Lester W. Beasley said that the Maritime Exchange felt that the canals ought to be improved, and spoke of the advantages of canal boats over railroad cars in being able to deliver grain to the ocean steamers without transfer.

H. B. Hebert discussed the Canadian routes which were diverting trade from New York, and presented the resolutions adopted by the Board of Managers of the Produce Exchange, which favored a canal of not less than 14 feet depth from Buffalo to the Hudson River.

William E. Cleary showed the influence of the canals on railroad rates, citing an instance where iron had been brought from 100 miles west of New York to be shipped west by the canal because the railroads had supposed they were beyond canal competition.

Frank S. Gardner presented the resolutions adopted at the Canal and Commerce Convention held at Utica, representing 53 commercial organizations, 4 boards of supervisors, 11 cities, and 19 incorporated villages in New York State—the resolutions favoring the improvement of the Erie, Oswego and Champlain Canals under a progressive scheme.

Dr. S. A. Robinson, of the Staten Island Chamber of Commerce, favored the maintenance and improvement of the canal.

F. S. Gardiner called attention to the report of the New York Board of Trade and Transportation made to the Committee on Canals, and urged that the needs of New York required a solution of the canal problem that should produce results at a very early day.

Erastus Wiman said the causes of the failure of the canals were the absence of organized traffic management, and the lack of terminal facilities.

Adam E. Schatz spoke in reference to traction on the canals, and referred to an invention of his for moving canal boats.

X. ABSTRACT OF MINUTES OF COMMITTEE MEETINGS.

The Committee appointed by the Governor to report upon the proper policy to be pursued by the State of New York in canal matters met at Albany, March 17th, 1899, and after consulting the Governor, made arrangements to secure information in regard to the canals in other States and in Canada.

A meeting of the Committee on Canals was held in New York, on March 24th, at which Francis V. Greene was elected Chairman; and various reports and correspondence on canal matters were read and discussed.

At a meeting of the Committee on Canals held in New York, March 31st, John A. Fairlie, Ph. D., was appointed Secretary and Statistician to the Committee; various reports on canals and internal commerce were received; and it was decided that the Committee should examine the canals of New York and Canada during the month of May.

The Committee on Canals met in New York on April 7th. A proposition to send a letter to those cognizant of canal matters, requesting their opinion on the present situation in New York, was discussed, and it was afterwards agreed to send such a letter. Suggestions were also made in reference to the statistics on commerce, freight rates, to be prepared for the use of the Committee.

At a meeting of the Committee, held in New York, April 21st, it was decided that the examination of the New York and Canadian canals should be made from May 17 to 24th. The circular letter to be sent out was discussed and adopted; and a list of those to whom the letter should be sent was prepared. Later, it was decided to send the letter also to the principal newspapers in the State; and the letter was sent out on May 1st.

The Committee on Canals met at New York, May 12th, and arranged the detailed itinerary for the investigation of the New

York and Canadian canals. Replies received to the circular letter of May 1st were also read and discussed.

From May 17th to the 24th, the Committee on Canals made an examination of the canals of New York State and Canada. Starting from Albany, special examinations were made at Cohoes, Schenectady, Little Falls, Syracuse, Oswego, Rochester, Lockport and Buffalo. In Canada, the Welland, Galop's, Cornwall, Soulanges and Lachine canals, and also the Montreal Harbor facilities, were inspected, the officials in charge showing the Committee every courtesy. On the return from Montreal, the Champlain Canal was examined, special investigations being made at Whitehall, Fort Edward, Glens Falls and Fort Miller. During the trip a large number of letters in reply to the circular letter of May 1st were received and discussed.

At a meeting of the Committee, held in Buffalo, June 14th, various suggestions on the propositions submitted by the Committee, made in replies received to the circular of May 1st, were carefully discussed. It was agreed that the State Engineer should have prepared plans and estimates of cost for the enlargement of the locks on the Erie Canal to accommodate boats 125 feet in length, 25 feet wide and 10 feet draft; and the Chairman was authorized to employ an engineer to undertake engineering investigations in reference to proposed plans of enlargement. It was agreed that the abandonment of the canals should not be considered; that the ship canal project was one for consideration by the National Government; and that the Committee should give special attention to plans for the enlargement of the canals.

On the afternoon of the 14th, the public hearing at Buffalo was held;* and next morning an examination was made of the Buffalo harbor facilities and government improvement works.

The Committee on Canals met in New York on August 3d, and engaged Mr. George W. Rafter to investigate the cost and feasibility of proposed new routes for the Erie Canal from Newark east, and for other engineering problems. The plans and drawings prepared in the State Engineer's office for enlarging the locks of the Erie Canal were presented and carefully examined. Various other matters were discussed informally.

At a meeting of the Committee held at Jamestown, R. I., August 18th, the plan and some general features of the report

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*See page 133.

of the Committee were discussed; and the Chairman was requested to draft those parts of the report on which decisions had been reached.

A meeting of the Committee on Canals was held at Albany, on October 6th. It was agreed to hold a public hearing at the New York Produce Exchange about the 20th of October. Major Symons submitted a memorandum in regard to the cost of transportation by boats on the present and an enlarged Erie Canal. An opinion prepared at the request of the chairman by Avery D. Andrews, Esq., upholding the constitutionality of assessing the cost of canal improvement on the canal counties was read; and after discussion it was decided that this method should be recommended by the Committee.

Mr. George W. Rafter submitted a preliminary report of his investigations; and additional instructions were given him in reference to further work. Major Symons was authorized to employ engineers to make estimates on the cost of enlarging the locks and prism of the Erie Canal.

It was agreed to have the report of the Committee printed and ready for distribution when the Governor submitted the report to the Legislature.

At a meeting of the Committee on Canals in New York, October 20th, Mr. H. C. Spaulding exhibited plans for a ship railway to be used in place of the canal locks at Lockport, which were examined and discussed. It was resolved that for the Oswego and Champlain canals, the Committee would recommend the completion of the improvement of 1895, with the possible substitution of the Hudson River for part of the Champlain Canal. Major Symons reported that he had employed Messrs. D. J. Howell and F. M. Sylvester to estimate the cost of the improvement plans for the Erie Canal under consideration. In the afternoon a conference with the Canal Committee of the New York Produce Exchange and a public hearing were held.

The Committee on Canals met in New York on November 23d and 24th. The reports of Messrs. George W. Rafter and F. M. Sylvester were submitted and also preliminary report from Mr. D. J. Howell. All of these were examined and discussed; and Mr. Rafter was requested to undertake certain additional investigations, some changes being also made in the instructions to Mr. Howell.

On December 12th and 13th, the Committee on Canals held conferences with the Canal Committee of the New York Produce Exchange in reference to the enlargement of the Erie Canal.

A meeting of the Committee on Canals was held in New York on December 20th and 21st. The report of Mr. D. J. Howell and supplementary report by Mr. George W. Rafter, together with summary, prepared by Major Symons, of all the estimates, were submitted. These were considered and carefully discussed; and it was agreed that the engineers should be engaged to prepare a joint report on those propositions which, with the information at hand, the Committee decided should have further consideration.

At a meeting of the Committee on Canals held in New York on January 3d, the joint report of Messrs. Rafter, Howell and Sylvester, prepared under instructions given at the previous meeting, was submitted and carefully considered. It was moved by Mr. Scatcherd, and seconded by Mr. George E. Green, that the Committee should recommend to the Governor that the Erie Canal should be enlarged to accommodate boats not less than 150 feet in length, 25 feet in width, and 10 feet draft, at an estimated cost of $58,894,000; and that the improvement of 1895 on the Oswego and Champlain canals should be completed at an estimated cost of $2,642,120. After full discussion, the roll of the Committee was called on this motion, and resulted as follows:

Ayes.—F. V. Greene, George E. Green, John N. Scatcherd, Thomas W. Symons, Frank S. Witherbee, Edward A. Bond, and J. N. Partridge.

Noes.—None.

The Chairman was directed to draft the report of the Committee in accordance with this resolution.

XI. EXTRACTS FROM THE CONSTITUTION OF THE STATE OF NEW YORK RELATING TO CANALS.

ARTICLE V.

Section 1. The Secretary of State, Comptroller, Treasurer, Attorney-General, and State Engineer and Surveyor shall be chosen at a general election at the times and places of electing the Governor and Lieutenant-Governor, and shall hold their offices for two years, except as provided in section two of this article. Each of the officers in this article named, excepting the Speaker of the Assembly, shall, at stated times during his continuance in office, receive for his services a compensation which shall not be increased or diminished during the term for which he shall have been elected; nor shall he receive to his use any fees or perquisites of office or other compensation. No person shall be elected to the office of State Engineer and Surveyor who is not a practical civil engineer.

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Section 3. A superintendent of public works shall be appointed by the Governor, by and with the advice of the Senate, and hold his office until the end of the term of the Governor by whom he was nominated, and until his successor is appointed and qualified. He shall receive a compensation to be fixed by law. He shall be required by law to give security for the faithful execution of his office before entering upon the duties thereof. He shall be charged with the execution of all laws relating to the repair and navigation of the canals, and also of those relating to the construction and improvement of the canals, except so far as the execution of the laws relating to such construction or improvement shall be confided to the State Engineer and Surveyor; subject to the control of the Legislature, he shall make rules and regulations for the navigation or use of the canals. He may be suspended or removed from office by the Governor, whenever, in his judgment, the public interest shall so require; but in case of the removal of such Superintendent of Public Works from office, the Governor shall file with the Secretary of State a statement of the cause of such removal and shall report such removal and the cause thereof to the Legislature at its next session. The Superintendent of Public Works shall appoint not more than three assistant superintendents, whose duties shall be prescribed by him, subject to modification by the Legislature, and who shall receive for their services a compensation to be fixed by law. They shall hold their office for three years subject to suspension or removal by the Superintendent of Public Works, whenever, in his judgment, the public interest shall so require. Any vacancy in the office of any such assistant superintendents shall be filled for the remainder of the term for which he was appointed, by the Superintendent of Public Works, but in case of suspension or removal of any such assistant superintendent by him, he shall at once report to the Governor, in writing, the cause of such removal. All other persons employed in the care and management of the canals, except collectors of tolls, and those in the department of the State Engineer and Surveyor, shall be appointed by the Superintendent of Public Works, and be subject to suspension or removal by him. The Superintendent of Public Works shall perform all the duties of the Canal Commissioners, and Board of Canal Commissioners, as now declared by law, until otherwise provided by the Legislature. The Governor, by and with the advice and consent of the Senate, shall have power to fill vacancies in the office of Superintendent of Public Works; if the Senate be not in session, he may grant commissions which shall expire at the end of the next succeeding session of the Senate.

Section 5. * * * The Lieutenant-Governor, Secretary of State, Comptroller, Treasurer, and Attorney-General shall be the Commissioners of the Canal Fund. The Canal Board shall consist of the Commissioners of the Canal Fund, the State Engineer and Surveyor and the Superintendent of Public Works.

Section 6. The powers and duties of the respective boards, and of the several officers in this article mentioned, shall be such as now are or hereafter may be prescribed by law.

ARTICLE VII.

Section 1. The credit of the state shall not in any manner be given or loaned to or in aid of any individual, association or corporation.

Section 2. The State may, to meet casual deficits or failures in revenues, or for expenses not provided for, contract debts; but such debts, direct or contingent, singly or in the aggregate, shall not at any time exceed one million of dollars; and the moneys arising from the loans creating such debts shall be applied to the purpose for which they were obtained, or to repay the debt so contracted, and to no other purpose whatever.

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Section 4. Except the debts specified in sections two and three of this article, no debts shall be hereafter contracted by or on behalf of this State, unless such debt shall be authorized by law, for some single work or object, to be distinctly specified therein; and such law shall impose and provide for the collection of a direct annual tax to pay, and sufficient to pay, the interest on such debt as it falls due, and also to pay and discharge the principal of such debt within eighteen years from the time of the contracting thereof. No such law shall take effect until it shall, at a general election, have been submitted to the people, and have received a majority of all the votes cast for and against it at such election. On the final passage of such bill in either house of the Legislature, the question shall be taken by ayes and noes, to be duly entered on the journals thereof, and shall be: "Shall this bill pass, and ought the same to receive the sanction of the people."

The Legislature may, at any time, after the approval of such law by the people, if no debt shall have been contracted in pursuance thereof, repeal the same; and may at any time, by law, forbid the contracting of any further debt or liability under such law; but the tax imposed by such act, in proportion to the debt and liability which may have been contracted, in pursuance of such law, shall remain in force and be irrepealable and be annually collected, until the proceeds thereof shall have made the provision hereinbefore specified to pay and discharge the interest and principal of such debt and liability. The money arising from any loan or stock creating such debt or liability shall be applied to the work or object specified in the act authorizing such debt or liability, or for the repayment of such debt or liability, and for no other purpose whatever. No such law shall be submitted to be voted on, within three months after its passage, or at any general election when any other law, or any bill, or any amendment to the Constitution, shall be submitted to be voted for or against.

Section 5. The sinking funds provided for the payment of interest and the extinguishment of the principal of the debts of the State shall be separately kept and safely invested, and neither of them shall be appropriated nor used in any manner other than for the specific purpose for which it shall have been provided.

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Section 8. The Legislature shall not sell, lease or otherwise dispose of the Erie Canal, the Oswego Canal, the Champlain Canal, the Cayuga and Seneca Canal, or the Black River Canal, but they shall remain the property of the State and under its management forever. The prohibition of lease, sale or other disposition herein contained, shall not apply to the canal known as the Main and Hamburg street canal, situated in the city of Buffalo, and which extends easterly from the westerly line of Hamburg street. All funds that may be derived from any lease, sale or other disposition of any canal shall be applied to the improvement, superintendence or repair of the remaining portion of the canals.

Section 9. No tolls shall hereafter be imposed on persons or property transported on the canals, but all boats navigating the canals, and the owners and masters thereof, shall be subject to such laws and regulations as have been or may hereafter be enacted concerning the navigation of the canals. The Legislature shall annually, by equitable taxes, make provision for the expenses of the superintendance and repairs of the canals. All contracts for work or materials on any canal shall be made with the persons who shall offer to do or provide the same at the lowest price, with adequate security for their performance. No extra compensation shall be made to any contractor; but if, from any unforeseen cause, the terms of any contract shall prove to be unjust and oppressive, the Canal Board may, upon the application of the contractor, cancel such contract.

Section 10. The canals may be improved in such manner as the Legislature shall provide by law. A debt may be authorized for that purpose in the mode prescribed by section four of this article, or the cost of such improvement may be defrayed by the appropriation of funds from the State treasury, or by equitable annual tax.

XII. APPROPRIATIONS FOR DEEP WATER-WAY SURVEYS.

1.	55th Congress, 1st session c. 2, June 4, 1897........	$150,000
2.	55th Congress, 2d session, c. 546, July 1, 1898......	225,000
3.	55th Congress, 3d session, c. 424, March 3, 1899....	90,000
	Total	$465,000

SUNDRY CIVIL APPROPRIATION BILL, JUNE 4, 1897.

"For surveys and examinations (including estimate of cost) of deep waterways and the routes thereof between the Great Lakes and the Atlantic tide-waters, as recommended by the report of the Deep Waterways Commission, transmitted by the President to Congress January 18, 1897, one hundred and fifty thousand dollars. Such examinations and surveys shall be made by a board of three engineers to be designated by the President, one of whom may be detailed from the Engineer Corps of the Army, one from the Coast and Geodetic Survey, and one shall be appointed from civil life."

SUNDRY CIVIL APPROPRIATION BILL, JULY 1, 1898.

"For surveys, examinations and investigations (including estimate of cost of deep waterways and the routes thereof between the Great Lakes and the Atlantic tide-waters, as recommended by the report of the Deep Waterways Commission, transmitted by the President to Congress, January 18, 1897, to be made by the board of three engineers designated and appointed by the President for this purpose July 28, 1897, in compliance with the provisions of the Act of June 4, 1897, two hundred and twenty-five thousand dollars; and said board shall make a report of the progress of the work to the Secretary of War, for transmission by him to Congress at the commencement of its next session, and submit in their report the probable and relative cost of various depths for said waterway respectively, as follows: twenty-one and thirty feet, with a statement of the relative advantages thereof."

SUNDRY CIVIL APPROPRIATION BILL, MARCH 3, 1899.

"For completing surveys, examinations and investigations (including estimate of cost of deep waterways and the routes thereof between the Great Lakes and the Atlantic tide-waters, as recommended by the report of the Deep Waterways Commission, transmitted by the President to Congress, January 18, 1897, such examinations and surveys to be made by the board of three engineers designated and appointed by the President for this purpose July 28, 1897, in compliance with the provisions of the Act of June 4, 1897, to be immediately available, ninety thousand dollars."

XIII. STATISTICAL TABLES AND DATA RELATING TO CANALS AND COMMERCE OF NEW YORK.

Compiled, under the direction of the Committee,

BY JOHN A. FAIRLIE, PH.D.

TABLES.

I. FINANCIAL STATEMENTS.

II. TRAFFIC ON NEW YORK CANALS.

III. DETAILS OF CANAL TRAFFIC.

IV. RAILROAD AND CANAL TRAFFIC.

V. FREIGHT RATES.

VI. LAKE COMMERCE.

VII. WELLAND CANAL AND MISSISSIPPI RIVER TRAFFIC.

VIII. FOREIGN COMMERCE.

CHARTS.

MAPS.

Table 1.

NEW YORK CANALS — REVENUES, OPERATING AND MAINTENANCE EXPENSES, COST OF CONSTRUCTION AND IMPROVEMENTS, AND NET RESULTS (EXCLUDING INTEREST) TO THE END OF **1882**, WHEN THE TOLLS WERE ABOLISHED.

From *Financial Report of Auditor of the Canal Department*, 1882, p. 12.

Canals.	Revenues.	Cost of Collection, Superintendence, and Ordinary Repairs.	Results from Operation.		Cost of Construction and Improvements.	Balance Sheet.	
			Loss.	Profit.		Loss.	Profit.
Erie	$121,461,871	$29,270,301		$92,191,570	$49,591,853		$42,599,718
Champlain	6,416,341	5,630,024		786,318	4,913,296	$4,126,978	
Oswego	3.708,548	3.371,446		337,102	4,295,373	3,958,271	
Cayuga and Seneca	1,054,356	1,027,539		26,817	1,834,184	1,807,367	
Genesee Valley	860,165	2,814,809	$1,954,644		6,737,430	8,692,074	
Chenango	744,027	2,081,739	1,337,712		4,789,471	6,127,181	
Chemung	525,565	2,022,259	1,496,694		1,463,586	2,960,280	
Black River	301,100	1,552,230	1,251,130		3,894,952	5,146,083	
Oneida Lake	65,894	144,060	78,166		511,649	589,816	
Oneida River Improvement	217,100	41,170		175,930	224,072	48,142	
Seneca River Tow Path	7,770	20		7,750	1,603		6,147
Cayuga Inlet	8,837	994		7,843	* 2,020		5,823
Baldwinsville	1,261	18,038	16,777		* 31,000	47,777	
Crooked Lake	45,490	424,658	379,168		395,091	774,260	
	$135,418,325	$48,399,287	$6,514,292	$93,533,330	$78,685,580	$34,278,229	$42,611,688
	Net Profit on Operation...		87,019,038				
			$93,533,330	$93,533,330			
	Balance in Excess of Cost of Construction and Maintenance....					8,333,459	
						$42,611,688	$42,611,688

* Does not include payments from the general fund.

Table 2.

ANNUAL EXPENDITURE ON NEW YORK CANALS SINCE 1882.

FOR ORDINARY REPAIRS AND MAINTENANCE.

Compiled from *Reports of Superintendents of Public Works.*

Year.	Erie.	Champlain.	Oswego.	Cayuga and Seneca.	Black River.	Other Canals.	General Expenses.	Total.
1883........	$362,342	$68,305	$28,224	$10,783	$48,130	$2,717	$78,785	$600,951
1884........	413,142	89,431	32,957	10,026	50,691	4,324	107,749	718,325
1885........	387,852	61,286	32,287	13,968	46,701	3,683	147,440	694,297
1886........	423,792	70 185	35,314	11,024	48,675	4 377	107,330	700,697
1887........	426,769	62,801	35,444	16,758	53,013	1,706	142,200	738,707
1888........	439,093	62,481	30,931	13,305	51,262	1,426	143,762	742,263
1889........	413,249	82,397	42,495	10,370	55,745	1,922	128,507	744,689
1890........	426,768	100,026	36,811	13,196	59,114	1,219	142,560	800,056
1891........	415,020	92,332	36,192	13,846	50,617	971	137,098	747,079
1892........	403,425	95,063	32,731	10,593	54,836	1,129	139,268	737,051
1893........	395,075	91,478	30,235	11,255	48,930	1,151	147,957	726,086
1894........	421,898	91,082	32,229	10,140	53,752	1,274	132,377	742,755
1895........	437,045	93,524	33,882	12,156	47,632	1,891	128,229	754,362
1896........	544,808	113,923	32,949	18,760	54,814	1,384	194,863	961,604
1897........	485,469	96,021	28,534	18,891	52,818	962	180,392	863,092
1898........	513,432	96,524	27,820	18,191	51,361	....	178,016	885,348
Total......	$6,845,179	$1,369,853	$528,873	$223,272	$828,091	$30,136	$2,236,572	$12,157,362
Average....	427,824	85,616	33,055	13,955	51,756	1,884	139,786	789,835
Per ton of freight carried.	14 cts.	9 cts.	33 cts.	17 cts.	55 cts.	....	...	23 cts.

FOR EXTRAORDINARY REPAIRS.

Compiled from *Comptroller's Reports.*

Year.	Erie.	Champlain.
1883..........	$374	
1884..........	189	$41,676
1885..........	52,262	132,651
1886..........	26,914	19,341
1887..........	265,286	10,741
1888..........	634,390	6,021
1889..........	660,571	
1890..........	796,211	
1891..........	624,906	
1892..........	277,247	
1893..........	254,915	
1894..........	601,387	
1895..........	521 060	
1896..........	514,852	
1897..........	649,856	
1898..........	765,700	
Total........	$6,646,120	$210,450

SUMMARY.

Maintenance..........	$12,157,362
Extraordinary repairs.	6,856,570
Laws of 1895........	9,000,000
Total, 1883–1898...	$28,013,932

Chart 1 (Table 2).

ANNUAL EXPENDITURE ON NEW YORK CANALS, 1882-98.

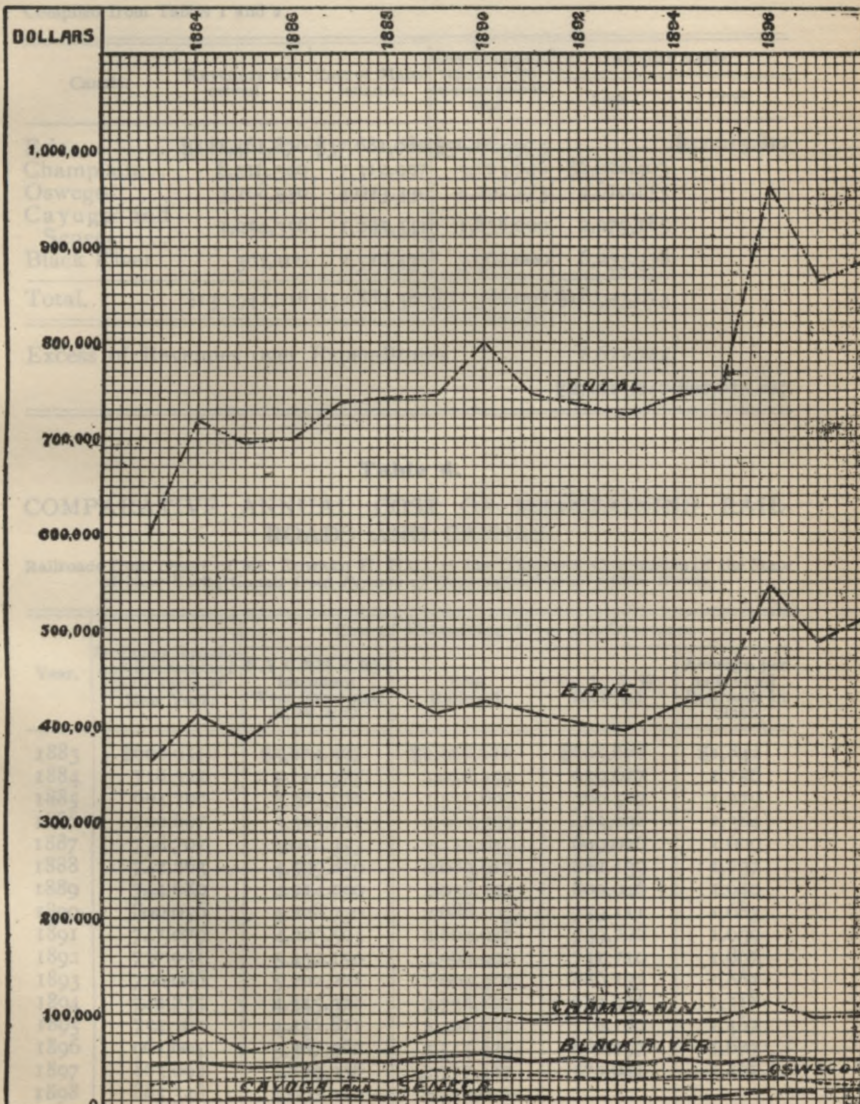


Table 3.

REVENUES AND COST OF CONSTRUCTION AND MAINTENANCE OF NEW YORK CANALS NOW IN USE, 1817–1898.

(EXCLUDING INTEREST.)

Compiled from Tables 1 and 2.

Canals.	Revenues Received	Cost of Maintenance.	Cost Construction and Improvements to 1896.	Balance Sheet.	
				Loss.	Profit.
Erie	$121,461,870	$37,681,080	$56,164,973		$27,615,817
Champlain...	6,416,340	7,312,997	5,123,746	$6,020,403	
Oswego......	3,708,550	4,023,330	4,295,373	4,610,153	
Cayuga and Seneca.....	1,054,356	1,295,541	1,838,000	2,079,185	
Black River..	301,100	2,570,432	3,964,000	6,233,332	
Total........	$132,942,216	$52,883,380	$71,386,092	$18,943,073	
Excess of Revenues over Expenditures.......				8,672,744	
				$27,615,817	$27,615,817

Table 4.

COMPARATIVE ANNUAL COST OF MAINTAINING RAILROADS AND CANALS.

Railroads from report of Mr. EDWARD H. HALL to the Commerce Commission of the State of New York; Canals from *Reports of Superintendent of Public Works.*

Year.	Ordinary Repairs and Operation of the Canals of New York.	Cost of Maintaining Ways and Structures.			
		N.Y.C.&H.R.Ry. including West Shore and R. W. & O.	Erie Railroad.	D., L. & W. Railroad	Average per mile of all Railroads in State.
1883	$600,951	$5,074,597	$2,967,616	$605,871	$1,842
1884	718,325	5,116,375	2,058,555	659,677	1,756
1885	694,297	3,363,572	1,551,609	360,507	1,279
1886	700,697	3,325,721	2,365,559	473,638	1,384
1887	738,707	4,050,353	2,444,649	609,076	1,609
1888	742,263	4,599,859	2,083,917	882,139	1,737
1889	744,689	4,214,090	2,058,544	800,046	1,640
1890	800,056	4,228,730	2,688,109	759,111	1,683
1891	747,079	4,203,505	2,864,047	739,726	1,639
1892	737,051	5,432,150	2,963,990	751,710	1,807
1893	726,086	5,202,221	2,904,404	886,133	1,883
1894	742,755	4,345,378	2,738,807	687,552	1,518
1895	754,362	4,436,871	2,491,867	710,180	1,467
1896	961,604	5,367,962	2,515,879	666,197	1,673
1897	863,092	4,879,336	2,777,487	573,041	1,595
1898	885,348	4,697,000	2,227,000		

Table 5.

AGGREGATE VALUATION, CANAL DEBT, AND CANAL TAXES, NEW YORK STATE,

1816–1898.

From *Reports of the State Comptroller*, and data furnished by W. C. Merriman, 2d Deputy Comptroller.

Year.	Aggregate Valuation.	State Canal Debt.		Canal Revenue from Taxes.	Canal Tolls to General Fund.
		Amount.	% of Valuation.		
1816	$292,388,827				
1817	299,418,207	$200,000	.07		
1818	311,343,390	400,000	.14		
1819	281,056,282	800,000	.28		
1820	255,818,416	1,493,500	.60		
1821	242,538,480	2,893,500	1.2		
1822	248,055,574	4,243,500	1.7		
1823	271,757,734	5,899,500	2.2		
1824	274,356,296	7,567,770	2.8		
1825	299,197,721	7,737,770	2.5		
1826	315,033,719	7,844,770	2.6		
1827	315,839,783	7,750,155	2.4		
1828	329,541,704	7,940,155	2.4		
1829	331,433,318	7,706,013	2.3		
1830	346,798,963	7,825,035	2.3		
1831	356,418,746	8,055,645	2.3		
1832	380,690,886	8,055,645	2.1		
1833	417,834,453	6,673,006	1.6		
1834	459,567,534	7,034,999	1.5		
1835	527,531,634	6,328,056	1.2		
1836	671,452,060	6,366,806	.95		
1837	626,609,987	6,166,082	.98		
1838	628,231,939	9,308,120	1.5		
1839	654,431,257	10,785,820	1.6		
1840	641,423,782	14,126,647	2.2		
1841	655,477,427	16,306,374	2.4		$1,837,602
1842	620,676,346	19,574,392	3.1		200,000
1843	595,262,444	20,392,324	3.4		
1844	599,891,923	20,713,905	3.8	$278,197	100,000
1845	605,646,095	19,690,020	3.5	2,366	
1846	616,824,955	17,028,240	2.7	56,503	400,000
1847	632,669,993	16,743,749	2.6	119,410	671,916
1848	651,649,595	16,713,649	2.5		550,000
1849	665,850,787	16,414,523	2.4		550,000
1850	727,494,583	16,215,144	2.2		550,000
1851	1,077,831,630	16,641,534	1.6		550,000
1852	1,168,335,237	17,001,267	1.5		550,000
1853	1,266,666,190	17,001,269	1.3		550,000
1854	1,364,154,825	18,772,244	1.4	657,145	550,000
1855	1,402,849,304	20,281,333	1.4		350,000
1856	1,430,334,696	22,542,066	1.5	320,000	350,000
1857	1,433,309,713	25,189,981	1.7	262,500	262,500
1858	1,404,907,679	24,460,014	1.7	1,240,500	
1859	1,404,913,679	24,307,844	1.7	890,567	
1860	1,419,297,520	27,107,321	1.9	1,069,515	
1861	1,441,767,430	26,131,770	1.8	840,552	

Chart 2. CANAL DEBT OF NEW YORK STATE. **(Table 5.)**

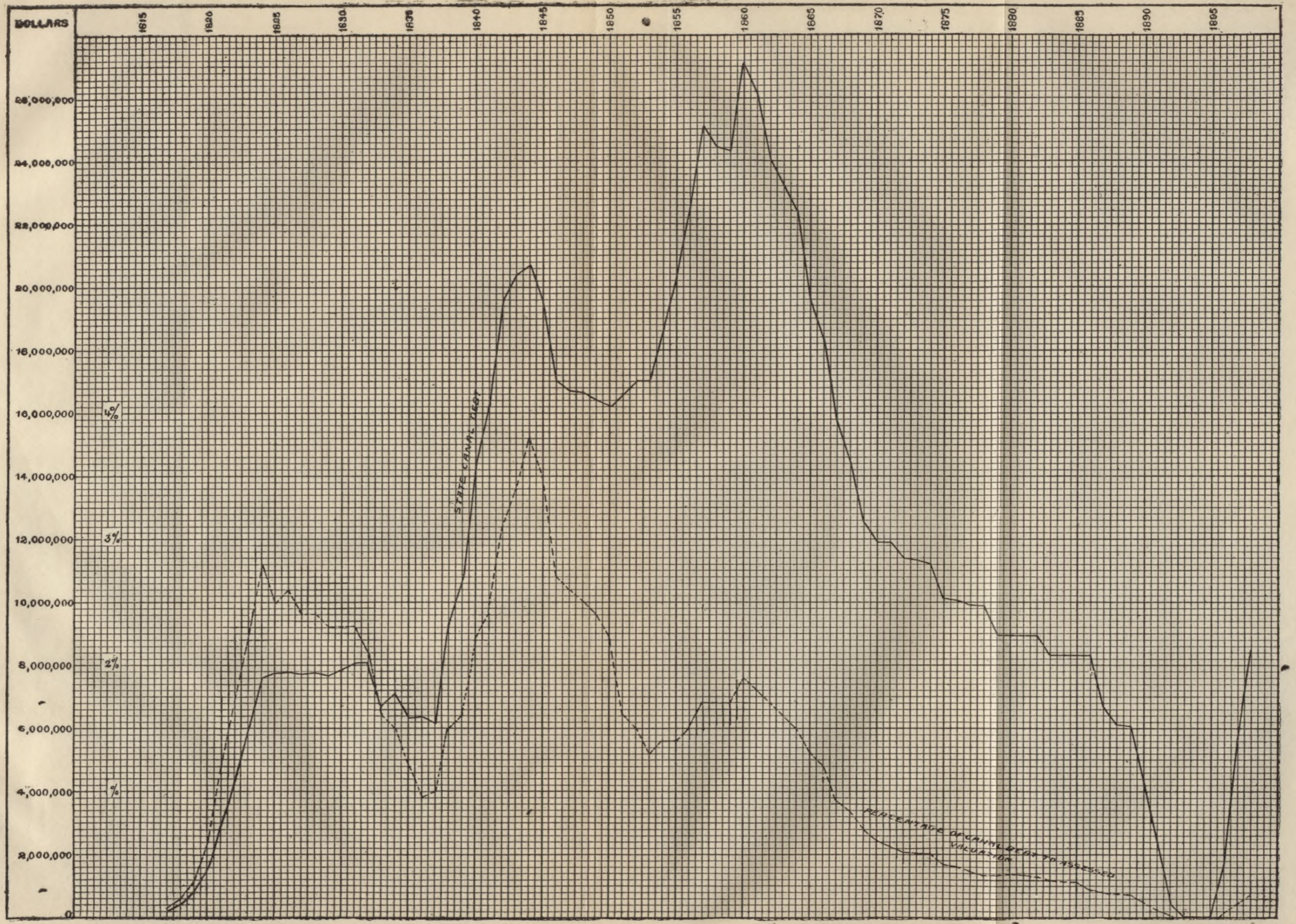


Chart 2. Canal Debt of New York State. (Table 5.)

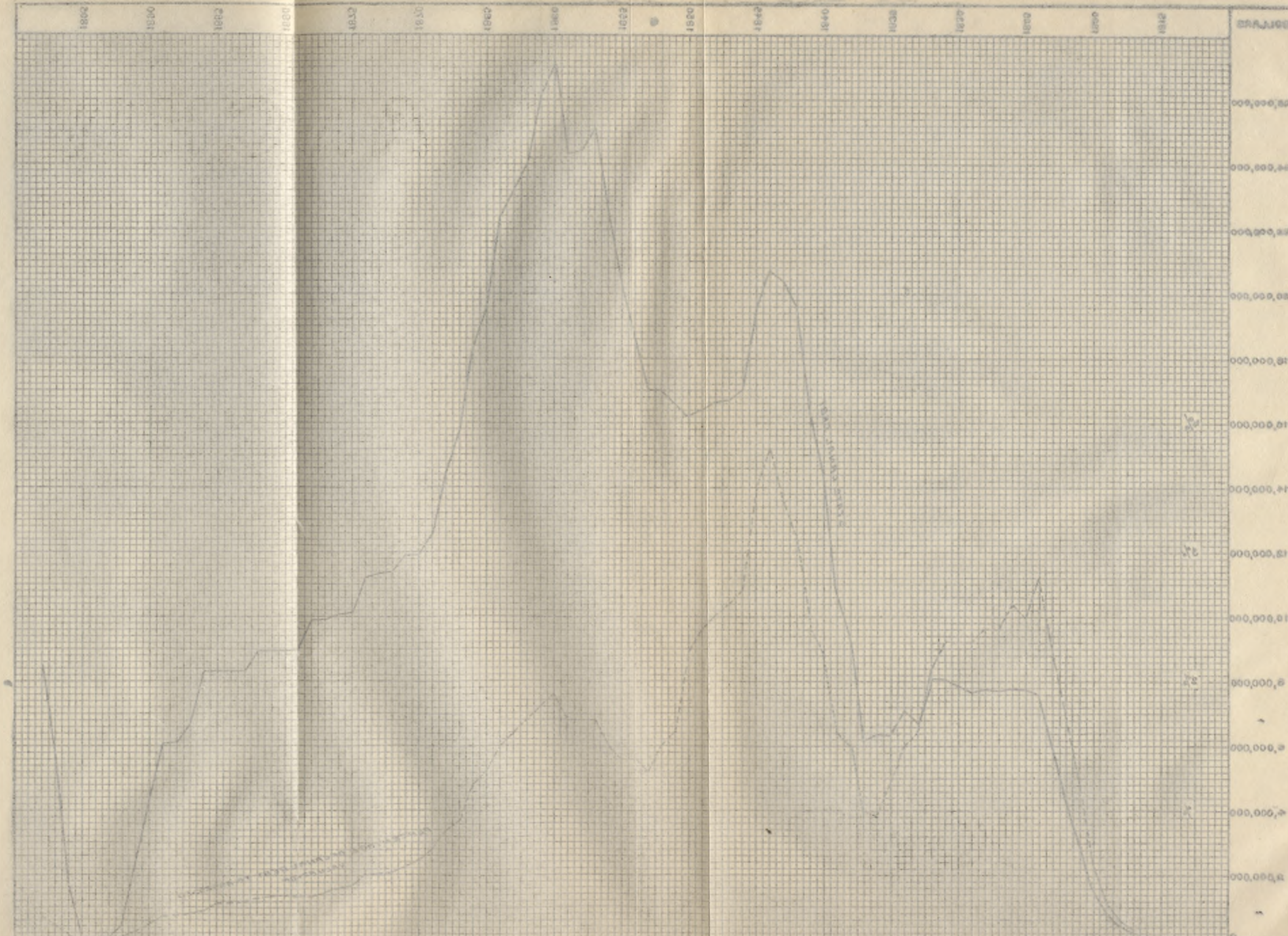


Table 5—Continued.

Year.	Aggregate Valuation.	State Canal Debt.		Canal Revenue from Taxes.	Canal Tolls to General Fund.
		Amount.	% of Valuation.		
1862	$1,449,303,948	$24,011,770	1.7	$2,769,623	$350,000
1863	1,454,404,817	23,278,470	1.6	1,420,188	550,000
1864	1,500,999,877	22,441,770	1.5	535,373	550,000
1865	1,550,879,685	19,597,395	1.3	881,779	1,101,113
1866	1,531,229,636	18,248,460	1.2	2,147,613	782,961
1867	1,664,107,725	15,733,060	.94	1,406.817	713,125
1868	1,766,089,140	14,429,960	.85	1,019,265	350,000
1869	1,860,120,770	12,564,780	.7	1,828,400	1,977,058
1870	1,967,001,185	11,966,580	.61	1,595,053	
1871	2,052,537,898	11,966,580	.58	3,880,035	569,974
1872	2,088,627,445	11,396,680	.55	2,238,095	981,588
1873	2,129,626,386	11,352,880	.54	2,863,069	1,202,571
1874	2,169,307,873	10,230,430	.47	3,279,985	1,500,000
1875	2,367,780,102	10,086,660	.43	2,537,819	200,000
1876	2,466,267,273	10,081,660	.41	712,819	
1877	2,755,740,318	9,900,360	.36		
1878	2,738,378,600	9,020,360	.33	900,208	
1879	2,686,139,133	8,988,360	.33	805,083	
1880	2,637,869,238	8,988,360	.34	789,724	
1881	2,681,257,606	8,983,360	.33	878,938	
1882	2,783,682,567	8,983,360	.32	788,289	
				$38,855,430	$18,850,408
1883	2,872,257,325	8,348,160	.29	1,145,763	
1884	3,014,591,372	8,339,160	.28	2,947,108	
1885	3,094,731,457	8,339,160	.27	1,683,950	
1886	3,224,682,343	8,304,510	.22	1,668,060	
1887	3,361,128,177	6,644,310	.20	2,148,928	
1888	3,469,199,945	6,142,660	.18	2,305,733	
1889	3,567,429,757	6,052,160	.17	2,209,880	
1890	3,683,653,062	4,341,610	.12	2,127,000	
1891	3,779,393,746	2,404,960	.07	2,314,600	
1892	3,931,741,499	463,160	.01	1,554,488	
1893	4,038,058,949	660		1,162,734	
1894	4,199,882,058	660		1,100,000	
1895	4,292,082,167	660		990,582	
1896	4,368,712,903	1,770,660	.04	2,095,559	
1897	4,506,985,694	5,770,660	.13	2,571,169	
1898	4,898,611,019	8,500,660	.17	2,120,086	
				$69,001,070	$18,850,408

Table 6.

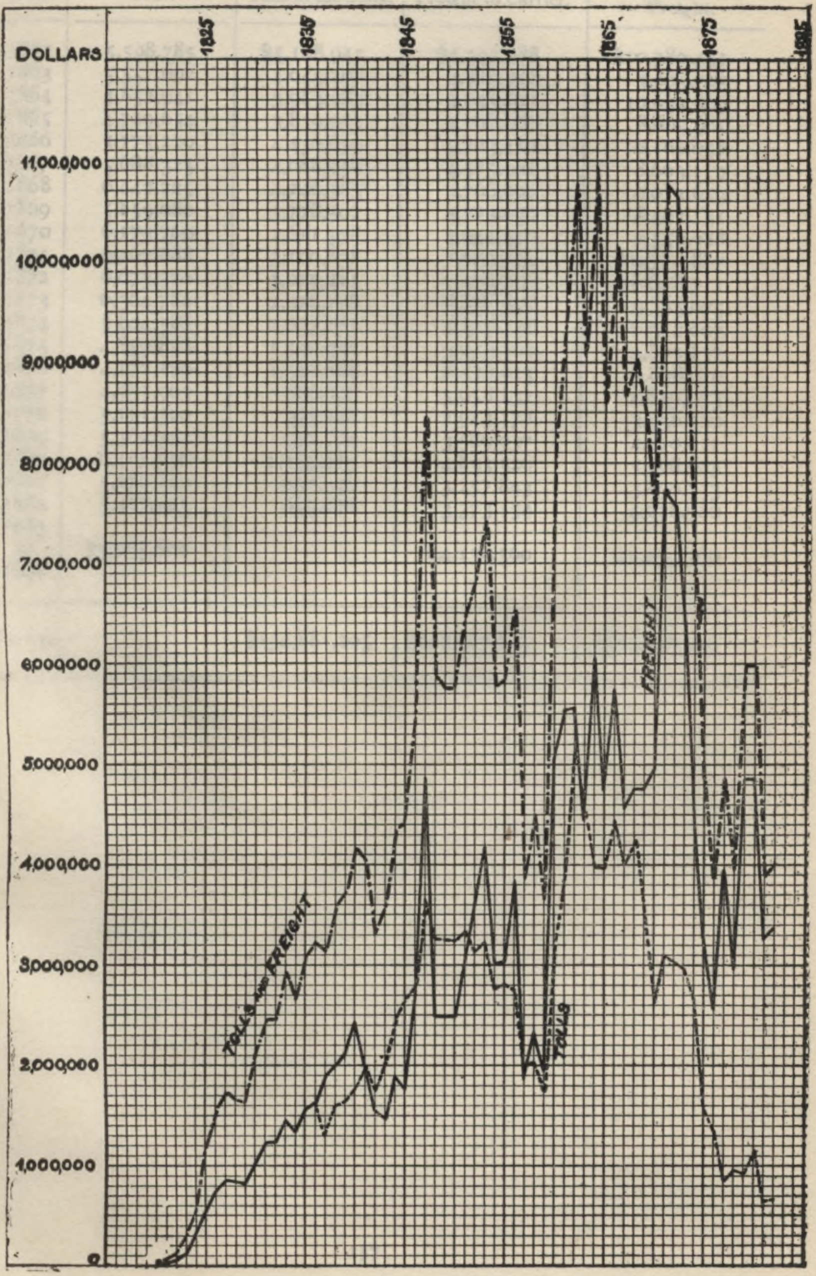
CANAL TOLLS AND FREIGHT

Year.	Tons.	Tolls to the State.	Freight to Carrier.	Total Tolls and Freight.
1820		$5,437	$5,000	$10,437
1821		14,388	14,000	28,388
1822		64,072	64,000	128,072
1823		152,958	153,000	305,958
1824		340,761	340,000	680,761
1825		566,112	566,000	1,132,112
1826		762,003	762,000	1,524,003
1827		859,058	859,000	1,718,058
1828		838,444	838,000	1,676,444
1829		813,137	813,000	1,626,137
1830		1,056,922	1,057,000	2,113,922
1831		1,223,801	1,223,000	2,446,801
1832		1,229,483	1,230,000	2,459,483
1833		1,463,715	1,463,000	2,926,715
1834		1,339,799	1,340,000	2,679,799
1835		1,548,672	1.548,000	3,096,672
1836	1,310,807	1,614,680	1,614,000	3,228,680
1837	1,171,296	1,292,623	1,890,773	3,183,396
1838	1,333,011	1,590,911	1,985,484	3,576,395
1839	1,435,713	1,616,382	2,109,989	3,726,371
1840	1,416,046	1,775 747	2,419,802	4,195,549
1841	1,521,661	2,034,882	1,992,532	4,027,414
1842	1,236,931	1,749,196	1,555,578	3,304,774
1843	1,513,439	2,081,590	1,478,147	3,559,737
1844	1,816,586	2,446,374	1,896,863	4,343,237
1845	1,977,565	2,646,181	1,785,280	4,431,461
1846	2,268,662	2,756,106	2,716,603	5,472,709
1847	2,869,810	3,635,381	4,818,152	8,453,533
1848	2,796,230	3,252,293	2,641,007	5,893,400
1849	2,894,732	3,268,226	2,495,963	5,764,189
1850	3,076,617	3,273,899	2,489,489	5,763,388
1851	3 582,733	3,329,727	3,072,122	6,401,849
1852	3,863,441	3,118,244	3,681,908	6,800,152
1853	4,247,853	3,204,718	4,189,166	7,393,884
1854	4,165,862	2,773,566	3,009,289	5,782,855
1855	4,022,617	2,805,077	3,036,343	5,841,420
1856	4,116,082	2,748,212	3,825,013	6,573,225
1857	3,344,061	2,045,641	1,830,359	3,876,000
1858	3,665,192	2,110,754	2,391,683	4,502,437
1859	3,781,684	1,723,945	1,941 861	3,665,806
1860	4,650,214	3 099,597	5,039,853	8,049,450
1861	4,507,635	3,908,785	5,460,593	9,369,378

[1] The statistics for the years 1837 to 1882 inclusive are from a table in the Report of the Comptroller on the Tolls, Trade and Tonnage of the Canals for 1882 (p. 39). The statistics of Tolls from 1820 to 1837 are from a table in Hunt's Merchant's Magazine, and the freight for these years is estimated at approximately equal to the tolls; the freight since 1882 is estimated at an average of 60 cents per ton; and these figures and the totals are therefore not exact. It is believed, however, that the total approximates, with a fair degree of accuracy, to the gross amount paid for transportation on the canals, distinguishing between the Tolls to the State and Freight to the carrier.

Chart 3 (Table 6.)

CANAL TOLLS AND FREIGHT.



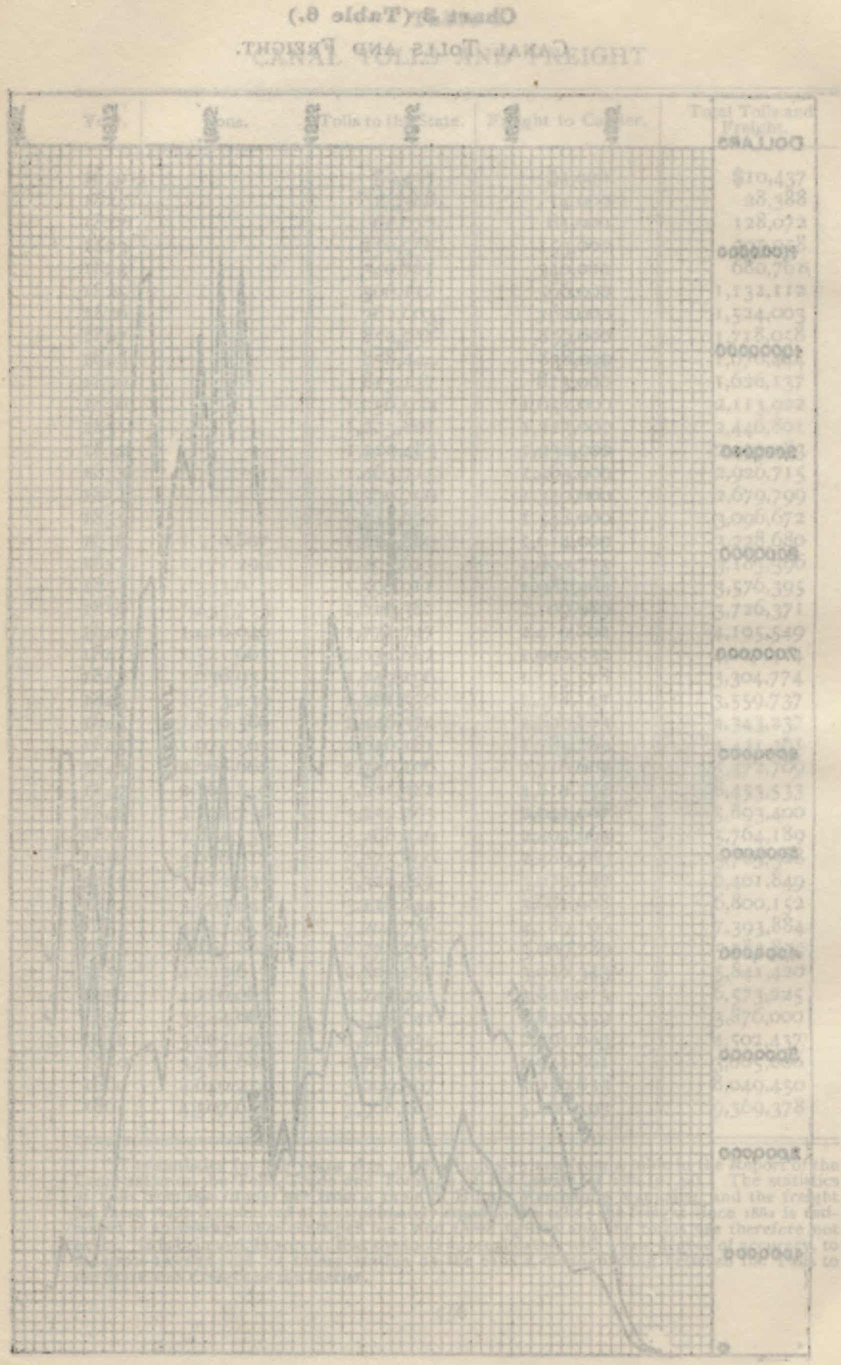


Table 6—Continued.

Year.	Tons.	Tolls to the State.	Freight to Carrier.	Total Tolls and Freight.
1862	5,598,785	$5,188,943	$5,591,488	$10,780,431
1863	5,557,692	4,645,207	4,419,798	9,065,005
1864	4,852,941	3,983,982	6,055,627	10,939,609
1865	4,729,654	3,839,955	4,766,066	8,605,961
1866	5,775,220	4,436,639	5,723,412	10,160,051
1867	5,688,325	4,088,058	4,575,061	8,663,119
1868	6,442,225	4,246,563	4,766,096	9,012,659
1869	5,859,080	3,778,501	4,713,630	8,492,131
1870	6,173,769	2,611,578	4,941,410	7,552,988
1871	6,467,888	3,100,838	7,679,049	10,779,887
1872	6,673,370	3,072,411	7,576,300	10,648,711
1873	6,364,782	2,976,718	6,408,357	9,385,075
1874	5 804.588	2,637,071	4,335,536	6,972,607
1875	4,859,858	1,590,032	3,273,105	4,863,137
1876	4,172,129	1,340,004	2,558,915	3,898,919
1877	4,955,963	880,896	3,958,137	4,839,033
1878	5,171,320	993,348	2,943,172	3,936,520
1879	5,362,372	941,584	3,529,037	4,470,611
1880	6,457,656	1,155,419	4,833,526	5,988,945
1881	5,179,192	632,390	3,257,843	3,890,233
1882	5,467,423	655,826	3,373,154	4,028,980
1883 to 1898	73,065,600		44,139,360	44,139,360
Totals,		$134,881,205	$228,067,034	$362,948,239

Table 7.

VALUATION AND POPULATION OF NEW YORK STATE COUNTIES, 1898.

Compiled from *Report of State Comptroller* for 1898.

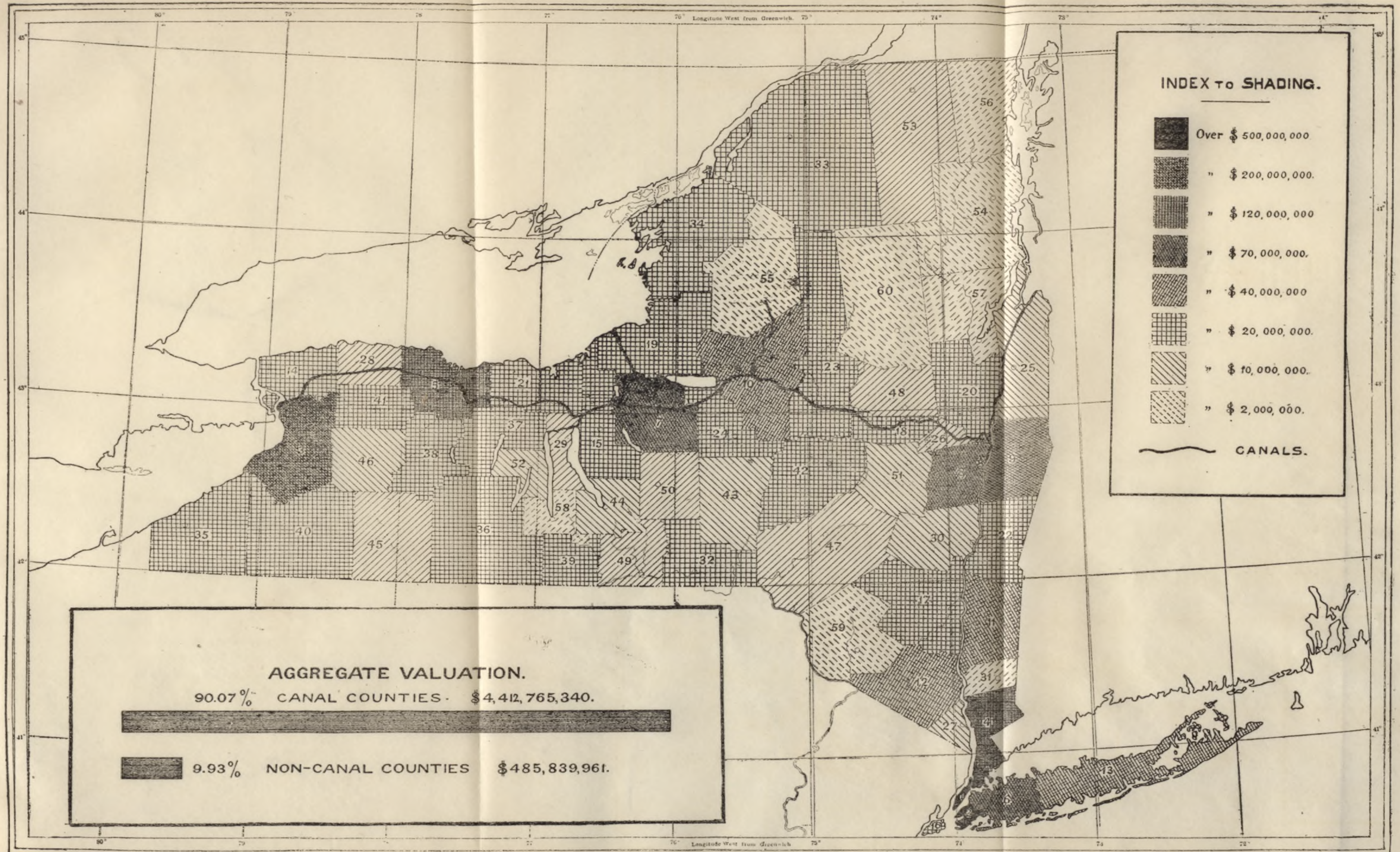
Ref. Nos. to Map 1.	Canal Counties.	Equalized Valuation 1898.	Population 1892.	Per cent Valuation.	Per cent Population.	Per capita Valuation.	Annual Payment[1] on $1,000,000 % 18 year Bonds. (a)	(b)
1	New York...	$2,277,483,941	1,795,840	46.48	27.68	$1,268	$33,805	$37.522
2	Kings.......	600,471,052	988,077	12.27	15.23	594	8,925	9.905
3	Erie	286,941,628	344.703	5.86	5.31	832	4,261	4,768
4	Westchester..	154,016,519	147,830	3.14	2.28	1,042	2,284	2,533
5	Monroe	124,816,283	197,053	2.55	3.04	633	1,856	2,058
6	Queens.......	96,750,000	130,007	1.98	2.00	744	1,441	1,598
7	Onondaga...	96,392,094	151,530	1.97	2.33	636	1,433	1,589
8	Albany......	93,052,461	167,526	1.90	2 58	555	1,381	1,542
9	Rensselaer...	71,277,306	129,257	1.46	2.00	551	1,062	1,177
10	Oneida......	64,291,647	123,669	1.31	1.90	507	953	1,056
11	Dutchess....	46,280,467	78,140	.95	1.20	592	681	755
12	Orange......	41,759,586	95,500	.85	1.47	421	618	685
13	Suffolk......	40,287,096	62,990	.82	.97	639	596	660
14	Niagara.....	37,522,781	64,321	.77	.99	583	560	620
15	Cayuga.... .	31,770,969	64,460	.65	.99	493	473	524
16	Richmond...	29,009,037	52,906	.60	.82	548	436	482
17	Ulster.......	28,372,434	87,269	.58	1.35	325	422	467
18	Montgomery.	28,080,424	46,074	.57	.71	609	414	458
19	Oswego.....	26,941,465	70,730	.55	1.09	381	400	443
20	Saratoga.....	25,060,384	56,645	.51	.87	442	371	411
21	Wayne......	24,999.953	49,345	.51	.76	506	371	411
22	Columbia....	23,433,494	44,812	.48	.69	523	349	386
23	Herkimer....	21,710,807	47,340	.44	.73	448	320	354
24	Madison.....	21,279,130	41,031	.43	.63	518	313	346
25	Washington .	18,677,717	46,193	.38	.71	404	276	305
26	Schenectady.	16,478,167	34,031	.33	.53	484	240	265
27	Rockland....	16,452,923	33,208	.33	.51	495	240	265
28	Orleans	14,953,436	30,778	.31	.48	486	225	248
29	Seneca......	14,713,609	26,363	.30	.41	558	218	241
30	Greene......	13,567,363	31,366	.27	.49	428	196	216
54	Essex.... .	9,504,332	32,847	.20	.51	289	144	158
56	Clinton......	8,476,606	46,418	.17	.71	182	123	135
31	Putnam	7,947,232	14,165	.16	.22	561	116	128
	All Canal Counties...	$4,412,772,343	5,332,424	90.07	82.20	$827	$65,503	$72,710

[1] Annual Interest on $1,000,000 at 3% $30,000
Sinking Fund to redeem in 18 years, per year............. 42,710

Total Annual Charge on $1,000,000..........$72,710

(a) Assessed on all counties.

(b) Assessed only on canal counties.



Map 1. VALUATION OF NEW YORK COUNTIES, 1898. **(Table 7.)**

Map I. Valuation of New York Counties, 1898. (Table 7.)

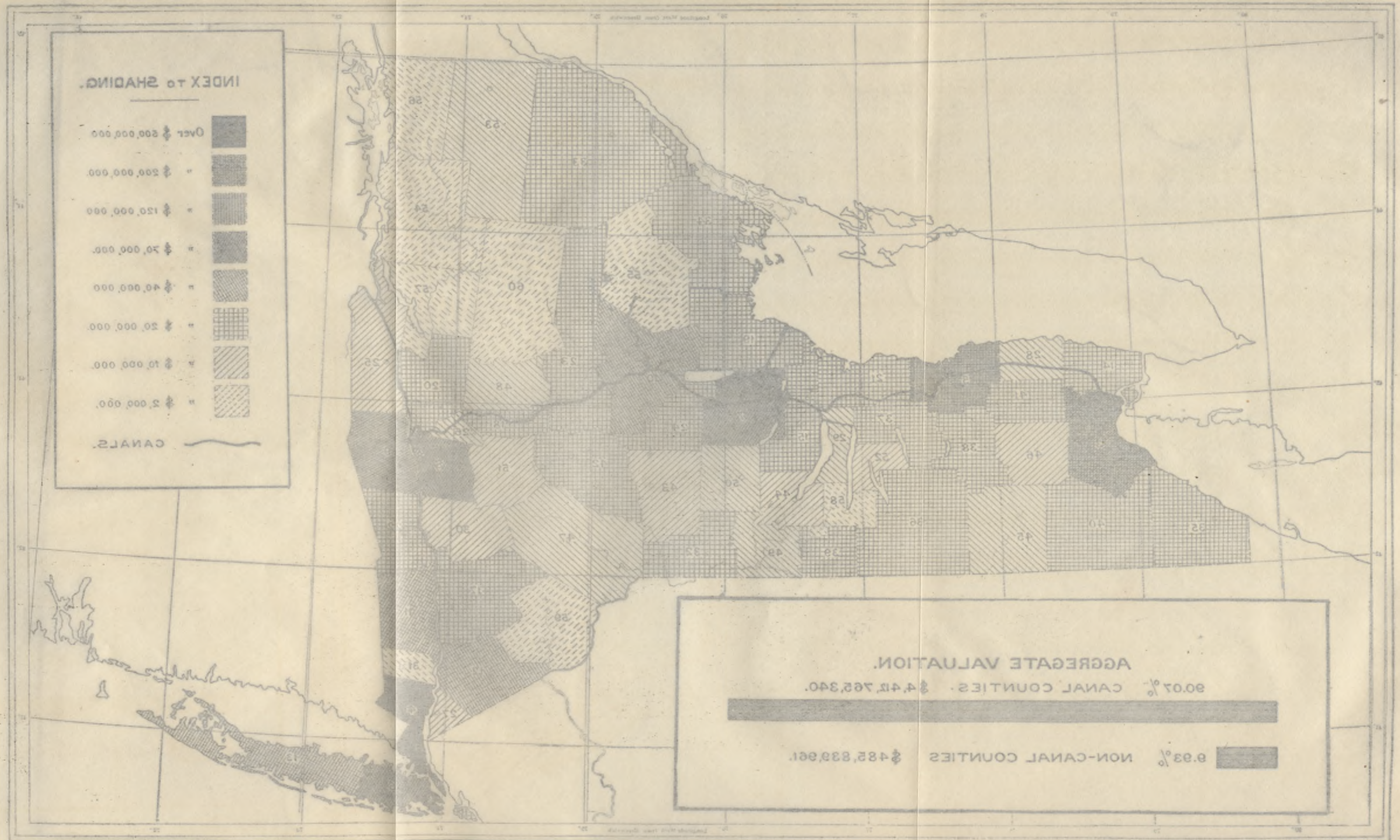


Table 7—Continued.

Ref. Nos. to Map 1.	Non-Canal Counties.	Equalized Valuation 1898.	Population 1892.	Per cent Valuation.	Per cent Population.	Per capita Valuation.	Annual Payment on $1,000,000 3% 18-yr. Bonds. (a)
32	Broome......	$33,113,104	63,760	.68	.98	$519	$494
33	St. Lawrence.	32,454,822	86,663	.66	1.33	374	481
34	Jefferson......	31,487,867	69,897	.64	1.08	450	466
35	Chautauqua..	31,217,396	78,748	.64	1.21	396	465
36	Steuben......	30,114,194	80,336	.61	1.24	375	443
37	Ontario......	28,223,585	48,282	.58	.74	584	421
38	Livingston....	26,234,370	36,843	.54	.57	712	392
39	Chemung....	24,615,832	48,810	.50	.75	504	363
40	Cattaraugus..	23,105,743	61,496	.47	.95	375	341
41	Genesee......	22,357,973	33,491	.46	.51	667	334
42	Otsego.......	22,102,112	50,255	.45	.77	439	327
43	Chenango....	16,791,973	37,616	.37	.58	562	269
44	Tompkins....	16,224,166	35,055	.33	.54	462	240
45	Allegany.....	15,029,177	49,950	.31	.77	306	225
46	Wyoming....	14,827,629	30,967	.30	.48	478	218
47	Delaware.....	14,226,279	45,237	.29	.70	314	210
48	Fulton..	14,190,519	38,504	.29	.59	368	210
49	Tioga........	12,984,094	29,597	.26	.46	438	187
50	Cortland......	12,100,956	28,289	.25	.44	427	180
51	Schoharie....	11,482,490	28,769	.23	.44	399	167
52	Yates........	10,732,146	20,662	.22	.32	519	160
53	Franklin......	10,473,345	40,960	.21	.63	255	152
55	Lewis........	9,335,643	30,215	.19	.47	309	137
57	Warren......	7,639,114	28,479	.15	.44	268	109
58	Schuyler......	6,513,426	16,791	.13	.26	388	94
59	Sullivan......	6,036,945	30,529	.12	.47	197	87
60	Hamilton.....	2,223,776	4,450	.05	.07	499	36
	Non-Canal Counties...	485,838,676	1,154,651	9.93	17.80	420	7,207
	Canal Counties...	4,412,772,343	5,332,724	90.07	82.20	827	65,503
	New York State......	$4,898,611,019	6,487,375	100.	100.	$735	$72,710

(a) If assessed on all counties.

ASSESSED VALUATION OF NEW YORK STATE.

From *United States Census Reports* 1870, 1880, 1890; data prior to 1870 not available.

Year.	New York State.	Canal Counties.	% Canal Counties.
1870.........	$1,967,001,185	$1,725,274,210	87.7
1880.........	2,651,940,006	2,254,224,737	85.0
1890.........	3,785,910,313	3,222,353,570	85.1
1898.........	4,898,611,019	4,412,772,343	90.07

Table 8.

POPULATION AND VALUATION OF NEW YORK CITIES (a), 1899.

Data furnished by municipal officials.

I. CITIES IN CANAL COUNTIES.

Cities.	Estimated Population.	Assessed Valuation.
New York City	3,549,558	$3,042,653,258
Buffalo	400,000	245,674,630
Rochester	177,000	112,793,740
Syracuse	130,000	78,000,000
Albany	100,000	66,684,940
Troy	65,000	47,777,058
Utica	60,000	37,694,144
Yonkers	45,000	35,439,320
Auburn	32,000	13,567,863
Schenectady	29,000	10,678,236
Newburgh	26,000	10,908,280
Kingston	26,000	13,280,030
Poughkeepsie	25,000	12,290,020
Oswego	25,000	10,085,841
Cohoes	24,000	11,720,639
Mt. Vernon	23,000	23,151,161
Niagara Falls	22,000	13,485,108
Amsterdam	22,000	12,975,000
Lockport	19,000	7,396,930
Watervliet	16,000	4,578,707
New Rochelle	16,000	15,247,900
Rome	16,000	5,531,364
Glens Falls	15,000	5,826,396
Lansingburgh	13,500	6,423,445
Dunkirk	13,000	3,184,331
Saratoga Springs	12,000	6,406,437
Little Falls	11,000	5,048,915
Peekskill	10,500	5,830,450
Hudson	10,000	5,040,422
Rensselaer	10,000	3,410,000
Cities in Canal Counties	4,938,558	$3,872,784,565
Total in New York State	7,000,000	4,898,611,019
% Cities in Canal Counties	70%	79.1%

(a) Including incorporated villages with over 10.000 population.

Table 8—Continued.

2. CITIES IN NON-CANAL COUNTIES.

Cities.	Estimated Population	Assessed Valuation.
Binghamton	45,000	$20,888,300
Elmira	42,000	17,189,389
Jamestown	26,000	10,787,799
Watertown	18,500	9,423,663
Gloversville	18,000	6,098,005
Ogdensburg	14,700	4,150,625
Hornellsville	13,500	4,404,103
Ithaca	13,460	7,224,762
Middletown	12,000	3,000,000
Olean	10,500	3,569,505
Johnstown	10,000	3,963,275
Port Jervis	10,000	1,900,000
Cities in Non-Canal Counties	231,660	92,599,426
Total in New York State	7,000,000	4,898,611,019
% Cities in Non-Canal Counties	3.3%	1.9%

Table 9.

COMPARATIVE COST OF CANAL CONSTRUCTION.

	Cost of Work.	Population of New York State.	Assessed Valuation of New York State.	Cost per Capita.	% Cost of Assessed Valution.
1	$8,966,830	(1817) 1,200,000	$299,418,207	$7.50	3.0
2	21,530,470	(1830) 1,873,683	346,798,963	11.53	6.2
3	26,000,000	(1850) 3,097,394	727,495,000	8.40	3.7
4	56,497,300	(1860) 3,980,735	1,419,297,520	14.60	4.0
5	38,044,850	(1890) 5,997,853	3,683,653,062	6.34	1.1
6	62,000,000	(1898) 7,000,000	4,898,611,019	8.86	1.3

1 Original Canals—Erie, Oswego and Champlain, 1817–1836.

2 { Erie enlargement, 1836–1845, $12,648,851.
New Canals, 1830–1845, 8,881,619.

3 Improvements, 1845–1862.

4 Total Canal Construction, 1817–1862.

5 Extraordinary Repairs and New Work, 1862–1898.

6 Recommended Enlargement.

Table 10.

STATE ENGINEER's estimates of amounts earned by contractors from the Nine Million Fund up to July 15th, 1898; also estimates by engineers of the Clinton Commission of amounts necessary to complete the canals and to repair or rebuild all structures requiring repairs within ten years.[1]

	Distance.	Amounts earned.	Estimates to complete.	Total.
ERIE CANAL.	Miles.			
Buffalo to Lockport........	30.8	$1,168,993	$525,000	$1,693,993
Lockport Locks...........	.1		650,000	650,000
Lockport to Macedon......	85.2	918,729	2,010,000	2,923,729
Macedon to 8.3 miles W. of Rome	100.0	2,548,716	2,090,000	4,538,716
Newark Locks............	0.34		370,000	370,000
Rome to Little Falls.......	47.2	1,268,690	915,000	2,183,690
Little Falls Locks..........	1.0		300,000	300,000
Little Falls to Lock 19.....	75.0	882,335	1,515,000	2,397,335
Cohoes to Albany..........	{ 3.4 11.7		2,415,000	2,415,000
OSWEGO CANAL.				
Syracuse to Phœnix........	17 0		730,000	730,000
Phœnix to Oswego.........	21.3	451,465	681,600	1,133,065
CHAMPLAIN CANAL.				
Waterford to Lock 8.......	5.9	238,848	110,000	348,848
Lock No. 8 to Fort Edward.	31.7	34,050	1,125,000	1,159,050
Fort Edward to Whitehall..	24.0	309,765	195,000	504,765
SUMMARY.				
Erie Canal	354.4	6,787,463	10,700,000	17,533,000
Oswego Canal....	38.3	451,465	1,411,600	1,863,065
Champlain Canal..........	61.6	582,663	1,520,000	2,012,663
Total....................	454.3	$7,821,591	$13,631,600	$21,453,191

"The amount thought necessary (to complete contracts now let and not completed; also to complete the contracts which have not been let) is $13,631,600, to which should be added 10 per cent for engineering and administration, making a total of say $14,995,000. This sum is not intended to cover either a dual system of inspection or advertising." . . .

"The estimates for completion are materially larger than those submitted by the State Engineer; as we have included items covering the estimated cost of strengthening banks and repairing or renewing locks, aqueducts, waste-weirs, etc., not thought necessary by the State Engineer, so that the estimate is intended to cover the cost of not only making the improvement required by chapter 79 of the Laws of 1895, as amended; but with all locks deepened and lengthened or replaced with pneumatic lifts, as at Lockport and Cohoes, ... and the cost of pneumatic lifts is also covered at Newark and Little Falls . . . . . . , the intention being to make the estimate liberal enough to enlarge the canal and restore all structures that are liable to require repairs or restoration within ten years."

[1] From Report of E. P. North and Lyman E. Cooley, Consulting Engineers to the Clinton Commission, pp 31, 32.

Chart 4. TONNAGE ON NEW YORK CANALS. **(Table 11.)**

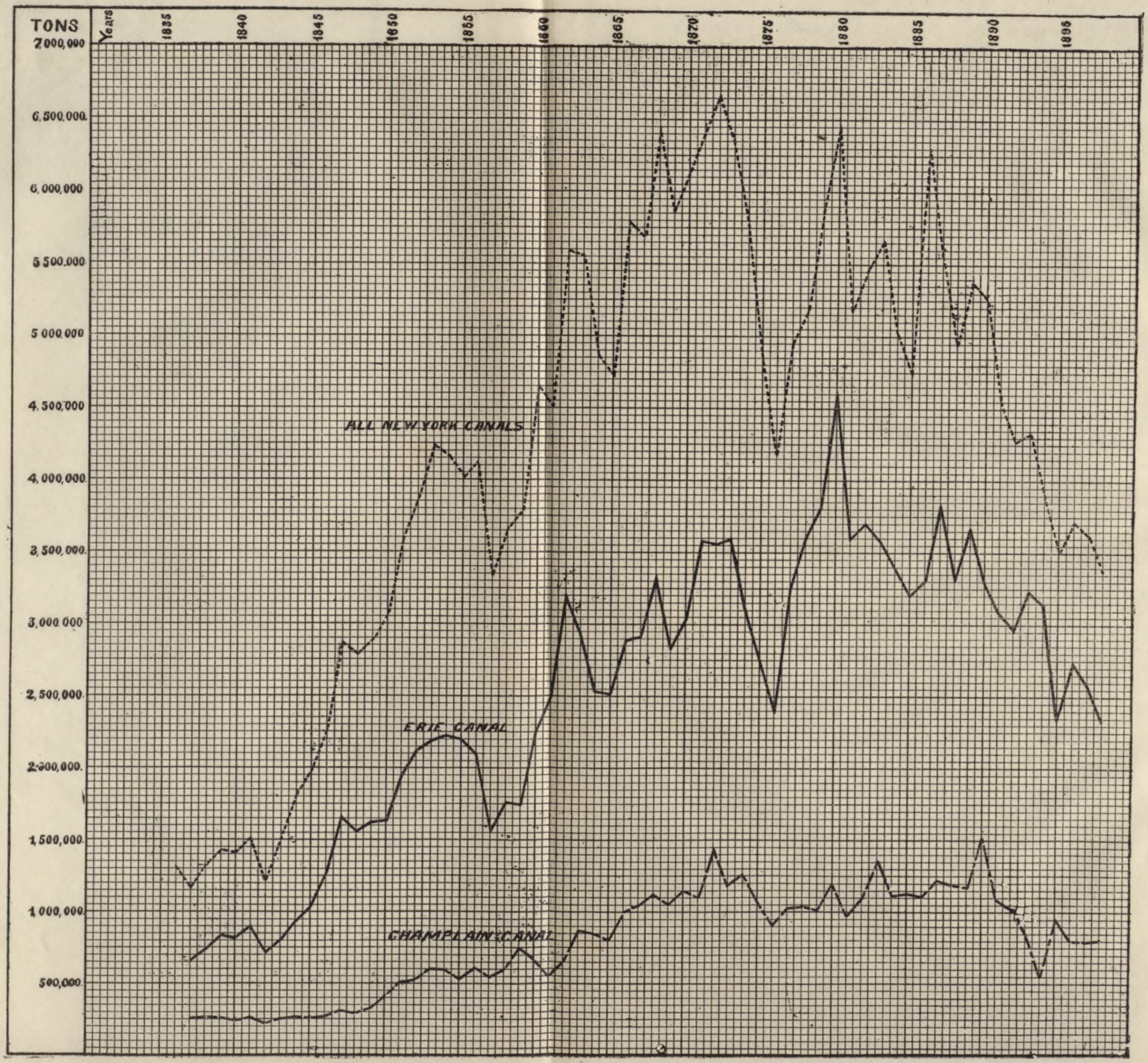


Table 11.

TONS OF PROPERTY MOVED ON EACH AND ALL THE NEW YORK STATE CANALS.

From *Reports of Supt. of Public Works.*

YEAR.	Erie.	Cham-plain.	Oswego.	Cayuga and Seneca.	Chemung.	Chenango.	Genesee Valley.	Black River.	Total. (a)
1837	667,151	261,659	161,353	20,274	20,288	8,213	....	....	1,171,296
1838	744,848	266,553	222,697	23,541	30,256	14,778	....	....	1,333,011
1839	845,007	263,552	221,014	26,300	36,089	16,928	....	....	1,435,713
1840	829,960	245,229	219 627	32,486	34,217	16,848	13,653	....	1,416,046
1841	906,442	276,418	135,689	34,634	63,042	23,356	26,892	....	1,521,661
1842	712,310	230,844	129,498	31,716	54,866	17,177	41,860	....	1,236,931
1843	819,216	262,212	240,571	25,998	66,247	19,026	48,313	....	1,513,439
1844	945,944	269,546	326,607	31,099	88,231	31,472	65,077	....	1,816,586
1845	1,038,700	266,922	340,481	46,464	114,740	38,305	73,546	....	1,977,565
1846	1,264,408	280,480	351,511	61,014	124,768	41,112	87,614	....	2,268,662
1847	1,661,575	313,124	441,096	58,204	189,165	44,051	95,632	....	2,869,810
1848	1,599,965	293,889	490,147	46,252	150,691	35,207	98,467	....	2,796,230
1849	1,622,444	321,345	557.637	40,440	135,867	36,557	84,674	....	2,894,732
1850	1,635,089	460,219	583,346	42,379	128,263	41,892	89,804	....	3,076,617
1851	1,955,265	513,793	676,321	37,084	159,563	40,307	100,000	25,320	3,582,733
1852	2,129,334	531,001	684,191	47,275	187,577	44,939	122,901	36,597	3,863,441
1853	2,196,308	608,354	761,276	58,793	249,980	76,538	157,164	41,924	4,247,853
1854	2,224,008	602,913	611,533	72,995	270,978	77,124	158,942	55,525	4,165,862
1855	2,202,463	537,108	654,399	76,744	223,271	89,390	102,321	51,347	4,022,617
1856	2,107,678	611,610	657,381	131,907	245,621	105,502	113,731	68,126	4,116,082
1857	1,566,624	547,236	605,218	120,435	187,201	96,722	114,576	69,135	3,344,061
1858	1,767,004	608,918	688,960	75,968	205,168	72,526	118,303	62,352	3,665,192

(a) Including a small traffic on Oneida Lake, from 1841 to 1861, and on Crooked Lake, from 1837 to 1874.

Table 11—Continued.

YEAR.	Erie.	Champlain.	Oswego.	Cayuga and Seneca.	Chemung.	Chenango.	Genesee Valley.	Black River.	Total. (a)
1859	1,753,954	751,046	612,390	80,602	256,323	89,691	124,263	75,946	3,781,684
1860	2,253,533	681,157	1,080,076	98,678	226,051	83,035	123,602	70,687	4,650,214
1861	2,500,782	545,930	852,920	100,992	208,792	91,661	94,329	69,930	4,507,635
1862	3,204,277	647,318	1,063,413	125,659	243,628	79,442	129,974	85,442	5,598,785
1863	2,955,302	878,920	992,173	119,704	307,151	90,215	112,549	90,448	5,557,692
1864	2,535,792	846,790	765,079	185,161	280,834	89,021	71,411	72,519	4,852,941
1865	2,523,490	815,311	825,649	192,312	164,796	68,822	56,581	73,317	4,729,654
1866	2,896,027	1,001,493	990,809	368,233	226,510	107,472	86,579	85,908	5,775,220
1867	2,920,578	1,047,440	940,136	389,704	145 627	103 064	64,679	70,539	5,688,325
1868	3,346,986	1,120,585	958,444	515,295	165,875	112,455	138,364	79,770	6,442,225
1869	2,845,072	1,059,339	934,638	533,516	245,761	83,527	69,141	80,550	5,859,080
1870	3,083,132	1,143,719	917,728	527,728	206,535	102,820	79,733	96,329	6,173,769
1871	3,580,922	1,099,995	941,858	445,186	173,281	39,793	85,269	89,560	6,467,888
1872	3,562,560	1,449,528	832,490	386,977	217,263	26,519	96,113	94,776	6,673,370
1873	3,602,535	1,195,390	655,588	437,382	257,962	30,317	86,770	86,017	6,364,782
1874	3,097,122	1,268,292	665,408	378,825	205,602	33,059	69,393	77,601	5,804,588
1875	2,787,226	1,077,746	486,530	224,492	129,425	23,769	64,677	65,993	4,859,858
1876	2,418,422	910,151	370,330	137,264	214,448	6,227	47,360	67,927	4,172,129
1877	3,254,367	1,021,782	319,327	247,864	12,026	....	37,311	63,286	4,955,963
1878	3,608,634	1,040,912	257,254	168,201	8,767	....	18,569	68,983	5,171,320
1879	3,820,027	1,012,005	333,713	117,027	....	....	....	79,600	5,362,372
1880	4,608,651	1,200,503	427,863	125,331	....	....	....	75,308	6,457,656
1881	3,598,721	986,079	394,542	99,617	....	....	....	100,233	5,179,192
1882	3,694,364	1,097,343	445 295	123,488	....	....	....	106,933	5,467,423
1883	3,587,102	1,366,358	276,350	134,631	....	....	....	128,656	5,664,056

(a) Including a small traffic on Oneida Lake, from 1841 to 1861, and on Crooked Lake, from 1873 to 1874.

Table 11—Continued.

YEAR.	Erie.	Champlain.	Oswego.	Cayuga and Seneca.	Chemung.	Chenango.	Genesee Valley.	Black River.	Total.
1884	3,389,555	1,118,073	260,541	119,990	......	......	......	116,359	5,009,488
1885	3,208,207	1,139,402	213,079	64,125	......	......	......	106,971	4,731,784
1886	3,308,642	1,119,663	186,484	64,995	......	......	......	114,198	5,293,982
1887	3,840,513	1,229,335	176,177	195,933	......	......	......	111,847	5,553,805
1888	3,321,516	1,198,305	134,078	201,237	......	......	......	118,213	4,942,948
1889	3,673,554	1,187,038	170,078	196,138	......	......	......	143,561	5,370,369
1890	3,303,929	1,520,757	225,936	63,419	......	......	......	132,061	5,246,102
1891	3,097,853	1,101,126	161,426	80,954	......	......	......	122,111	4,563,472
1892	2,978,832	1,021,139	90,886	75,669	......	......	......	115,469	4,281,995
1893	3,235,726	848,965	92,634	38,761	......	......	......	115,877	4,331,963
1894	3,144,144	550,279	98,843	33,270	......	......	......	56,024	3,882,560
1895	2,356,084	966,335	64,154	49,050	......	......	......	64,691	3,500,314
1896	2,742,438	802,519	57,245	54,739	......	......	......	57,953	3,714,894
1897	2,584,906	797,637	53,537	110,277	......	......	......	71,447	3,617,804
1898	2,338,020	804,076	47,662	100,342	......	......	......	69,963	3,360,063

Table 12.

CLASSIFIED TONNAGE ON ALL THE NEW YORK STATE CANALS.

(From *Reports of Supt. of Public Works.*)

YEAR.	Products of the Forest.	Agriculture.	Manufactures.	Merchandise	Other Articles	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons*
1836	....	....	....	....	....	1,310,807
1837	618,741	208,043	81,735	94,777	168,000	1,171,296
1838	665,089	255,227	101,526	124,290	186.879	1,333,011
1839	667,581	266,052	111,968	132,286	257,826	1,435,713
1840	587,647	393,780	100,367	112,021	222,231	1,416,046
1841	645,548	391,905	127,896	141,054	215,258	1,521,661
1842	504,597	401,276	98,968	101,446	130,644	1,236,931
1843	687,184	455,797	124,277	119,209	126,972	1,513,439
1844	864,373	509,387	144,245	141,930	156,651	1,816,586
1845	881,774	555,160	160,638	151,450	228,543	1,977,565
1846	916,976	814,258	149,006	169,799	218,623	2,268,662
1847	1,087,714	1,092,946	176,448	224,890	287,812	2,869,810
1848	1,086,880	913,824	202,781	261,458	331,287	2,796,230
1849	1,104,940	1,020,259	203,990	255,455	310,088	2,894,732
1850	1,261,991	965,619	200,218	269,370	379,419	3,076,617
1851	1,393,698	1,125,264	222,529	365,404	475,838	3,582,733
1852	1,586,080	1,213,357	207,955	420,295	435,754	3,863,441
1853	1,821,525	1,150,924	230,036	458,327	587,041	4,247,853
1854	1,768,745	992,839	258,021	406,022	740,235	4,165,862
1855	1,534,934	1,047,344	281,873	374,402	784,064	4,022,617
1856	1,478,664	1,192,673	284,901	370,768	789,076	4,116,082
1857	1,364,002	767,370	232,803	222,954	756,932	3,344,061
1858	1,232,968	1,279,891	295,903	188,441	667,989	3,665,192
1859	1,542,035	816,784	299,421	211,182	912,262	3,781,684
1860	1,509,977	1,682,754	268,759	250,360	938,364	4,650,214
1861	1,052,392	2,144,373	280,256	135,096	895,518	4,507,635
1862	1,569,674	2,494,036	364,877	167,927	1,002,271	5,598,785
1863	1,628,688	2,236,075	319,432	172,278	1,201,219	5,557,692
1864	1,478,921	1,572,836	282,354	143,984	1,374,846	4,852,941
1865	1 467,315	1,696,091	281,832	154,968	1,129,448	4,729,654
1866	1,769,994	1,786,060	302,241	179,878	1,737,047	5,775,220
1867	1,744,252	1,438,517	320,844	319,880	1,964,832	5,688,325
1868	1,958,309	1,442,147	373.262	324,064	2,344.443	6,442,225
1869	1,855,930	1,314,071	342,239	268,970	2,077,870	5,859,080
1870	1,916,511	1,309,153	352,497	271,856	2,333,752	6,173,769
1871	1,941,297	1,863,868	336,288	288,428	2,038,007	6,467,888
1872	1,950,798	1,683,962	325,564	298,758	2,414.288	6,673,370
1873	1,582,072	1,750,418	267,820	172,990	2,591,482	6,364,782
1874	1,482,753	1,772,583	246,697	132,181	2,170,374	5,804,588
1875	1,250,546	1,311,613	275,731	110,141	1,911,827	4,859,858
1876	1,175,313	1,067,497	180,201	64,943	1,684,175	4,172,129
1877	1,312,526	1,522,317	184,218	83,010	1,853,892	4,955,963
1878	1,364,120	1,921,236	220,063	138,064	1,527,837	5,171,320
1879	1,368,849	1,850,347	255,303	237,071	1,650,802	5,362,372
1880	1,566,764	2,408,358	278,114	355,165	1,849,255	6,457,656

Chart 5. CLASSIFIED TONNAGE ON NEW YORK CANALS. **(Table 12.)**

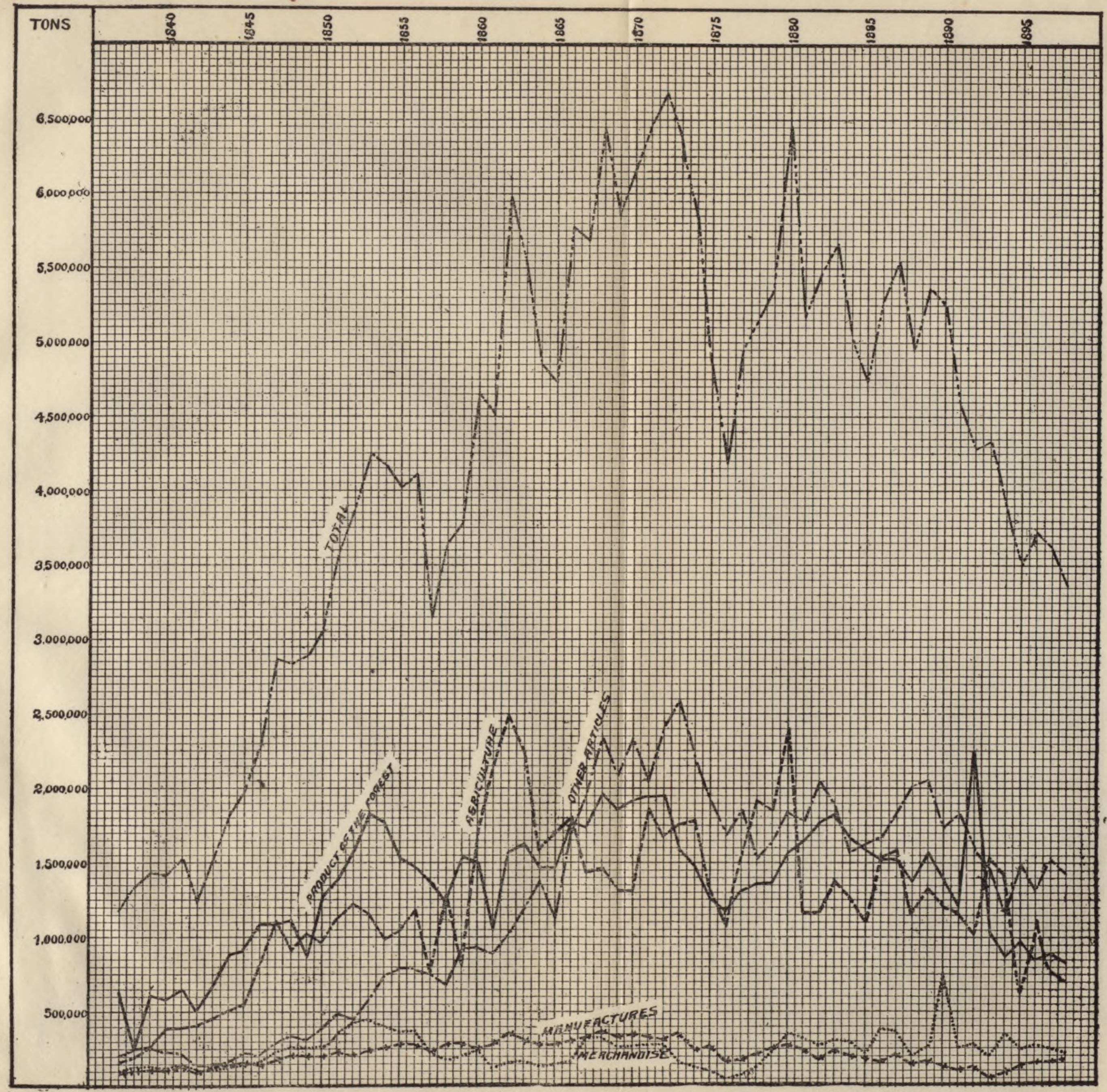


Chart 6. RECEIPTS AT TIDE-WATER FROM ERIE AND CHAMPLAIN CANALS. **(Table 13.)**

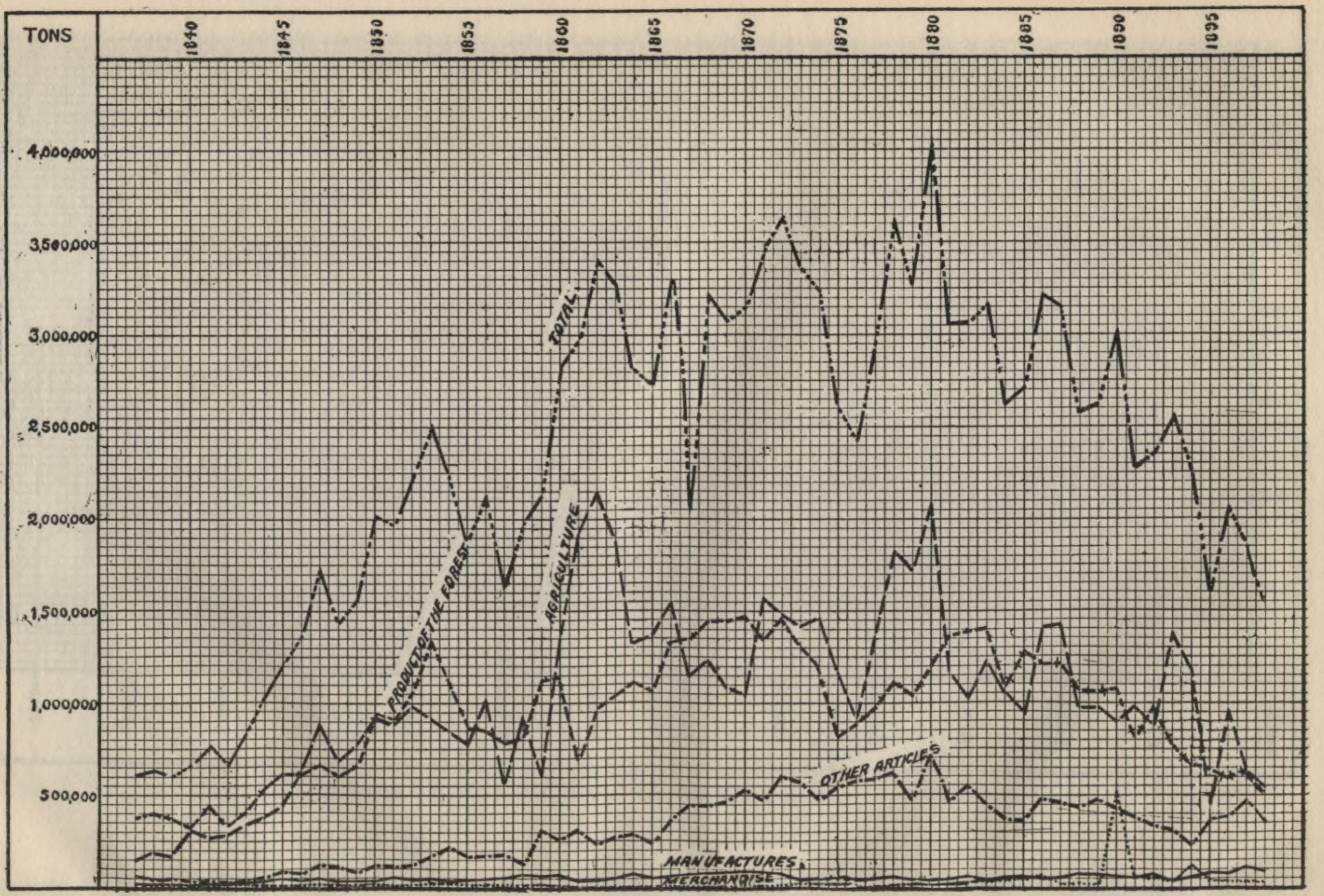


Table 12—Continued.

Year.	Products of the Forest.	Agriculture.	Manufactures.	Merchandise.	Other Articles.	Total.
	Tons	Tons.	Tons.	Tons.	Tons.	Tons.
1881	1,652,543	1,171,400	250,961	325,775	1,778,513	5,179,192
1882	1,771,743	1,173,257	187,535	283,174	2,051,714	5,467,423
1883	1,828,643	1,394,581	242,649	310,844	1,887,339	5,664,056
1884	1,671,706	1,264,237	205,013	300,480	1,568,052	5,009,488
1885	1,595,632	1,108,711	194,714	220,237	1,612,490	4,731,784
1886	1,523,496	1,537,331	165,760	397,249	1,670,146	5,293,982
1887	1,529,809	1,590,509	212,216	378,734	1,842,537	5,553,805
1888	1,389,728	1,177,587	153,905	206,437	2,015,291	4,942,948
1889	1,567,311	1,330,231	161,074	262,818	2,048,935	5,370,369
1890	1,397,862	1,201,916	139,310	769,672	1,737,342	5,246,102
1891	1,206,986	1,171,192	109,387	250,083	1,825,824	4,563,472
1892	1,249,381	1,038,851	125,781	292,468	1,575,514	4,281,995
1893	1,030,604	1,544,146	66,892	216,013	1,474,308	4,331,963
1894	872,601	1,412,142	87,241	352,741	1,157,835	3,882,560
1895	974,870	644,009	133,911	251,537	1,495,987	3,500,314
1896	852,467	1,136,665	152,322	270,603	1,302,837	3,714,894
1897	896,971	789,783	152,388	250,872	1,527,790	3,617,804
1898	820,668	707,855	175,632	220,107	1,435,801	3,360,063
1899	838,449	620,908	159,413	260,063	1,807,218	3,686,051

Table 13.

CLASSIFIED TONNAGE ARRIVING AT TIDE WATER FROM ERIE AND CHAMPLAIN CANALS.

From *Reports of Superintendent of Public Works.*

Year.	Products of the Forest.	Agriculture.	Manufactures.	Merchandise.	Other Articles.	Total.
	Tons.	Tons.	Tons.	Tons.	Tons	Tons.
1835	....	....	....	....	....	753,191
1836	....	....	....	....	....	696,347
1837	385,017	151,469	10,124	394	64,777	611,781
1838	400,877	182,142	8,487	298	48,677	640,481
1839	377,720	163,785	8,565	499	51,559	602,128
1840	321,709	302,356	8,665	104	36,178	669,012
1841	449,095	270,240	17,891	155	36 953	774,334
1842	321,480	293,177	16,015	185	35,769	666,626
1843	416,173	346,140	29,493	201	44,854	836,861
1844	545,202	383,363	39,957	246	62,627	1,031,395
1845	607,930	744,627	49,812	253	99,321	1,204,943
1846	603,010	628,454	46,076	1,797	83,982	1,362,319
1847	666,113	897,717	51,532	4,831	124,090	1,744,283
1848	603,272	685,896	44,867	6,343	107,527	1,447,905
1849	665,547	769,600	44,288	5,873	94,638	1,579,949
1850	947,768	926,048	39,669	7,105	113,273	2,033,863

Table 13—Continued.

Year.	Products of the Forest.	Agriculture.	Manufactures.	Merchandise.	Other Articles.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1851.....	913,268	891,420	52,302	4,580	115,581	1,977,151
1852.....	1,064,677	989,268	47,512	10,605	122,760	3,234,822
1853.....	1,340,261	932,189	52,817	12,633	167,897	2,505,797
1854.....	1,103,018	846,447	40,082	14,632	219,564	3,223,743
1855.....	877,805	782,604	44,844	15,559	174.781	1,895,593
1856.....	858,771	1,023,417	50,454	14,073	176,754	2,123,469
1857.....	798,986	561,894	55,611	16,987	183,709	1,617,187
1858.....	817,613	929,789	74,981	15.233	147,526	1,985,142
1859.....	1,123,607	610,317	63,079	15,804	308,865	2.121,672
1860.....	1,137,873	1,373,393	66,969	11,235	265,407	2,824,877
1861.....	690,586	1,934,247	43.074	8,405	303,832	2,980,144
1862.....	968,062	2,152,159	45,502	5,470	231,516	3,402,709
1863.....	1,049,559	1,898,253	56,268	5,123	265,524	3,274,727
1864.....	1,106,148	1,320,562	79,480	3,469	295,598	2,805,257
1865.....	1,051,616	1,379.331	58,211	4,302	236,721	2,730,181
1866.....	1,329,884	1,542,035	60,180	6,372	367,136	3,305.607
1867.....	1,359,287	1,143,712	77,250	5,196	444,250	2,029,695
1868.....	1,459,353	1,229,554	89,814	5,058	453,370	3,237,149
1869	1,453,419	1,087 105	84.623	4,122	465,873	3,096,142
1870.....	1,465,517	1,049,586	91,166	12,118	537,915	3,156,302
1871.....	1,347,979	1,571,754	94,911	7,603	473.554	3,495,801
1872.....	1,467,865	1,490,248	80,936	7,672	601,223	3,647,944
1873.....	1,308,471	1,421,469	46,421	12,091	588,197	3,376,649
1874	1,192,681	1,470,872	49,426	12,905	497,228	3,223,112
1875.....	813,275	1,175,495	70,209	8,341	541,457	2,608,777
1876.....	890,725	906,483	44,268	4.364	580,342	2,426,182
1877.....	978,366	1.362,700	53,845	5.341	586,860	2,986,812
1878.....	1,120,666	1,833,266	56,108	7,367	619,694	3.637,101
1879.....	1,043,970	1,710,539	46,928	15,299	469,440	3,286,176
1880.....	1,202,207	2,090,283	39,397	30,264	705,251	4,067,402
1881.....	1,367,938	1,165,347	53,043	15,466	464,085	3,065,839
1882.....	1,397,816	1,024,318	61,876	24,154	559,988	3,068,152
1883.....	1,403,174	1,234.463	47,910	27,798	449,152	3,162,497
1884.....	1,097,450	1,054,041	56,899	45,538	377,259	2,631,190
1885.....	1,284.213	949,870	61,912	48,185	371,039	2,715,219
1886.....	1,202,190	1,400,301	50,704	65,988	495,708	3,215,177
1887.....	1,206,279	1,412,166	52,566	21,710	466,202	3,158,923
1888.....	1,074,279	972,746	73,027	20,364	444,245	2,584,661
1889.....	1,065,747	976,660	75,250	16,428	489,751	2,623,836
1890.....	1,086,408	901,407	65,098	524,179	447,673	3,024,765
1891.....	817,228	980,612	51,524	53,924	383,549	2,286,855
1892.....	997,436	865,958	71,380	33,946	347,799	2,366,519
1893.....	784,052	1,384,103	37,972	46,526	313,192	2,565,845
1894.....	676,155	1,189,935	58,646	103,430	228,729	2.256,895
1895.....	649,605	442,595	96,356	40,306	374,883	1,603,745
1896.....	603,545	973.253	84,605	35,107	386,868	2,073,378
1897.....	634,618	633,753	108,871	32,830	486,146	1,878,218
1898.....	527,830	552,054	94,465	27,239	342,985	1,544,573

Chart 7. Canal Traffic: Movement To and From Tide-Water, and Internal Movement. **(Table 14.)**

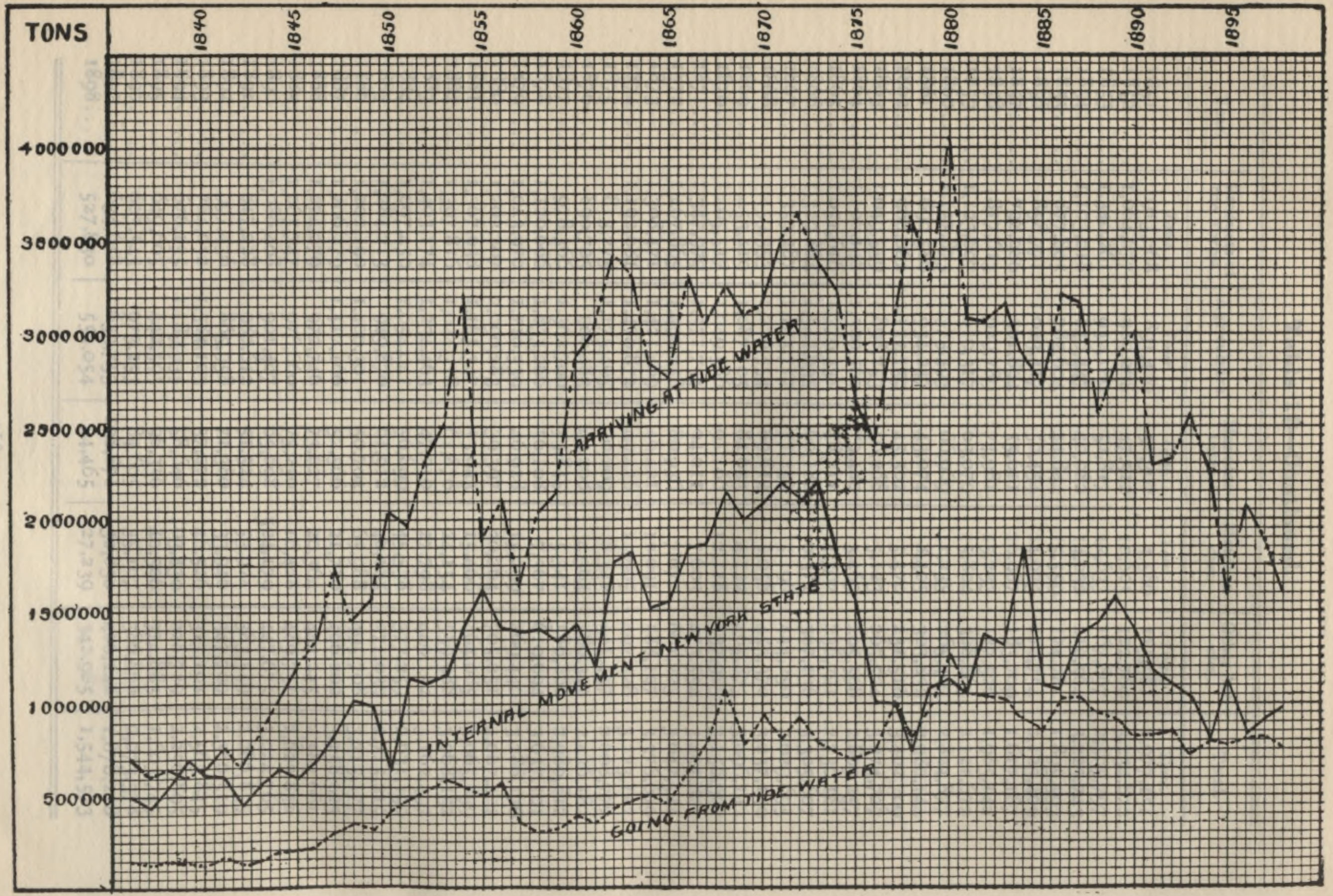


Table 14.

TONS ARRIVING AT AND GOING FROM TIDE-WATER; AND INTERNAL MOVEMENT OF NEW YORK STATE.

From *Report of Auditor of Canals*, 1882, pp. 242-3, and *Reports of Supt. of Public Works.*

Years.	ARRIVING AT TIDE-WATER.					Going from Tide-Water	Internal Movement New York State.
	By Erie Canal.		By Champlain Canal.		Total.		
	From Western States.	From New York.	Vt. and Canada.	New York.			
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1836	54,219	364,906	53,853	223,369	696,347	133,796	480,666
1837	56,255	331,251	43,546	180,729	611,781	122,130	437,385
1838	83,233	336,016	36,330	184,902	640,481	142,808	549,722
1839	121,761	264,596	56,308	159,553	602,128	142,035	691,550
1840	158,148	309,167	50,900	150,797	669,012	129,580	617,454
1841	224,176	308,344	50,909	190,905	774,334	162,715	584,612
1842	221,477	258,672	30,515	155,962	666,676	123,294	447,011
1843	256,376	378,969	32,126	169,390	836,861	143,595	532,983
1844	308,025	491,791	33,974	185,304	1,019,094	176,737	620,755
1845	304,551	655,039	33,389	211,964	1,204,943	195,000	577,622
1846	506,830	600,440	41,852	213,196	1,362,319	213,815	692,528
1847	812,840	618,412	51,377	261,654	1,744,283	288,267	837,260
1848	650,154	534,183	34,528	229,040	1,447,905	329,557	1,018,768
1849	768,659	498,065	65,471	247,751	1,579,946	315,550	999,236
1850	841,501	530,358	124,033	355,155	2,033,863	418 370	624,384
1851	1,045,820	462,857	80,656	387,818	1,977,151	467,961	1,137,621
1852	1,151,978	492,726	107,941	482,182	2,334,828	521,527	1,107,087
1853	1,213,690	637,748	129,609	524,750	2,505,787	584,141	1,157,914
1854	1,094,391	602,167	108,848	412,202	2,223,743	531,831	1,410,288
1855	1,092,876	327,839	99,928	374,950	1,895,593	504,696	1,622,328
1856	1,212,550	374,580	91,254	445,085	2,123,469	573,733	1,418,880
1857	1,019,998	197,201	92,207	407,781	1,617,187	340,176	1,386,698
1858	1,273,099	223,588	93,069	395,386	1,985,142	287,073	1,392,977
1859	1,036,634	414,699	122,917	547,422	2,121,672	317,459	1,342,553
1860	1,896,975	379,086	104,150	474,666	2,854,877	373,735	1,421,602
1861	2,158,425	291,184	53,096	477,442	2,980,144	340,736	1,186,755
1862	2,594,837	322,257	72,601	413,014	3,402,709	417,623	1,778,453
1863	2,279,252	368,437	198,116	428,922	3,274,727	456,800	1,826,165
1864	1,907,136	239,498	195,532	466,091	2,805,257	493,913	1,553,771
1865	1,904,156	174,205	202,331	449,489	2,730,181	458,684	1,540,789
1866	2,235,716	287,948	220,890	561,053	3,305,607	626,974	1,842,639
1867	2,129,405	96,707	206,634	596,949	3,029,695	792,573	1,866,057
1868	2,215,222	163,350	193,474	668,760	3,240,806	1,067,020	2,134,399
1869	2,028,568	229,121	203,876	634,577	3,096,142	772,201	1,990,737
1870	2,048,947	241,751	244,617	620,987	3,156,302	940,429	2,077,038
1871	2,473,832	175,045	212,054	634,870	3,495,801	801,538	2,170,549
1872	2,456,022	214,383	261,058	716,481	3,647,944	926,228	2,099,198
1873	2,359,455	225,900	27,895	763,399	3,376,649	795,117	2,193,016
1874	2,200,364	269,933	193,523	559,292	3,223,112	753,981	1,827,495
1875	1,664,056	250,886	135,115	558,720	2,608,777	701,253	1,549,828
1876	1,402,768	342,552	128,223	552,639	2,426,182	745,797	1,000,150
1877	2,010,081	287,927	156,150	532,654	2,986,812	978,991	990,160

Table 14—Continued.

Years.	ARRIVING AT TIDE-WATER. By Erie Canal. From Western States.	By Erie Canal. From New York.	By Champlain Canal. Vt. and Canada.	By Champlain Canal. New York.	Total.	Going from Tide-Water	Internal Movement New York State.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons
1878	2,450,512	381,278	151,081	654,230	3,637,101	783,150	751,069
1879	2,196,177	349,825	151,913	588,261	3,286,176	992,434	1,083,762
1880	2,801,282	425,076	224,437	616,607	4,067,402	1,264,179	1,126,075
1881	1,804,120	389,182	212,179	660,358	3,065,839	1,056,196	1,057,157
1882	1,824,129	278,311	213,422	752,290	3,068,152	1,038,003	1,361,268
1883	2,288,127		884,370		3,162,497	1,023,125	1,307,475
1884	2,184,790		716,998		2,900,788	908,493	1,854,775
1885	1,923,665		691,524		2,715,2[illegible]9	840,600	1,089,422
1886	2,348,085		867,092		3,215,177	1,012,676	1,066,109
1887	2,278,806		880,117		3,158,923	1,019,375	1,371,811
1888	1,850,261		734,400		2,584,661	936,893	1,421,394
1889	2,090,926		778,736		2,869,662	910,992	1,588,921
1890	1,842,301		1,182,364		3,024,765	827,182	1,393,668
1891	*		*		2,286,855	*	*
1892	1,664,388		672,131		2,336,519	844,194	1,101,282
1893	2,033,939		531,906		2,565,845	739,567	1,026,551
1894	1,881,454		365,441		2 256,895	816,312	809,353
1895	1,266,174		437,571		1,603,745	784,530	1,112,039
1896	1,596,326		477,052		2,073,378	808,541	832,975
1897	1,422,620		455,590		1,878,210	827,334	912,340
1898	1,276,875		333,617		1,609,492	756,055	994,516

* Records destroyed by fire.

Table 15.

TRAFFIC ON NEW YORK CANALS, BY MONTHS.

From *Superintendent of Public Works.*

Month.	1894.	1895.	1896.	1897.	1898.	1899.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
April						65,113
May......	558,445	433,108	558,898	408,042	266,013	401,328
June	571,227	464,796	542,963	563,817	487,628	556,908
July	582,053	506,481	496,317	507,157	505,961	566,908
August ...	550,761	509,086	555,255	549,087	518,807	538,699
September	522,580	507,423	519,762	532,739	522,474	469,907
October...	568,913	548,771	546,892	568,284	551,755	553,274
November	520,086	498,183	494,807	488,678	465,302	534,372
Agents ...	8,495	32,466			42,123	
Total...	3,882,560	3,500,314	3,714,894	3,617,894	3,360,063	3,686,509

Table 16.

BOATS ON NEW YORK CANALS.

Data for 1894 and 1898, furnished by *Wm. J. Warwick*, Insurance Agent.

U. S. Census 1880. Number of boats, 4,349, averaging 172 tons, 70 steamboats.
" " 1890. " " " 2,903 " 181 " 96 "

Year.	GRAIN.			Lumber.	Coal.	No Class.	Not Insurable.	Total.
	1st Class.	2d Class	3d Class.					
1894	241	588	758	266	480	874	718	3,923
1898	434	421	248	435	185	451	30	1,904

Table 17.

VEGETABLE FOOD CARRIED ON ALL CANALS IN NEW YORK STATE.

From *Report of Canadian Dep't of Railways and Canals*, 1898, V., p. 32.

Years.	Flour.	Wheat.	Corn.	Barley.	Oats.	Rye.	Other Vegetable Foods.[1]	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1869....	71,051	670,534	256,475	99,012	92,309	13,489	99,743	1,302,613
1870....	54,978	658,524	193,129	123,191	117,941	19,520	127,727	1,295,010
1871....	41,211	748,549	672,057	113,992	129,891	34,563	109,935	1,850,198
1872....	20,534	403,903	902,753	120,061	92,959	13,357	120,753	1,674,320
1873....	19,307	803,064	637,296	70,586	70.023	30,160	114.735	1,745,171
1874....	29,134	772,163	519,203	98,654	59,408	8,215	280,821	1,767,598
1875....	17,635	744,293	282,031	104,475	62,717	8,309	86,090	1,305,550
1876....	9,290	416,376	365,254	96,494	52,147	19,949	104,783	1,064,293
1877....	8,923	448,043	723,458	139,453	66,045	35,948	77,114	1,498,984
1878 ..	5,904	844,555	734,993	89,534	85,029	64,613	88,106	1,912,734
1879....	7,164	949,466	621,180	96,144	23,164	59,210	77,071	1,833,399
1880 ...	8,266	966,052	1,156,619	106,247	20,893	26,340	86,673	2,371,090
1881....	6,926	444,832	475,823	81,587	30,321	15,484	61,588	1,116,561
1882....	9,372	642,215	251,687	96,650	22,180	43,372	53.300	1,118,776
1883....	9,047	573,740	522.978	58,787	51,607	95,246	67,595	1,379,000
1884.. .	7,251	790,409	198,216	65,008	52,696	71,462	51,944	1,236,986
1885....	6,869	565,922	359.982	64,587	8,234	10 211	47.505	1,063,310
1886....	9,005	993,129	354,765	62,854	7,278	3,073	59,782	1,489,886
1887....	4,089	936,840	446,617	75,458	35,365	6,717	47,678	1,552.764
1888....	3,287	491,419	499,218	41,100	70,315	12,532	49.087	1,166,958
1889....	4,429	484,141	592,550	66,110	63 674	36,329	49,663	1,296,896
1890....	3,489	353,738	616,702	90,754	48,438	21,657	33,123	1,167,901
1891	3,126	756,101	142,141	71,903	16,362	68,771	33,951	1,092,355
1892....	4,879	620,768	150,269	51,596	72,444	4,236	33,807	937,999
1893....	2,367	1,093,927	252,283	49,651	24,714	6,518	20,656	1,450,116
1894....	2,909	903,361	275,377	89,700	100,874	5,288	22,620	1,400,129
1895....	2,240	280,550	94,403	77,868	87,839	205	59,400	602,505
1896....	7,963	408,872	100,227	109,967	197,713	77,210	55,230	957,182
1897....	3,206	180,035	312,776	100,337	50,345	66,387	31,489	744,575
1898....	1,854	69,986	364,248	89,906	76,244	7,745	38,980	648,963

[1] Apples, meal of all kinds, pease, potatoes.

Table 18.

VEGETABLE FOOD CLEARED AT OSWEGO, FOR TRANSIT THROUGH THE ERIE CANAL.

From *Report of the Canadian Dep't of Railways and Canals*, 1898, V., p. 37.

Year.	Flour.	Wheat.	Corn.	Barley.	Oats.	Rye.	Other Articles.[1]	Total.
	Tons.	*Tons*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons*
1869....	7,361	141,360	28,585	66,794	1 113	8,569	14,033	267,815
1870....	11,440	115,732	10,120	77,906	3.953	7,402	11,628	238,181
1871....	10,043	123,173	70,218	72,675	1,806	6,250	13,259	297,424
1872....	4,773	57,865	27,148	62,172	684	6,751	10,425	169,818
1873....	4,061	53,361	10,578	46,337	670	6,019	10,739	131,765
1874....	.....	108,288	46,127	77,007	1,103	7,053	3,747	243,325
1875....	1,728	32,690	3,034	75,083	3,308	4,989	5,931	126,763
1876....	967	21,890	1,324	63,336	117	5.703	6,638	99,975
1877....	855	28,955	3,308	80,306	316	6.603	6,556	126,899
1878....	1,394	24,171	1,383	50,381	....	10.598	5,222	93,149
1879....	734	25,740	9.268	71,693	....	16,623	3,110	127,168
1880....	951	17.466	15,656	82,743	....	12.598	5,996	135,410
1881....	758	25,352	8,064	62,793	200	14,444	4,027	115.638
1882....	813	20,274	4,401	70,862	416	22,265	7,773	126,804
1883....	432	22,634	535	32,557	....	14,384	1,967	72,507
1884....	404	5,932	413	48,391	....	12,173	2,819	70,132
1885....	519	6,484	22	45,264	....	4,613	2,945	59,847
1886....	737	9,579	154	42,261	....	1,671	4,814	59,216
1887....	790	675	2	44,580	....	716	1,370	48,133
1888....	384	2,206	168	6,237	....	...	2,196	11,191
1889....	473	8,002	8,950	40,096	16	1,405	1,003	59,945
1890....	545	10,378	10,408	26,639	8	4,635	2,356	54.969
1891....	292	4,298	1,652	27,418	....	2,130	3,620	39,410
1892....	273	4,806	5,657	5,283	....	199	2,340	18,558
1893....	119	2,036	3,968	8,476	....	237	2 784	17,620
1894...	8	10,293	10,514	17,160	....	....	2,609	40,584
1895....	66	3,073	7,352	1.900	1,816	....	258	14,465
1896....	.....	1,825	7,778	7,552	....	....	2,468	19,623
1897....	.....	6,588	5,550	7,349	498	219	245	20,449
1898....								

[1] Apples, meal of all kinds, potatoes.

Table 19.

VEGETABLE FOOD CLEARED AT BUFFALO, FOR TRANSIT THROUGH THE ERIE CANAL.

From *Report of Canadian Dep't of Railways and Canals*, 1898, V., p. 36.

Year.	Flour.	Wheat.	Corn.	Barley.	Oats.	Rye.	Other Articles.[1]	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1869....	5,609	490,904	219,874	1,978	63,728	2,150	2,193	786,436
1870....	8,258	502,158	165,577	19,944	89,156	10,593	6,906	802,592
1871....	5,607	570,849	579,709	19,810	106,391	27,622	5,705	1,315,693
1872....	....	330,032	866,169	41,515	73,572	5,900	88	1,317,276
1873....	6	737,167	611,675	8,636	51,615	22,441	634	1,432,174
1874....	....	650,161	459,728	3,192	44,079	112	237	1,157,509
1875....	5,589	695,315	273,006	1,156	36,609	2,242	3,372	1,017,559
1876....	231	377,317	356,064	6,334	24,488	12,205	4,691	783,331
1877....	1,710	398,416	709,723	26,351	52,559	27,365	4,976	1,223,100
1878 ...	987	775,953	718,714	21,665	69,256	51,064	6,662	1,644,301
1879....	1,239	892,404	602,171	7,193	14,537	40,471	7,528	1,565,543
1880....	2,743	897,603	131,857	434	16,154	12,137	4,256	2,065,184
1881....	1,491	386,605	458,318	86	24,751	107	7,484	878,842
1882....	1,123	586,019	241,406	1,858	9,046	19,158	6,216	864,826
1883....	538	535,150	517,219	6,816	47,190	79,010	6,051	1,191,974
1884....	520	767,784	194,368	4,910	47,060	57,856	4,411	1,078,909
1885....	323	540,533	356,737	3,317	5,610	6,405	5,427	918,352
1886....	488	955,851	351,272	6,799	5,180	....	4,001	1,353,591
1887....	334	914,152	438,069	15,207	32 907	4,612	44,693	1,449,984
1888....	534	469,965	494,110	6,589	68,922	10,997	1,717	1,052,834
1889....	845	457,922	579,526	16,380	61,175	34,167	5,160	1,155,175
1890....	195	329 531	498,641	58,563	45,202	16,903	4,362	953,397
1891....	1,071	733,967	137,679	43,779	14,803	66,278	2,594	1,000,171
1892....	2,485	611,177	141,506	37,570	70,363	3,997	3,472	870,570
1893....	424	1,086,834	240,767	38,986	21,981	6,156	243	1,395,391
1894....	327	887,908	265,947	69,707	99,898	5,191	2,123	1,331,101
1895....	98	271,957	83,611	71,185	85,507	205	15	508,596
1896....	6,971	402,114	89,726	101,154	194,442	77,162	5,575	877,144
1897....	1,665	168,870	303,761	88,293	48,591	65,490	11,965	688,635
1898....								

[1] Apples, meal of all kinds, pease, potatoes.

Table 20.

GRAIN AND FLOUR MOVEMENT AT BUFFALO.

From *Reports of Supt. of Public Works.*

Year.	Flour (bbls.).		Grain (bushels).		
	Lake Receipts.	Canal Shipments. (a)	Lake Receipts.	Canal Shipments.	% Canal Shipments to Lake Receipts.
1861....	2,159,591	1,667,416	50,062,646		
1862....	2,846,022	2,102,574	58,642,344		
1863....	2,978,088	1.930,731	49,845,065		
1864....	2,028,520	1,474.582	41,044,498		
1865....	1,788,393	1,271,129	42.473.223		
1866....	1,313,543	751,870	51,820,342		
1867....	1,440,056	569,234	43,499.780		
1868....	1,502,731	575,900	42.436,201		
1869....	1,598,487	657,870	37,014,728	28,588,000	77.3
1870....	1.470,391	509,055	39,261,141	30,001,000	76.6
1871....	1,278,077	381,583	60,765,357	48,644,000	80.1
1872....	762,502	190,129	58,447,822	47,861,000	80.2
1873....	1,259.205	181,731	67,340,570	51,432,000	76.4
1874....	1,693,585	269,759	61,562,627	41.437,000	67.2
1875....	1,810,402	163,287	65,194,716	35,782,000	54.9
1876....	807,210	86,019	46,038,598	27,879,000	60.0
1877....	693,044	82,621	61,734,071	44,308,000	71.6
1878....	911,980	54.666	79.176.152	58,815,000	74.3
1879....	897,105	66,333	74,379,829	54,206,000	72.8
1880....	1,317,911	76,537	105,453.372	72,069,000	68.4
1881....	1,051.250	64,129	56,806,545	31,175,000	54.9
1882....	1,199,350	86,777	50,833,590	29,753,000	58.5
1883....	2,071,570	83,768	65,722,080	42.378,000	64.4
1884....	2,615,510	67,138	56,963,970	38,100,000	68.0
1885....	2,903,280	63,602	49,740,060	31,660,000	63.5
1886....	4,582,190	83,296	72,514,840	45,224,000	62.4
1887....	4,001,360	37,861	84.730,910	49,246,000	58.2
1888....	5,244,930	30,463	73,223.500	38.194,000	52.2
1889....	5,480,710	40.555	90,869 880	42,023,000	46.3
1890....	6,245,580	32,046	89,312,800	38,479,000	43.1
1891....	7,093,340	28,900	128,993.020	34,658,000	26.8
1892....	9,746,120	45,176	133,039,090	31,821,000	23.9
1893....	10,562,090	22,574	135,919,920	48,127,000	36.1
1894....	11,488,530	27,147	103,959.165	48,567,000	46.7
1895....	8,971,740	20,333	118,027,930	20,364,000	17.2
1896....	10,384,184	73,741	163,431,814	36.327,000	22.1
1897....	11,339,298	29,685	185,443,816	26,193,000	14.1
1898....	10,371,653	17,166	215,537,169	23,296,000	10.8

(a) Total flour moved on all canals.

Chart 9 (Table 21).

LUMBER MOVEMENT AT TONAWANDA.

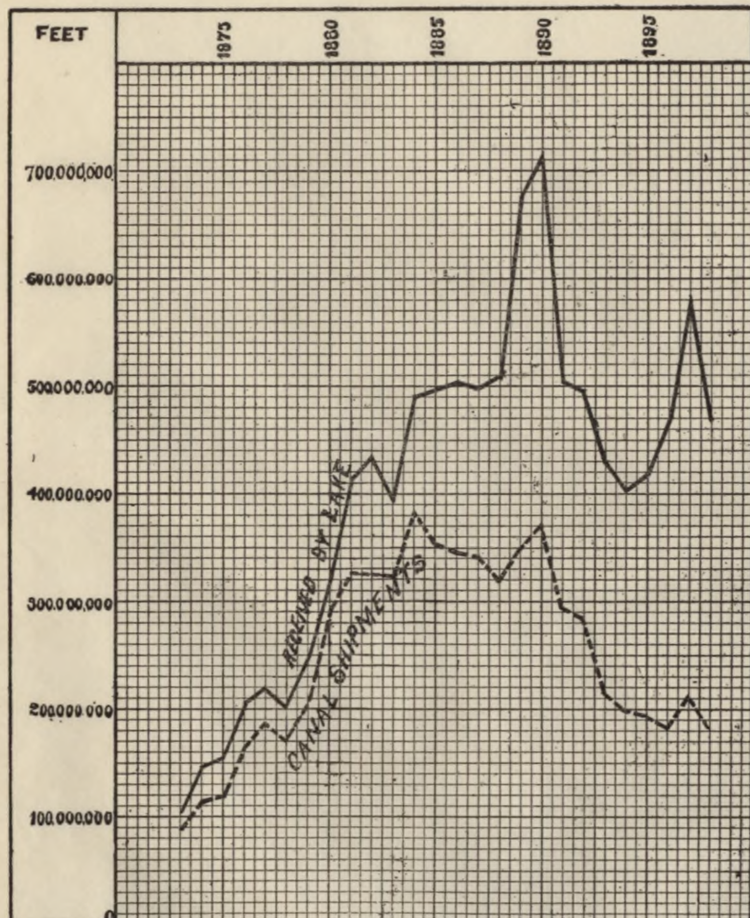


Table 21.

LUMBER MOVEMENT AT TONAWANDA, N. Y.

From tables in *Reports of Buffalo Merchants' Exchange* for 1887, 1889 and 1898.

Year.	Receipts by Lake.			Canal Shipments.
	Lumber.	Lath.	Shingles.	Lumber.
	Feet.	*Pieces.*	*Pieces.*	*Feet.*
1873	104,900,000	1,258,000	1,112,000	89,272,258
1874	144,754,000	1,506,000	10,822,000	115,752,111
1875	155,384,805	6,559,200	13,088,500	120,659,792
1876	207,728,327	6,137,700	18,907,500	165,545,742
1877	221 897,007	5,126,000	23,249,400	188,400,335
1878	206,655,122	3,629,300	21,435 500	173,085,467
1879	250,699,043	5,606,400	30,122,000	206,442,542
1880	323,370,814	1,249,600	22,920,000	291,000,000
1881	415,070,913	282,000	24,271,000	328,886,395
1882	433,241,000	419,000	38,312,000	326,800,681
1883	398,871,853	6,061,850	55,417,000	324.528,266
1884	493,268,323	16,367,000	66,185,000	384,455.635
1885	498,613,000	7,652,000	52,004,000	355.230,390
1886	505,425,400	11,883,000	52,821,000	347,932,840
1887	501,536,825	10,096,000	63,435,000	341,925,473
1888	569,522,850	14,617,000	64,903,000	320,149,450
1889	676,017,200	11,506,000	68,712,000	350,220,303
1890	717,650,900	13,039,600	52,323,300	373,569,621
1891	505,512,000	8,209,800	52,561,000	293,211,900
1892	498,000,000	6,243,245	42,809,300	286,329,307
1893	430,248,922	13,232,600	25,257,400	216,116,532
1894	406,907,136	8,495,450	31,468,700	202,110,990
1895	421,372,458	8,547,050	41,310,650	195,886,000
1896	469,246,500	7,195,350	35,823,200	185,580,352
1897	584,836,500	7,528,500	49,501,200	218,576,701
1898	469,177,448	3,601,500	78,674,500	184,709,746

Table 22.

RECEIPTS OF GRAIN AND FLOUR AT ATLANTIC AND GULF PORTS. (*A.*)

(Bushels, 000's omitted.)

From *Reports of New York Produce Exchange.*

Year.	New York.				Boston. Philadelphia. Baltimore. Portland, Me. New Orleans.	Grand Total, New York and Other Ports.	% of New York Receipts by Canal.
	By Canal.	Coastwise and River.	By Railroad	Total New York.			
1868	46,254,			61,234,			75.8
1869	38,301,			65,241,	58,392,	123,633,	58.9
1870	37,491,			69,921,	61,077,	130,998,	53.6
1871	55,589,			89,543,	71,595,	161,139,	62.4
1872	53,863,			90,930,	78,963,	169,893,	59.8
1873	49,060,			92,137,	77,879,	170,017,	53.3
1874	51,463,			107,273,	80,174,	187,447,	48.1
1875	39,531,			93,895,	77,327,	171,223,	42.5
1876	31,766,			95,949,	107,863,	203,813,	33.1
1877	48,083,			103,313,	96,746,	200,059,	46.7
1878	62,561,			152,853,	139,296,	292,149,	41.1
1879	56,972,			163,124,	164,274,	327,399,	35.0
1880	69,440,	4,236,	95,414,	169,042,	170,775,	339,868,	41.1
1881	38,192,	3,131,	98,574,	139,898,	133,144,	273,042,	28.7
1882	32,150,	2,481,	79,773,	114,405,	91,757,	206,162,	28.7
1883	41,220,	3,725,	79,390,	124,336,	117,281,	241,617,	33.2
1884	37,925,	2,417,	75,076,	115,420,	108,894,	224,314,	33.0
1885	29,930,	3,738,	92,968,	126,637,	106,524,	233,162,	23.8
1886	44,036,	2,132,	84,741,	130,910,	114,523,	245,433,	33.6
1887	46,011,	1,414,	80,075,	127,500,	119,465,	246,966,	36.0
1888	34,021,	3,474,	68,556,	106,052,	94,866,	200,919,	32.1
1889	33,995,	2,436,	76,118,	112,550	119,881,	232,431,	30.4
1890	30,185,	1,609,	90,218,	122,013,	140,690,	262,704,	24.7
1891	31,710,	1,322,	124,844,	157,878,	133,991,	291,869,	20.0
1892	26,882,	2,194,	140,750,	169,826,	193,152,	362,978,	15.8
1893	43,835,	2,363,	99,443,	145,642,	156,910,	302,553,	30.2
1894	43,031,	1,431,	78,720,	123,184,	132,397,	255,584,	35.0
1895	14,690,	898,	103,119,	118,707,	128,128,	246,838,	12.5
1896	32,517,	563,	117,745,	150,827,	198,310,	349,137,	20.6
1897	21,892,	571,	166,064,	188,528,	255,601,	444,129,	11.6
1898	19,407,	424,	175,988,	195,407,	278,494,	473,902,	10.0
1899	16,771,						
1898÷1868=	.42		10.6	3.3	4.5	3.9	

Chart 10 (Table 22 A.)

RECEIPTS OF GRAIN AND FLOUR AT AMERICAN PORTS.

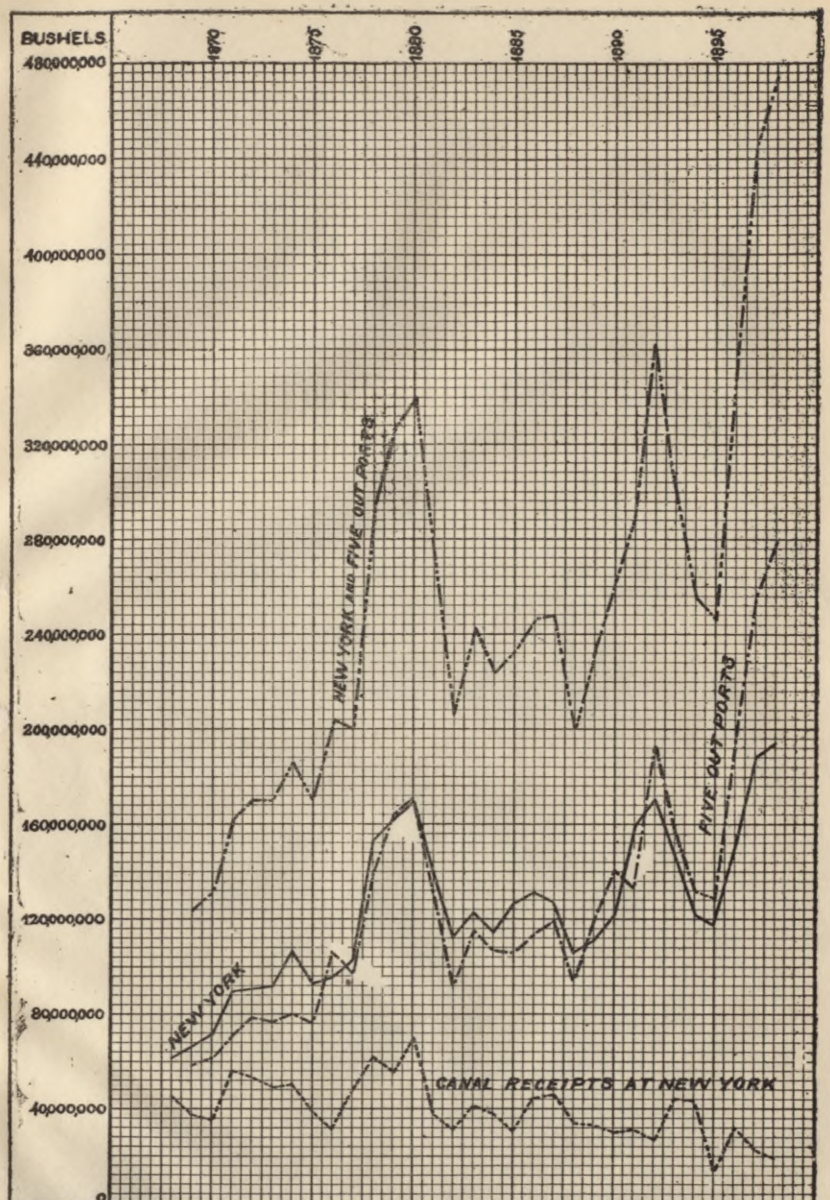


Chart 11 (Table 22 B).

RECEIPTS OF GRAIN AND FLOUR AT AMERICAN PORTS.

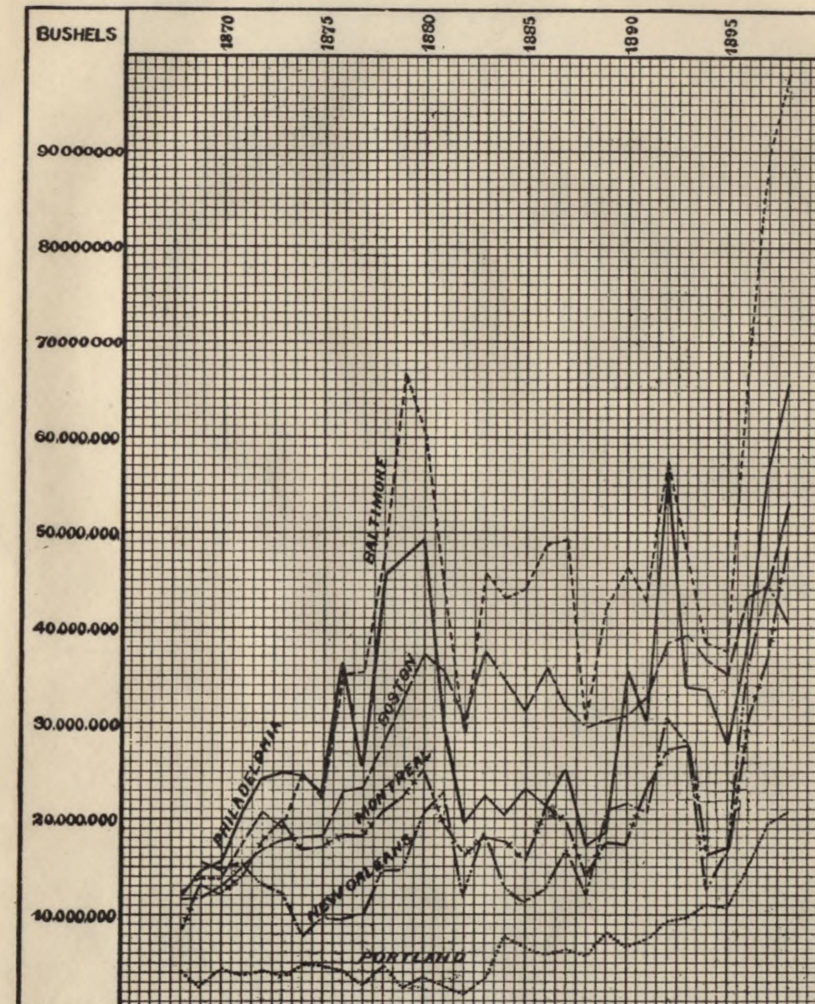


Chart 10 (Table 22 A.)

Receipts of Grain and Flour at American Ports.

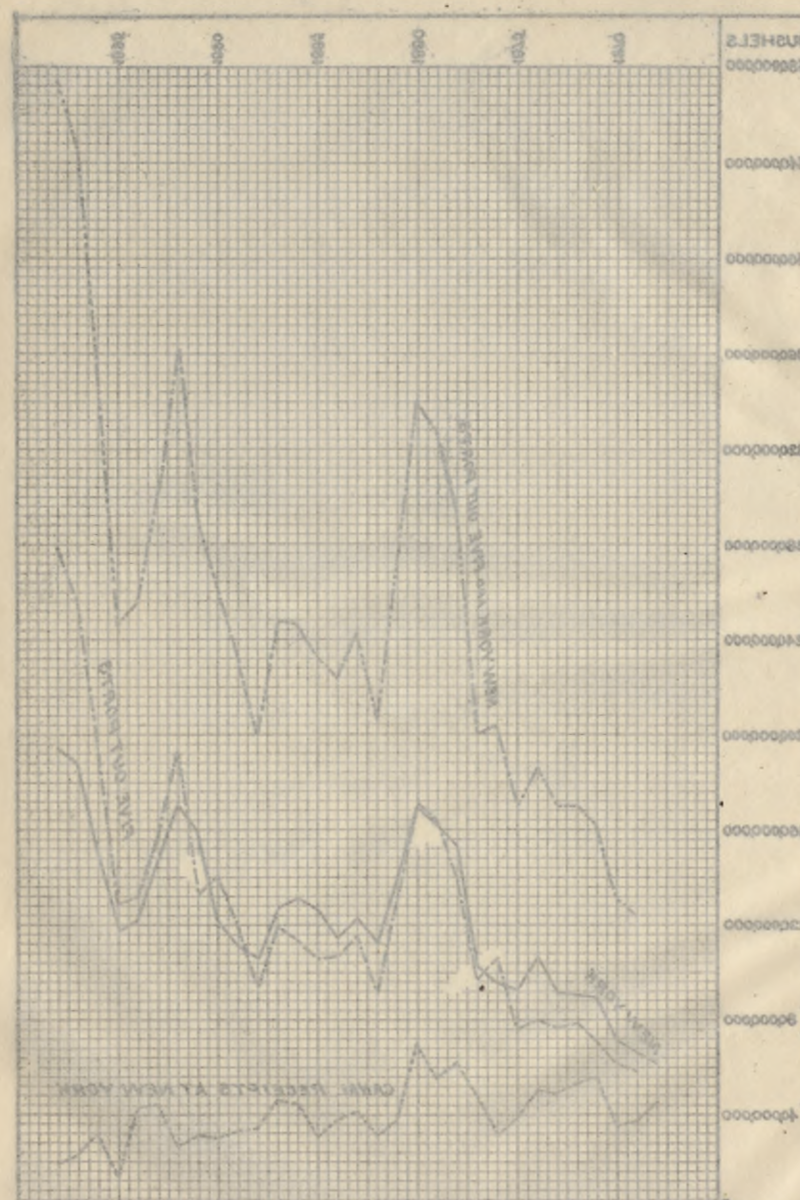


Chart 11 (Table 22 B).

Receipts of Grain and Flour at American Ports.

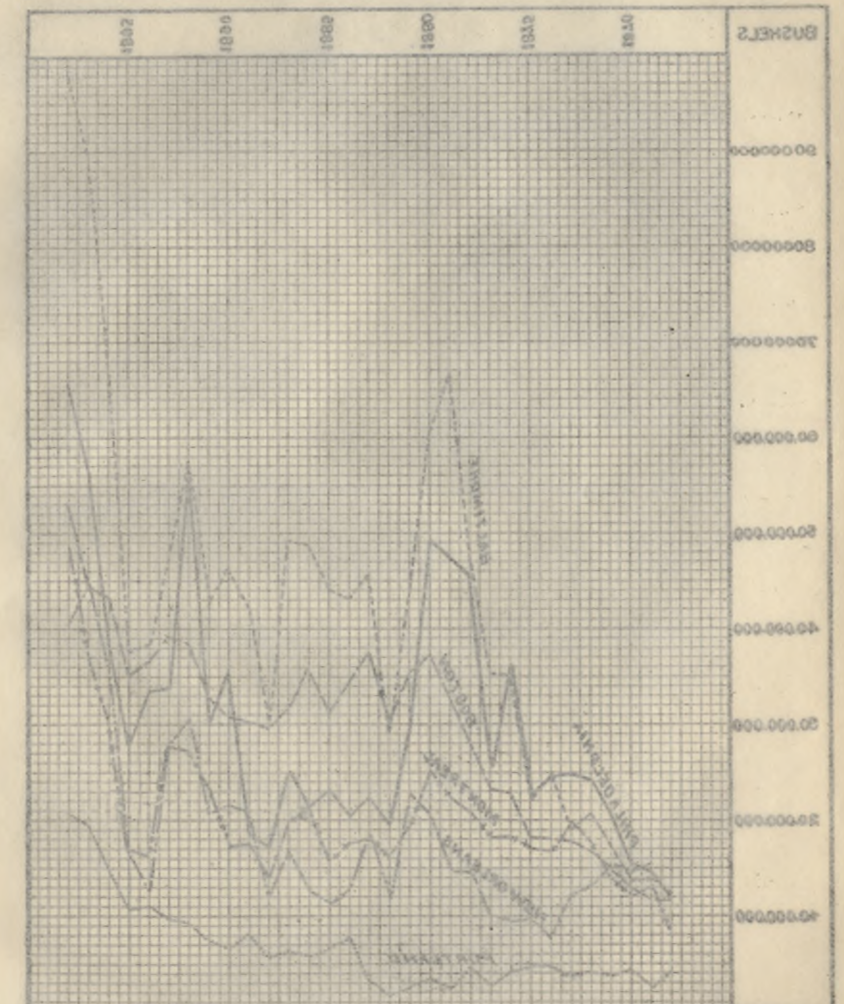


Table 22—Continued.

RECEIPTS OF GRAIN AND FLOUR AT ATLANTIC AND GULF PORTS. (*B.*)

(Bushels, ooo's omitted.)

From *Reports of New York Produce Exchange.*

Year.	Boston.	Philadelphia.	Baltimore.	New Orleans.	Portland, Me.	Montreal.
1868	11,508,	12,151,	12,235,		4,086,	8,353,
1869	11,863,	14,679,	13,818,	15,480,	2,611,	13,039,
1870	13,102,	15,307,	13,819,	14,601,	4,246,	12,230,
1871	15,037,	20,102,	17,389,	15,256,	3,808,	14,166,
1872	16,972,	24,117,	20,571,	13,214,	4,087,	17,547,
1873	17,805,	24,949,	19,099,	12,295,	3,729,	19,713,
1874	18,000,	24,625,	24,936,	7,669,	4,943,	16,875,
1875	18,321,	22,452,	22,048,	9,669,	4,836,	17,134,
1876	22,753,	36,310,	35,244,	9,544,	4,000,	18,313,
1877	23,215,	25,420,	35,346,	10,025,	2,738,	18,358,
1878	27,291,	45,474,	47,075,	14,529,	4,925,	20,872,
1879	32,798,	47,398,	66,799,	14,895,	2,381,	22,363,
1880	37,091,	49,255,	60,631,	20,357,	3,440,	25,329,
1881	35,423,	28,854,	43,341,	22,754,	2,769,	19,083.
1882	29,903,	19,412,	29,022,	11,689,	1,729,	16,302,
1883	37,527,	22,333,	35,847,	18,373,	3,200,	18,096,
1884	34,520,	20,339,	33,119,	12,981,	7,934,	17,554,
1885	31,166,	23,189,	34,299,	11,305,	6,563,	15,814,
1886	35,769,	21,314,	38,772,	12,799,	5,867,	21,098,
1887	31,921,	25,038,	39,252,	16,853,	6,398,	19,891,
1888	29,401,	17,158,	30,275,	12,030,	5,999,	14,018,
1889	30,189,	18,488,	42,349,	20,812,	8,069,	17,659,
1890	30,815,	35,214,	46,435,	21,575,	6,649,	17,444,
1891	32,943,	30,101,	42,811,	20,708,	7,425,	23,244,
1892	38,570,	57,004,	57,686,	30,634,	9,256,	27,436,
1893	39,267,	33,761,	46,428,	27,737,	9,716,	27,713,
1894	36,671,	33,408,	38,442,	12,716,	11,160,	16,071,
1895	35,101,	27,821,	37,622,	16,763,	10,819,	16,948,
1896	43,126,	38,750,	66,371,	35,351,	14,709,	29,926,
1897	44,797,	56,575,	89,986,	45,029,	19,212,	36,960,
1898	53,022,	65,908,	98,366,	40,320,	20,876,	48,256,
1898 ÷ 1868 =	4.8	5.5	8.2	2.7	5.2	6.

Table 23.

RAIL AND WATER MOVEMENT OF GRAIN AT NEW YORK.

(FLOUR NOT INCLUDED.)

From *Reports of New York Produce Exchange.*

Year.	Receipts by Canal.	Receipts by Railroad.	Total Receipts.	Exports.	% Receipts by Canal.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	
1868	44,012,258		45,788,408	13,219,131	96.1
1869	35,438,209		46,729,726	19,642,113	75,8
1870	35,224,450		48,489,141	19,458,945	72.6
1871	54,148,216		70,947,226	35,119,808	76.3
1872	53,138,945		75,025,915	39,408,173	70.8
1873	48,560,045		73,732,174	45,167,691	62.9
1874	51,000,000		86,321,263	54,636,885	59.1
1875	39,000,000		73,342,316	40,027,764	53.2
1876	32,267,274	40,672,536	75,005,775	44,780,724	43.0
1877	47,911,754	34,081,586	83,808,418	54,040.284	55.9
1878	63,663,049	63,960,486	128,613,771	92,893,892	49.5
1879	57,035,507	76,483,604	136,098,289	103,857.438	41.9
1880	69,345,829	71,901,088	143,856,040	115,063,666	48.2
1881	38,188,910	73.289,097	113,120,200	75,182,826	33.8
1882	32,148,345	53,672,968	87,193.263	49,251,711	36.9
1883	41,214,293	51,389,834	95,155,727	52,586,752	43.3
1884	37,924,524	48,086,975	87,456,418	48,216,393	43.4
1885	29.926,879	65,563,023	98,419,558	50,782,188	30.4
1886	43,995,885	59,200 235	104,400,129	55,141,066	42.1
1887	46,009,200	50,755,235	97,509,142	54,936,034	47.2
1888	34,020,600	40,515,050	77,141,012	27,395,359	44.1
1889	33,994,590	50,434,748	85,613,533	42,418,448	40,6
1890	30,185,400	63,938,068	94,969,908	48,400,010	31.8
1891	31,696,694	96,194,173	128,426,096	69,525,786	24.9
1892	26,780,675	105,111,076	132,859,336	76,498,205	19.7
1893	43,835,800	61,802,966	106,830,450	57,218,177	41.0
1894	43,031,800	42,535,695	86,385,297	36,520,427	49.8
1895	14,690,100	72,778,335	87,931,948	45,731,125	16.3
1896	32,250,050	88,227,725	120,707,809	69,120,665	26.7
1897	21,828,200	132,524,575	154,450,995	117,521,143	14.0
1898	19,407,100	141,623,160	161,114,573	124,615,822	12.0

Chart 12 (Table 23.)

RECEIPTS AND EXPORTS OF GRAIN AT NEW YORK.

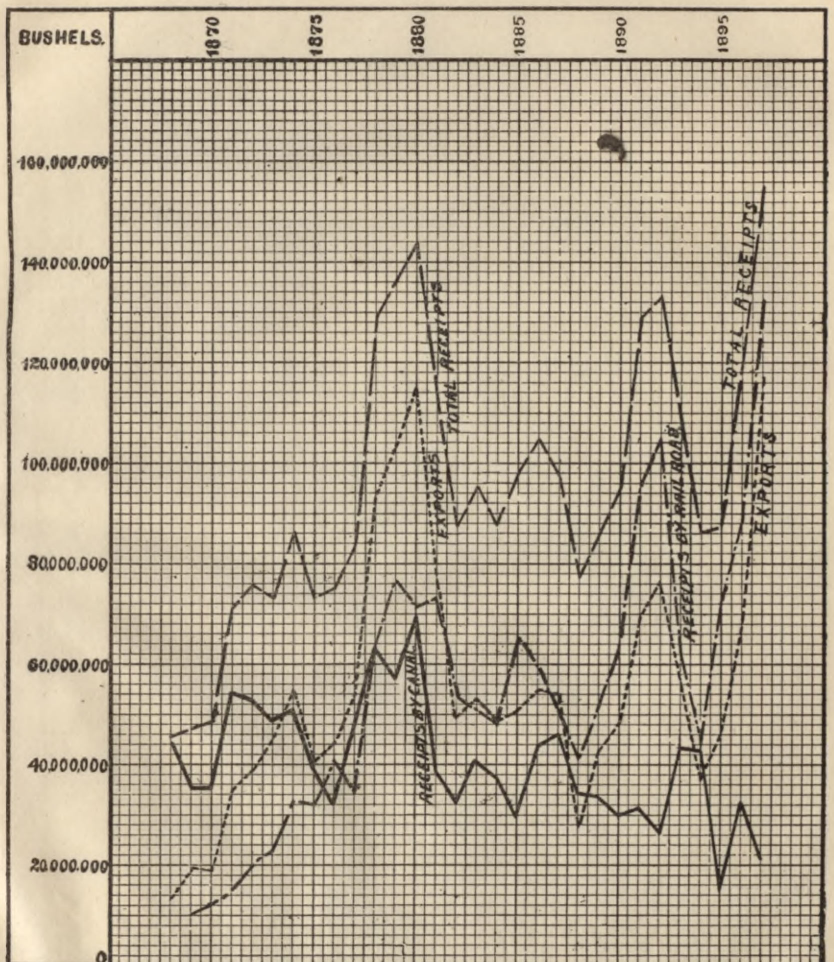


Chart 13 (Tables 22-24).

PERCENTAGE OF GRAIN RECEIPTS AT NEW YORK ARRIVING BY CANAL.

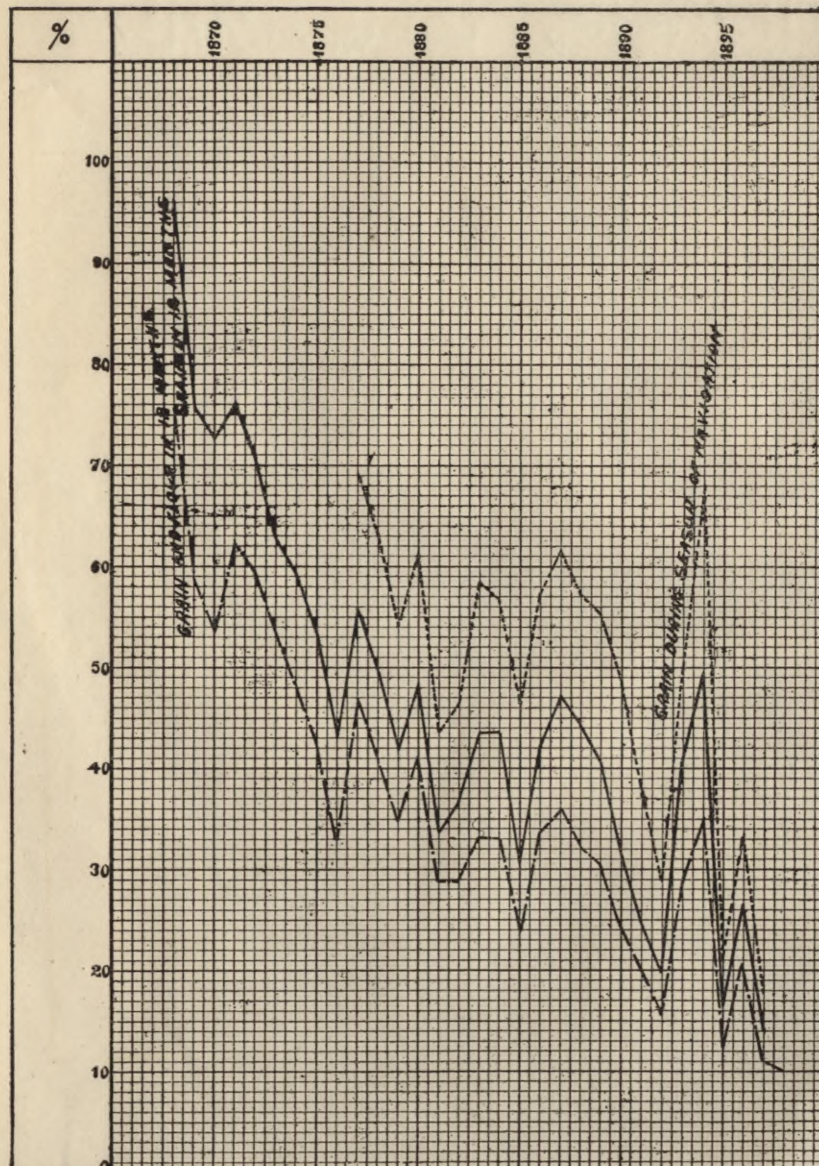


Chart 12 (Table 23.)

RECEIPTS AND EXPORTS OF GRAIN AT NEW YORK.

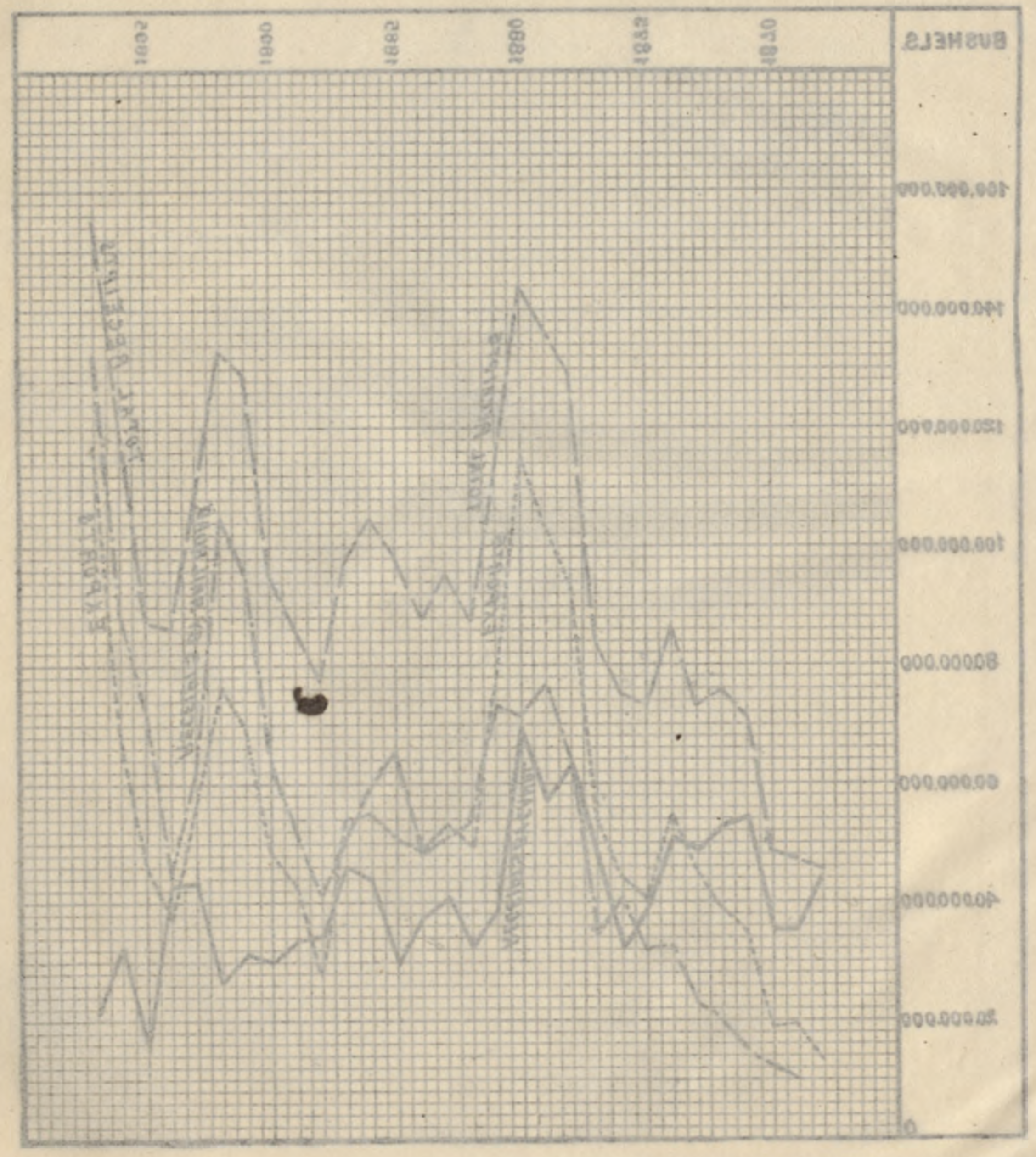


Chart 13 (Tables 22-24).

PERCENTAGE OF GRAIN RECEIPTS AT NEW YORK ARRIVING BY CANAL.

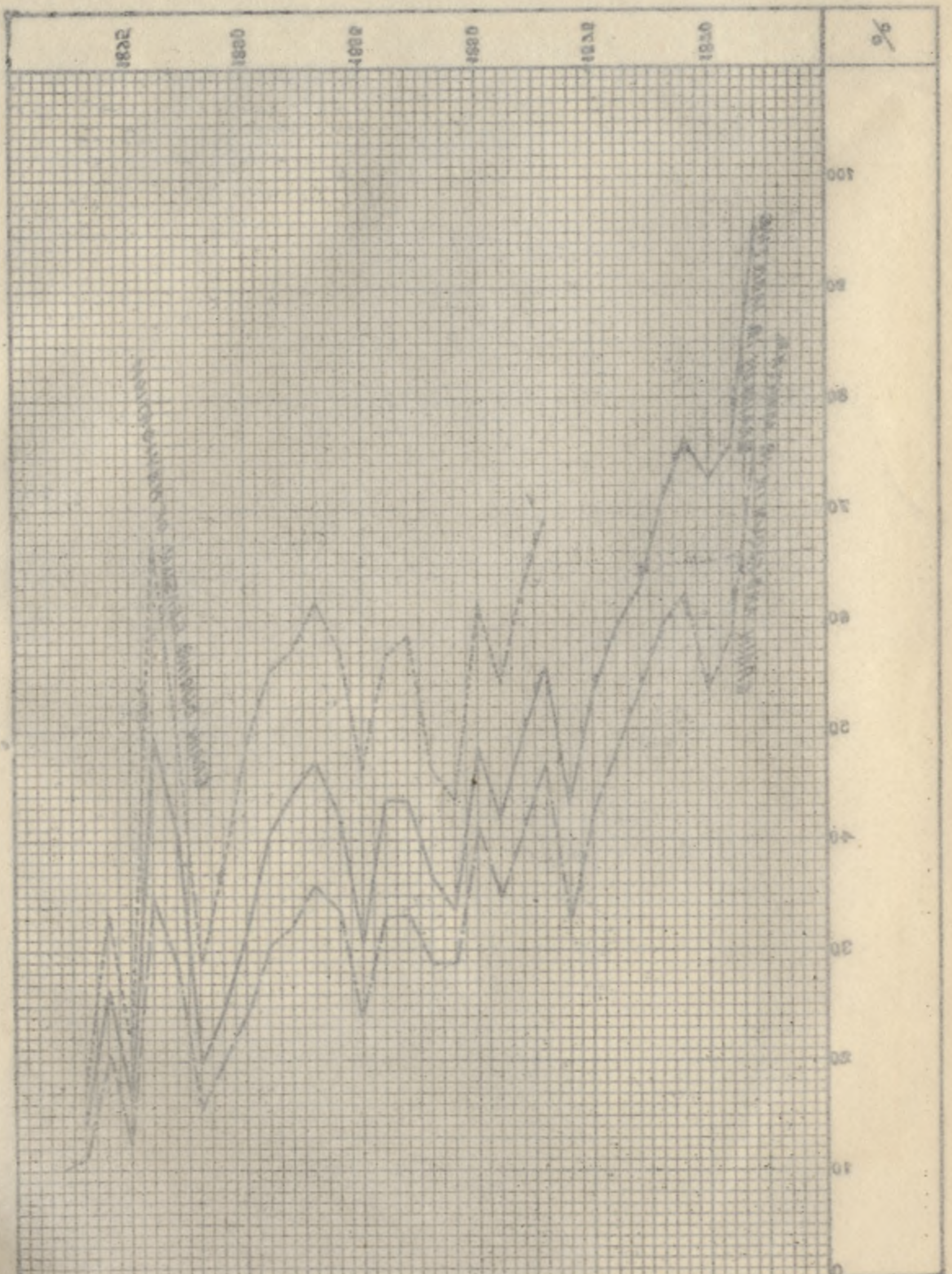


Chart 14 (Table 24.)

GRAIN RECEIPTS AT NEW YORK DURING SEASON OF NAVIGATION.

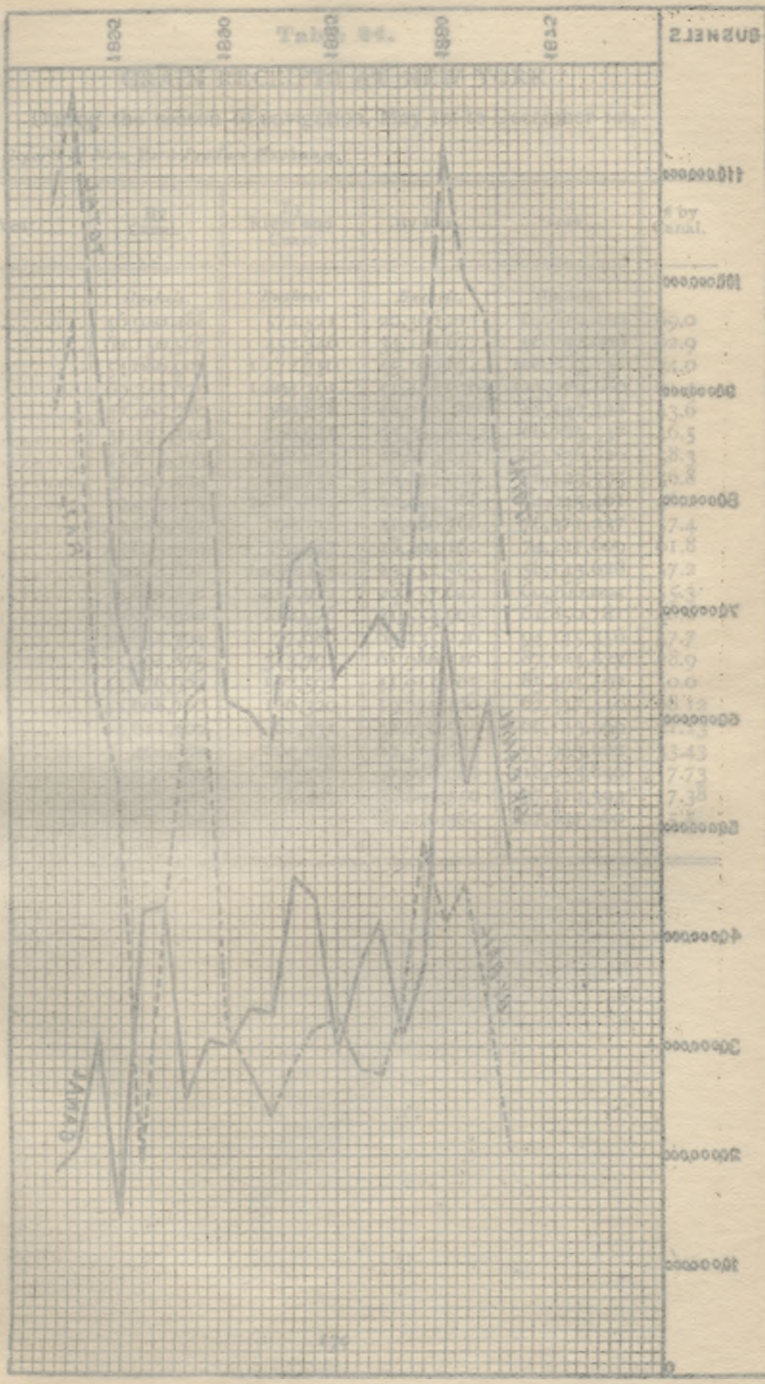


Chart 14 (Table 24.)

GRAIN RECEIPTS AT NEW YORK DURING SEASON OF NAVIGATION.

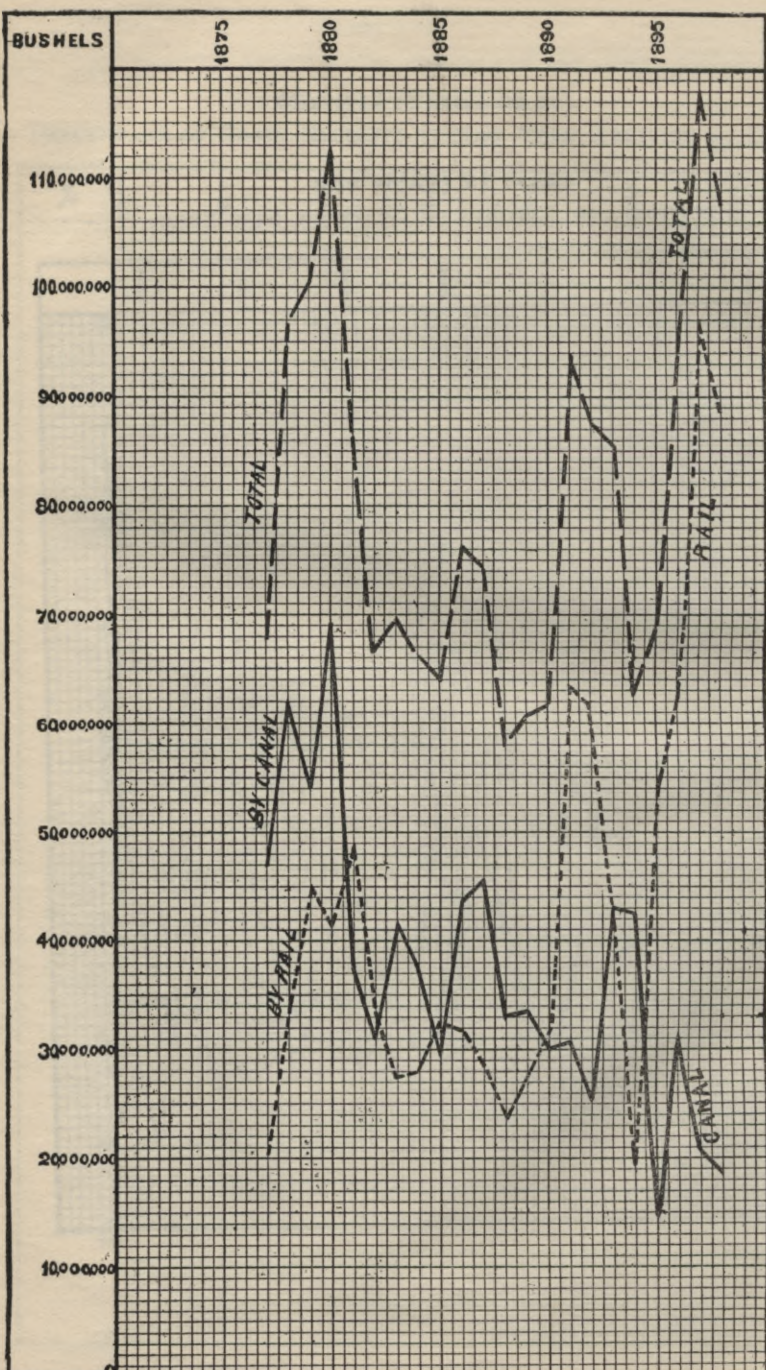


Table 24.

GRAIN RECEIPTS AT NEW YORK

During the season of navigation, May 1st to December 1st.

From *Reports of New York Produce Exchange.*

Year.	By Canal.	By River and Coast.	By Rail.	Total.	% by Canal.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	
1877........	46,940,488	572,571	20,366,211	67,879,270	69.0
1878	62,150,568	452,346	34,144,677	96,747,609	62.9
1879........	54,086,907	1,472,350	45,109,874	100,669,131	54.0
1880........	69,345,829	1,894,395	41,838,936	113,079,160	61.4
1881........	37,465,210	360,838	48,716,380	86,542,428	43.6
1882........	31,171,519	790,945	33,763,073	66.725.537	46.5
1883........	41,815,393	1,341,953	27,679,840	69,836,826	58.3
1884........	37,501,424	579,151	28,049,020	66,129,595	56.8
1885........	29,429,679	2,211,354	32,404,368	64,045,401	46.0
1886........	43,619,355	765,116	31,986,766	76,371,237	57.4
1887........	45,673,300	350,147	28,204,162	74,227,609	61.8
1888........	33,154,800	1,236,245	23,752,583	58,143,628	57.2
1889........	33,605,390	412,972	26,757,642	60,766,004	55.3
1890........	30,082,900	212,976	31,554,905	61,850,781	48.6
1891	30,832,394	77,686	63,235,276	94,145,356	37.7
1892........	25,394,875	343,792	61,986,210	87,724,877	28.9
1893........	43,076,900	502,592	41,915,005	85,494,497	50.0
1894........	42,608,700	166,320	19,772,420	62,547,440	68 12
1895........	14,011,400	61,331	52,070,535	66,143.266	21.23
1896........	31,404,650	224,172	62,314,800	93,943,622	33.43
1897........	20,934,400	41,456	97,078,000	118,053,856	17.73
1898........	18,686,900	18,243	88,809,250	107,514,393	17.38
1899........	16,771,600		91,076,360	107,847,960	15.5

Table 25.

HEAVY GOODS ON ALL NEW YORK CANALS.

From *Report of Canadian Department of Railways and Canals*, 1898, V., p. 33.

Years.	Railway Iron.	Other Iron.	Salt.	Coal.	Ores.	Total.
	Tons.	*Tons*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1869	137,677	79,652	263,333	1,324,408	183,992	1,989,062
1870	135,930	89,708	266,740	1,558,185	238,802	2,289,365
1871	178,269	100,310	248,709	1,194,037	289,952	2,011,277
1872	161,667	96,996	248,558	1,462,590	377,592	2,347,403
1873	53,363	62,581	216,706	1,625,859	415,968	2,374,477
1874	24,511	82,955	173,590	1,413,162	232,544	1,926,762
1875	36,603	95,305	186,785	1,217,091	283,219	1,819,003
1876	11,691	69,450	114,070	1,036,698	173,530	1,405,439
1877	10,341	58,828	156,918	1,286,881	250,573	1,763,541
1878	8,385	65,642	139,927	889,873	210,078	1,313,905
1879	27,634	99,568	136,021	971,074	314,411	1,548,708
1880	93,613	139,993	144,487	959,342	370,884	1,709,319
1881	78,650	205,005	113,756	1,092,003	337,873	1,827,287
1882	58,921	122,786	108,040	1,228,435	364,361	1,882,543
1883	46,553	47,212	190,392	1,152,849	293,892	1,731,098
1884	28,513	54,471	161,788	954,288	210,610	1,400,670
1885	12,215	38,726	161,272	1,025,941	195,750	1,433,904
1886	10,878	152,030	112,002	857,884	269,914	1,402,708
1887	21,368	224,979	124,054	905,424	243,578	1,539,403
1888	2,596	43,881	106,344	1,219,680	259,269	1,631,770
1889	3,278	78,135	112,100	1,094,897	234,948	1,523,358
1890	5,800	26,804	93,181	830,154	202,072	1,157,291
1891	1,960	36,770	81,232	881,502	215,686	1,217,150
1892	524	40,073	93,216	832,397	136,612	1,102,822
1893	536	25,204	52,094	741,934	102,275	922,043
1894	267	22,614	70,353	609,368	37,641	740,243
1895	4,263	59,402	71,334	766,723	144,076	1,045,798
1896	1,568	74,651	83,309	682,167	89,998	931,693
1897	5,080	71,117	66,879	646,803	76,311	866,190
1898	6,288	101,376	85,525	626,616	73,199	893,004
1899	2,725	66,950	91,068	777,743	205,234	1,143,720

Chart 15 (Table 25).

HEAVY GOODS MOVED ON NEW YORK CANALS.

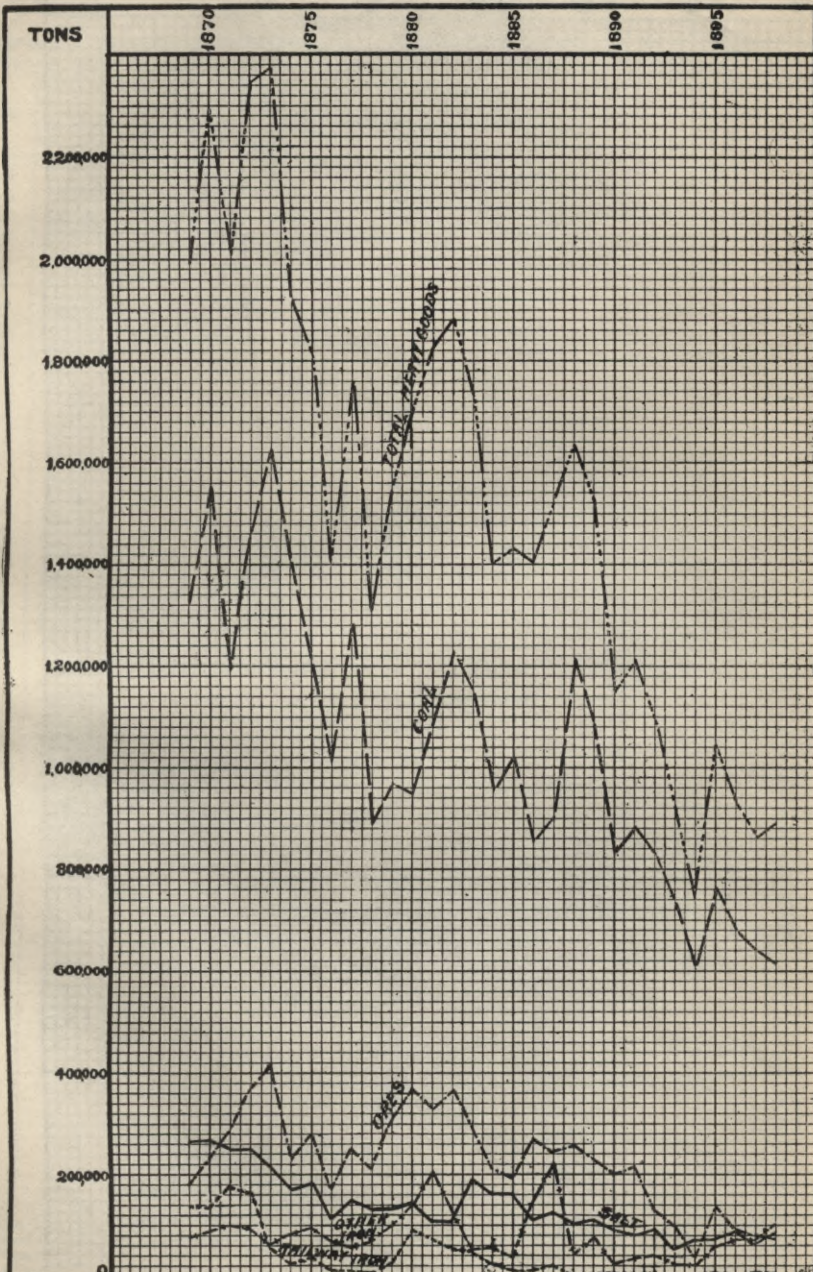


Chart 16. Ton-Mileage on New York Canals and Railroads. **(Table 26.)**

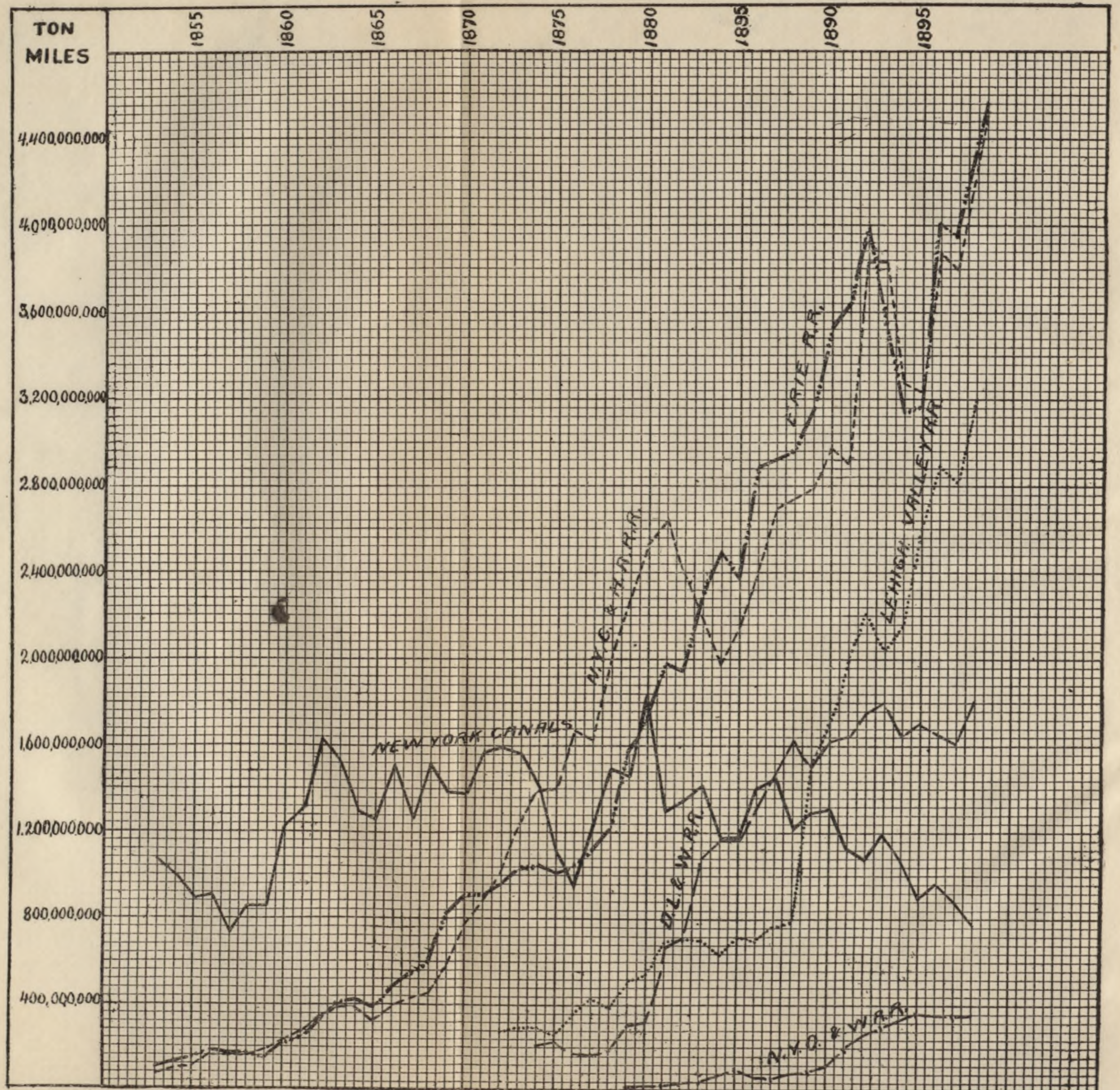


Table 26.

TON-MILEAGE ON NEW YORK CANALS AND RAILROADS.

(In millions of ton-miles.)

Compiled from *Poor's Manuals of Railroads* and *Reports of Supt. of Public Works.*

Year.	New York Canals.		N. Y. C. & H. R. R. R.	Erie R.R.	Lehigh Valley R. R.	D.L.& W.R.R.	N.Y. O. & W. R. R.	Total New York Traffic.	% by Canals.
	On Canals (a)	On Canals and River (a)	(b)		(c)	(c)			
1853	700	1,075	70	101				1,246	86
1854	668	1,002	99	130				1,231	81
1855	619	904	114	150				1,168	78
1856	592	910	165	183				1,258	74
1857	485	726	165	167				1,058	69
1858	564	861	161	166				1,188	72
1859	544	862	187	147				1,196	72
1860	809	1,232	239	214				1,685	72
1861	864	1,311	280	251				1,842	71
1862	1,123	1,633	357	351				2,341	70
1863	1,034	1,524	387	403				2,314	66
1864	871	1,291	386	422				2,099	61
1865	844	1,255	318	388				1,961	64
1866	1,012	1,507	388	479				2,374	64
1867	958	1,262	435	550				2,247	56
1868	1,033	1,518	455	595				2,568	59.
1869	919	1,384	589	817				2,790	50
1870	904	1,378	769	898				3,045	46
1871	1,050	1,575	888	897				3,360	47
1872	1,048	1,594	1,020	965	275			3,854	41.
1873	1,057	1,564	1,246	1,032	293			4,135	38
1874	938	1,421	1,391	1,047	291	212		4,362	33
1875	727	1,117	1,404	1,016	268	229		4,034	28.
1876	571	934	1,674	1,040	361	174		4,184	22
1877	857	1,205	1,619	1,114	432	168		4,538	27
1878	938	1,483	2,042	1,224	374	187		5,310	28
1879	963	1,455	2,295	1,569	516	308	12	6,155	24
1880	1,223	1,833	2,525	1,721	541	316	14	6,950	26
1881	930	1,300	2,646	1,984	695	676	19	7,320	18.
1882	980	1,350	2,394	1,954	706	711	31	7,146	19
1883	1,020	1,420	2,200	2,306	703	1,079	39	7,747	18
1884	900	1,180	1,970	2,498	637	1,148	69	7,502	16
1885	850	1,180	2,137	2,381	717	1,162	94	7,971	15
1886	930	1,410	2,414	2,882	697	1,315	61	8,779	16
1887	1,000	1,450	2,704	3,022	766	1,475	55	9,472	15
1888	890	1,210	2,705	3,062	788	1,630	81	9,476	13.
1889	960	1,290	2,799	3,165	1,504	1,508	85	10,351	13
1890	940	1,310	2,973	3,517	1,706	1,630	114	11,228	12
1891	820	1,120	2,890	3,640	1,890	1,645	194	11,379	10
1892	770	1,070	3,830	3,990	2,208	1,753	263	13,114	8.1
1893	780	1,190	3,833	3,551	2,048	1,800	294	12,716	9.4
1894	700	1,070	3,275	3,144	2,151	1,644	328	11,612	9.2
1895	525	890	3,329	3,169	2,606	1,704	359	11,957	7.4
1896	560	970	3,874	4,009	2,889	1,654	356	13,752	7.1
1897	540	870	3,790	3,939	2,821	1,616	353	13,389	6.5
1898	510	770	4,500	4,556	3,204	1,825	354	15,980	4.8

(a) The first column is the mileage on canals alone, the second includes also estimated ton-mileage of Canal Traffic on Hudson River; after 1880 the entire canal ton-mileage is estimated, as no records are kept.
(b) Including Hudson River R.R before consolidation. (c) Including coal traffic.

Table 27.

FREIGHT TONNAGE ON NEW YORK CANALS AND RAILROADS.

Compiled from *Poor's Manuals of Railroads*, and *Reports of Supt. of Public Works.*

Year.	N.Y.C. & H R. R. R. (a)	Erie R. R.	Lehigh Valley R. R (b)	D. L. & W. R. R. (b)	N. Y. O. & W. R. R.	New York Canals.	New York Railroads.	Total.	% by Canals.
1854	549,805	743,250				4,165,862	1,293,055	5,458,916	76
1855	670,073	842,055				4,022,617	1,512,128	5,534,738	75
1856	932,844	983,221				4,116,082	1,916,065	6,032,147	68
1857	1,075,589	978,067				3,344,061	1,954,656	5,298,717	63
1858	925,604	816,964				3,665,192	1,742,568	5,407,760	68
1859	1,093,284	869,072				3,781,684	1,962,356	5,744,040	66
1860	1,366,035	1,139,554				4,650,214	2,505,589	7,155,803	65
1861	1,537,400	1,253,419				4,507,635	2,790,819	7,298,474	62
1862	1,905,173	1,632,955				5,598,785	3,538,128	9,136,913	62
1863	2,106,571	1,815,096	510,022	249,509		5,557,692	4,681,198	10,238,890	54
1864	2,158,972	2,170,798	755,230	238,760		4,852,941	5,323,760	10,176,701	47
1865	1,767,059	2,234,350	547,228	206,923		4,729,654	4,755,560	9,485,214	50
1866	2,099,594	3,242,792	768,373	312,258		5,775,220	6,422,927	12,218,147	42
1867	2,249,363	3,484,546	1,085,439	319,021		5,688,325	7,138,369	12,826,694	44
1868	2,562,862	3,908,253	1,198,712	356,098		6,442,225	8,025,925	14,468,150	44
1869	3,190,840	4,312,209	1,338,062	398,884		5,859,080	9,239,995	15,099,075	39
1870	4,122,000	4,852,505	1,812,641	527,554		6,173,769	11,314,700	17,488,469	35
1871	4,532,956	4,844,208	1,513,745	397,356		6,467,888	11,288,265	17,756,153	37
1872	4,393,965	5,564,274	1,968,162	433,406		6,673,370	12,359,807	19,033,177	35
1873	5,522,724	6,312,702	2,228,886	648,096		6,364,782	14,712,408	21,077,190	30
1874	6,114,678	6,364,276	1,933,468	433,469		5,804,588	14,845,591	20,650,479	29

(a) Including tonnage of Hudson River R. R. before consolidation.

(b) Excluding coal.

Chart 17 (Table 27).

FREIGHT TONNAGE ON NEW YORK CANALS AND RAILROADS.

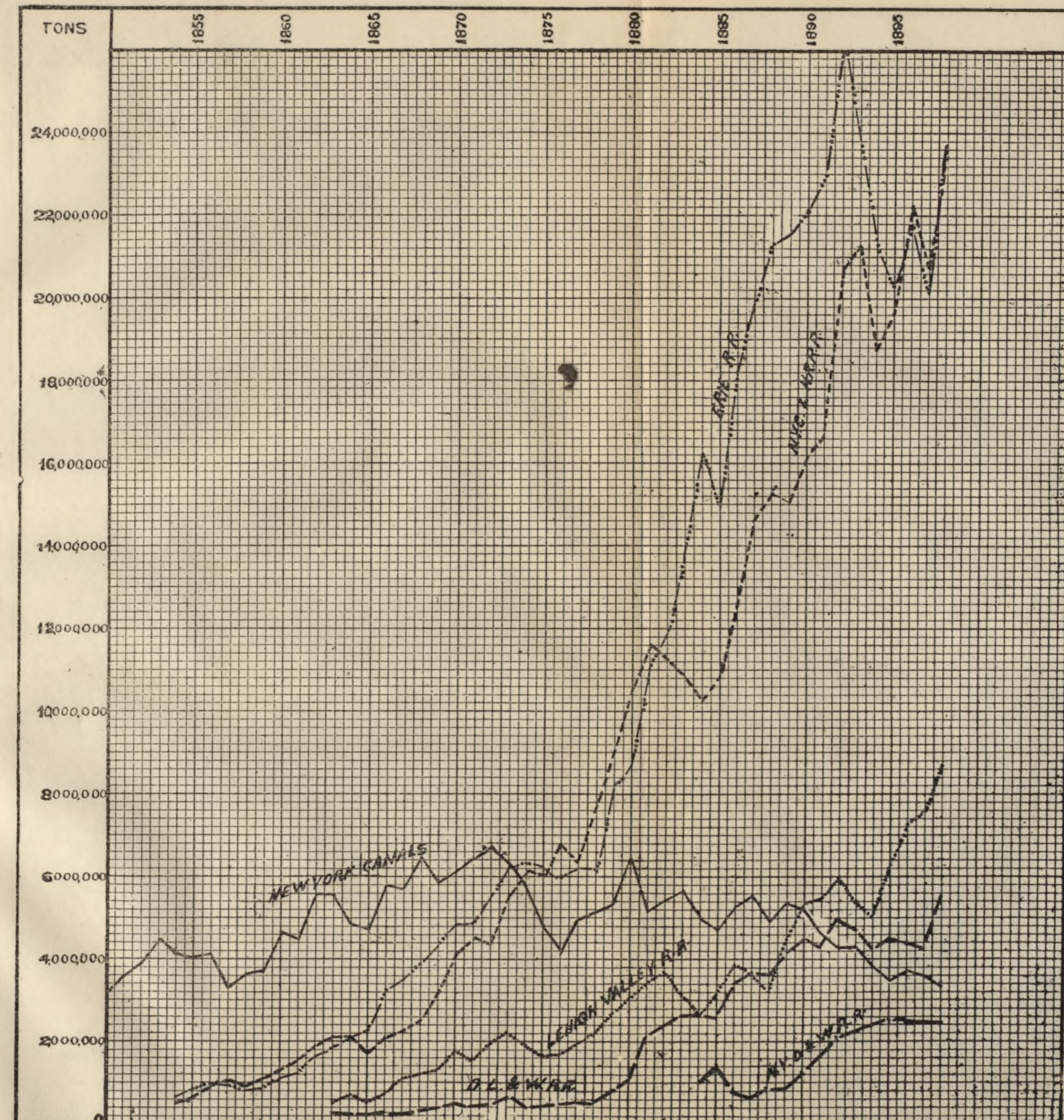


Chart 17 (Table 27).

FREIGHT TONNAGE ON NEW YORK CANALS AND RAILROADS.

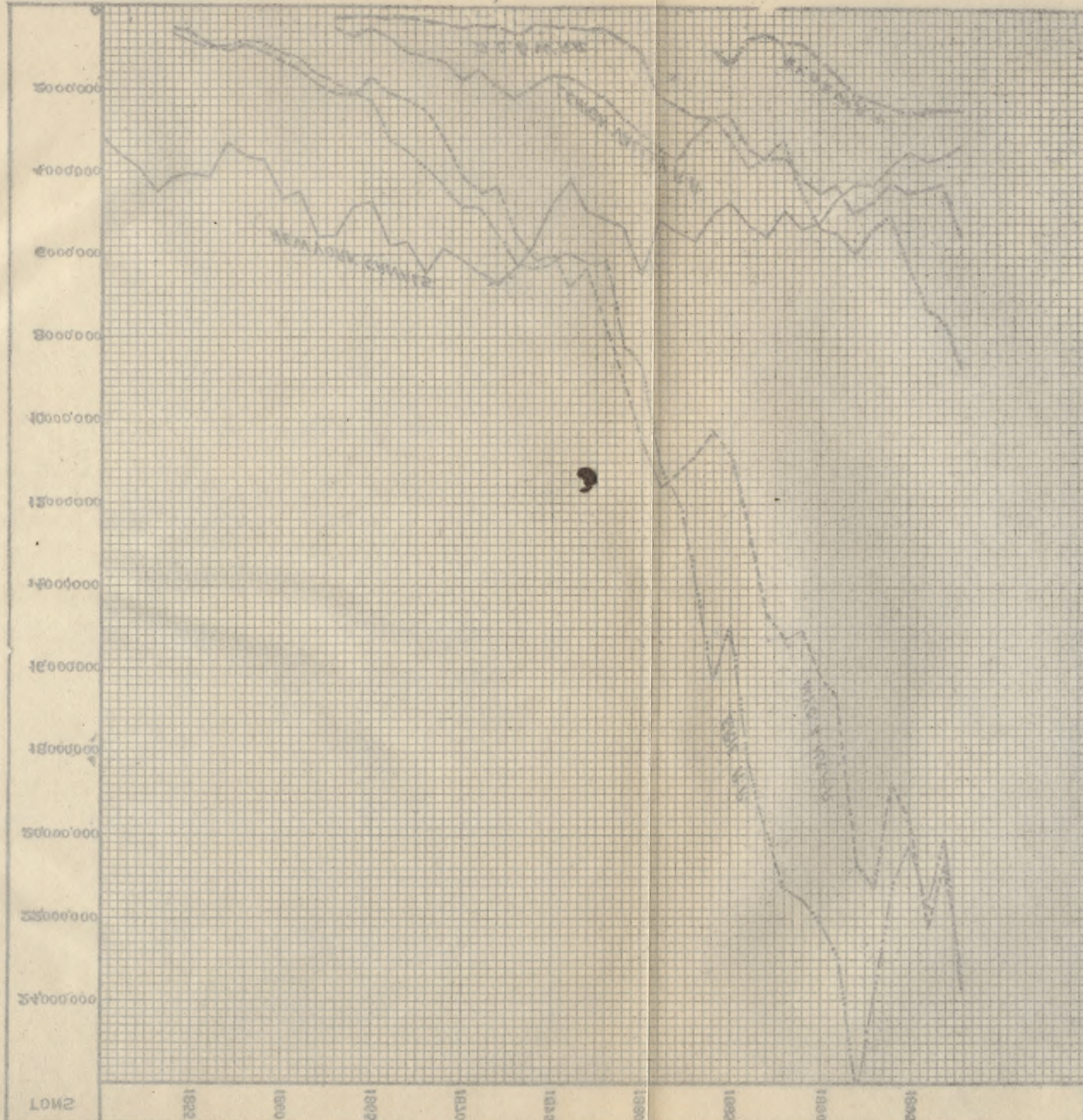


Table 27—Continued.

Year.	N.Y.C. & H.R R. R. (a)	Erie R. R.	Lehigh Valley R R. (b)	D L. & W. R. R. (b)	N Y. O. & W. R R.	New York Canals.	New York Railroads.	Total.	% by Canals.
1875	6,001,954	6,239,946	1,668,813	482,989		4,859,858	14,393,701	19,253,560	25
1876	6,803,680	5,972,812	1,684,123	522,985		4,172,129	14,983,600	19,155,729	22
1877	6,351,356	6,182,451	1,953,121	552,923		4,955,963	14,959,851	19,915,814	25
1878	7,695,413	6,150,468	2,229,949	549,987		5,171,320	16,625,817	21,797,137	24
1879	9,015,753	8,212,641	2,731,324	795,531		5,362,372	20,755,249	26,117,619	20
1880	10,533,038	8,715,892	3,028,710	1,108,437		6,457,656	23,486,077	29,943,633	21
1881	11,591,379	11,066,823	3,397,588	2,131,179		5,179,192	28,187,069	33,366,261	15.5
1882	11,330,393	11,895,238	3,685,436	2,404,398		5,467,423	29,315,465	35,782,888	15.3
1883	10,892,440	13,610,623	3,123,247	2,640,135		5,664,056	30,266,445	35,930,511	15.6
1884	10,212,418	16,219,598	2,606,828	2,636,312	1,004,248	5,009,488	32,680,404	37,689,892	13.3
1885	10,802,957	14,959,970	3,170 012	2,619,718	1,470,808	4,731,784	33,023,465	36,755,249	12.9
1886	12,718,101	18,268,239	3,839,794	3,416,321	807,441	5,293,982	39,049,896	44,343,878	11 9
1887	14,626,954	19,865,749	3,604,275	3,654,027	661,825	5,553,805	42,412,830	47,966,635	11.6
1888	15,038,501	21,312,859	3,202,209	3,621,871	872,192	4,942,948	44,247,632	49,190,580	10.0
1889	15,089,738	21,585,818	4,489,157	4,224,049	863,540	5,370,369	46,252,302	51,622,671	10.4
1890	16,208,451	24,127,160	5,358,064	4,530,689	1,257,199	5,246,102	51,481,559	56,327,661	9.3
1891	16,621,657	24,911,699	5,496,760	4,323,845	1,737,059	4,563,472	53,091,020	57,744,492	8.0
1892	20,721,752	26,071,151	5,967,257	4,926,831	2,085,769	4,281,995	59,772,760	64,054,755	6.7
1893	21,312,072	24,130,136	5,297,612	4,740,220	2,291,430	4,331,963	57,781,470	62,113,433	7.0
1894	18,728,592	21,215,209	5,018,392	4,257,244	2,404,358	3,882,560	51,623,795	55,506,355	7.0
1895	19,741,495	20,307,802	6,313,819	4,494,367	2,540,157	3,500,314	53,397,640	56,897,954	6.4
1896	22,123,617	21,785,922	7,340,514	4,405,253	2,524,622	3,714,894	58,179,928	61,894,822	6.0
1897	20,649,810	20,122,086	7,591,163	4,241,285	2 492,056	3,617,804	55,096,400	58,714,204	6.2
1898	23,403,439	23,643,425	8,722,501	5,532 436	2,479,292	3,360,063	63,781,083	67,141,146	5.0

(a) Including tonnage of Hudson River R. R. before consolidation.

(b) Excluding coal.

Table 28.

THROUGH AND WAY TRAFFIC.

NEW YORK CANALS, NEW YORK CENTRAL AND HUDSON RIVER RAILROAD AND PENNSYLVANIA RAILROAD.

Compiled from *Reports of Supt. of Public Works*, and *Poor's Manual of Railroads.*

Year.	New York Canals.		N. Y. C. & H. R. R.R.		Pennsylvania R.R. Division.	
	Through.	Way.	Through.	Way.	Through.	Way.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1870			793,073	3,328,927	722,719	4,654,682
1871			871,967	3,660,089	1,022,632	5,553,211
1872			845,165	3,548,800	1,155,279	6,699,499
1873			1,132,637	4,390,087	1,193,459	8,017,775
1874			1,417,166	4,697,512	1,366,971	7,259,975
1875			1,374,909	4,627,045	1,354,203	7,761,165
1876			1,667,927	5,135,753	1,615,539	8,307,372
1877			1,671,468	4,679,888	1,307,787	8,430,908
1878			2,131,651	5,563,762	1,738,543	9,208,209
1879	3,538,521	1,823,851	2,379,920	6,635,933	2,076,540	11,607,501
1880	4,354,077	2,103,579	2,435,099	8,097,939	2,067,360	13,297,428
1881	3,112,846	2,066,346	2,493,085	9,098,294	2,208,529	16,020,836
1882	3,176,675	2,290,748	2,106,707	9,223,686	1,934,819	18,425,580
1883	3,346,297	2,317,759	1,813,320	9,079,120	1,937,850	19,636,310
1884	3,009,190	2,000,298	1,495,066	8,717,352	1,824,769	20,759,056
1885	2,687,312	2,044,472	1,715,897	9,087,060	2,267,180	21,779,868
1886	3,269,615	2,024,367	1,824,905	10,893,196	2,278,472	24,142,476
1887	3,373,781	2,180,224	1,960,340	12,666,614	2,315,460	28,532,175
1888	2,752,409	2,190,539	1,886,535	13,151,966	2,240,282	32,328,804
1889	2,901,189	2,469,189	1,984,716	13,105,022	2,304,551	30,103,647
1890	3,110,490	2,135,612	2,216,980	13,991,471	2,412,316	35,495,003
1891	2,651,838	1,911,634	2,023,133	14,598,434	2,181,804	35,807,588
1892	2,407,858	1,884,137	3,230,914	17,490,838	2,440,577	39,330,572
1893	2,636,312	1,695,651	2,914,392	18,397,680	2,162,100	36,757,512
1894	2,321,743	1,560,817	2,335,162	16,393,430	2,327,602	34,239,327
1895	1,712,261	1,888,043	2,036,453	17,705,042	2,222,722	44,322,371
1896	2,257,579	1,457,313	2,977,888	19,145,729	2,095,439	40,066,196
1897	1,736,289	1,881,615	3,317,097	17,332,713	2,548,217	45,082,603
1898	1,573,227	1,786,836	4,153,084	19,250,355	2,686,383	48,864,256
1899	1,692,972	1,993,079	3,764,958	21,591,516		

Chart 18 (Table 28).

THROUGH AND WAY TRAFFIC.

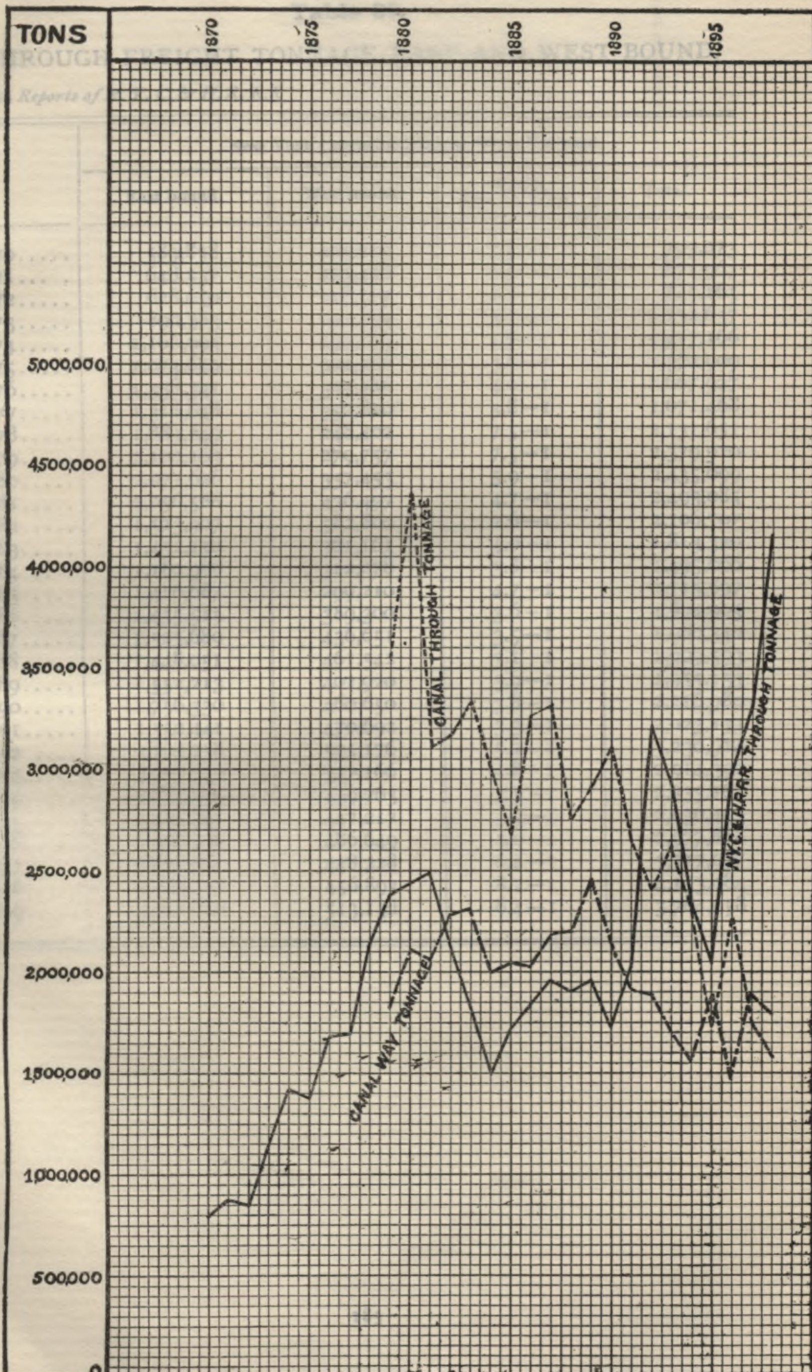


Chart 18 (Table 28).

Through and Way Traffic.

Table 29.

THROUGH FREIGHT TONNAGE, EAST AND WEST BOUND.

From *Reports of N. Y. C. & H. R. R.R*

	New York Central & Hudson River Railroad.			
	East bound.	West bound.	Ratio East to West.	Total.
1870.....	589,858	203,215	2.9 – 1	793,073
1871.....	648,537	223,430	2.5 – 1	871,967
1872.....	628,650	216,515	2.5 – 1	845,165
1873.....	890,383	242,254	3.7 – 1	1,132,637
1874.....	1,166,993	250,173	4.6 – 1	1,417,166
1875.....	1,074,649	300,260	3.6 – 1	1,374,909
1876.....	1,338,341	329,586	4.0 – 1	1,667,927
1877.....	1,318,648	352,820	3.8 – 1	1,671,468
1878.....	1,883,249	248,402	7.5 – 1	2,131,651
1879.....	2,100,163	279,757	7.5 – 1	2,379,920
1880.....	2,077,626	357,453	5.9 – 1	2,435,099
1881.....	2,056,588	436,497	4.7 – 1	2,493,085
1882.....	1,523,907	582,800	2.6 – 1	2,106,707
1883.....	1,452,159	361,161	4.0 – 1	1,813,320
1884.....	1,182,988	312,078	3.8 – 1	1,495,066
1885.....	1,416,687	299,210	4.7 – 1	1,715,897
1886.....	1,435,515	389,300	3.6 – 1	1,824,905
1887.....	1,523,689	436,651	3.5 – 1	1,960,340
1888.....	1,448,051	461,542	3.1 – 1	1,909,593
1889.....	1,552,213	402,920	3.9 – 1	1,955,133
1890.....	1,756,330	460,650	3.8 – 1	2,216,980
1891.....	1,552,441	470,692	3.3 – 1	2,023,133
1892.....	2,705,738	525,176	5.2 – 1	3,230,914
1893.....	2,367,226	547,166	4.8 – 1	2,914,392
1894.....	1,895,399	439,763	4.3 – 1	2,335,162
1895.....	1,589,236	447,217	3.5 – 1	2,036,453
1896.....	2,491,239	486,649	5.0 – 1	2,977,888
1897.....	2,868,869	448,228	6.4 – 1	3,317,097
1898.....	3,696,191	456,893	8.2 – 1	4,153,084
1899.....	3,251,826	513,132	6.4 – 1	3,764,958

Table 30.

EAST-BOUND RAIL SHIPMENTS OF GRAIN FROM CHICAGO.

1895-1898.

From *Reports of Chicago Board of Trade.*

Railroad.	To New York.	Baltimore	Norfolk & Newport News.	Phil-adelphia.	Boston.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Balt. & Ohio....	1,091	39,352		20,676	595	76,020
Grand Trunk ..	37,949			43,798	67,358	244,271
L. S. & M. S....	42,011	7,322		25,866	38,513	158,496
Mich. Central...	75,575	2,409		45,793	77,211	262,383
N. Y. C. & St. L.	45,338	224		22,578	43,746	124,409
P. Ft. W. & C..	21,059	25,295		12,598	6,792	103,770
Chicago & Erie.	69,815	8,883		4,821	34,382	128,657
Wabash	51,912			31,679	53,952	172,528
C. C. C. & St. L.	10,585	7,666	37,041	4,798	9,142	76,267
P. C. C. & St. L.	20,146	25,870		8,708	1,086	78,479
Totals, 1895..	375,481	117,021	37,041	221,315	332.777	1,425,281
Balt. & Ohio....	10,998	107,717	2,507	13,505	2,461	156.099
Grand Trunk...	31,621			12,660	79,342	207,262
L. S. & M. S..	51,513	14,112	836	16,544	30,595	192,286
Mich. Central...	81,298	12,793	56	26,858	71,197	241,331
N. Y. C. & St. L.	58,526	110		20,895	34,419	126,887
P. Ft. W. & C..	17,983	24,186	738	9,742	7,242	106,703
Chicago & Erie.	91,705	46,049	41,531	11,467	33,335	233,936
Wabash.	95,553	1,368		23,071	69,792	211,352
C. C. C. & St. L.	15,814	17,737	100,551	5,043	3,069	146,687
P. C. C. & St. L.	18,482	20,448		6,707	3,367	79,826
Totals, 1896..	465,293	244,520	146,219	146,491	334,819	1,702,369
Balt. & Ohio....	2,491	36,042	681	2,701	1,475	53,607
Grand Trunk...	22,323			24,052	47,003	132,331
L. S. & M. S....	56,150	9,927	748	20,902	54,096	206,389
Mich. Central...	72,074	10,410	187	23,596	154,560	286,746
N. Y. C. & St. L.	51,853	6,465		21,881	38,968	136,961
Chicago & Erie.	70,592	1,021	1,059	9,967	30,888	127,413
Wabash...... ..	56,337	775		33,612	67,930	184,254
C. C. C. & St. L.	2,727	11,544	63,160	2,011	8,916	93,024
P. C. C. & St. L.	15,972	45,563	2,639	19,640	7,439	111,547
Totals, 1897..	386,223	204,077	69,925	203,448	423,289	1,541,060
Balt. & Ohio....	3,290	183,205	524	5,459	223	211,222
Grand Trunk...	49,565	12		29,762	37,980	226,776
L. S. & M. S....	120,189	14,667	596	97,894	167,281	446,621
Mich. Central...	92,937	1,259	73	27,464	184,791	329,476
N. Y. C. & St. L.	76,018	88		52,836	68,702	211,732
P. Ft. W. & C..	13,264	196,040	1,314	62,113	12,276	306,688
Chicago & Erie.	158,507	546	62,644	19,566	48,452	310,051
Wabash........	51,301	35		71,716	41,963	202,046
C. C. C. & St. L.	4,486	9,307	143,259	3,754	9,900	173,912
P. C. C. & St. L	7,441	90,878	1,258	40,317	5,121	154,837
Totals, 1898..	508,018	496,037	209,668	410,881	571,689	2,573,361
Increase, 1895-98 .	38%	324%	466%	85%	42%	80%

Table 31.

FREIGHT TRAFFIC ON UNITED STATES RAILROADS.

Year Ending June 30, 1898.

From *Statistics of Railways, Inter-State Commerce Commission*, 1898, pp. 69, 80-82, 96.

Group.	Miles Run by Freight Trains.	Freight Traffic. Tons Carried.	Freight Traffic. Ton Mileage.	Freight Earnings. Gross Amount.	Freight Earnings. Average per Ton-Mile, cents.	Freight Earnings. Average per Train-Mile.	Average Haul per Ton. Miles.
I. New England	23,817,508	46,526,441	3,809,383,556	$44,866,204	1.17	$1.94	81.88
II. New York to Maryland	122,481,570	306,434,069	34,548,543,175	215,787,001	.62	1.76	112.74
III. Ohio, Michigan and Indiana	81,202,830	182,218,514	21,846,965,138	126,459,095	.58	1.56	119.89
IV. Virginias and Carolinas	22,296,764	27,000,958	5,812,200,367	35,120,939	.59	1.57	215.26
V. Kentucky to Florida	43,997,779	67,872,395	7,920,756,464	67,008,081	.84	1.51	116.70
VI. Chicago to Missouri River	102,079,657	144,899,101	20,976,055,269	180,722,887	.83	1.75	144.76
VII. Missouri River to Rocky Mts.	16,364,071	18,440,120	3,088,287,731	35,744,338	1.16	2.18	167.48
VIII. St. Louis to Denver and Texas	49,768,827	47,038,009	8,243,310,806	83,555,839	.96	1.62	175.25
IX. Louisiana and Texas	21,182,463	19,554,966	3,387,469,732	36,060,499	1.04	1.70	173.23
X. Pacific Coast	20,574,789	19,021,734	4,444,604,067	51,402,836	1.15	2.49	233.66
United States	503,766,258	879,006,307	114,077,576,305	876,727,719	.75	1.73	129.78

FREIGHT RATES.

The following tables show the continuous decline of transportation charges during the last thirty years. The average rates per ton-mile by the trunk railroads have declined from about two cents, to about six mills on most of the standard trunk routes, but on the L. S. & M. S. R.R. to 5 mills, and on the C. & O. R.R. to 3.6 mills. This last-named low average is due to the fact that most of the C. & O. freight traffic is in long hauls of coal, and there is very little local or high grade traffic, as on the other roads. The average rates on the New York canals have declined from 6.5 mills in 1865 to 1.9 mills, the present average being about one-half of the average rate by any railroad, and one-third of the average rates by most roads.

On certain classes of commodities the railroad rates are much closer to the canal rates. These are bulk articles, shipped in large quantities, and capable of being handled at the terminals by mechanical appliances which reduce the cost of handling. The coal traffic on the C. & O. road is moved at an average rate of 3.3 mills per ton-mile; and the through coal shipments at an average of 2.21 mills, which closely approaches the average canal rate of 1.9 mills. No such rates, however, are made by any other railroads on coal. The lowest average rate for coal on the Lehigh Valley R R. has been 6.55 mills; and on the Erie R.R. 5.37 mills per ton-mile.

The one bulk commodity for which the railroads come in direct competition with the canals is grain; and the railroad rates on grain have been reduced almost to the rates on the present canal. The rail rate on wheat for 1898 from Buffalo to New York was 3.4 cents per bushel, and the canal rate 2.8 cents—equal to 2.2 mills per ton-mile on the railroad and 1.9 mills per ton-mile on the canal. For the year 1899 the average rates on wheat will be somewhat higher. The fact that these low railroad rates are made only on grain, while other bulk commodities are charged much higher rates, can only be explained by the presence of the canal as an active or potential competitor for the grain traffic; while for other commodities there is only railroad and no canal competition. In the report proper, the possibilities of lower rates by an enlarged canal, and of the higher rates in the future by rail, have been fully discussed.

The statistics of rail rates on high class goods also illustrate the effects of canal competition and the limits of reduction of rail rates. In the rates from New York to Chicago, the cost of hauling is shown to be from 4.1 mills per ton-mile on first class goods to 3.06 mills per ton-mile on sixth class goods, indicating that rates of 2.2 mills per ton-mile on grain cannot be much if any above the cost of handling such commodities. The rates charged on high grade freights from New York to Chicago are from 5.1 to 15.3 mills per ton-mile; while on the shorter hauls to New York State points, the sixth class rate is from 6 to 12.5 mills per ton-mile, and the first class rate from 17.7 to 31 mills.

At present railroads carry most of this high class freight in the face of much lower canal rates, on account of their better facilities for handling and delivering package goods—due in part to advantages inherent in the railroad, and in part to the advantages of large corporations over the small canal-boat owners. Nevertheless, the potential competition of the canals secures lower rates for this traffic than exist where there is no canal competition possible. The rates on high grade freight from New York to competitive railroad points in Pennsylvania are from 10% to 35% higher than to points on the canals a corresponding distance from New York. Buffalo and Pittsburg are at almost equal distances by rail from New York; yet the rates to Buffalo on sixth class goods are 13 cents, to Pittsburg 15 cents per 100 lbs.; on first class goods, rates to Buffalo are 39 cents, to Pittsburg 45 cents per 100 lbs. Similar differences exist in the rates to Albany, Utica, Rome, Syracuse, and Rochester as compared with those of Reading, Wilkes-barre, Harrisburg, and Altoona, the only explanation of which is the existence of the canal route across New York State.

The possibilities of water navigation are illustrated by the rates prevailing on the great lakes. The average rate on all traffic through the St. Mary's Falls Canal in 1898 was .79 mill per ton-mile. This includes some proportion of high grade package freight; and on the bulk commodities the rates are still lower. The average rate on wheat from Duluth to Buffalo in 1898 was 2 cents per bushel, and from Chicago to Buffalo 1.5 per bushel, equal to ⅔ of a mill per ton-mile. The rate on iron ore from Lake Superior to Ohio ports was 60 cents a ton or ¾ mill per ton-mile. Grain, ore, and lumber form the east-bound traffic on the lakes; for west-bound ships the most important freight is coal, which is carried at rates much lower than those mentioned, averaging in 1898 from 25 to 30 cents per ton for the entire distance from Ohio ports to Duluth, or .25 to .3 mills per ton-mile.

Long-distance freights on the ocean are as low, and in some cases lower, than rates on the lakes. Between Havre and New York (3,596 miles) the wheat rate, with of course variations, is about $3.00 per ton, or .84 mills; but from New Orleans to Havre (5,332 miles) the rate is $3.40 per ton or .64 mills. Coal is carried between Havre and Valparaiso (9,920 miles) for $3.60 per ton or .37 mills. Wheat is carried from San Francisco to Europe (15,500 miles) for $5.00 per ton, or about .3 mills. English coal on return trips is carried for $3.20 per ton, or .2 mills. Wheat from Bombay to Marseilles is carried for an average rate of $3.50 per ton, and coal from Cardiff to Bombay (6,273 miles) at $2.90 per ton or .46 mills. Wheat is carried from Bombay to London and Continental ports for $3.60 per ton or .6 mill.*

* **Ocean Freight Rates from E. L. Corthell's letter of August 25th**

Table 32.

FREIGHT RATES ON WHEAT PER BUSHEL.

(CORRECTED SPECIE VALUES.)

From *Changes in the Rates of Charge for Railway and Other Transportation Services*, U. S. Department of Agriculture, 1898; and *Reports* of New York Produce Exchange and Chicago Board of Trade

	Chicago to New York.			Chicago to Buffalo by Lake.	Buffalo to New York.	
	All Rail.	Lake and Rail.[1]	Lake and Canal.[1]		By Rail.[3]	By Canal.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
1868........	30.49	20.76	17.33	5.09	14.57	11.15
1869........	26.39	18.80	18.30	5.07	12.63	12.14
1870........	28.98	19.15	16.03	5.14	12.90	9.80
1871........	27.75	22.38	19.09	6.77	14.51	11.22
1872........	29.80	24.91	22.65	10.08	13.73	11.47
1873........	29.17	23.64	17.99	6.71	15.83	10.18
1874........	25.81	15.20	13.85	3.64	10.46	9.14
1875........	20.97	12.71	10.80	2.96	8.85	6.94
1876........	14.80	10.58	9.53	2.61	7.03	6.02
1877........	19.37	15.08	11.70	3.56	10.48	7.20
1878........	17.56	11.31	10.08	3.05	7.26	6.05
1879........	17.30	13.30	12.60	4.74	7.56	6.86
1880........	19.90	15.70	13.27	5.76	8.94	6.51
1881........	14.40	10.40	9.06	3.44	6.09	4.75
1882........	14.60	10.90	8.76	2.50	7.53	5.39
1883........	16.50	11.50	9.24	3.41	7.32	4.96
1884........	13.12	9.95	7.18	2.18	6 90	4.13
1885........	14.00	9.02	6.74	2.02	6.13	3.85
1886........	16.50	12.00	9.58	3.68	7.45	5.03
1887........	15.74[2]	12.00	9.38	4.13	7.00	4.38
1888........	14.50[2]	11.00	6.80	2.56	7.59	3.37
1889........	15.00	8.70[2]	7.76	2.51	5.32	4.38
1890........	14.31	8.50	6.72	1.96	5.67	3.89
1891........	15.00	8.53	6.83	2.38	5.28	3.58
1892........	14.23	7.55	6.48	2.19	4.49	3.42
1893........	14.70	8.44	7.18	1.66	5.91	4.65
1894........	12.88	7.00	5.31	1.27	4.86	3.17
1895........	12.17	6.95	4.98	1.92	4.16	2.19
1896........	12.00	7.32	6.25	1.61	4.84	3.77
1897........	12.32	7.37	5.22	1.53	4.97	2.82
1898........	11.55	5.40	4.82	1.50	3.40	2.82

[1] Including Buffalo transfer charges. [2] Published rates; actual rates lower.
[3] Calculated by deducting Lake rates and Buffalo transfer charges from Lake and Rail rate from Chicago.

Chart 19 (Table 32).

Freight Rates on Wheat (per Bushel) Chicago to New York.

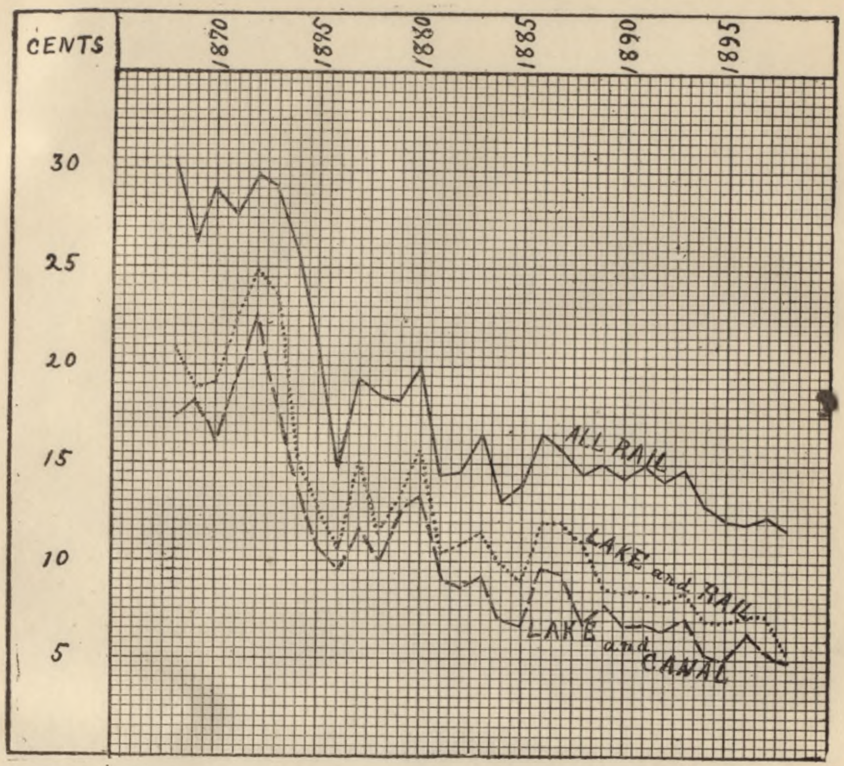
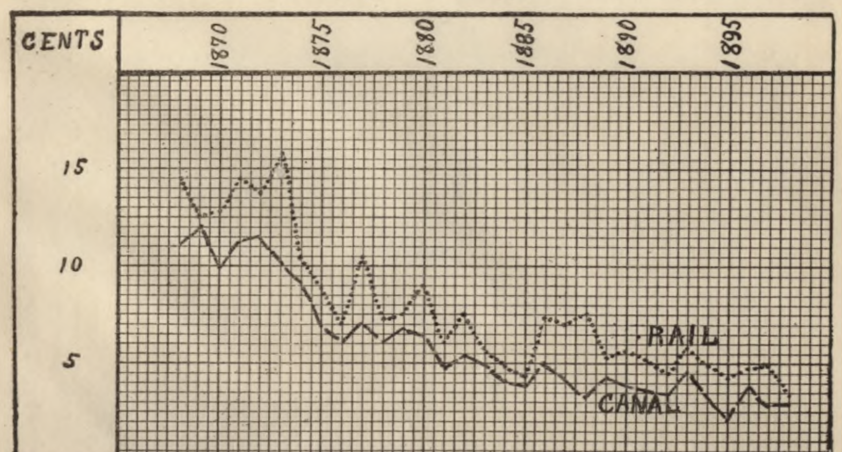


Chart 20 (Table 32).

Freight Rates on Wheat (per Bushel) Buffalo to New York.



(Chart 21 Table 33).

Average Freight Rates (per Ton-Mile) 1865–1899.

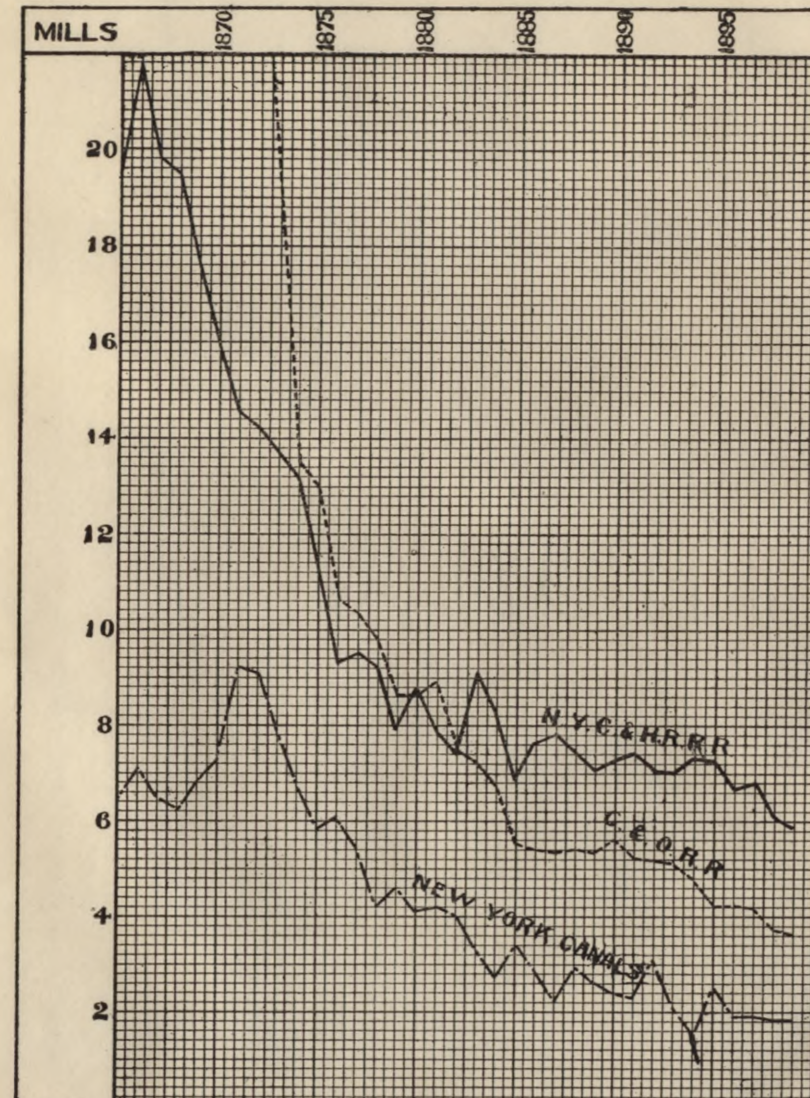


Table 33.

AVERAGE FREIGHT RATES PER TON-MILE.[1]

CORRECTED SPECIE VALUES.

Year.	Erie R. R.	New York Central and Hudson River R. R.	Lake Shore and Michigan Southern Ry.	Michigan Central R. R.	Pennsylvania R. R.	Pittsburgh, Fort Wayne and Chicago Ry.	Chesapeake and Ohio Ry.	New York Canals.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
1865..	1.564	1.955	1.645	1.735	1.538	1.385	.....	.65
1866..	1.712	2.181	1.746	1.834	1.636	1.423	4.661	.71
1867..	1.465	1.980	1.745	1.787	1.497	1.403	3.753	.65
1868..	1.287	1.951	1.661	1.743	1.322	1.211	3.179	.62
1869..	1.137	1.763	1.266	1.544	1.229	1.198	3.752	.68
1870..	1.125	1.590	1.269	1.673	1.268	1.229	4.101	.73
1871..	1.282	1.457	1.244	.972	1.211	1.276	4.445	.92
1872..	1.362	1.422	1.227	1.392	1.304	1.264	3.643	.91
1873..	1.268	1.371	1.164	1.365	1.258	1.220	1.909	.78
1874..	1.184	1.319	1.065	1.728	1.164	1.134	1.354	.67
1875..	1.061	1.119	.887	1.018	.989	.970	1.299	.58
1876..	.972	.929	.722	.986	.841	.827	1.061	.61
1877..	.898	.954	.813	.924	.954	1.024	1.035	.54
1878..	.960	.919	.724	.836	.914	.867	.985	.42
1879..	.779	.793	.641	.691	.823	.754	.860	.46
1880..	.836	.879	.750	.842	.918	.....	.866	.41
1881..	.805	.783	.617	.718	.857	.745	.892	.42
1882..	.749	.738	.628	.772	.874	.752	.753	.40
1883..	.786	.915	.728	.830	.881	.787	.723	.33
1884..	.719	.834	.652	.646	.804	.673	.672	.27
1885..	.656	.688	.553	.560	.695	.577	.550	.26
1886..	.659	.765	.639	.686	.755	.692	.541	.34
1887	.687	.782	.670	.694	.730	.717	.537	.29
1888..	.716	.753	.673	.702	.723	.66	.541	.22
1889..	.644	.712	.632	.702	.685	.69	.538	.29
1890.	.643	.730	.644	.701	.661	.69	.561	.26
1891..	.636	.740	.630	.723	.656	.70	.525	.24
1892..	.614	.699	.602	.687	.647	.67	.518	.23
1893..	.631	.701	.599	.691	.620	.68	.511	.31
1894..	.609	.733	.587	.671	.606	.65	.478	.21
1895..	.604	.726	.567	.662	.565	.64	.425	.15
1896..	.606	.668	.551	.626	.563	.66	.425	.25
1897..	.609	.679	.538	.615	.561	.60	.419	.19
1898..	.56	.61	.502	.597	.....	.57	.37	.19
1899..	.52	.59	.....	.....	.....	.....	.36	.19

[1] Railroads from "*Changes in the Rates of Charge for Railway and Other Transportation Services*," U. S. Dept. of Agriculture, 1898, pp. 19, 20.

Canals from *Reports* of Auditor of Canal Dept. and Supt. of Public Works, corrected for gold premium from 1865 to 1879. From 1883 to 1899, canal rates are based on rates on wheat from Buffalo to New York.

Table 34.

AVERAGE FREIGHT RATES ON NEW YORK CANALS.

(CURRENCY VALUES.)

(Per ton.)

From *Report of Comptroller on Tolls, Trade and Tonnage of Canals*, 1882, p. 37. No records of average freight rates in later reports of the Supt. of Public Works.

(A) For 4-year periods, 1830–81.

Years.	Up Freight Albany to Buffalo.			Down Freight Buffalo to Albany.		
	Total Charge.	Tolls.	Leaving Freight.	Total Charge.	Tolls.	Leaving Freight.
1830–33	$18.65	$9.85	$8.80	$8.84	$4.74	$4.10
1834–37	18.00	6.57	11.43	7.15	3.28	3.87
1838–41	16.10	6.57	9.53	6.94	3.28	3.66
1842–45	11.75	6.57	5.18	5.93	3.28	2.65
1846–49	7.85	4.80	3.05	5.90	2.92	2.98
1850–53	6.05	3.76	2.29	5.07	2.37	2.70
1854–57	5.05	2.92	2.13	4.86	2.19	2.67
1858–61	2.45	1.24	1.21	3.54	1.51	2.03
1862–65	2.52	1.22	1.30	4.66	2.11	2.55
1866–69	2.60	1.05	1.55	4.61	2.11	2.50
1870–73	2.60	1.05	1.55	3.45	1.05	2.40
1874–77	2.60	1.05	1.55	2.22	.70	1.52
1878–81	2.05	.57	1.48	1.53	.36	1.17

(B) Yearly, 1868-1882.

Years.	Total Charge.	Tolls.	Leaving Freight.	Total Charge.	Tolls.	Leaving Freight.
1868	2.60	1.05	1.55	4.44	2.11	2.33
1869	2.60	1.05	1.55	4.72	2.11	2.61
1870	2.60	1.05	1.55	3.06	1.05	2.01
1871	2.60	1.05	1.55	3.70	1.05	2.65
1872	2.60	1.05	1.55	3.70	1.05	2.65
1873	2.60	1.05	1.55	3.33	1.05	2.28
1874	2.60	1.05	1.55	2.78	1.05	1.73
1875	2.60	1.05	1.55	2.13	.70	1.43
1876	2.60	1.05	1.55	2.04	.70	1.34
1877	2.60	1.05	1.55	1.94	.37	1.57
1878	2.60	1.05	1.55	1.48	.37	1.11
1879	2.60	1.05	1.55	1.85	.37	1.48
1880	1.50	.18	1.32	1.70	.35	1.35
1881	1.50	..	1.50	1.11	.37	.74
1882	1.20	..	1.20	1.29	.37	.92

Table 35.

RAILROAD RATES ON HIGH CLASS FREIGHT.

A. TO CANAL POINTS.

N. Y. C. & H. R. R.R. *Freight Tariff No.* 897, taking effect Aug. 20, 1898.
West Shore R.R. *Freight Tariff No.* 1,241, taking effect Sept. 25, 1894.
Erie R.R. *Freight Tariff No.* 869, taking effect Aug. 1, 1897.

Miles	From New York to	1st Class.	2d Class.	3d Class.	4th Class.	5th Class.	6th Class.
	1. In cents per hundred pounds.						
143	Albany.......	25	18	14	13	12	10
238	Utica....... ..	32	27	22	17	14	12
252	Rome........	33	28	23	17	14	12
291	Syracuse.	35	30	25	18	15	13
371	Rochester	35	30	25	18	15	13
440	Buffalo.......	39	33	28	19	16	13
	2. In mills per ton-mile.						
143	Albany.......	31	25.2	17.5	16	15	12.5
238	Utica.........	27	22.5	18.5	14	12	10.0
252	Rome........	26	22.2	18.2	13.5	11	9.5
291	Syracuse. ...	24	20.5	17.2	13.5	10.3	9
371	Rochester	18.6	16.2	13.4	9.7	8.1	7
440	Buffalo......	17.7	15.0	12.7	8.6	7.3	6

B. TO NON-CANAL POINTS.

Pennsylvania R.R. Co. *Local Freight Tariff from New York.*
Lehigh Valley R.R. *Tariff No. A 3,000, taking effect Aug.* 1, 1899.

Miles	From New York to	1st Class.	2d Class.	3d Class.	4th Class.	5th Class.	6th Class.
	1. In cents per hundred pounds.						
90	Philadelphia ..	22	18	15	12	10.5	9.5
148	Reading......	30	25	21	15	13	11
176	Wilkesbarre ..	35	30	23	17	15	12
195	Harrisburg...	33	28	22	17	15	12
327	Altoona.......	45	39	30	21	18	15
445	Pittsburg.....	45	39	30	21	18	15
	2. In mills per ton-mile.						
90	Philadelphia ..	50	40	33	27	23.3	21
148	Reading......	40.5	34	29	20.3	18.2	15
176	Wilkesbarre..	40.0	34	26.7	19.3	17.1	13.6
195	Harrisburg ...	33.8	29	22.6	17.4	15.4	12.3
327	Altoona......	27.5	25	18.3	12.8	11.0	9.2
445	Pittsburg. ...	20.2	17.5	13.5	9.5	8.1	6.8

C. NEW YORK TO CHICAGO. (980 miles.)

From *New York Herald*, Dec. 1, 1899.

1. In cents per hundred pounds.						
Rates....	75	65	50	35	30	25
Cost of Hauling...	20	17	17	15	15	15
Profit.............	55	48	33	20	15	10
2. In mills per ton-mile.						
Rates............	15.3	13.3	10.2	7.2	6.12	5.10
Cost of Hauling...	4.1	3.5	3.5	3.1	3.06	3.06
Profit...........	11.2	9.8	6.7	4.1	3.06	2.04

Table 36.

AVERAGE RATES PER TON-MILE ON COAL.

(CORRECTED SPECIE VALUES.)

From *Changes in the Rates of Charge for Railway and Other Transportation Services*, by H. T. Newcomb, p. 31; and *Engineering News*, August 17, 1899.

Year.	Central R. R. of New Jersey.	Philadelphia & Reading R. R.	Erie R. R.	Lehigh Valley R. R.	Penn. & New York Canals & R. R.	C. & O. R. R. Coal to Seaboard.	C. & O. R. R. Coal Elsewhere.
	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.
1865........		1.513					
1866........		1.319					
1867........		1.143					
1868........		1.088					
1869........		1.459		1.746			
1870........		1.430		1.888			
1871........		1.580		2.039			
1872........	1.128	1.375		1.791			
1873........	1.462	1.589		1.866	1.312		
1874........	1.516	1.658		1.994	1.218		
1875........	1.462	1.629		1.851	1.165		
1876........	.859	1.418		1.522	1.088		
1877........	.885	1 253		1.287	.983		
1878........		1.548		1.429	.955		
1879........		1.218		1.093	.775		
1880........		1 540	.738	1.426	1.106		
1881........		1 556	.845	1.516	1.249		
1882........		1.551	.808	1.460	1.302		
1883........		1.404	.745	1.411	1 132		
1884........		1.291	.687	1.331	1.015		
1885........		1.072	.595	1.221	.837		
1886........		.978	.537	1.150	.837		
1887........		1.159	.566	1.200	.882		
1888........	1.106	1.117	.601	1.247			
1889........	1.052	1.018	.563	.967			
1890........	1.027	1.011		.863			
1891........	1.018			.840			
1892........	1.124			.830		.344	.479
1893........	1.065		.605	.837		.327	.456
1894........	.989			.751		.320	.443
1895........	.905			.655		.293	.386
1896........	.959			.682		.253	.384
1897........				.712		.297	.380
1898........				.681		.259	.333
1899........						.221	.355

Table 37.

LAKE FREIGHT RATES.

Rates for Water Transportation to and from Lake Superior.

From the *Marine Record*, May 18, 1899.

Year.	Flour.	Wheat	Corn.	Man'f'd Iron.	Pig Iron.	Salt.	Copper.	Iron Ore.	Coal.	Lumber.	Unclas'd Fr't.
	Bbl.	*Bush.*	*Bush.*	*Ton.*	*Ton.*	*Bbl.*	*Ton.*	*Ton.*	*Ton.*	*M.ft.*	*Ton.*
1887	$.29		$.07	$2.35		$.18	$2.60	$1.75	$.90	$4.00	$4.00
1888	.175	$.035	.043	1.80	$1.30	.16	2.35	1.28	.70	2.80	3.00
1889	.18	.04	.0375	2.10	1.45	.18	2.25	1.14	.47	2.70	3.00
1890	.13	.03	.03	1.34	1.35	.15	2.38	1.10	.45	2.38	2.75
1891	.15	.046	.035	2.50	1.17	.18	2.00	.98	.43	2.70	3.58
1892	.165	.036	.0375	2.15	1.23	.15	1.40	1.00	.41	2.95	3.60
1893	.17	.028	.0275	2.00	1.30	.12	1.75	.80	.40	2.35	3.00
1894	.14	.025	.0275	.90	1.15	.12	1.95	.70	.40	1.90	2.75
1895	.14	.044	.045	1.50	1.05	.13	1.66	.82	.37	2.00	2.50
1896	.11	.025	.0225	1.40	1.05	.15	1.95	.82	.32	1.80	2.30
1897	.10	.017	.02	1.40	1.05	.15	1.95	.65	.30	1.55	2.30
1898	.10	.02	.02	1.40	1.05	.15	2.00	.60	.25	1.65	2.40

Average Rates on Coal.

(Per ton.)

From *Report on Lake Commerce*, by Geo. G Tunnell, p. 91.

Year.	From Buffalo to			From Ohio Ports to				
	Chicago.	Duluth.	Toledo	Milwaukee.	Escanaba	Duluth.	Green Bay.	Manitowoc.
1886...	$0.87	$0.62		$0.83	$0.60	$0.78		
1887...	1.05	.70	$0.35	1.60	.72	.89		
1888...	.86	.65	.41	.84	.61	.66		
1889...	.52	.41	.27	.54	.49	.52		
1890...	.62	.43	.33	.64	.45	.49		
1891...	.56	.29	.25	.61	.52	.49		
1892...	.59	.43	.27	.58	.43	.43	$0.55	$0.49
1893...	.49	.29	.28	.48	.40	.38	.50	.41
1894...	.46	.25	.25	.43	.39	.375	.495	.48
1895...	.59	.24	30	.54	.39	.365	.50	.51
1896...	.36	.24	.25	.335	.27	.295	.325	.32
1897...	.29	.26		.285	.295	.26	.30	.31

LAKE COMMERCE.

Up to the time of the American Revolution there was but little lake shipping; but from that time a flourishing commerce—as it was then considered—sprang up by sailing vessels on Lake Ontario. The first American ship on the upper lakes was built at Erie, Pa., in 1797; but for some time after that the Ontario traffic was larger than that on all the other lakes combined.

The first steamer on the lakes was built at Oswego in 1816; and up to 1820 there had been built only four steamers on the lakes, as against 71 on western rivers, and 52 on the Atlantic coast. In the next decade eight steamers were built on the lakes, and one of these made the first trip from Lake Erie to Chicago in 1832.

The first propeller built on the lakes was the Vandalia, a sloop-rigged craft of about 140 tons, launched at Oswego in 1841. In 1843 there were seven propellers built at various points between Oswego and Chicago. By 1850 there had been built on the lakes fifty propellers, aggregating 13,247 tons. The total tonnage on the lakes in 1851 was 215,000 tons, two-thirds of which was in sailing vessels averaging about 200 tons each.

By this time the main lines of lake traffic were established on all the lakes except Superior, and the opening of the Michigan state canal around the Sault Ste. Marie rapids in 1855 opened that lake also to the small vessels then in use. For the next two decades and a half the traffic increased steadily, with a corresponding increase in the number of vessels, and a growing tendency towards a larger proportion of steamers to sailing vessels. In 1875 the total tonnage on the lakes was nearly 600,000 tons, and the steam tonnage was equal to about three-fifths of the sailing tonnage. The traffic, as estimated by entrances and clearances at American ports, was for that year about 15 000,000 tons.

This development had, however, been secured without any material increase in the size of the vessels in use,—a limit being placed on size by the depth of water in the harbors and in the channels connecting Lake Erie and Lake Superior with Lake Huron-Michigan. By 1875 the advance in railroad construction and management had reached a point which enabled the railroads to compete with the lake vessels; and when to this was added the railroad rate wars of the next few years there was not only a cessation of increase in lake commerce, but a positive decline both in equipment and traffic. New construction of vessels, which had reached as high as 73,000 tons in 1874, was only 7,000 tons in 1877, and averaged only 13,000 tons a year for the five years ending in 1880. In the latter year all the vessels on the lakes aggregated only 560,000 tons, 30,000 less than five years before.

The beginning of the new decade marked a significant revival in lake commerce, which cannot be disconnected from the improvements in lake harbors and channels undertaken by the national government. The most important work brought to completion at this time was the opening of the ship canal with an 18-foot draft, which took the place of the ten-foot canal and locks maintained by the State of Michigan at Sault Ste. Marie; but other works were well under way, which have had for their ultimate aim the securing of twenty feet of water in all the main channels and important harbors on the lakes.

The most striking feature of the new movement was in the character of shipbuilding in the year 1881. In that year 65,000 tons of vessels were constructed, three-fourths of which were steam vessels averaging 450 tons, where hitherto the average had been but little over 200 tons. Before 1880 a 1,000-ton vessel was a rarity, from now on 2,000-ton vessels were commonly built for the long-distance traffic.

For a few years the increase in traffic and shipping was at moderate rates; but beginning about the year 1886 the annual increment rose to figures which soon made the lake traffic one of the most important features of the internal commerce of the United States.

The shipping engaged in the lake commerce increased to 1,000,000 tons in 1890, and to nearly 1,500,000 tons in 1898. The size of vessels increased to an average of 700 tons in 1890, and 1,200 tons in 1897; while the maximum size of vessels rose from 200 tons to 5,000, 6,000 and even 7,000 tons. Of more importance is the change in the motive power of the lake shipping. Sailing vessels have almost gone out of use, and although the records continue to show a considerable number in the class of "rigged vessels," by far the greater part of the traffic is in steamers or large barges towed by steamers. Still more significant has been the change in the material of construction. Before 1888 nine-tenths of the ships were built of wood; in that year the iron and steel proportion rose to twenty per cent; by 1891 the steel tonnage was greater than the wooden tonnage of new vessels, and at the present time barely ten per cent of the tonnage of new vessels is of wood.

The increase of shipping was, of course, but the accompaniment of the increase of traffic. In 1885 the record of entrances and clearances at the United States ports on the lakes showed a traffic of 19,200,000 tons; by 1890, this had almost doubled, reaching the figure of 37,500,000 tons, about 9,000,000 tons of which passed through the St. Mary's Falls canal. By 1896 the total traffic was 52,000,000 tons, and in 1898 62,500,000 tons, 18,000,000 tons passing through the St. Mary's Falls canal. The total freight movement is more difficult to ascertain. That for Lake Superior exceeds in tonnage the shipping movement; but in the other lakes the freight traffic is probably less than the vessel movement, owing to many vessels bound west carrying little cargo. Allowing for this, and also for the Canadian traffic, which is not included in the above shipping figures, probably 60,000,000 tons will not over-estimate the freight movement on all the lakes for 1898. As almost the whole of this traffic moves the full length of the lakes, an average of 700 miles to the ton is not excessive (Soo canal tonnage averages 836 miles); and at this rate we have a ton mileage of 42,000,000,000 for the year 1898. This figure is equal to nearly forty per cent of the entire ton mileage of all the railroads in the United States; it exceeds the total ton mileage of railroads in the district from the Missouri river east to Buffalo and Pittsburgh.

The bulk of this traffic is made up of the four commodities of grain (including flour), iron ore, lumber and coal. In 1889 the shipments of these commodities comprised over ninety per cent of the total freight movement on the lakes. In 1898 the grain shipped from the principal United States ports aggregated nearly 9,000,000 tons, iron ore 14,000,000 tons, lumber nearly 3,000,000,000 feet, and coal 10,000,000 tons. Only a small portion of the ore and coal at present passes across New York state; but as has been shown in the main body of the Report, it is possible to secure a considerable traffic in ore and iron and steel manufactures for the canal route. Most of the grain and probably half of the lumber arrive at Buffalo at the eastern end of Lake Erie, and from there are sent on to their destination either on the Atlantic coast or in Europe. At present most of this traffic goes by rail, the Erie canal carrying but one-third of the lumber and one-tenth of the grain arriving at Buffalo.

Table 38.

CLASSIFIED TONNAGE OF VESSELS ON GREAT LAKES.

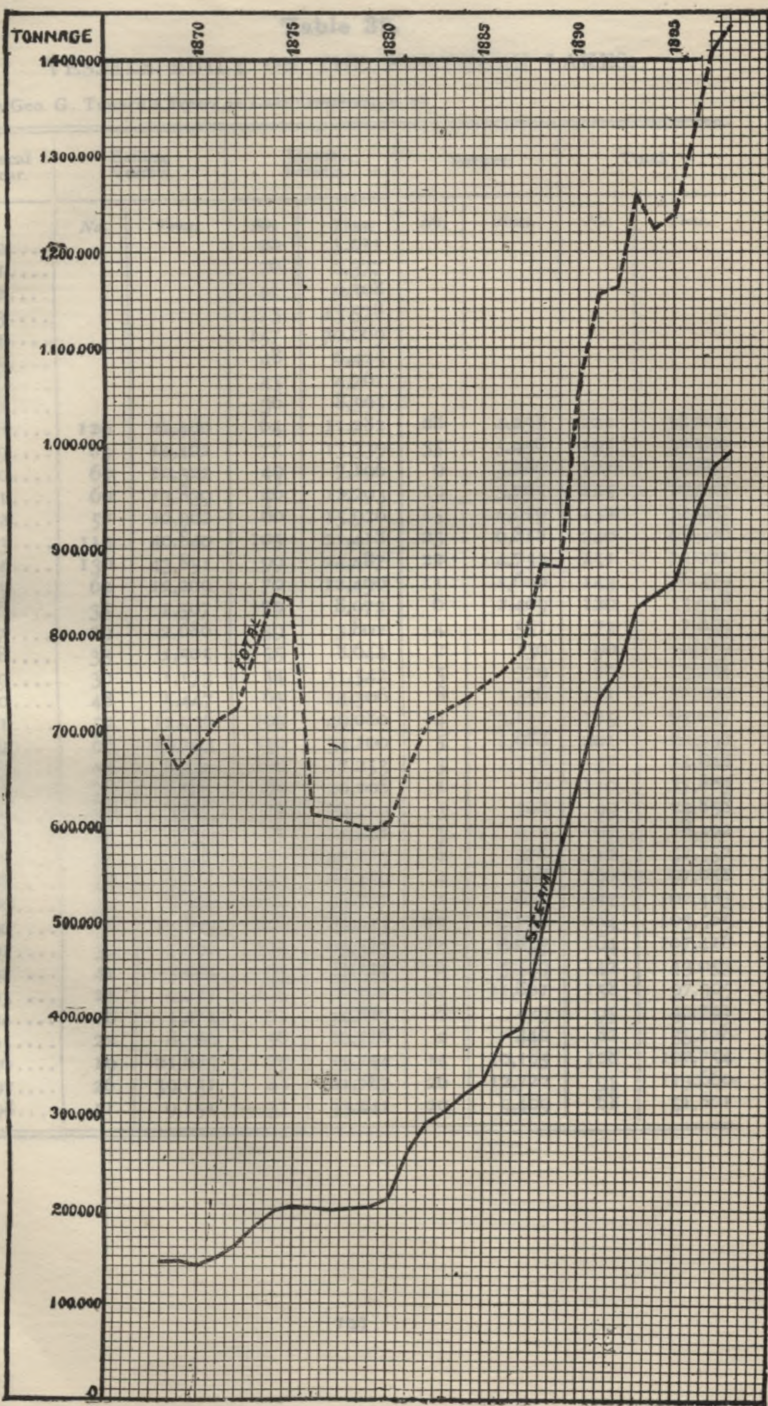
From *Report of the Commissioner of Navigation*, 1898, p. 318.

Year.	Sailing Vessels.		Steam Vessels.		Canal Boats and Barges.		Total.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
1851......		138,000		74,000				214,000
1862......	1,152	257,689	350	125,620			1,502	383,309
1868......	1,855	293,978	624	144,117	2,886	257,509	5,365	695,604
1869.	1,752	277,893	636	146,236	2,487	237,237	4,875	661,366
1870......	1,699	264,609	642	142,973	3,008	277,122	5,349	684,704
1871......	1,662	267,154	682	149,467	3,169	295,406	5,513	712,027
1872......	1,654	270,051	708	162,523	2,975	291,919	5,337	724,493
1873......	1,663	298,002	802	180,250	2,934	310,160	5,399	788,412
1874......	1,696	336,801	876	198,121	3,028	307,458	5,600	842,381
1875......	1,710	339,787	891	202,307	2,895	295,297	5,496	837,891
1876......	1,643	331,498	921	201,742	[a]629	79,971	3,193	613,211
1877......	1,604	324,394	923	201,085	664	84,681	3,191	610,160
1878......	1,546	315,908	918	201,550	702	87,198	3,166	604,656
1879......	1,473	307,078	896	203,298	718	86,970	3,087	597,376
1880......	1,459	304,933	931	212,045	572	47,159	3,127	605,102
1881......	1,417	306,436	988	260,114	802	96,832	3,207	663,382
1882......	1,412	313,651	1,101	292,257	866	105,361	3,379	711,269
1883......	1,373	310,454	1,149	304,641	881	108,810	3,403	723,911
1884	1,333	307,933	1,165	322,456	882	102,680	3,380	733,069
1885......	1,322	313,129	1,175	335,859	882	100,966	3,379	749,948
1886......	1,235	282,319	1,280	381,907	890	98,334	3,405	762,560
1887......	1,286	315,079	1,225	390 397	633	79,245	3,144	783,721
1888......	1,277	314,765	1,342	480,138	671	79,199	3,290	874,102
1889......	1,285	325,083	1,455	575,307	672	71,881	3,412	972,271
1890......	1,272	328,656	1,527	652,923	711	81,484	3,510	1,063,063
1891......	1,243	325,131	1,592	736,752	765	92,987	3,600	1,154,870
1892......	1,226	319,618	1,631	763,063	800	100,901	3,657	1,183,582
1893... ..	1,205	317,789	1,731	828,702	825	114,576	3,761	1,261,067
1894......	1,139	302,985	1,731	843,240	471	81,175	3,341	1,227,400
1895......	1,100	300,642	1,755	857,735	487	83,082	3,342	1,241,459
1896......	1,044	309,152	1,792	924,631	497	90,284	3,333	1,324,067
1897......	993	334,104	1,775	977,235	462	98,763	3,230	1,410,102
1898......	960	333,704	1,764	993,644	532	110,152	3,256	1,437,500

(*a*) The decrease in the number of canal boats and barges in 1876 is due to an Act of Congress of April 18, 1874, which exempted canal boats engaged in local traffic from federal documents.

Chart 22 (Table 38).

VESSEL TONNAGE ON GREAT LAKES.



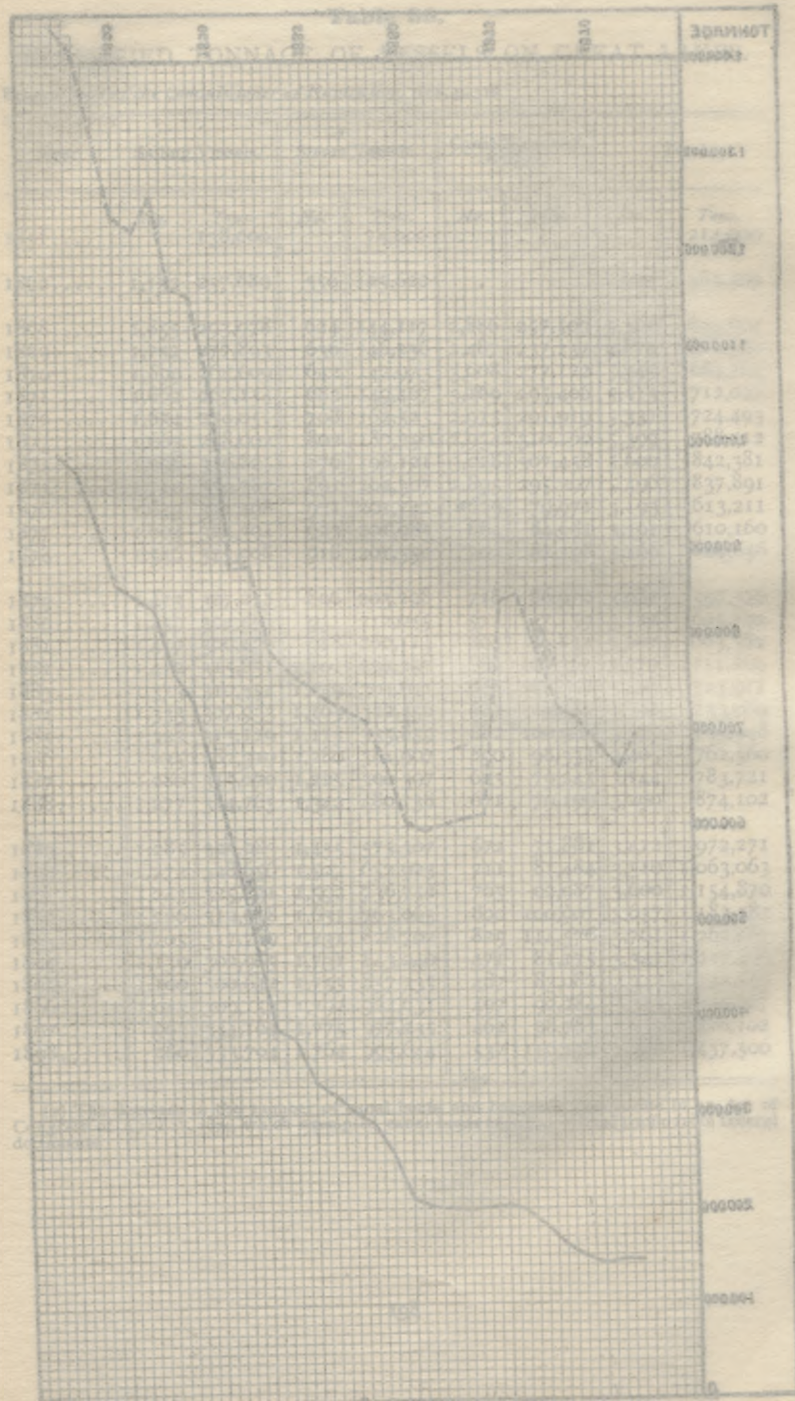


Table 39.

VESSELS BUILT ON THE NORTHERN LAKES.

From Geo. G. Tunnell's *Report on Lake Commerce*, p. 27.

Fiscal Year.	Sailing Vessels.		Steam Vessels.		Barges.		Total.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
1860....			20	5,011				
1861....			20	2,377				
1862....			41	9,308				
1863....			73	13.578				
1864....			157	70,669				
1865....			48	6,425				
1866....			45	4,761				
1867....			36	8,595				
1868....	129	22,490	64	11,282	28	4,238	221	38,010
1869....	83	14,462	77	13.339	35	5.458	195	33.259
1870....	69	10,322	49	7,196	9	3,289	127	20,807
1871....	60	13,839	46	12,293	19	3,795	125	29,927
1872....	57	12,962	60	15,926	15	4,019	132	32,907
1873....	112	40,840	105	21,418	23	6,818	240	69,076
1874....	130	43,851	99	24,487	22	4,733	251	73,071
1875....	62	12,269	70	12,490	11	1,620	143	26,379
1876....	35	2,507	79	8,972	6	2,469	120	13.948
1877....	29	2,686	39	3,802	4	551	72	7,039
1878....	33	1,505	55	8,644	2	130	90	10,279
1879....	30	1,173	44	11,542	5	579	79	13,294
1880....	48	5,447	65	14,306	8	1,356	121	21,109
1881....	52	12,936	109	49.080	14	3,111	175	65,127
1882....	66	16,164	130	34,100	5	1,988	201	52,252
1883....	34	6,437	100	17,253	3	1,158	137	24,848
1884....	29	7,667	80	20,206	1	10	110	27,883
1885....	30	3,861	64	20,229	5	768	99	24,858
1886....	15	5,232	47	12,648	5	412	67	18,292
1887....	35	4,991	75	47,183	8	378	118	52,552
1888....	48	9,131	140	87,459	2	468	190	97,058
1889....	32	8,098	145	93,707	5	678	182	102,483
1890....	36	12,803	116	86,023	12	6,739	164	105,565
1891....	30	7,240	123	93.323	11	6,853	164	107,416
1892 ...	41	3.474	93	34.129	8	5,449	142	43.053
1893	21	9,277	126	76,161	11	11,867	158	97,305
1894....	18	5.473	71	34,889	6	429	95	40,791
1895....	22	8,166	58	26,516	2	446	82	35,128
1896....	19	21,825	75	75.744	14	10,185	108	107,754
1897....	26	39,151	43	61,787	26	12,722	95	113.660
1898...	11	9,151	37	33.241	20	9,409	68	51,801

Table 40.

VESSELS BUILT ON THE NORTHERN LAKES.

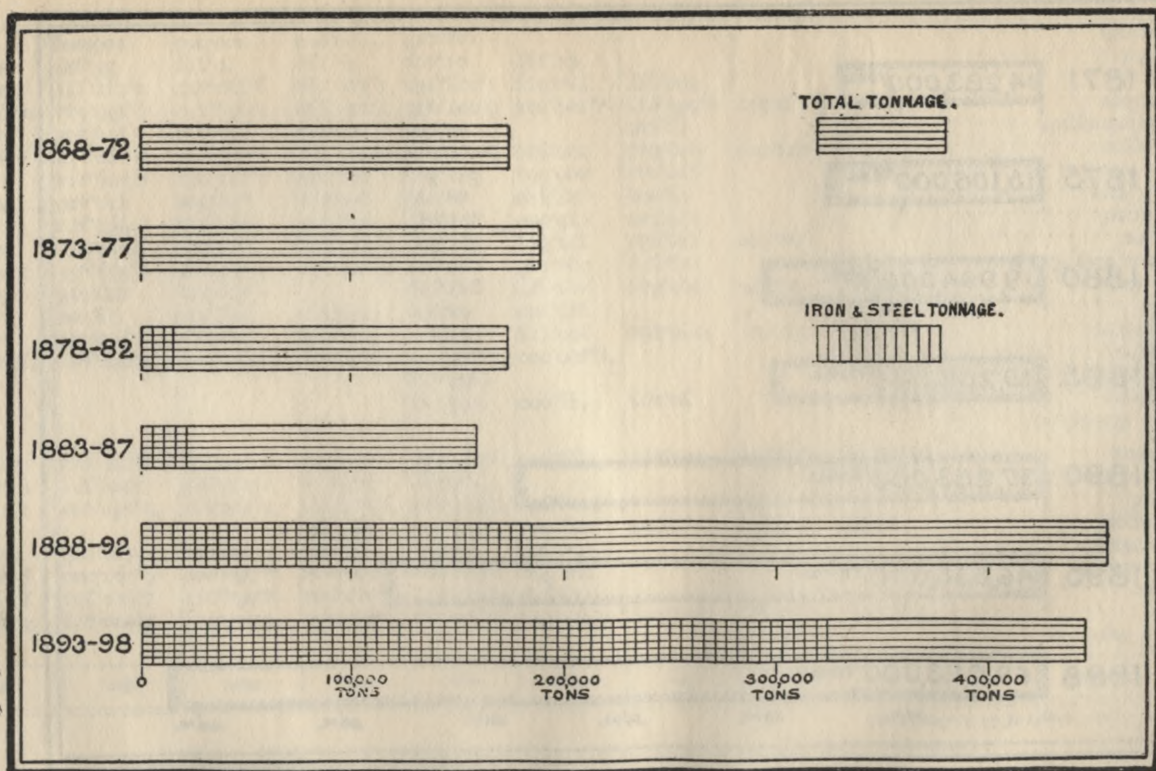
(Average Tonnage and Material Used.)

From Geo. G. Tunnell's *Report on Lake Commerce*, pp. 27, 28.

Year.	Average Tonnage.			Total Tonnage.	
	Sailing Vessels.	Steam Vessels.	All Vessels.	Wood.	Iron and Steel.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1868......	174.34	176.28	172.		
1869......	180.26	173.23	170.58		
1870......	149.59	146.85	163.83		
1871......	230.65	267.22	239.42		
1872......	227.40	265.43	249.30		
1873......	364.64	203.99	287.82		
1874......	337.31	247.34	291.12		
1875......	197.88	178.29	184.47		
1876......	71.62	113.57	116.23		
1877......	92.60	97.48	97.77		
1878......	45.60	157.15	114.21		
1879......	39.10	262.32	158.65		
1880......	113.47	220.09	172.80	20,082	2,817
1881......	248.77	450.28	372.12	67,673	5,831
1882......	244 90	262.31	260.	52,041	6,328
1883......	189.31	172.53	181.37	28,593	45
1884......	264.39	252.56	253.48	26,233	1,650
1885......	128.70	316.07	250.08	15,678	9,180
1886......	348 80	269.10	273.01	14,071	4,221
1887......	142.60	629.10	445.35	46,475	6,078
1888......	190.22	624.70	510.83	81,085	20,018
1889......	253.05	646.25	563.09	73,068	29,415
1890......	355.65	741.57	643.69	66,964	38,602
1891......	241.34	758.72	654.98	49,428	57,989
1892......	84.74	366.98	303.19	14,594	28,459
1893......	441.76	604.45	615.85	34,480	62,825
1894......	304.05	491.39	429.35	20,851	19,950
1895[1]	144.86 371.16	457.17	428.39	11,932	23,195
1896......	581.46 1,148.69	1,009.91	997.72	27,330	80,424
1897......	301.37 1,505 80	1,436.91	1,196.42	13,281	100,379
1898......	832.	971.38	761.78	16,649	35,152

[1] The upper figures of the years 1895–97, in the column headed Sailing Vessels, represent the average of the sailing vessels after the tonnage of the steel sailing vessels has been removed. The steel sailing vessels are commonly known on the lakes as barges. The average should be still further reduced, as several large wooden barges have been built in recent years.

Chart 23. VESSELS BUILT ON THE GREAT LAKES. **(Table 40).**



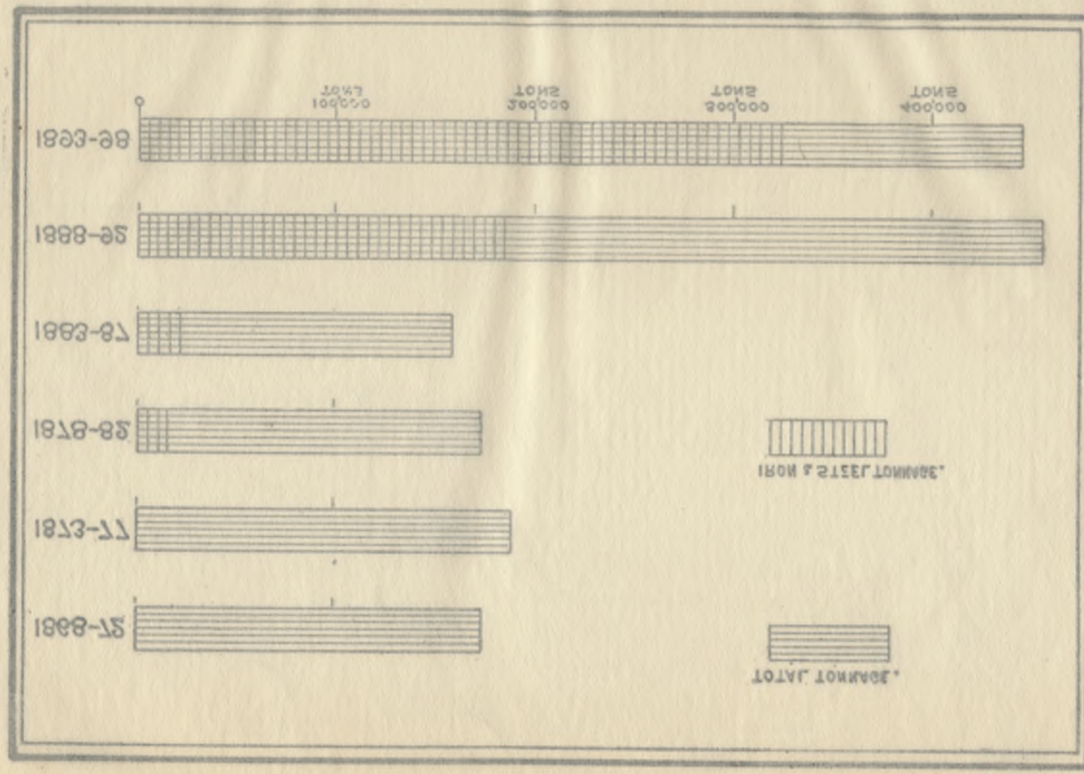


Chart 22. Vessels Built on the Great Lakes. (Table 40).

Chart 24. LAKE TRAFFIC. **(Table 41.)**

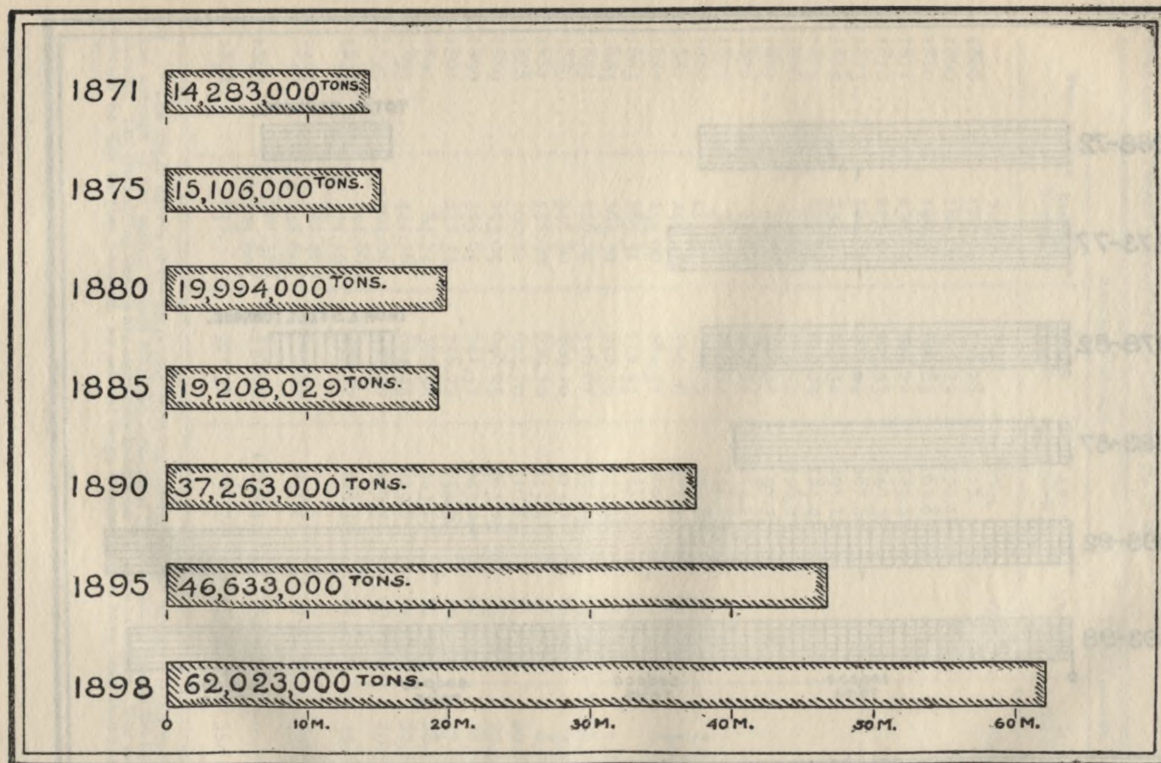


Table 41.

TONNAGE OF ENTRANCES AND CLEARANCES AT LAKE PORTS.

Compiled from *Reports of U. S. Engineers.*

Ports.	1871.	1875.	1880	1885.	1890.	1895.	1896.	1897.	1898.
Lake Superior.									
Duluth	200,000	366,823	605,915	1,371,869	2,740,354	7,401,280	8,668,811	8,004,473	8,798,007
Superior				113,519	1,541,777	4,042,992	4,684,257	4,841,392	5,337,230
Two Harbors				295,800	2,625,000	4,900,000	4,360,000	6,192,000	5,832,000
Grand Marais				164,300	20,000	56,200	[4]90,000	[4]142,536	[4]142,536
Ontonagon	[4]2,290	238,002	137,960	243,200	[1]188,000	296,490			32,500
Ashland				[4]119,501	2,816,924	3,747,251	2,391,337	[5]2,967,000	2,808,891
Portage Lake Canal					[4]348,239	956,779	1,076,548	1,025,375	1,447,216
Marquette	369,102	[4]578,879	862,452	759,506	3,077,566	915,800	1,586,184	1,577,111	1,178,468
Lake Michigan.									
Manistique			50,293	[1]55,000	[4]168,621				
Gladstone					[4]368,452				
Escanaba				[4]1,460,000	[4]4,496,521	[4]3,560.000	[4]2,921,928	[4]2,877,121	[4]3,503,513
Menominee	737,298	567,041	[1]736,464	366,515	663,002	770,159	705,137	760,000	917,046
Oconto				346,300	64,960	128,190	306,720	73,100	116,253
Green Bay	292,830	195,676	201,845	213,577	347,519		467,202	470,618	601,189
Sturgeon Bay Canal			113,379	694,148	954,407	1,304,415	1,558,148	1,685,981	1,285,885
Ahnepee		334,350	139,942	371,855	431,802	518,344	[1]455,622	936,647	508,781
Kewaunee			176,720	176,000	414,947	997,910	931,014	952,374	1,143,280
Two Rivers			15,000	47,510	49,256	404,810	478,800	511,426	672,380
Manitowoc			570,142	406,664	831,816	930,787	1,220,062	4,205,414	3,108,724
Sheboygan		1,025,600	918,649	720,549	1,049,246	1,047,187	1,228,916	1,159,112	1,391,587
Port Washington			13,540		26,580	161,950	125,050	174,400	164,400
Milwaukee	5,219,230	6,132,611	4,880,913	4,705,028	6,007,986	7,280,539	7,963,512	9,386,644	10,927,469
Racine			860,557	730,615	1,023,382	1,142,194	3,550,477	2,231,371	2,288,703
Kenosha				61,557	61,499	83,232	76,355	88,527	132,569
Waukegan					144,428	[5]200,000	200,000	200,000	66,902

Table 41—Continued.

Ports.	1871.	1875.	1880.	1885.	1890.	1895.	1896.	1897.	1898.
Chicago	[1]6,033,207	6,279,055	9,154,351	7,306,222	10,288,918	12,722,199	13,072,355	14,394,766	15,243,663
Michigan City				213,686	172,817	91,106	106,543	118,137	[4]144,983
St. Joseph	[1]383,927	267,311	376,920	144,000	263,002	655,121	874,064	733,965	2,331,127
South Haven	[1]76,945	41,120	61,913		128,800	238,060	343,016	351,000	322,620
Saugatuck	143,707	63,628	61,789	50,000	42,000	134,948	153,190	70,360	128,325
Black Lake	30,893	72,446	15,818		85,708	210,299	269,182	153,852	163,119
Grand Haven	799,565	651,207	768,829	[2]632,159	834,089	482,822	727,209	1,018,805	874,312
Muskegon	852,409	1,237,003	1,560,641	[2]1,076,398	649,540	441,289	562,757	725,514	1,165,802
White Lake	122,894	162,426	254,543	[2]262,440	62,276	34,574	27,962	33,409	16,415
Pentwater	50,608	55,863	60,342	20,000	[4]2,559				108,253
Ludington	106,463	376,878	435,153	[2]259,800	461,997	594,124	952,469	2,944,425	2,014,019
Manistee	426,807	696,555	830,362	991,872	975,049	930,645	643,048	666,000	528,752
Frankfort	25,255	162,187	77 006		57,140	412,951	509,277	706,546	793,896
Charlevoix			77,074	[2]151,360	75,224	92,387	75,263	110,474	106,797
Petoskey						28,000	24,000	91,600	76,000
Lakes Huron & St. Clair.									
St. Ignace					[4]72 617				
Cheboygan		219,786	289,316	251,518	[4]406,413	378,291	379,069	386,559	422,741
Alpena		161,472	248,879	300,000	[4]404,676	325,899	272,921	353,982	270,743
Au Sable (Oscoda)			125,263	125,000	[4]577,338	[5]500,000			
Saginaw River	[5]800,000	[5]800,000	1,315,948	1,083,671	[4]1,625,000	[5]1,600,000	[5]1,700,000	1,350,820	[5]1,300,000
East Tawas					[4]149,460				
Port Huron					[4]175,613	60,650	72,950	121,748	82,410
Detroit	[5]300,000	[5]300,000	[5]400,000	[5]500,000	[4]701,331	[5]900,000	[5]1,100,000	[5]1,250,000	[5]1,250,000
Lake Erie.									
Monroe	11,088	3,437	3,632	[3]2,776	27,000			22,360	44,844
Toledo	1,107,256	881,774	1,674,246	[3]1,046,792	[3]1,842,617	1,806,673	2,252,394	2,492,044	2,490,906
Port Clinton	23,799	31,833		[3]7,072	[3]6,149		3,946	4,951	10,106
Sandusky	392,648	522,465	442,788	[3]557,683	[3]1,251,108	1,346,233	1,046,332	1,411,211	1,190,317
Huron, O.	7,732	23,737	6,500	[3]37,092	[3]88,464	230,644	350,312	281,583	126,429

Table 41—Continued.

Ports.	1871.	1875.	1880.	1885.	1890.	1895.	1896.	1897.	1898.
Vermillion, O.		16,385		[3]14,950				3,760	11,030
Kelley's Island					[4]211,862				260,975
Put-in-Bay					[4]2,932				280,870
Lorain	11,600	28,170	52,355	109,904	[3]401,241	617,126	[4]565,219	915,440	795,104
Cleveland	2,167,406	2,136,803	2,341,370	2,107,493	[4]4,371,269	5,649,537	5,991,656	6,189,883	[4]6,545,488
Fairport	13,402	7,855	22,576	36,965	[3]1,422,683	2,184,982	1,698,809	1,670,981	1,354,269
Ashtabula	3,993	234,714	476,942	794,873	3,036,395	4,410,984	3,994,198	4,560,077	4,180,701
Conneaut		1,669	1,838	[3]955		927,833	1,519,873	1,284,663	2,483,160
Erie	1,398,771	734,384	1,565,183	1,478,087	2,480,853	3,323,672	3,634,842	4,051,984	3,939,019
Dunkirk	15,876	2,316	25,376	[3]6,296	22,496	15,650	12,160	16,745	22,005
Buffalo	4,575,659	3,281,231	5,377,383	3,635,195	7,556,413	9,612,423	11,053,206	11,581,858	12,040,993
Tonawanda				291,507	1,186,697	869,765	915,444	1,110,919	1,107,761
Port Day						28,284	36,000	70,764	84,418
Lake Ontario.									
Wilson Harbor			3,165	2,279	25,250	41,820	9,850	3,840	7,198
Olcott	2,303		5,279	5,778					
Oak Orchard Harbor	11,608	4,300	1,952	552					
Pultneyville	7,064	1,500	2,860	1,834	668				
Charlotte Harbor	159,181	227,312	273,188	300,175	[2]597,570	676,382	728,601	811,582	923,898
Great Sodus	9,943	25,765	32,740	47,822	32,873	67,046	57,849	71,814	111,132
Fair Haven			47,927	68,731	164,206	102,303	84,256	110,876	49,518
Oswego	1,243,965	709,392	807,370	700,401	1,071,504	815,793	882,048	787,876	743,807
Sackett's Harbor			18,000	11,554	13,782	15,379			
Cape Vincent							253,561	151,431	132,290
Ogdensburg	430,125	352,971	407,482	358,153	731,994	904,199	886,437	[4]1,173,021	1,230,053
Total	28,566,849	30,213,942	39,988,070	38,416,058	74,527,075	93,265,952	102,815,399	114,703,085	124,046,366
Lake Traffic[6]	14,283,000	15,106,000	19,994,000	19,208,029	37,263,000	46,633,000	51,407,000	57,351,000	62,023,000

[1] Calendar Year preceding date at head of column.
[2] Fiscal Year following " " " "
[3] Calculated from record for 11 months of fiscal year ending June.
[4] Tonnage of freight received and shipped.
[5] Estimated.
[6] Lake Traffic figures are determined by taking one-half of the total tonnage of entrances and clearances at United States ports.

Table 42.

FREIGHT TRAFFIC THROUGH ST. MARY'S FALLS CANAL.

From the *Reports of the United States Engineers.*

Year.	Coal.	Flour.	Wheat.	Grain other than wheat.	Manufactured and pig iron.	Salt.	Copper.	Iron ore.	Lumber.	Silver ore and bullion (*a*)	Building stone. (*b*)	Unclassified freight. (*c*)	Total freight. (*c*)
	Net tons	*Barrels.*	*Bushels.*	*Bushels.*	*Net tons.*	*Barrels*	*Net tons*	*Net tons.*	*B. M. feet.*	*Net tons.*	*Net tons*	*Net tons.*	*Net tons.*
1855	1,414	10,289			1,040	587	3,196	1,447	126,000				
1856	3,968	17,686		33,908	781	464	5,727	11,597	395,000				
1857	5,278	16,560		22,300	1,325	1,500	5,760	26,184	572,000				
1858	4,118	13,782		10,500	2,597	950	6,744	31,035	185,000				
1859	8,884	39,459		71,738	5,504	2,737	7,247	65,769					
1860		50,250		133,437			9,000	120,000					
1861	11,507	22,743		76,830	4,194	3,014	7,645	44,836	394,000				
1862	11,346	17,291		59,062	6,438	2,477	6,881	113,014	196,000				
1863	7,805	31.975		78,480	6,681	1,506	1,044	181,567	1,411,000				
1864	11,282	33,937		143,560	7,643	1,776	5,331	213,753	2,001,000				
1865		34,985			7,346	3,175	9,935	147,459	822,000				
1866	19.915	33,603		229,926	13,235	4,454	9,550	152,102	144,000				
1867	22,927	28,345		249,031	20,602	5,316	10,585	222,861	390,000				
1868	25,814	27,372		285,123	22,785	4,624	12,222	191,939	1,119,000				
1869	27,850	32,007		323,501	23,851	5,910	18,662	239,368	1,260,000				
1870	15,952	33,548	49,700	304,077	42,959	11 089	11,301	409,850	722,000	92	2,917		
1871	46,798	26,060	1.376,705	308,823	54,984	36,199	14,562	327,461	1,072,000	464	5,228		
1872	80,815	136,411	567,134	445,774	86,194	42,690	14,591	383,105	1,742,000	306	5,213		
1873	96,780	172,692	2,119,997	309,645	44,920	29,335	15,927	504,121	1,162,000	580	2,218		
1874	61,123	179,855	1,120,015	149,999	31,741	42,231	15,346	427,658	638,000	443	401		
1875	101,260	309,991	1,213,788	250,080	54,381	43,989	18,396	493,408	5,391,000	847	2,978		
1876	124,734	315,224	1,971,549	407,772	64,091	46,666	25,756	609,752	17,761,000	985	2,102		
1877	91,575	355,117	1,349,738	343,542	39,971	63,188	16,767	568,082	4,143,000	987	2,506		
1878	91,856	344,599	1,872,940	264,674	14,882	63,520	22,529	555,750	24,119,000	650	2,754		

Table 42—Continued.

Year.	Coal.	Flour.	Wheat.	Grain other than wheat.	Manufactured and pig iron.	Salt.	Copper.	Iron ore.	Lumber.	Silver ore and bullion. (a)	Building stone. (b)	Unclassified freight. (c)	Total freight. (c)
	Net tons.	*Barrels.*	*Bushels.*	*Bushels.*	*Net tons.*	*Barrels.*	*Net tons.*	*Net tons.*	*B. M. feet.*	*Net tons.*	*Net tons*	*Net tons.*	*Net tons.*
1879	110,704	451,000	2,603,666	951,496	39,218	92,245	22,309	540,075	35,598,000	324	2,226		
1880	170,501	523,860	2,105,920	2,547,106	46,791	77.916	21,753	677,073	44,539,000	66	2,283		
1881	295,647	605,453	3,456,965	367,838	87,830	65,897	29,488	748,131	58,877,000		1,400	129,031	1,567,741
1882	430,184	344,044	3,728,856	473,129	92,870	176,612	25,409	987,060	82,783,000	22	5,428	172,167	2,029,521
1883	714,444	687,031	5,900,473	776,552	109,910	70,898	31,024	791,732	87,131,000	814	2,405	191,571	2,267,105
1884	706,379	1,248,243	11,985 791	517,103	72,428	144,804	36,062	1,136,071	122,389,000	9,731	6,047	207,173	2,874,557
1885	894,991	1,440,093	15,274,213	422,981	60,842	136,355	31,927	1,235,122	127,984,000	3,669	8,189	184,963	3,256,628
1886	1,009,999	1,759,365	18,991,485	715,373	115,208	158,677	38,627	2,087,809	138,688,000	2,009	9,449	230,726	4,527,759
1887	1,352,987	1,572,735	23,096,520	775,166	74,919	204,908	34,886	2,497,713	165,226,000	350	13,401	344,586	5,494,649
1888	2,105,041	2,190,725	18,596,351	2,022,308	63,703	210,433	28,960	2,570,517	240,372,000	3,385	33,541	345,854	6,411,423
1889	1,629,197	2,228,707	16,231,854	2,133,245	57,561	168,250	33,456	4,095,855	315,554,000	5,947	33,538	312,410	7,516,022
1890	2,176,925	3,239,104	16,217,370	2,044,384	116,327	179,431	43,729	4,774,768	361,929,000	3,432	47,973	371,294	9,041,213
1891	2,507,532	3,780,143	38,816,570	1,032,104	69,741	234,528	69,190	3,560,213	366,305,000	1,731	44,080	417,093	8,888,759
1892	2,904,266	5,418,135	40,994,780	1,666,690	101,520	275,740	64,993	4,901,132	512,814,000	1,930	39,698	459,146	11,214,333
1893	3,008,120	7,420,674	43,481,652	2,405,344	89,452	228,730	87,530	4,014,556	588,545,000	2,470	19,426	415,180	10,796,572
1894	2,797,184	8,965,773	34,869,483	1,545,008	60,659	237,461	99,573	6,548,876	722,788,000	412	21,417	451,185	13,195,860
1895	2,574,362	8,902,302	46,218,250	8,328,694	100,337	269,919	107,452	8,062,209	740,700,000	100	23,876	463,308	15,062,580
1896	3,023,340	8,882,858	63,256,463	27,448,071	121,872	237,515	116,872	7,909,250	684,986,000	240	17,731	520,851	16,239,061
1897	3,039,172	8,921,143	55,924,302	24,889,688	135,164	285,449	122,324	10,633,715	805,612,000	5	6,249	579,048	18,982,755
1898	3,776,450	7,778,043	62,339,996	26,078,384	250,170	301,560	124,226	11,706,960	895,485,000		4,670	623,146	21,234 664

(a) No record kept until 1870.
(b) None shipped from Lake Superior until 1870.
(c) No record kept until 1881.

Table 43.

TRAFFIC STATISTICS OF ST. MARY'S FALLS CANAL.

From *Marine Record*, May 18, 1899

Seasons.	Value of Freight.	Total Ton-miles.	Total Cost of Transportation.	Cost of Carrying per Ton-mile.	Average distance Freight Carried.	Proportion by Canadian Vessels.
				Mills.	*Miles.*	*Per cent.*
1887	$71,031,757	4,458,544,804	$10,075,153	2.3	811.4	7
1888	82,156,019	5,173,132,972	7,883,077	1.5	806.4	6
1889	83,732,527	5,940,646,352	8,634,247	1.5	790.4	4
1890	102,214,948	7,207,299,415	9,472,215	1.3	797.2	3.5
1891	128,178,208	7,292,462,269	9,849,023	1.35	820.4	4
1892	135,117,267	9,222,773,938	12,072,851	1.31	822.4	3.8
1893	145,436,957	8,980,310,240	9,957,483	1.1	831.9	4.1
1894	143,114,502	10,927,871,324	10,798,310	.99	821.1	3.5
1895	159,575,129	12,502,548,892	14,238,758	1.14	830	3.75
1896	195,146,842	13,582,641,886	13,511,615	.99	836.4	4
1897	218,235,927	15,969,393,576	13,220,099	.83	841.3	3
1898	233,069,739	17,891,597,030	14,125,896	.79	842.6	2.2

Table 44.

LAKE COMMERCE: GRAIN AND MILL PRODUCTS.[1]

SHIPMENTS BY VESSEL FROM LAKE PORTS. (TONS.)

Ports.	1889.	1895.	1896.	1897.	1898.
Duluth and Superior......	655,299	2,065,566	2,601,639	2,445,643	2,803,339
Gladstone	72,354	211,000	242,000	271,810	138,322
Green Bay...............	24,969		109,640		78,972
Manitowoc	17,112	37,013	49,670	128,000	254,682
Milwaukee...............	348,662	728,932	987,148	976,517	1,078,000
Chicago and Calumet	2,819,041	2,221,331	2,961,076	3,573,707	3,762,873
Detroit..................	114,684	48,200	62,696	92,552	70,400
Toledo	275,532	201,400	293,916	432,595	461,852
Sandusky................	8 063				
Cleveland......	791	4,808	13,421	35,320	65,950
Leading Ports.....	4,336,507	5,518,250	7,321,206	7,956,144	8,754,390
St. Mary's Falls Canal.....	777,194	2,509,977	3,555,525	3,266,560	3,750,360

RECEIPTS BY VESSEL AT LAKE PORTS (TONS)

Ports.	1889.	1895.	1896.	1897.	1898.
Detroit	7,148	20,327	24,888	21,306	39,400
Cleveland................	24,649	61,240	76,659	100,362	40,880
Erie	293,641	419,328	709,609	894,605	708,629
Buffalo	3,132,433	4,291,631	5,545,648	6,517,347	7,021,985
Welland Canal...........	530,759	484,785	784,538	815,067	
Oswego	116,068	39,095	31,915	44,101	26,897
Ogdensburg	237,332	166,061	287,061	412,883	243,582
Ontario Ports	19,075	32,096	73,386	53,257	50,000
Montreal	275,414	247,550	495,898	560,254	750,000
Leading Ports...	4,105,760	5,277,328	7,245,064	8,604,115	8,881,373

[1] The statistics for 1889 are from the Eleventh Census volume on Water Transportation; other figures for United States Ports are generally from reports of U. S. Engineers, but in a few cases where these did not give the figures, from reports of trade organizations; statistics for Canadian Ports are from the reports of the Canadian Department of Railways and Canals.

Map 2. Lake Commerce: Shipments and Receipts of Grain and Mill Products, 1898. **(Table 44.)**

Table 45.

SHIPMENTS OF EAST-BOUND FLOUR (BARRELS).

From Geo. G. Tunnell's *Report on Lake Commerce*, pp. 53, 55; *Report of Duluth Board of Trade*, 1897, p. 35.

Year.	Milwaukee.				Chicago.		
	Rail.	Transit lines.	Lake.	Total.	Lake.	Rail.	Total.
1868....	359,721	104,882	552,995	1,017,598	650,367	1,187,582	1,837,949
1869....	340,493	188,864	690,701	1,220,058	774,556	1,749,973	2,524,529
1870....	233,540	209,201	783,200	1,225,941	574,393	989,160	1,563,553
1871....	127,722	362,606	719,921	1,210,249	488,705	694,274	1,182,979
1872....	306,076	421,757	507,168	1,235,001	223,457	1,022,968	1,246,425
1873....	757,805	257,608	789,787	1,805,200	428,321	1,773,467	2,201,788
1874....	854,584	330,271	1,032,724	2,217,579	555,152	1,672,037	2,227,189
1875....	990,038	353,300	819,047	2,162,385	328,283	1,872,943	2,201,226
1876....	1,289,147	719,268	643,977	2,652,392	236,591	2,309,530	2,546,121
1877....	102,675	555,700	493,026	1,151,401	148,779	2,229,729	2,378,508
1878....	170,084	533,439	734,543	1,438,066	321,648	2,371,623	2,693,271
1879....	333,118	821,728	728,639	1,883,485	330,257	2,675,402	3,005,659
1880....	230,415	859,666	938,575	2,028,656	527,873	2,264,886	2,792,759
1881....	473,340	668,825	717,707	1,859,872	159,415	4,235,559	4,394,974
1882....	218,241	971,369	1,540,549	2,730,159	792,764	2,887,603	3,680,367
1883....	162,678	1,236,932	1,402,181	2,801,791	801,099	3,067,275	3,868,374
1884....	200,398	1,272,860	1,581,997	3,055,205	753,357	3,930,576	4,683,933
1885....	530,636	883,476	1,370,922	2,785,034	652,373	4,450,051	5,102,424
1886....	153,609	1,495,500	2,344,673	3,993,782	1,391,235	2,244,376	3,635,611
1887....	328,538	1,306,791	1,663,914	3,299,243	1,544,196	4,682,546	6,226,742
1888....	413,418	1,167,660	1,820,123	3,401,201	1,711,370	3,613,922	5,325,292
1889....	268,819	1,114,446	1,836,308	3,219,573	1,811,467	1,951,274	3,762.741
1890....	196,389	1,379,389	1,613,728	3,189,504	1,757,745	2,172,761	3,930,506
1891....	407,912	1,543,120	1,858,027	3,809,059	1,640,738	2,244,280	3,885,018
1892 ...	467,728	1,525,035	2,312,673	4,305,436	2,455,006	3,123,553	5,578,559
1893.. .	417,405	962,694	1,677,033	3,057,132	1,471,060	2,493,206	3,964,266
1894....	336,525	928,000	1,889,686	3,154,211	1,630,345	1,926,285	3,556,630
1895....	416,172	1,149,781	1,790,653	3,356,606	791,620	1,597,495	2,389,115
1896....	410,710	2,164,016	1,975,165	4,549,891	1,006,951	1,666,739	2,673,690
1897....	449,330	1,395,355	2,077,145	3,921,830	1,060,734	1,557,342	2,618,076
1898....	611,095	540,985	2,000,977	3,824,152	713,633	4,318,603	5,032,236

Year.	Minn. St. P. & S. Ste. M. R. R.			Duluth & Superior.
	All Rail.	Via Gladstone & Lake.	Total.	
1885				1,076,044
1886				1,357,141
1887				1,322,715
1888			931,502	1,747,176
1889			1,367,792	1,953,053
1890			1,156,516	2,589,384
1891			1,200,642	3,142,501
1892			1,684,005	4,763,481
1893			1,720,166	7,033,759
1894			1,458,146	7,844,473
1895			2,111,455	7,144,155
1896			2,419,914	7,499,230
1897	735,608	2,718,102	3,453,510	7,630,170
1898	1,127,797	1,783,225	2,911,022	6,259,795

Table 46.

EAST-BOUND GRAIN MOVEMENT.

(BUSHELS, 000'S OMITTED.)

Statistics for Chicago and Milwaukee, compiled from tables in Geo. G. Tunnell's *Report on Lake Commerce.*

	Shipments from Chicago.		Through St. Mary s Falls Canal.	Shipments from Milwaukee.		
	By Rail.	By Lake.		By Lake.	By transit lines.	By Rail.
1868..........	3,072	38,117	285	10,183	112	460
1869..........	7,485	43,322	323	14,301	90	324
1870..........	8,703	33,766	353	15,935	201	304
1871..........	6,323	55,117	1,685	14,188	98	313
1872..........	13,604	56,780	1,013	13,289	268	894
1873..........	19,902	56,000	2,429	23,840	494	1,848
1874..........	17,283	51,957	1,270	18,972	1,212	3,353
1875..........	15,789	42,490	1,463	20,363	389	3,302
1876..........	30,793	38,497	2,379	13,585	1,790	2,869
1877..........	18,038	53,965	1,693	16,810	1,072	881
1878..........	33,671	65,526	2,137	11,694	2,404	2,228
1879..........	43,823	50,772	3,555	11,168	1,214	2,080
1880..........	44,244	91,224	4,653	9,100	494	1,628
1881..........	55,197	56,659	3,824	5,630	608	1,214
1882..........	38,851	49,971	4,202	1,373	262	639
1883..........	51,834	59,743	6,677	4,870	44	485
1884..........	58,628	41,322	12,502	2,228	90	1,678
1885..........	64,103	36,389	15,697	3,380	42	2,622
1886..........	44,121	54,688	19,706	4,359	9	802
1887..........	42,179	66,238	23,871	4,395	110	876
1888..........	50,279	67,418	20,618	1,914	217	1,099
1889..........	49,698	98,748	18,365	1,236	353	825
1890..........	85,391	82,742	18,261	2,029	285	1,324
1891..........	79,270	89,003	39,848	1,944	640	2,166
1892..........	71,259	96,545	42,661	4,443	1,232	2,638
1893..........	59,098	105,250	45,887	5,500	1,648	2,038
1894..........	49,830	66 077	36,414	4,966	1,147	631
1895..........	65,522	78,809	54,547	8,845	4,305	5,217
1896..........	77,900	111,409	90,704	11,568	2,190	1,781
1897..........	70,333	153,891	80,813	8,820	2,148	1,822
1898..........	101,770	151,780	88,818	18,324	2,796	3,629

Chart 25 (Table 46.)

GRAIN MOVEMENT FROM CHICAGO AND ST. MARY'S FALLS CANAL.

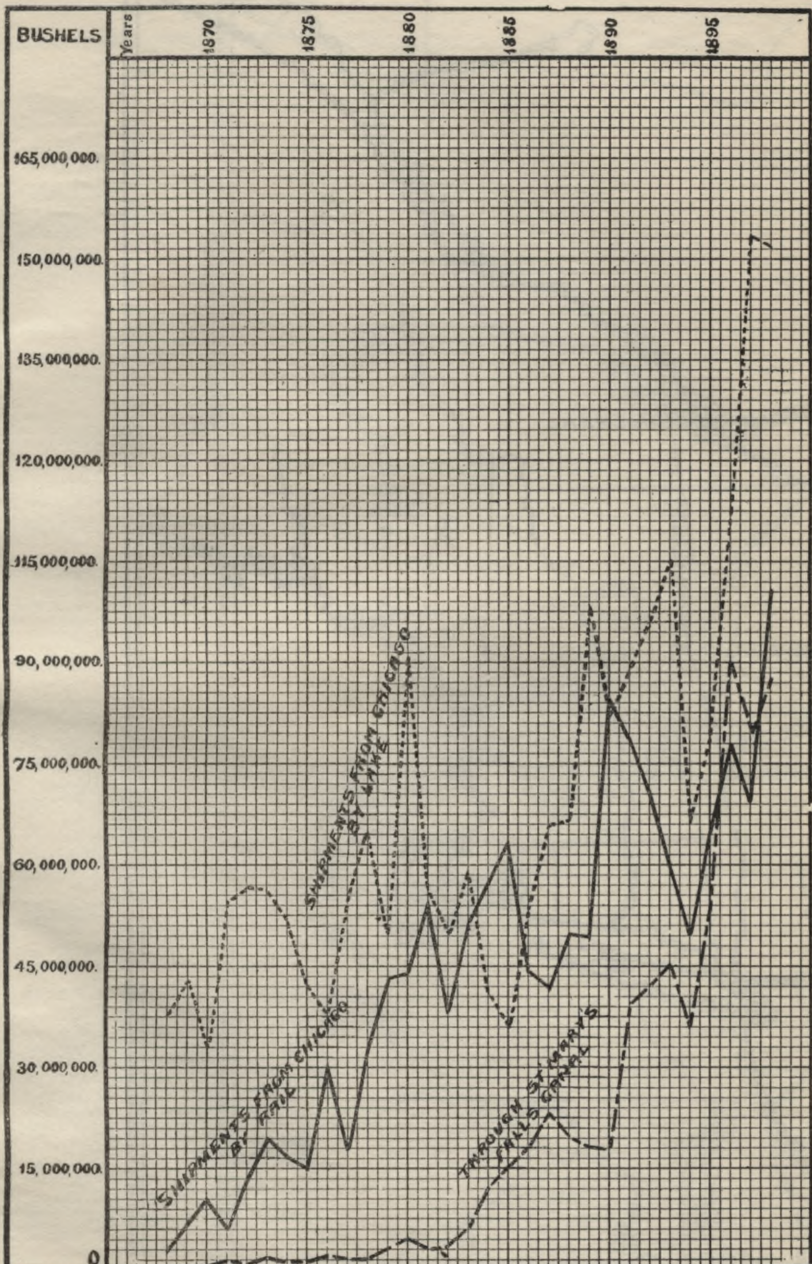
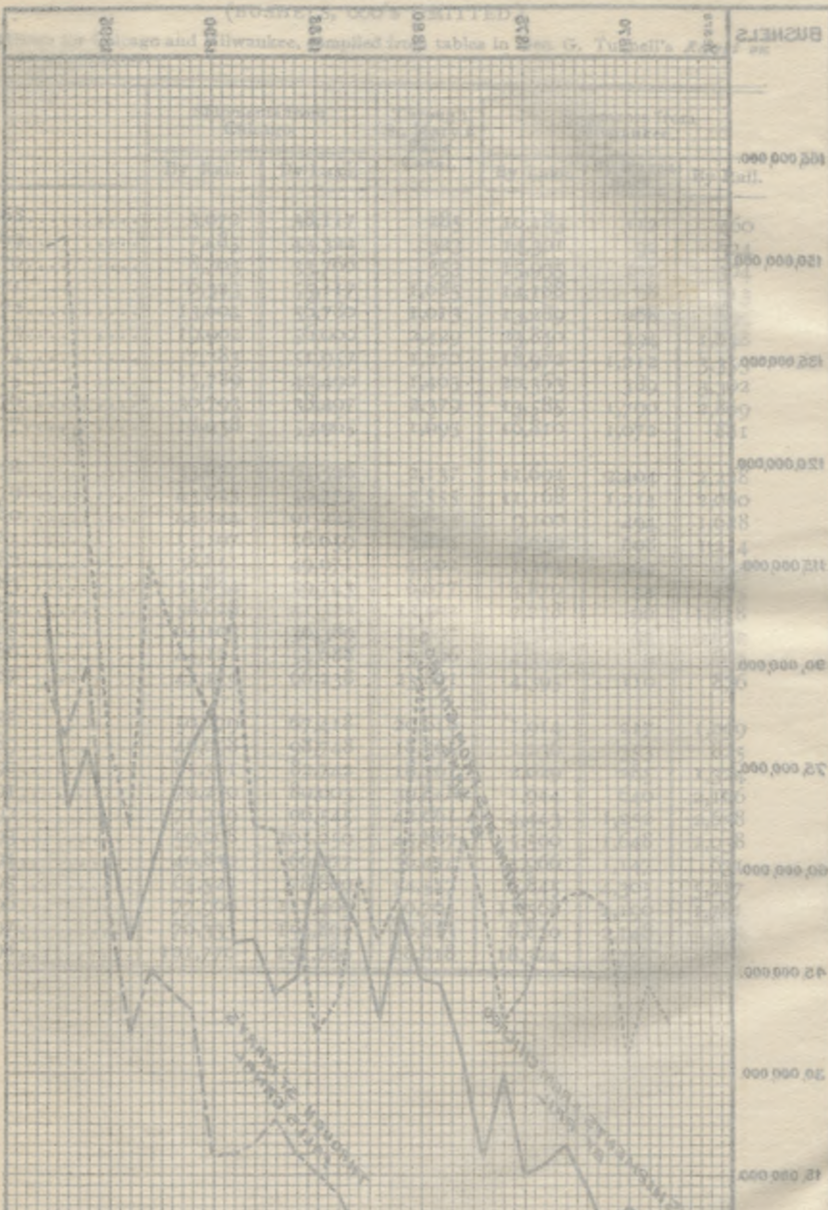
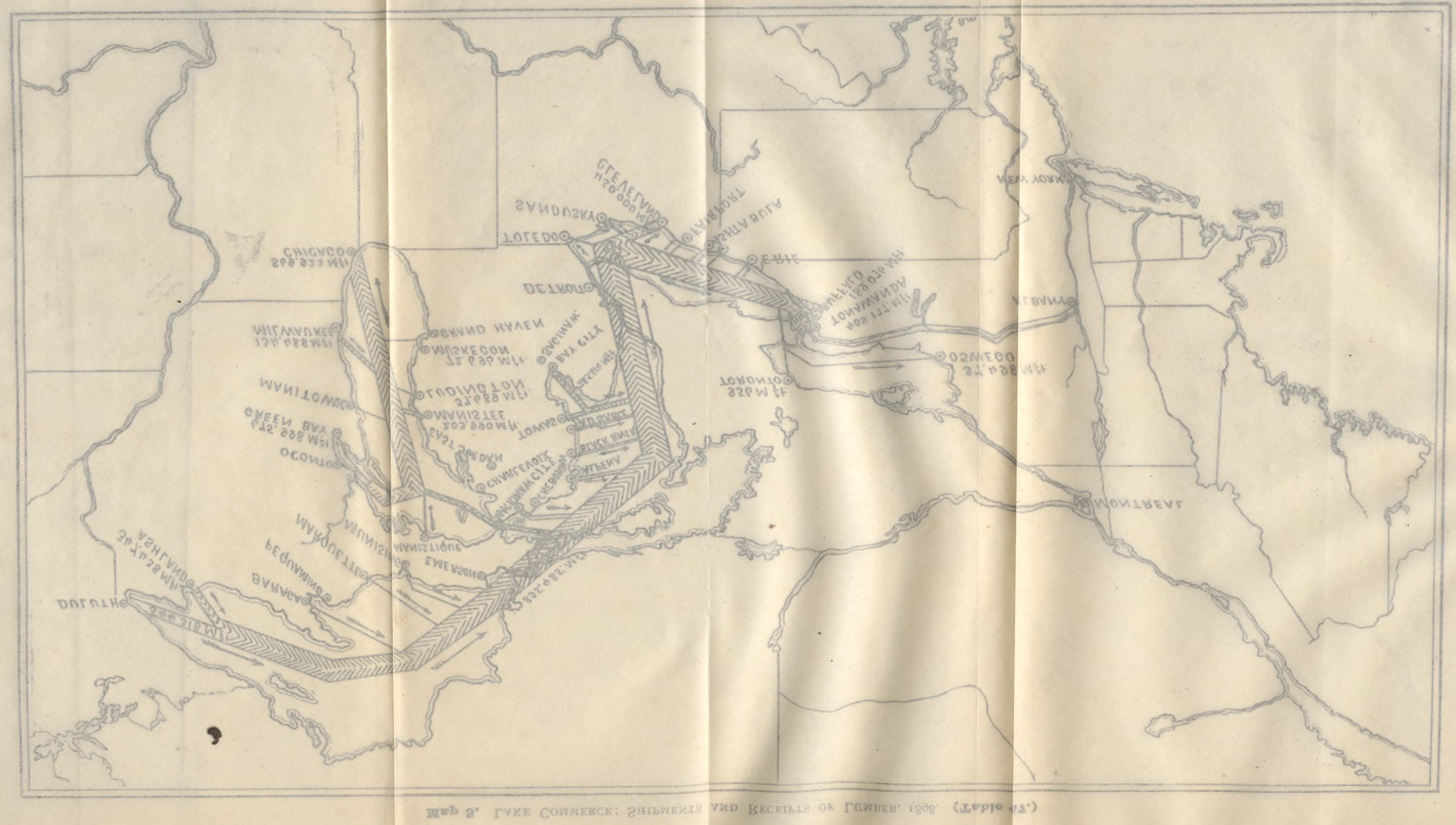


Chart 25 (Table 46.)

GRAIN MOVEMENT FROM CHICAGO AND ST. MARY'S FALLS CANAL.





Map 3. LAKE COMMERCE: SHIPMENTS AND RECEIPTS OF LUMBER, 1898. **(Table 47.)**

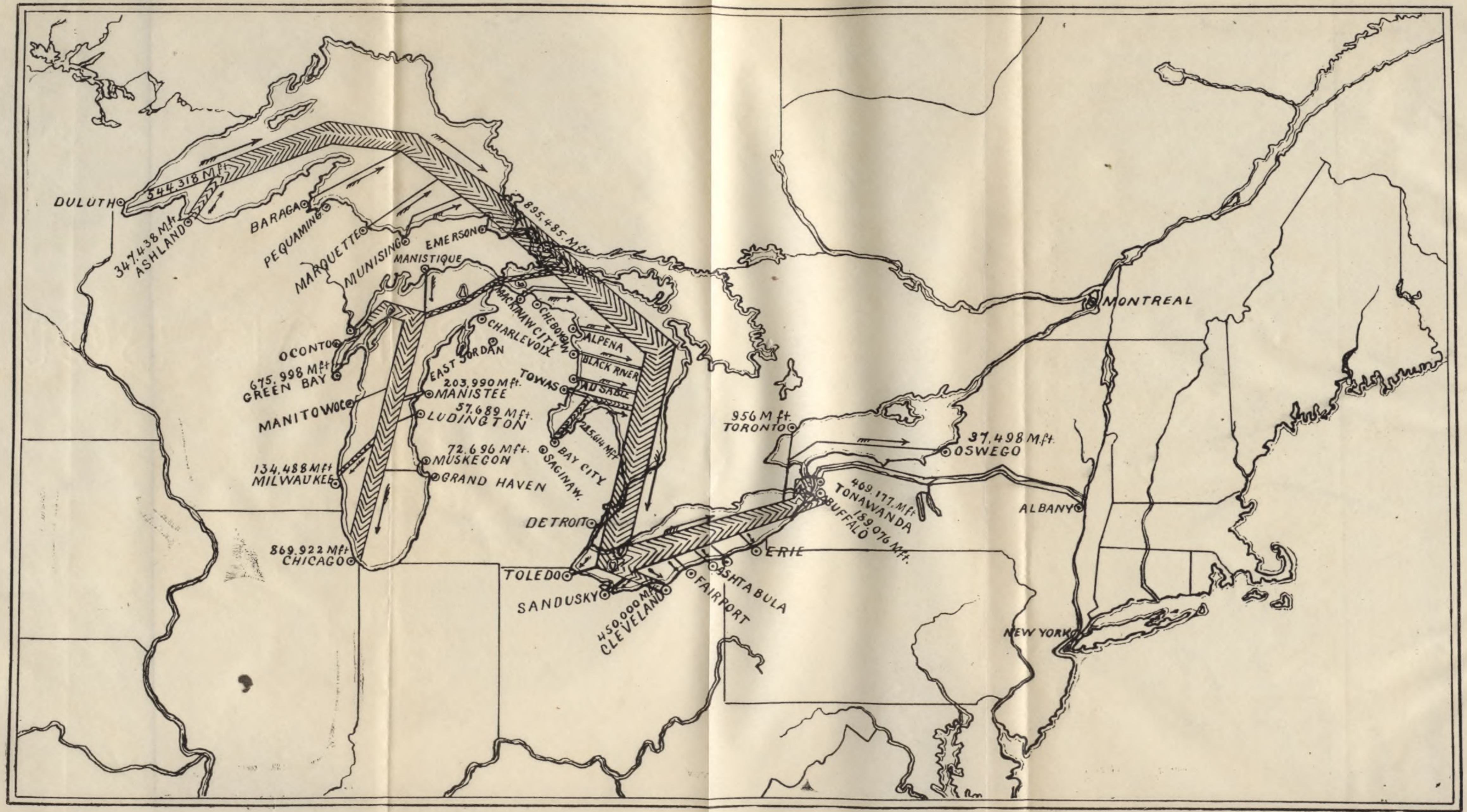


Table 47.

LAKE COMMERCE: LUMBER.

From *American Lumberman*, January 21, 1899.

1. PRODUCTION AT LAKE POINTS. *M. ft.*

	1890.	1895.	1896.	1897.	1898.
Lake Michigan.					
Green Bay*	881,355	749,253	639,673	625,552	675,998
Manistee	280,495	250,116	211,801	195,461	203,990
Ludington	150,606	68,212	55,306	55,802	57,689
Muskegon	433,960	40,908	48,250	24,650	72,696
Miscellaneous	470,723	488,911	470,590	505,646	408,717
	2,217,140	1,597,400	1,425,620	1,407,111	1,419,090
Lake Superior.					
Duluth*	206,600	463,920	322,169	477,269	544,318
Ashland*	198,000	333,467	222,200	265,350	347,438
	404,600	797,387	544,369	742,619	891,756
St. Mary's Falls Canal	361,929	740,700	684,986	805,602	895,485
Lake Huron.					
Cheboygan	427,540	102,362	75,500	83,298	109,500
Lake Shore	597,863	229,545	196,787	140,939	119,323
Saginaw Valley	815,768	388,266	316,798	339,991	285,614
	1,841,171	720,173	589,085	564,228	514,437
Total Lake Production	4,462,912	3,114,960	2,563,074	2,713,960	2,825,283
Total N. W. "	8,597,659	7,050,669	5,725,763	6,233,454	6,155,300

2. LAKE RECEIPTS. *M. ft.*

Compiled from *Reports* of Boards of Trade, and Geo. G. Tunnell's *Report on Lake Commerce.*

	1890.	1895.	1896.	1897.	1898.
Chicago	1,359,921	1,073,847	779,922	917,212	869,922
Milwaukee	140,273	145,809	119,025	150,332	134,488
Detroit	78,085				
Toledo	192,000	159,000	127,000	122,000	120,000
Cleveland	495,984	351,383	244,765	229,971	450,000
Buffalo	287,334	231,257	201,277	221,302	189,076
Tonawanda	717,651	421,372	469,247	584,837	469,177
Toronto				255	956
Oswego	158,042	58,626	68,830	54,246	37,498
Leading Ports	3,429,290	2,441,294	2,010,066	2,280,156	2,270,000

Points marked * ship some part of their product by rail; on the other hand, there are some lake shipments from inland points not included in the figures above.

From letter of J. E. DEFEBAUGH, Editor *American Lumberman*:

"Of the lumber which passes through the Soo Canal, probably three-fifths goes to lower lake ports and probably two-fifths of it to Buffalo and Tonawanda. The remaining two-fifths go to Chicago and other Lake Michigan markets. Practically all the lumber that is shipped by water from the mills on the east shore of Lake Michigan, including Ludington and Manistee, goes to Lake Michigan ports. Probably two-thirds of the Green Bay Shore district produce is shipped by water, about half going from the Straits of Mackinac bound for lower lake ports. Of the product of Cheboygan, half goes to Chicago and half to the east. The mills along the shore of Lake Huron all ship to the east, excepting Saginaw Valley mills. The Saginaw valley district ships in so much lumber that you can probably allow not over 100,000 feet for its shipment. The mills at Detroit, Toledo and Cleveland all ship their product direct by rail. . . .

"Probably not more than two-thirds of the lumber which passes through the Detroit river goes to Buffalo and Tonawanda, where it is subject to shipment by canal, though it is possible that a slightly greater proportion than this is available for canal shipment."

Table 48.

LUMBER BUSINESS ON SAGINAW RIVER.

From *Reports of U. S. Engineers*, and *American Lumberman*, Jan. 21, 1899.

Year.	Lumber manufactured. Feet.	Shingles. No.	Lath. No.	Lumber shipped by water. Feet.
1865...	250,639,340			
1866....	349,767,834		48,623,000	
1867....	423,963,190	90,983,000	63,870,875	
1868 ...	451,395,225	104,104,500	61,478,910	
1869....	523,500,830	119,843,500	51,754,221	
1870....	576,726,606	178,570,000	61,287,500	
1871....	529,682,878	187,691,000	62,850,000	
1872....	602,118,980	159,001,750	76,951,800	
1873....	619,877,021	218,394,550	89,330,400	
1874....	573,632,771	208,489,500	73,675,950	
1875....	581,558,273	124,030,240	73,209,255	
1876....	583,950,771	204,346,725	72,703,660	
1877....	640,116,231	167,806,750	72,514,999	
1878....	574,162,757	153,989,750	53,236,075	
1879....	736,106,000	218,934,000	65,969,000	
1880....	873,047,731	241,075,160	65,663,883	
1881....	976,320,317	304,925,500	65,983,750	
1882....	1,011,274,905	295,046,500	94,703,800	
1883....	938,675,078	242,126,000	106,132,490	
1884....	964,435,984	261,266,750	127,346,000	
1885....	717,790,214	222,953,000	80,931,400	659,565,000
1886....	798,826,224	227,463,000	100,119,400	591,013,100
1887....	779,661,265	196,983,000	89,873,550	486,106,000
1888....	897,904,875	267,224,000	110,966,945	451,411,000
1889....	868,428,425	220,786,250	135,940,240	432,130,000
1890.. .	833,054,465	221,839,000	129,731,800	409,972,000
1891....	762,910,386	226,938,000		404,577,000
1892....	705,969,027	182,315,250		347,866,091
1893....	594,410,676	112,826,000		173,154,000
1894....	482,558,546	88,307,250		182,600,017
1895....	388,266,202	49,843,000		136,120,632
1896 ..	316,797,879	38,180,750		68,743,000
1897....	339,991,000	48,276,000		89,137,511
1898....	285,614,000	87,029,000		

Chart 26 (Table 48).

LUMBER TRAFFIC OF SAGINAW RIVER.

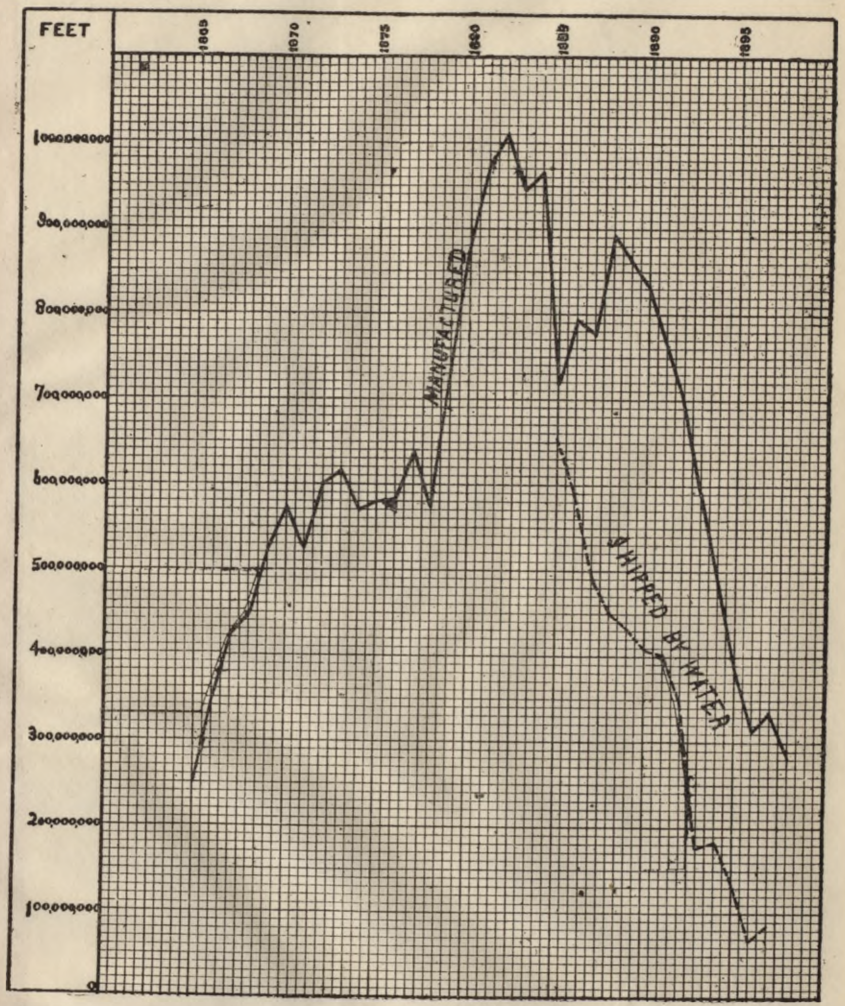


Chart 27 (Table 49).

IRON ORE PRODUCTION AT LAKE SUPERIOR MINES.

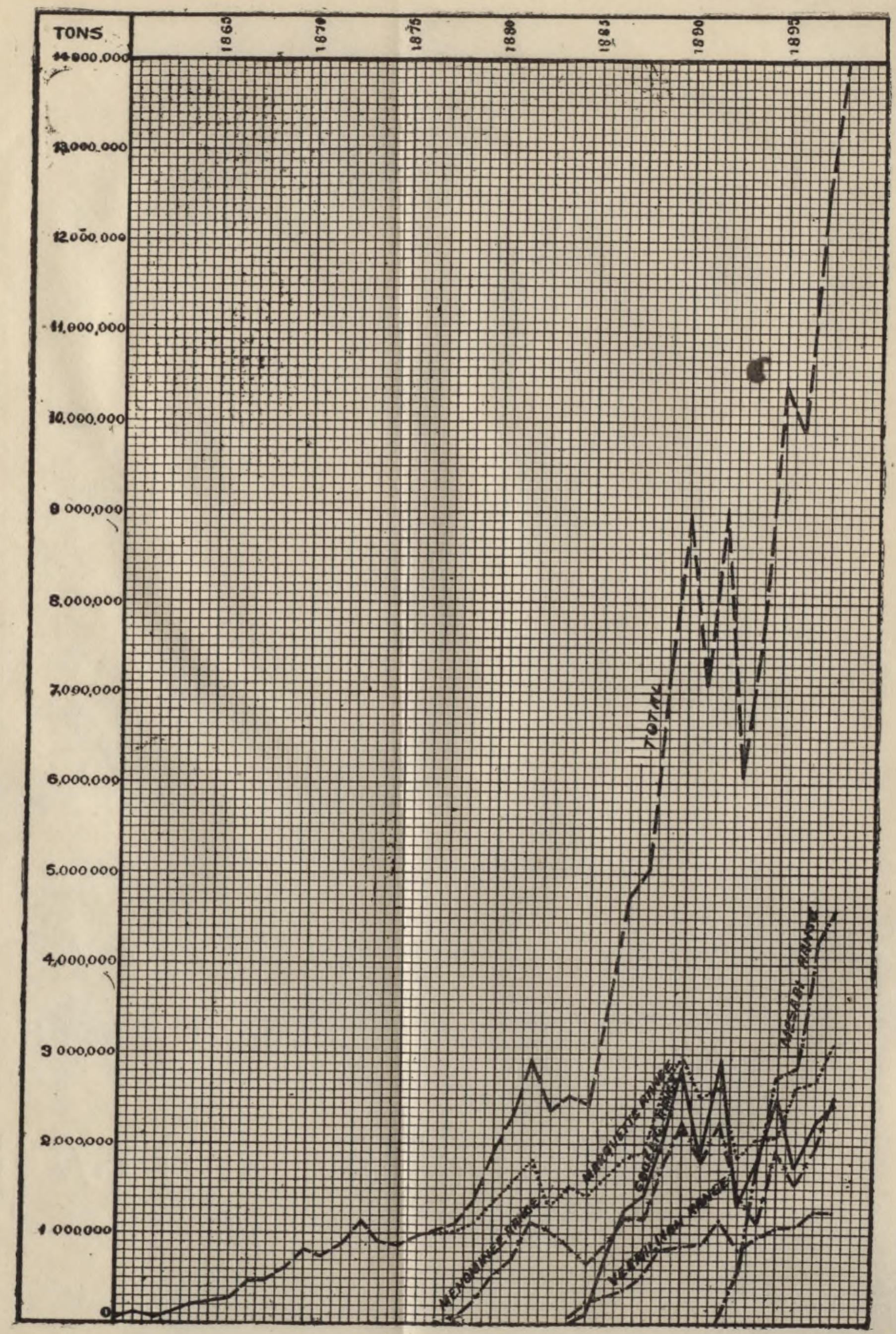


Table 49.

IRON-ORE PRODUCTION AT LAKE SUPERIOR MINES.

From the *Iron Trade Review*.

Year.	Marquette Range.	Menominee Range.	Gogebic Range.	Vermillion Range.	Mesabi Range.	Total.
Before 1856	79,532					79,532
1856.....	36,343					36,343
1857.....	25,646					25,646
1858.....	15,876					15,876
1859.....	68,832					68,832
1860.....	114,401					114,401
1861.....	49,909					49,909
1862.....	124,169					124,169
1863.....	203,055					203,055
1864.....	243,127					243,127
1865.....	236,208					236,208
1866.....	278,796					278,796
1867.....	473,567					473,567
1868.....	491,449					491,449
1869.....	617,444					617,444
1870.....	830,940					830,940
1871.....	779,607					779,607
1872.....	900,901					900,901
1873.....	1,162,458					1,162,458
1874.....	919,557					919,557
1875.....	891,257					891,257
1876.....	992,764					992,764
1877.....	1,014,687	4,593				1,019,280
1878.....	1,033,082	78,028				1,111,110
1879.....	1,130,019	245,672				1,375,691
1880.....	1,384,010	524,735				1,908,745
1881.....	1,579,834	726,671				2,306,505
1882.....	1,829,394	1,136,019				2,965,412
1883.....	1,305,425	1,047,863				2,353,288
1884.....	1,558,033	895,634	1,022	62,124		2,516,813
1885.....	1,430,422	690,435	119,590	225,484		2,465,931
1886.....	1,627,383	880,000	756,237	304,396		3,568,022
1887.....	1,851,717	1,199,343	1,285,265	394,252		4,730,577
1888.....	1,918,672	1,191,097	1,433,689	511,953		5,055,411
1889.....	2,634,817	1,796,764	2,016,391	844,782		7,292,754
1890.....	2,993,664	2,282,237	2,847,786	880,014		9,003,701
1891.....	2,512,242	1,824,619	1,839,574	894,618		7,071,053
1892.....	2,666,856	2,261,499	2,971,771	1,167,650	4,245	9,072,241
1893.....	1,835,393	1,466,197	1,329,385	820,621	613,620	6,065,716
1894.....	2,059,830	1,137,949	1,809,468	948,513	1,793,052	7,748,312
1895.....	2,097,838	1,923,798	2,547,976	1,077,838	2,781,587	10,429,037
1896.....	2,604,221	1,560,467	1,799,971	1,088,090	2,882,079	9,934,828
1897.....	2,715,035	1,937,013	2,258,236	1,278,481	4,275,809	12,464,574
1898.....	3,125,039	2,522,265	2,498,461	1,265,142	4,613,766	14,024,673
Total..	52,378,261	27,453,706	25,545,484	11,763,858	16,964,158	134,107,787

Table 50.

LAKE COMMERCE: IRON ORE.

SHIPMENTS FROM LAKE SUPERIOR PORTS. (TONS.)

From *The Iron Trade Review.*

Year.	Marquette.	Escanaba.	Ashland.	Two Harbors.	Gladstone.	St. Ignace and L'Anse	Total.
1885....	750,047	1,219,777	119,563	225,484		113,615	2,428,486
1886....	853,396	1,538,821	721,983	304,396		74,590	3,493,186
1887....	803,411	2,072,708	1,040,727	390,467		91,554	4,398,857
1888....	844,694	2,202,965	1,016,414	450,475		107,399	4,621,947
1889....	1,376,335	3,003,632	1,484,802	819,639	68,250	51,853	6,804,511
1890....	1,307,395	3,714,662	2,123,856	826,063	91,091	Duluth & Superior.	8,063,067
1891....	1,056,027	3,058 590	1,261,658	890,299	177,866		6,444 440
1892....	1,026,338	4,010,085	2,223,684	1,165,076	115,886	4,245	8,545,314
1893....	1,086,934	2,048,981	1,117,520	903,329	203,585	520,865	5,881,214
1894....	1,424,850	1,644,776	1,738,590	1,373,253	79,208	1,369,252	7,629,829
1895....	1,079,485	2,860,172	2,350,219	2,118,156	109,211	1,716,667	10,233,910
1896....	1,578,600	2,321,928	1,566,336	1,813,992	220,888	2,156,177	9,657,921
1897....	1,945,519	2,302,121	2,067,637	2,651,465	341,014	2,907,889	12,215,645
1898....	2,245,973	2,803,513	2,391,088	2,693,245	335,956	3,181,013	13,650,788

RECEIPTS AT LAKE PORTS. (TONS.)

Year.	Toledo.	Sandusky.	Huron.	Lorain.	Cleveland.	Fairport.
1885......	15,000	143,180		13,180	589,234	31,992
1886......	26,960	157,970	44,021	99,744	1,034,650	112,000
1887......	61,729	160,600	21,288	134,764	1,216,423	501,363
1888......	75,601	154,924	4,351	197,000	971,775	611,140
1889......	82,961	186,082	680	280,000	1,742,415	829,121
1890......	164,295	174,596	1,200	280,450	1,945,492	1,096,408
1891.....	191,105	106,907	14,910	266,009	1,257,775	699,434
1892......	139,987	49,736	65,000	190,400	1,950,224	866,611
1893......	145,515	4,464	137,700	165,667	1,260,716	792,517
1894......	158,384	23,043	172,775	150,424	1,624,573	976,222
1895......	260,730	12,361	146,442	214,219	2,312,370	914,617
1896......	301,794	58,667	226,515	191,445	2,313,170	941,446
1897......	416,438	79,792	198,231	355,188	2,456,704	1,008,340
1898	414,012	136,200	126,755	536,086	2,645,318	912,879

Year.	Ashtabula.	Conneaut.	Erie	Buffalo, Tonawanda (*a*)	Total Lake Erie Ports.	Receipts at other ports. (*b*)
1885......	582,000		122,223	7,160	1,493,969	934,517
1886.....	672,000		91,250	31,869	2,270,464	1,222,722
1887......	1,103,839		20,488	28,699	3,249,198	1,149,659
1888......	1,288,530		240,338	240,000	3,791,659	830,288
1889.....	1,963,490		373,595	298,000	5,756,344	1,048,167
1890.....	2,176,730		487,493	548,000	6,874 664	1,188,403
1891......	1,599,785		393,759	410,000	4,939,684	1,504,756
1892......	2,555,416	1,130	645,230	197,000	6,660,734	1,884,580
1893.....	1,845,738	203,207	469,299	308,238	5,333,061	548,153
1894......	1,987,722	237,905	624,438	395,339	6,350,825	1,279,104
1895......	2,474,791	244,967	811,989	719,742	8,132,228	2,121,682
1896......	2,272,822	327,623	847,849	545,101	8,026,412	1,631,509
1897......	3,001,914	495,327	1,311,526	797,446	10,120,906	2,094,739
1898......	2,684,563	1,404,169	1,092,364	1,075,975	11,028,321	2,622,467

(*a*) Buffalo alone to 1893. (*b*) Most of this ore was received at South Chicago.

Map 4. Lake Commerce: Shipments and Receipts of Iron Ore, 1898. **(Table 50.)**

Table 51.

LAKE COMMERCE: COAL.

From *U. S. Engineers' Reports*, and Tables in Geo. G. Tunnell's *Report on Lake Commerce*, 1898

SHIPMENTS BY VESSEL FROM LAKE ONTARIO PORTS. (TONS.)

Year.	Ogdensburg.	Oswego.	Fair Haven.	Sodus Pt.	Charlotte.	Down Welland Canal.	Total Lake Ontario.
1889..	67,666	282,098	119,317	12,935	350,000	27,500	859,516
1890..	100,192	548,560	198,764	32,468	465,835	23,396	1,369,215
1891..	50,462	438,970	129,394	32,174	462,084	24,397	1,137,481
1892..	34,090	538,751	99,763	60,563	439,092	15,490	1,187,749
1893..	77,543	620,590	63,922	73,051	332,979	20,067	1,188,152
1894..	75,228	541,015	62,996	76,019	369,985	14,545	1,139,788
1895..	75,815	544,882	62,285	42,669	361,578	8,412	1,095,641
1896..	115,286	600,335	63,501	34,540	437,972	12,997	1,264,631
1897..	162,929	528,552	67,950	53,129	372,713	9,803	1,195,076
1898..	165,532	500,267	50,066	79,216	478,899		1,273,980

SHIPMENTS BY VESSEL FROM LAKE ERIE PORTS. (TONS.)

Year.	Buffalo.	Erie.	Conneaut.	Ashtabula.	Fairport.	Cleveland.
1885..	1,448,086	188,860				
1886..	1,541,210	235,255				
1887..	1,912,766	230,848				703,506
1888..	2,527,358	405,44				800,000
1889..	2,168,343	410,403		489,585	59,438	825,030
1890..	2,188,682	566,932		624,328	100,000	1,287,177
1891..	2,404,961	586,990		506,297	156,992	1,521,659
1892..	2,881,446	567,028		726,262	114,738	1,728,831
1893..	2,703,673	625,023	13,886	787,653	210,390	1,522,557
1894..	2,485,255	711,928	91,665	679,121	291,537	1,117,894
1895..	2,617,268	727,184	171,363	979,199	224,080	1,278,627
1896..	2,400,068	677,095	223,510	1,105,547	398,717	1,803,709
1897..	2,334,329	750,233	256,687	1,012,758	185,318	2,027,693
1898..	2,455,191	970,152	113,627	1,110,669	334,362	2,108,310

Year.	Lorain.	Huron.	Sandusky.	Toledo.	Up Welland Canal.	Total Lake Erie.
1885..					203,763	
1886..					206,751	
1887..					108,392	
1888..					189,746	
1889..	273,674	56,000	275,385	650,000	238,388	5,446,246
1890..	316,858	150,000	271,540	940,000	133,896	6,579,413
1891..	450,513	200,000	157,571	947,288	202,564	7,134,835
1892..	385,158	240,000	157,515	858,935	195,635	7,855,548
1893..	540,194	227,444	195,276	938,533	213,029	7,977,654
1894..	356,618	213,595	261,363	836,232	189,063	7,234,271
1895..	295,057	208,000	223,134	716,099	150,452	7,590,463
1896..	332,164	257,059	281,351	707,655	210,220	8,397,095
1897..	230,789	200,000	367,951	1,005,000	166,420	8,537,178
1898..	174,356	270,000	275,000	911,000		8,722,667

Table 51—Continued.

RECEIPTS BY VESSEL AT PRINCIPAL LAKE PORTS. (TONS.)

	1889	1895.	1896.	1897.	1898.
Montreal.........	124,290	165,151	161,551	164,963	235,983
Toronto..........		550,000	602,949	551,404	523,404
Ogdensburg......	66,230	166,017	181,156	163,000	165,532
Toledo......	93,369	125,600	119,000	88,705	90,000
Detroit...........	141,900				
Saginaw River....	97,316			124,000	
Green Bay.......	70,374		170,311		147,397
Manitowoc.......	75,000	200,000	220,000	250,000	293,262
Sheboygan.......	50,000	188,623	155,000	290,000	278,273
Milwaukee	907,743	1,336,603	1,487,483	1,493,528	1,586,965
Racine...........	67,000		64,140	133,178	180,000
Chicago..........	1,337,495	1,269,512	1,351,699	1,318,965	1,527,511
Marquette........	126,421	200,000	280,000	140.965	
Portage Lake Canal	144,261	328,046	398,000	437,849	619,000
Ashland..........	201,241	286,111	200,000	270,000	
Duluth...........	485,000	581,682	662,123	682,274	754,000
Superior........	720,000	1,188,000	1,378,000	1,467,107	1,795,000

RECEIPTS BY VESSEL 1872-1898. (TONS.)

	Chicago.			Milwaukee.	Duluth and Superior.	Montreal via St. Lawrence Canals.
	Anthracite.	Bituminous.	Total.			
1872..	495,765	90,820	586,585	210,194		
1873..	538,837	199,107	737,944	229,784		
1874..	404,383	257,200	661,583	177,655		
1875..	474,812	273,894	748,706	228,674		
1876..	373,146	338,426	711,572	188,444		
1877..	446,046	358,713	804,759	253,640		
1878..	325,553	404,447	730,000	237,332	31,000	
1879..	464,360	282,469	746,829	325,281		
1880..	457,317	288,987	746,304	300,245	60,000	
1881..	545,312	288,161	833,473	450,005	163,000	
1882..	663,785	287,794	951,579	510,493	260,000	
1883..	738,723	214,488	953,211	550,861	420,000	
1884..	820,002	243,188	1,063,190	623,018	372,000	
1885..	741,866	206,817	948,683	710,736	592,000	122,829
1886..	768,164	166,762	934,926	714,242	736,000	118,802
1887..	853,158	123,221	976,379	724,594	912,000	121,618
1888..	1,242,044	115,862	1,357,906	961,164	1,535,000	123,050
1889..	1,283,811	53,684	1,337,495	907,743	1,205,000	124,290
1890..	1,236,021	40,766	1,276,781	903,659	1,780,000	135,168
1891..	1,301,347		1,301,347	1,006,656	1,776,000	141,701
1892..	1,475,237		1,475,237	1,210,865	1,812,561	157,134
1893..	1,424,853		1,424,853	1,117,448	2,126,781	147,131
1894..	1,277,191		1,277,191	1,229,310	2,010,731	169,552
1895..	1,269,512		1,269,512	1,336,603	1,654,882	165,151
1896..	1,351,699		1,351,699	1,487,483	1,775,712	161,551
1897..	1,318,965		1,318,965	1,492,278	2,153,000	164,963
1898..	1,527,511		1,527,511	1,586,646	2,549,411	235,983

Map 5. Lake Commerce: Shipments and Receipts of Coal, 1898. (Table 51.)

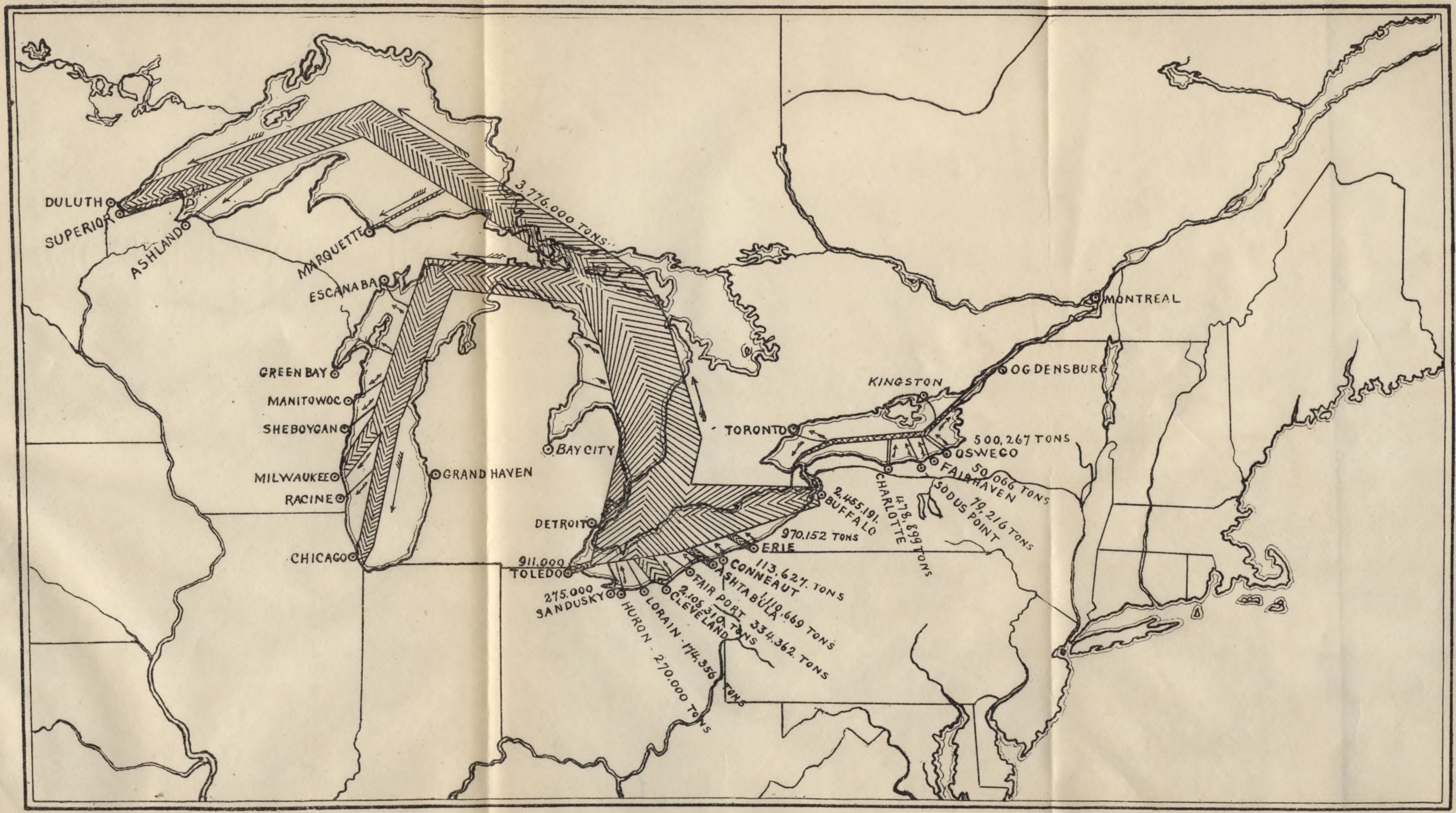


Chart 28 (Table 52).

TRAFFIC ON WELLAND CANAL.

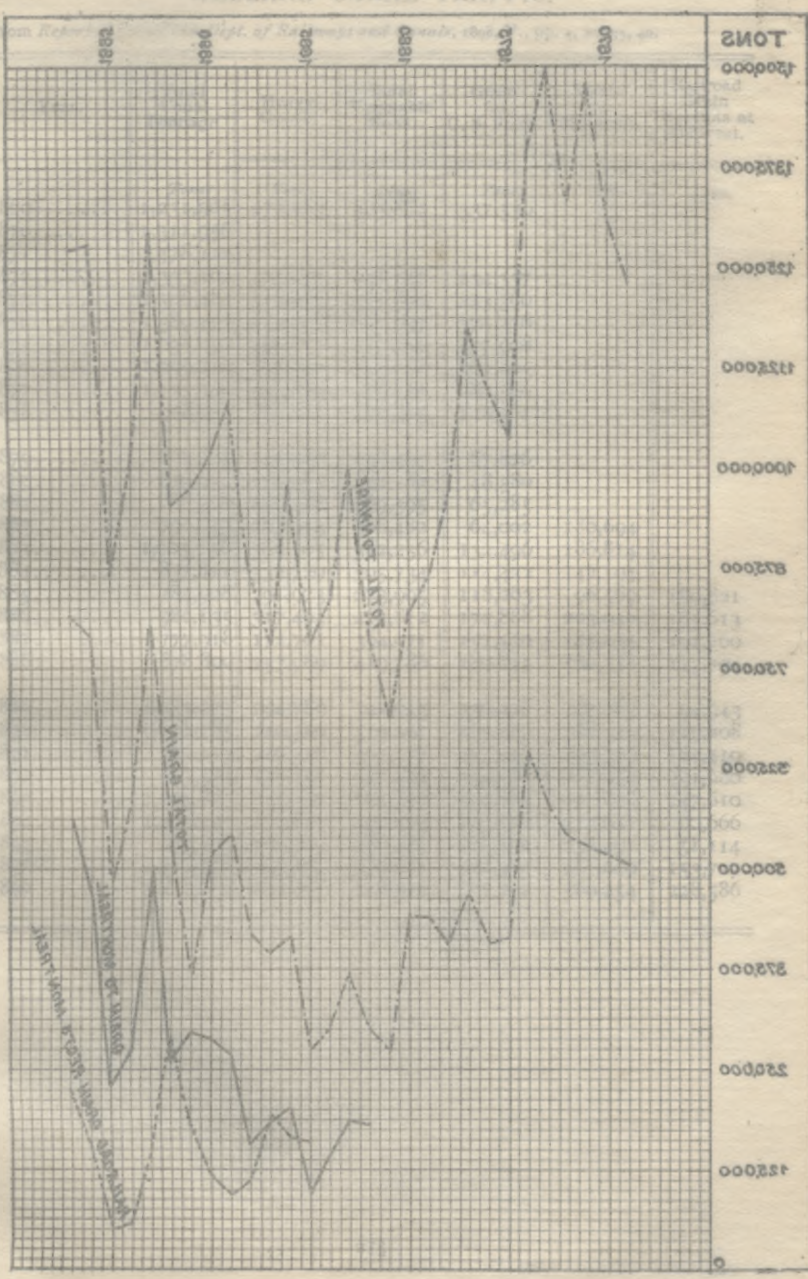


Chart 28 (Table 52).

TRAFFIC ON WELLAND CANAL.

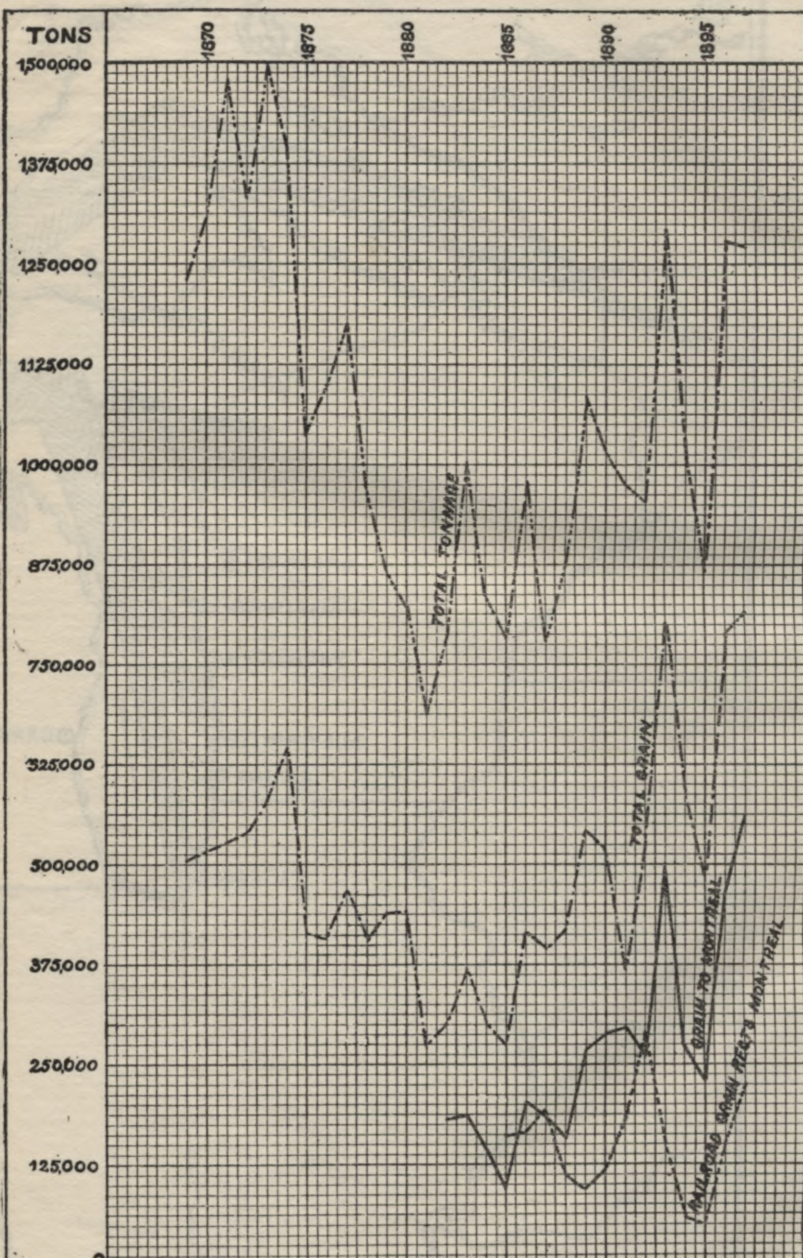


Table 52.

WELLAND CANAL TRAFFIC.

From *Report of Canadian Dept. of Railways and Canals*, 1898, V., pp. 4, 10, 35, 40.

Year.	Total Canal Tonnage.	Heavy Goods.	Total Vegetable Food	Grain for U. S. Ports.	Grain to Montreal.	Railroad Grain Receipts at Montreal.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1869........	1,231,903	275,263	503,860	337,530		
1870........	1,311,956					
1871	1,478,122					
1872........	1,333,104	423,678	538,147	234,337		
1873........	1,506,484	543,387	579,880	243,366		
1874........	1,389,173	431,316	647,397	374,226		
1875........	1,038,050	397,565	417,936	177,908		
1876........	1,099,810	378,540	409,788	162,405		
1877........	1,175,398	399,109	464,181	180,586		
1878........	968,758	338,741	403,403	128,361		
1879........	865,664	245,670	438,564	87,826		
1880........	819,934	176,983	442,182	48,580		
1881........	686,506	189,188	269,395	65,285		
1882........	790,643	283,984	306,482	64,002	180,694	
1883........	1,005,156	365,105	372,236	132,496	186,814	
1884........	837,811	332,729	305,734	114,422	142,194	
1885........	784,928	291,973	273,905	118,203	96,569	160,821
1886........	980,135	317,464	414,812	172,888	203,940	165,613
1887........	777,918	172,761	394,971	157,530	185,034	191,760
1888........	878,800	257,989	419,786	189,825	160,358	113,794
1889........	1,085,273	294,789	542,043	236,208	267,769	94,943
1890........	1,016,165	240,349	519,291	275,619	288,513	119,208
1891........	975,013	240,316	367,177	253,444	295,509	184,410
1892........	955,554	218,245	527,426	244,550	261,954	291,680
1893........	1,294,823	243,690	805,253	311,389	501,806	147,610
1894........	1,008,221	207,816	591,409	293,148	273,651	60,666
1895........	869,595	169,309	486,421	209,802	231,491	51,114
1896........	1,279,987	235,473	788,974	300,407	461,049	153,717
1897........	1,274,292	201,261	816,914	276,242	560,254	228,586

Table 53.

HEAVY GOODS THROUGH WELLAND CANAL.

From *Report of Canadian Dept. of Railways and Canals*, 1898.

Year.	Railway Iron.	Other Iron.	Salt.	Iron and Salt.	Coal.	Ores.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1869	68.064	16,924	91,575	37,153	103.126	58,781	275,623
1872	26,217	17,141	50,540	44,243	186,932	98,605	423,678
1873	6,923	20,754	40,850	17,157	339,016	118,685	543,387
1874	6,032	12,068	23,309	9,579	323,503	56,825	431,316
1875	1,517	7,588	13,509	9,962	321,306	43,683	397,565
1876	51	7,997	30,300	20,327	288,211	81,654	378,540
1877	9,630	9,696	9,173	3,983	323,869	42,758	399,109
1878	10	11,518	3.980	12,686	295,318	15,229	338,741
1879	2,782	5,797	7,174	17,796	192,957	19,164	245,670
1880	5,360	4,812	413	22,273	109,986	34,139	176,983
1881	4,585	7,013	10	30,682	128,113	18,785	189,188
1882		5,348	50	17,327	237,559	23,700	283,984
1883	1,237	7,922	66	17,037	307,058	31,785	365,105
1884	698	652	461	3,242	274,471	53,205	332,729
1885	78	2,055	597	14,243	248,272	26,728	291,973
1886	166	6,123	48	12,324	271,356	27,447	317,464
1887	1,351	5,636		6,715	145,193	13,866	172,761
1888	93	3,220	316	13,617	223,871	16,872	257,989
1889	47	2,479	1,254	20,269	268,305	2,435	294,789
1890		753	1,027	28,047	202,384	8,138	240,349
1891	127	1,610	2,567	7,953	224,644	3,415	240,316
1892	163	1,567	878	3,666	211,616	355	218,245
1893	6	2,075	374	8,139	233,096		243,690
1894		3,072	159	977	203,608		207,816
1895	185	6,245	54	2,819	158,866	1,140	169,309
1896	1,192	6,332	82	3,264	223,445	1,158	235,473
1897	7,206	17,012	227	590	176,226		201,261

Table 54.

VEGETABLE FOOD THROUGH WELLAND CANAL.

From *Report of Canadian Dept. of Railways and Canals*, 1898, V, 34.

Year	Flour.	Wheat.	Corn.	Barley.	Oats.	Rye.	Other Articles.[2]	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1869[1]	45,674	313,825	120,599	20,951		904	1,937	503,860
1872	26,651	239,998	254,902	6,035	7,752	64	2,745	538,147
1873	30,665	355,847	180,169	8,225	1,194	3	3,777	579,880
1874	24,019	413,212	181,151	18,871	5,954	513	8,677	647,397
1875	13,964	253,835	103,749	35,751	3,383	917	6,337	417,936
1876	15,778	201,906	144,501	18,455	24,496	1,454	3,198	409,788
1877	13,558	253,953	169,196	19,870	2 810	2,439	2,355	464,181
1878	9,121	191,982	185,931	10,979	3,088		2,302	403,403
1879	10,710	274,570	144,506	3,655	1,239	440	2,444	438,564
1880	12,679	242,020	163,738	17,772	477	1,016	1,480	442,182
1881	9,959	127,832	101,075	24,509		1,844	2,086	269,395
1882	12,261	215,056	54,799	20,126	611	3,226	403	306,482
1883	13,471	152,794	182,269	10,436	731	1,642	10,983	373,326
1884	13,683	144,851	118,811	7,155	10,746	1,320	9,168	305,734
1885	13,334	124,206	117,536	15,801	1,116		1,912	273,905
1886	19,474	154,169	219,442	1,595	4,911	564	14,657	414,812
1887	23,949	221,927	114,938	9,574	12,050		12,533	394,971
1888	16,983	160,963	194,886	5,906	26,629	811	13,608	419,786
1889	7,931	126,664	353,595	4,272	28,356	2,673	18,552	542,043
1890	14,461	118,002	327,394	10,830	27,728	1,549	20,876	519,291
1891	13,517	198,658	185,180	8,113	52,959	65,888	28,042	367,177
1892	17,046	232,019	192,548	6,433	37,173	9,392	32,815	527,426
1893	15,235	258,392	441,092	18,599	31,283	3,671	36,981	805,253
1894	33,628	270,993	169,233	28,353	27,962	567	60,673	591,409
1895	44,044	203,088	164,894	8,689	18,236	1,007	46,463	486,421
1896	42,425	320,563	320,444	11,368	28,178	9,405	56,591	788,974
1897	9,065	324,743	390,615	14,173	25,161	8,483	44,674	816,914

[1] Fiscal Year.
[2] Apples, meal all kinds, peas, potatoes.

Table 55.

GRAIN MOVEMENT ON THE MISSISSIPPI RIVER.

Compiled from *Reports of New York Produce Exchange.*

Years.	Shipments From St. Louis by River.	Total Receipts at New Orleans.	Exports from New Orleans.
	Bushels.	*Bushels.*	*Bushels.*
1868		6,540,464	
1869		5,975,831	
1870		7,272,794	
1871		6,895,617	
1872	1,711,039	9,819,365	
1873	1,373,969	8,334,106	1,119,073
1874	1,423,036	7,287,813	1,510,751
1875	308,578	5,348,086	403,832
1876	1,774,379	5,585,689	1,676,858
1877	4,101,353	6,867,371	2,930,192
1878	5,451,603	11,332,784	7,416,217
1879	6,164,838	12,108,262	6,884,381
1880	15,762,664	17,538,986	14,620,033
1881	12,993,947	19,863,887	12,292,071
1882	8,333,417	8,405,477	6,366,767
1883	11,059,508	15,104,921	12,002,264
1884	6,647,558	9,865,937	5,810,142
1885	8,667,919	8,593,272	7,935,815
1886	8,834,924	9,675,127	9,183,141
1887	11,566,799	14,042,102	11,867,984
1888	7,252,578	9,009,876	6,765,982
1889	14,158,044	17,770,501	14,942,980
1890	10,127,289	18,693,764	13,752,221
1891	8,468,546	17,770,885	12,556,816
1892	8,415,210	26,845,029	21,953,834
1893	7,079,598	24,289,181	19,525,600
1894	2,345,503	9,313,930	8,379,701
1895	1,689,417	13,814,861	9,616,698
1896	10,527,208	32,888,032	29,425,682
1897	5,475,342	42,270,220	39,624,908
1898	6,602,707	36,955,012	35,428,641

Table 56.

EXPORTS OF FLOUR, WHEAT AND CORN.

From Pamphlet of *New York Produce Exchange*, December 12, 1899.

NEW YORK'S PERCENTAGE OF EXPORTS FROM THE SIX PRINCIPAL ATLANTIC PORTS.

	Flour.	Wheat.	Corn.
	Per cent.	*Per cent.*	*Per cent.*
Years 1873 to 1882, inclusive..............	70.42	63.35	47.70
" 1883 to 1892, "	40.06	60.22	46.57
" 1893 to 1896, "	43.99	56.13	32.55
Year 1897..............................	44.32	43.83	23.72
" 1898..............................	37.61	55.49	26.14
January 1st to October 31st, 1899..........	34.58	50.10	26.71

PERCENTAGE OF EXPORTS FROM EACH OF THE SIX PRINCIPAL ATLANTIC PORTS—JANUARY 1 TO OCTOBER 31, 1899.

	Flour.	Wheat.	Corn.
	Per cent.	*Per cent.*	*Per cent*
New York..............................	34.58	50.10	26.71
Boston..............................	11.27	21.65	12.16
Philadelphia..............................	15.81	7.41	19.37
Baltimore..............................	24.38	19.41	29.38
Norfolk..............................	2.32	0 33	3.79
Newport News..............................	11.64	1.10	8.59

PRODUCTION OF WHEAT IN THE DAKOTAS AND MINNESOTA.

	Bushels.	*Bushels.*
Year 1879..............................	3 million.	35 million.
" 1889..............................	41 "	52 "
" 1898..............................	98 "	78 "

Table 56—Continued.

From *Statistical Abstract of the United States*, 1898, p 300.

CORN AND CORN MEAL.

Year	Production of Corn in United States.	Exports of Corn and Corn Meal. (a)	Domestic retained for consumption.	Per cent of domestic product exported
	Bushels.	*Bushels.*	*Bushels.*	
1866	867,946,295	16,026,947	851,919,348	1.85
1867	768,320,000	12,493,522	755,826,478	1.63
1868	906,527,000	8,286,665	898,240,335	.91
1869	874,320,000	2,140,487	872,179,513	.24
1870	1,094,255,000	10,676,873	1,083,578,127	.98
1871	991,898,000	35,727,010	956,170,990	3.60
1872	1,092,719,000	40,154,374	1,052,564,626	3.67
1873	932,274,000	35,985,834	896,288,166	3.86
1874	850,148,500	30,025,036	820,123,464	3.53
1875	1,321,069,000	50,910,532	1,271,158,468	3.85
1876	1,283,827,500	72,652,611	1,211,174,889	5.66
1877	1,342,558,000	87,192,110	1,255,365,890	6.49
1878	1,388,218,750	87,884,892	1,300,333,858	6.33
1879	1,547,901,790	99,572,329	1,448,329,461	6.43
1880	1,717,434,543	93,648,147	1,623,786,396	5.46
1881	1,194,916,000	44,340,683	1,150,575,317	3.71
1882	1,617,025,100	41,655,653	1,575,369,447	2.58
1883	1,551,066,895	46,258,606	1,504,808,289	2.99
1884	1,795,528,000	52,876,456	1,742,651,544	2.95
1885	1,936,176,000	64,829,617	1,871,346,383	3.35
1886	1,665,441,000	41,368,584	1,624,072,416	2.48
1887	1,456,161,000	25,360,869	1,430,800,131	1.74
1888	1,987,790,000	70,841,673	1,916,948,327	3.57
1889	2,112,892,000	103,418,709	2,009,473,291	4,85
1890	1,489,970,000	32,041,529	1,457,928,471	2.15
1891	2,060,154,000	76,602,285	1,983,551,715	3.72
1892	1,628,464,000	47,121,894	1,581,342,106	2.89
1893	1,619,496,131	66,489,529	1,553,006,602	4.11
1894	1,212,770,052	28,585,405	1,184,184,647	2.36
1895	2,151,138,580	101,100,375	2,050,038,205	4.70
1896	2,383,875,165	178,817,417	2,105,057,748	7.83
1897	1,902,967,933	212,055,543	1,690,912,390	11.14
1898	1,924,184,660	177,650,790	1,746,533,870	9.23

(a) Years ending June 30 following calendar year.

Table 56—Continued.

From *Statistical Abstract of the United States*, 1898, p. 301.

WHEAT AND WHEAT FLOUR.

Year	Production of Wheat in United States.	Exports of Wheat and Wheat Flour. (*a*)	Domestic retained for consumption.	Per cent of domestic product exported.
	Bushels.	*Bushels.*	*Bushels.*	
1866	151,999,906	12,646,941	139,352,965	8.32
1867	212,441,400	25,284,803	187,156,597	11.90
1868	224,036,600	29,717,201	194,319,399	13.27
1869	260,146,900	53,900,780	206,246,120	20.72
1870	235,884,700	52,580,111	183,304,589	22.30
1871	230,722,400	38,995,755	191,726,645	16.88
1872	249,997,100	52,014,715	197,982,385	20.80
1873	281,254,700	91,510,398	189,744,302	32.54
1874	309,102,700	72,912,817	236,189,883	23.60
1875	292,136,000	74,750,682	217,385,318	25.58
1876	289,356,500	57,043,936	232,312,564	19.73
1877	364,196,146	92,071,726	272,154,520	25.29
1878	420,122,400	150,502,506	269,619,894	35.82
1879	448,756,630	180,304,180	268,452,450	40.18
1880	498.549,868	186,321,514	312,228.354	37.38
1881	383,280,090	121 892,389	261,387,701	31.82
1882	504,185,470	147,811,316	356,347,154	29.33
1883	421,086,160	111,534,182	309,551,978	26.49
1884	512,765 000	132,570,366	380,194,634	25.86
1885	357,112,000	94,565,793	262,546,207	26.48
1886	457,218,000	153 804,969	303,413,031	33.66
1887	456,329,000	119,624,344	336,703,656	26.23
1888	415,868,000	88,600,742	327,267,258	21.31
1889	490,560,000	109,430,467	381,129,533	22.31
1890	399,262,000	106,181,316	293,080,684	26.60
1891	611,780,000	225,665,812	386,114,188	36,88
1892	515,949,000	191,912,635	324,036.365	37.20
1893	396,131,725	164,283,129	231,848,596	41.47
1894	460,267,416	144,812,718	315,454,698	31.46
1895	467,102,947	126,443,968	340,658,979	27.07
1896	427,684,346	145,124,972	282,559,374	33.93
1897	530,149,168	217,306,004	312,843,164	40.91
1898	675,148,705	222,598,420	452,550,285	32.98

(*a*) Years ending June 30 following calendar year.

Table 57.

DOMESTIC EXPORTS FROM UNITED STATES PORTS.

(CORRECTED SPECIE VALUES.)

1856–1898.

From tables prepared for the *Commerce Commission of the State of New York.*

Year.	New York.	Boston.	Philadelphia.	Baltimore.
1856....	$74,088,184	$12,813,318	$6,777,724	$10,856,637
1857....	74,538,238	12,181,581	6,838,653	13,393,393
1858....	56,029,723	10,676,770	5,488,337	9,816,336
1859....	53,835,751	10,070,650	5,039,464	9,008,731
1860 ..	70,292,018	11,200,790	5,441,455	8,802,406
1861....	118,267,177	12,259,436	9,804,931	12,946,385
1862....	110,747,824	10,357,179	9,796,566	7,446,644
1863....	131,297,565	15,147,820	9,613,732	8,689,971
1864....	105,140,908	9,323,577	7,350,362	6,622,475
1865....	98,282,166	12,267,872	6,806,733	7,312,618
1866....	204,829,348	13,890,464	13,972,388	8,291,241
1867....	120,693,238	12,345,085	12,534,375	8,325,520
1868....	113,291,653	11,430,050	11,117,445	10,609,028
1869 ...	115,950,970	10,088,377	11,158,784	10,480,165
1870....	154,126,476	10,227,898	14,242,289	12,050,669
1871....	188,457,157	10,846,396	16,218,463	13,700,011
1872....	194,696,717	19,040,221	17,128,264	16,726,808
1873....	224,295,511	23,892,982	21,550,859	17,246,806
1874....	262,612,560	25,926,190	30,022,215	25,001,412
1875....	222,400,207	26,741,296	25,764,288	24,878,799
1876....	221,582,452	32,176,489	16,335,463	27,967,698
1877...	254,858,806	32,184,600	42,539,449	36,653,232
1878....	320,446,624	46,542,044	44,617,907	44,582,677
1879....	327,796,819	48,100,019	47,013,751	57,474,495
1880....	385,506,602	58,023,587	49,612,195	76,220,870
1881....	393,658,208	72,100,193	44,147,296	72,444,414
1882....	332,162,136	61,614,526	37,957,661	39,412,642
1883....	347,308,334	61,273,101	38,132,145	54,956,050
1884.. .	320,016,246	62,528,000	36,467,799	43,064,217
1885....	334,718,227	61,378,633	38,642,516	45,041,634
1886....	304,496,611	53,428,513	33,719,861	35,844,829
1887....	306,842,375	57,775,156	35,361,876	51,601,118
1888....	301,486,784	55,482,664	28,733,415	46,212,036
1889....	310,928,151	65,868,409	29,707,437	50,602,996
1890....	340,268,765	70,364,955	37,239,820	73,964,802
1891....	337,806,277	76,719,517	33,438,639	64,356,479
1892....	404,935,770	86,611,526	58,460,926	98,799,890
1893....	339,040,667	84,595,157	49,374,447	71,482,652
1894....	359,192,983	82,841,346	40,280,353	78,340,083
1895....	317,906,816	85,035,218	34,908,723	61,894,218
1896....	344,355,492	94,638,178	39,436,059	66,363,273
1897....	382,610,975	99,451,605	46,993,644	85,670,912
1898....	437,426,637	116,129,227	56,187,309	118,782,172
1899....	449,801,525	125,599,418	60,849,993	107,099,201

Chart 29. DOMESTIC EXPORTS FROM UNITED STATES PORTS. **(Table 57.)**

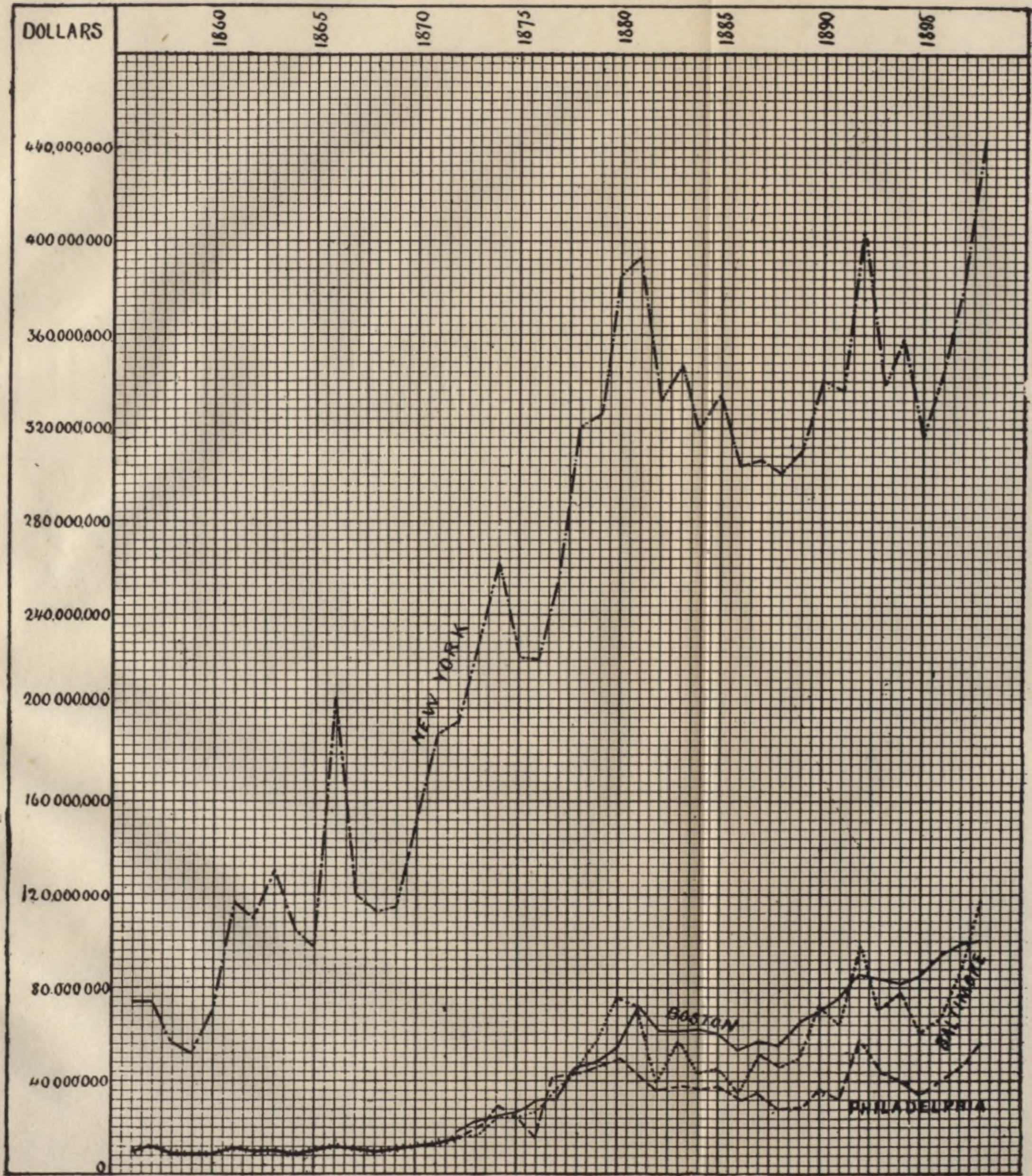


Chart 30 (Table 58).

PERCENTAGE OF EXPORTS FROM UNITED STATES PORTS.

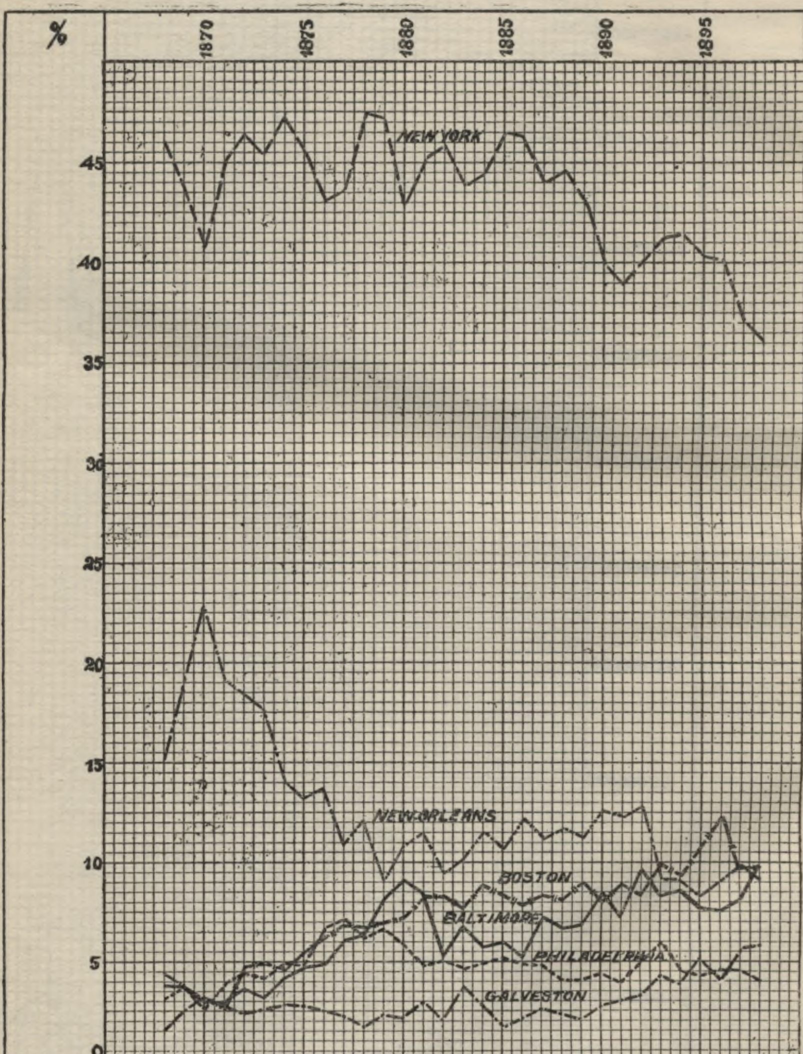


Table 58.

PERCENTAGES OF EXPORTS FROM UNITED STATES PORTS.

From tables in *Report of State Engineer and Surveyer* for 1897, pp. 26-31.

Year.	New York.	Boston.	Philadelphia.	Baltimore.	New Orleans.	Galveston.
1868..	46.0	4.46	3.07	3.62	15.22	1.53
1869..	43.6	3.84	3.76	3.61	19.82	2.50
1870..	40.7	3.05	2.56	3.06	22.67	3.13
1871..	45.2	2.79	3.60	3.05	19.03	2.79
1872..	46.5	4.62	4.25	3.76	18.22	2.47
1873..	45.5	4.95	4.06	3.26	17.57	2.64
1874..	47.3	4.68	5.00	4.24	14.28	2.90
1875..	45.6	5.39	4.94	4.66	13.17	2.78
1876..	43.1	6.11	6.59	4.82	13.76	2.51
1877..	43.7	6.83	7.11	6.04	10.87	2.35
1878..	47.4	6.75	6.28	6.42	12.05	1.71
1879..	47.1	6.91	6.61	8 08	8.98	2.39
1880..	43.9	7.08	5.94	9.13	10.82	2.01
1881..	45.1	8.13	4.90	8.03	11.49	2.96
1882..	45.9	8.32	5.08	5.24	9.45	2.06
1883..	43.8	7.56	4.62	6.79	10.31	3.59
1884..	44.5	8.57	4.92	5.81	11.55	2.76
1885..	46.5	8.33	5.19	6.07	10.67	1.69
1886..	46.2	7.97	4.99	5.27	12.14	2.05
1887..	44.1	8.39	4.95	7.20	11.16	2.63
1888..	44.6	8.11	4.14	6.62	11.66	2.26
1889..	43.0	9.00	4.01	6.80	11.15	2.12
1890..	40 6	8.03	4.24	8.61	12.59	2.84
1891..	39.0	8.93	3.80	7.28	12.34	3.08
1892..	40.1	8.36	4 49	9.59	12.79	3.43
1893..	41.2	10.08	5.82	8.43	9.18	4.42
1894..	41.4	9.40	4.53	8.79	9.13	3.92
1895..	40.3	10.59	4.33	7.67	8.47	5.18
1896..	40.1	12.29	4.48	7.52	9.17	4.12
1897..	37.2	9.60	4.49	8.15	9.68	5.52
1898..	36.1	9.6	4.64	9.81	9.15	5.69
1899.	37.4	10.43	5.05	8.90	6.39	7.17

Table 59.

TONNAGE IN FOREIGN TRADE.

ENTERING AT ATLANTIC AND GULF SEAPORTS. 1853–1898.

From *U. S. Statistical Abstract*, and *Reports of Montreal Harbour Commissioners.*

Year.	Montreal.	Boston.	Philadelphia.	Baltimore.	New Orleans.	Five Out ports.	New York.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1853....	59,712	582,490	183,944	119,089	511,878	1,457,113	1,755,521
1854....	72,305	653,443	191,673	156,448	492,434	1,566,303	1,840,007
1855....	48,139	707,924	185,975	165,127	435,863	1,543,028	1,735,907
1856....	69,962	682,165	173,178	153,323	663,067	1,741,695	1,681,659
1857....	65,712	714,821	189,102	163,381	612,286	1,745,302	2,035,469
1858....	70,183	665,442	156,671	156,810	583,776	1,632,882	1,694,219
1859....	85,319	734,167	180,421	189,982	659,083	1,848,972	1,890,144
1860....	118.216	718,587	185,162	186 417	632,398	1,840,780	1,973,812
1861....	248,351	771,948	183,408	225,110	68,993	1,497,810	2,320,927
1862....	259,901	619,435	171,882	123,688		1,174,906	2,509,749
1863....	195,809	639,828	194,443	128,565		1,158,645	2,554,858
1864....	142,046	681,189	188,938	102,752	50,588	1,165,513	2,382,192
1865 ...	134,758	655,035	159,579	88,466	50,970	1,088,808	2,075,477
1866....	189,280	725,424	222,552	132,836	228,339	1,498,431	2,697,325
1867....	185,354	731,930	286,735	203,618	253,729	1,661,366	2,754,005
1868....	186,104	642,478	278,440	216,727	326,216	1,649,965	2,865,252
1869....	251,557	779,371	292,595	225,302	381,882	1,930,707	3,101,691
1870....	306,065	793,927	300,006	272,290	458,447	2,130,735	3,093,186
1871....	344,323	836,104	369,619	315,734	566,797	2,432,577	4,413,436
1872....	391,926	881,486	417,911	368,136	501,965	2,561,424	3,969,339
1873....	412,478	819,819	466,817	397,167	522,791	2,619,072	4,211,624
1874....	423,423	730,769	657,045	558,599	630,945	3,000,781	5,049,618
1875....	642,386	768,679	582,295	561,314	454,006	3,007,679	4,421,074
1876....	391,180	637,738	844,294	667,857	599,582	3,140,651	4,467,139
1877 ...	312,284	752,391	810,633	921,118	603,183	3,399,609	4,672.300
1878....	346,740	938,102	853,027	951,521	718,163	3,807,553	5,545,026
1879....	418,589	1,137,632	1,315,649	1,374,554	652,789	4,899.213	6,661,826
1880....	514,821	1,347,447	1,391,312	1,502,713	760,910	5,517,203	7,611,282
1881....	432,551	1,565,926	1,076,035	1,365,965	963,835	5,404,212	7,506,522
1882....	394,725	1,416,231	1,055,961	852,575	620,072	4,339,564	7,360,843
1883....	484,273	1,344,515	857,292	893,774	734,791	4,314,645	6,448,837
1884....	515,685	1,186,871	776,927	627,344	684,231	3,791,058	5,658,871
1885....	550,300	1,152,415	1,038,767	627,418	656,931	4,025,231	5,659,733
1886....	652,218	1,184,108	1,155,066	521,470	703,620	4,176,482	5,558,938
1887....	713,292	1,282,159	1,290,762	692,762	720,404	4,699,379	6,087,110
1888....	578,521	1,335,906	1,170,528	534,218	721,128	4,340,301	5,683,371
1889....	643,982	1,399,384	1,104,032	480,874	770,047	4,398,319	5,596,821
1890....	690,726	1,404,828	1,410,640	845,239	1,019,522	5,370,955	6,258,222
1891....	671,906	1,502,215	1,351,466	711,833	885,785	5,123,205	6,452,877
1892....	755,749	1,664,713	1,733,047	1,129,447	1,222,261	6,505,217	7,304,015
1893....	824,843	1,631,934	1,622,482	785,172	936,905	5,801,336	7,015,030
1894 ..	734,802	1,696,118	1,431,901	808,980	1,018,134	5,689,935	7,121,527
1895....	769,326	1,689,687	1,426,794	630,907	999,773	5,516,667	6,688,595
1896....	921,487	1,757,281	1,416,081	895,093	1,071,475	6,061,417	6,911,782
1897....	1,012,639	1,943,582	1,539,401	1,253,072	1,396,261	7,144,955	7,267,480
1898....	1,110,401	1,909,756	1,636,149	1,654,361	1,598,557	8,009,224	7,771,412

Chart 31. TONNAGE OF ENTRANCES IN FOREIGN TRADE. **(Table 59.)**

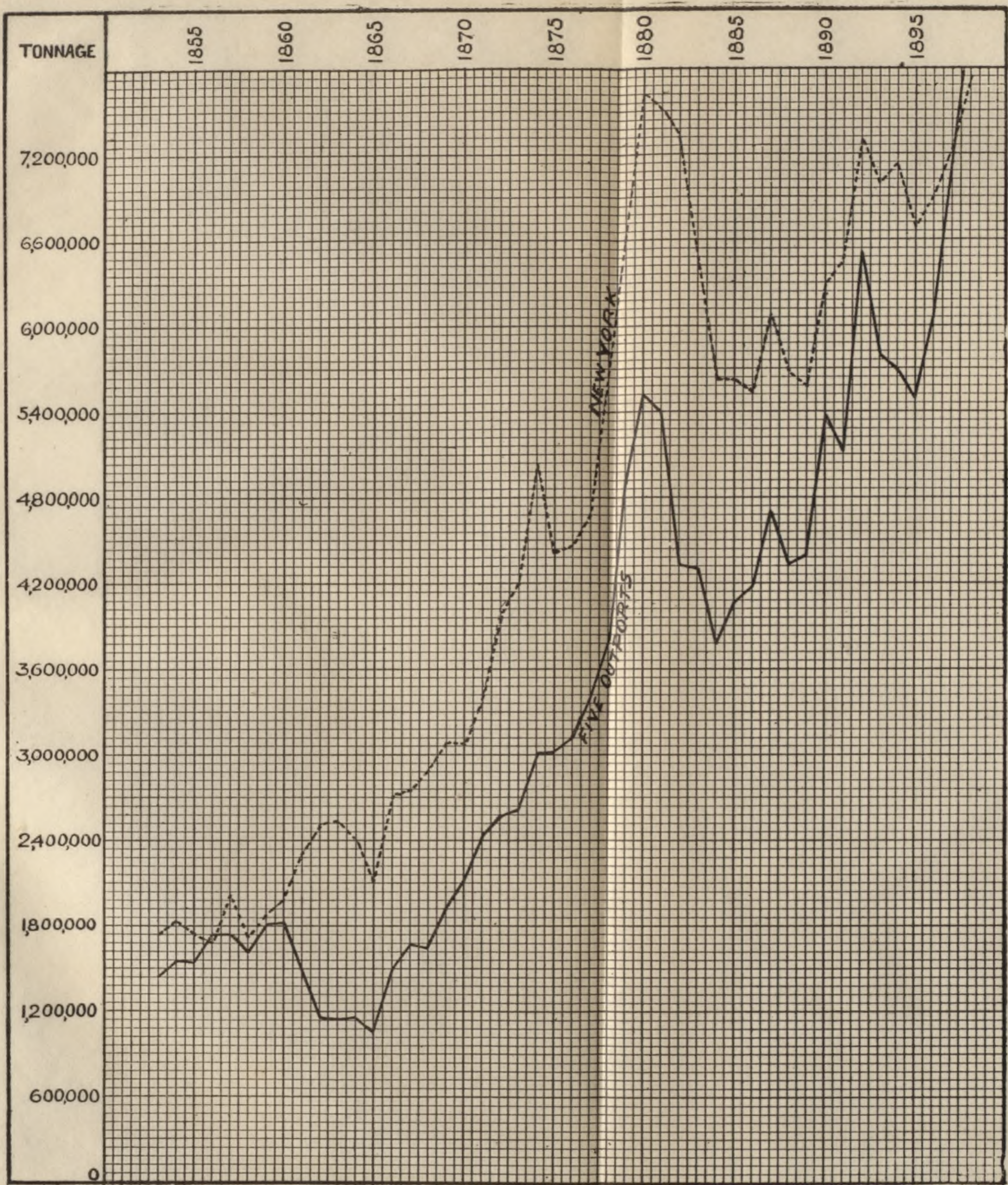


Chart 31. TONNAGE OF ENTRANCES IN FOREIGN TRADE. (Table 59.)

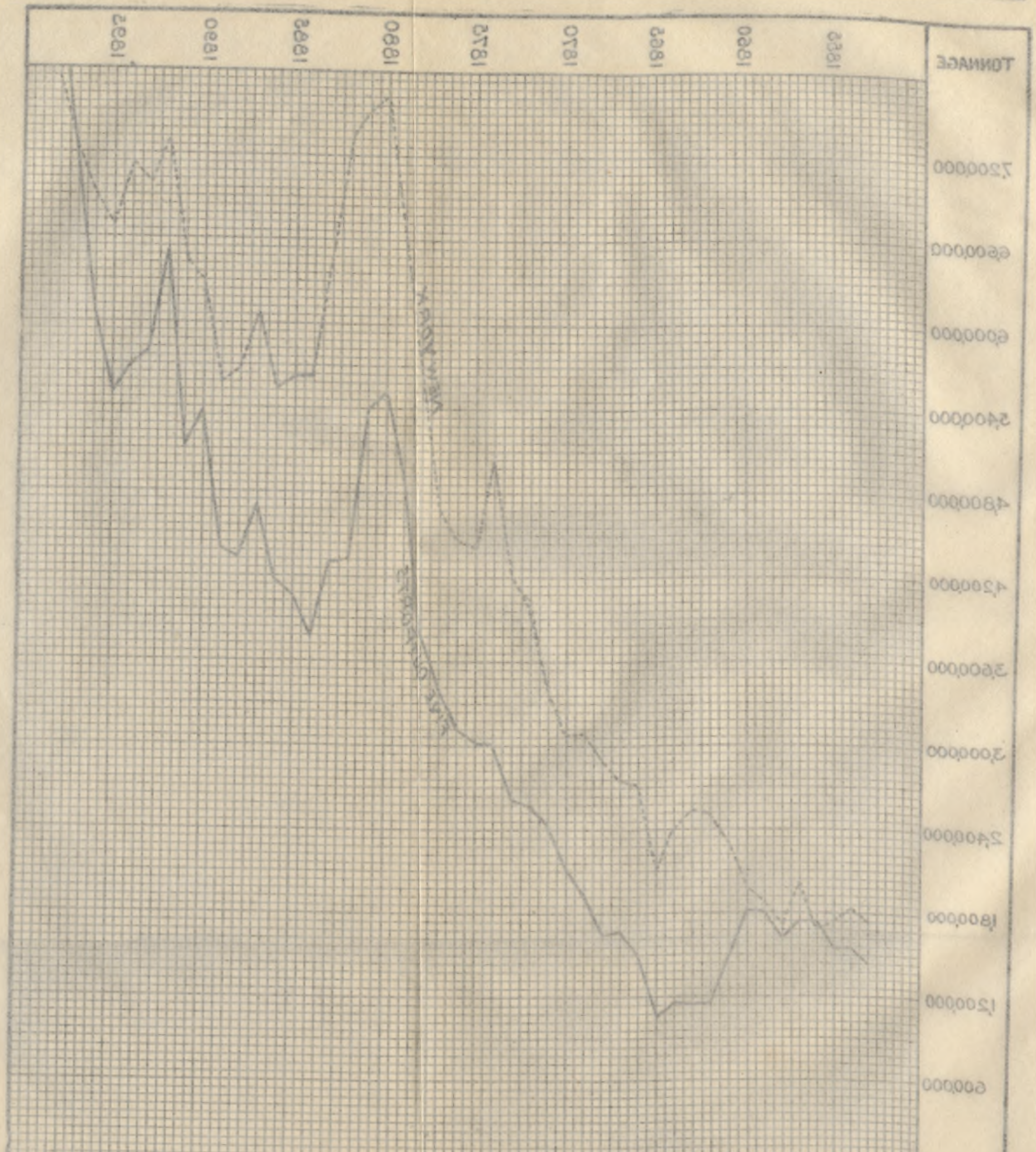


Chart 39 (Table 60).

GROWTH OF ATLANTIC SEAPORTS.

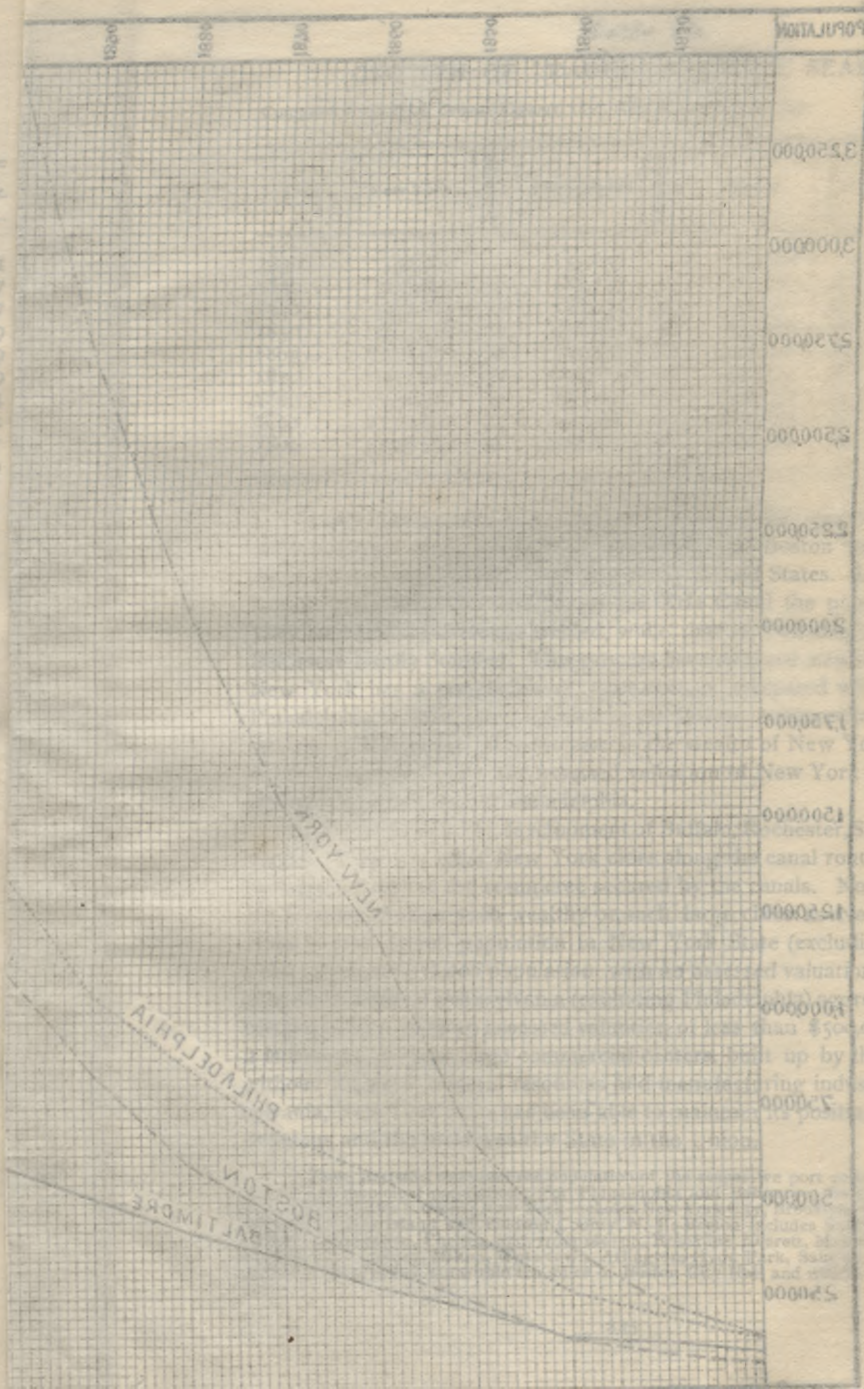


Chart 32 (Table 60).

GROWTH OF ATLANTIC SEAPORTS.

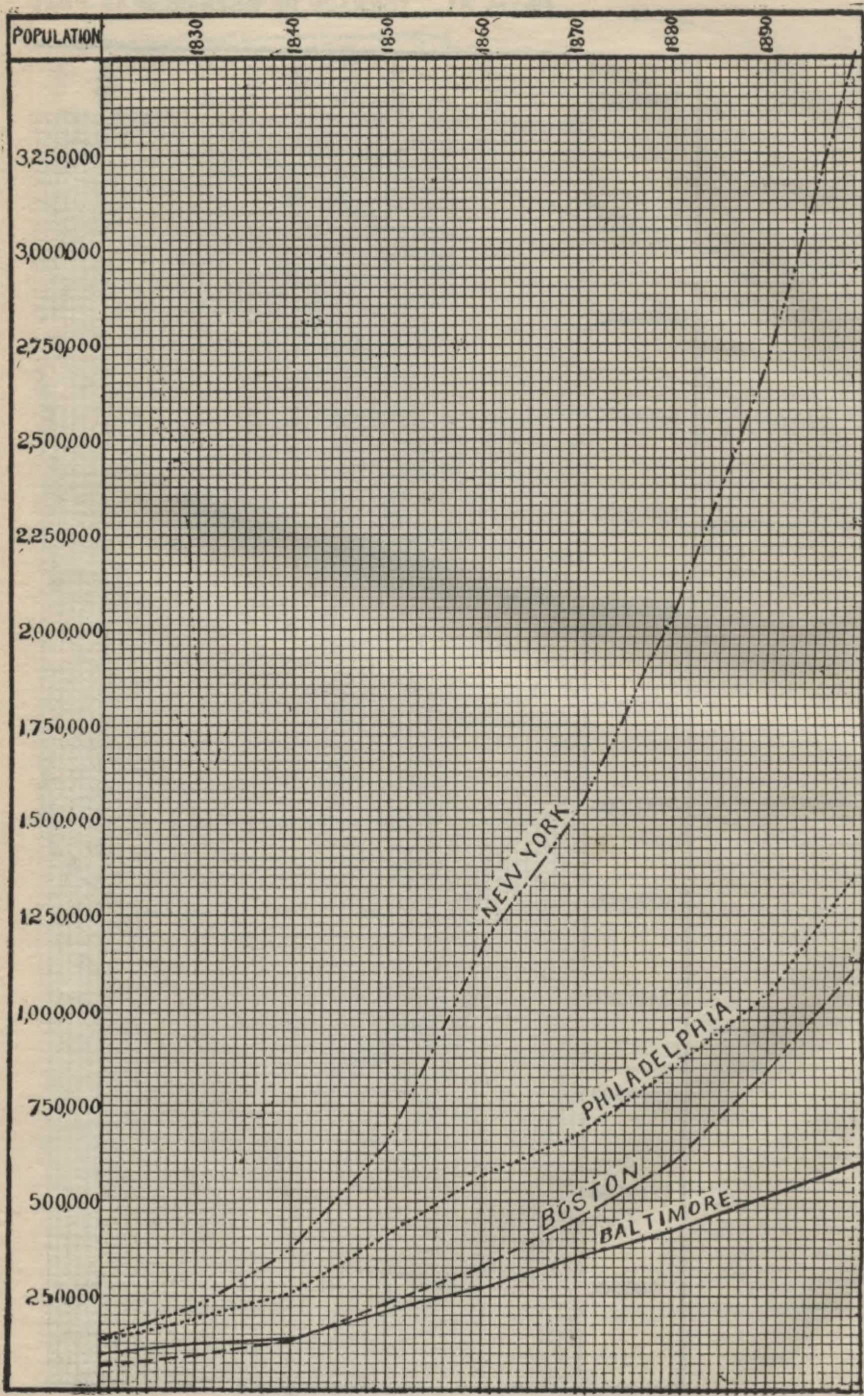


Table 60.

GROWTH OF LEADING ATLANTIC SEAPORTS.[1]

Compiled from *U. S. Census Reports*, 1850, 1860, 1870, 1880 and 1890.

Year.	New York.	Increase %	Philadelphia.	Increase %	Boston.	Increase %	Baltimore.	Increase %
1820....	137,016		135,637		63,688		96,201	
1830....	216,600	58	188,797	39	89,039	41	120,870	33
1840....	369,898	71	258,037	37	131,021	47	134,379	12
1850....	653,428	76	408,762	58	230,309	76	210,646	57
1860....	1,172,376	78	565,529	14	326,477	42	266,553	27
1870....	1,517,087	30	674,022	20	444,274	36	351,741	25
1880....	2,034,918	34	847,170	27	641,155	44	415,649	25
1890....	2,710,880	33	1,046,964	22	839,184	33	507,348	22
1899....	3,549,558	31	1,350,000	30	1,100,000	30	600,000	18

In 1820 the population around New York harbor was equalled by that of Philadelphia, while the ports of Baltimore and Boston were also strong rivals for the commercial supremacy of the United States. During the next twenty years after the opening of the Erie Canal the population of New York harbor district almost trebled, while that of Philadelphia, Boston and Baltimore hardly doubled. This process has continued steadily, until to-day New York has a population of 3,500,000, as compared with 1,350,000 in Philadelphia, a little over 1,000,000 in the Boston metropolitan district and 600,000 in Baltimore. The increase in the wealth of New York has been at an even more rapid rate, the assessed valuation of New York City being now almost four times that of Philadelphia.

In the same way, the development of Buffalo, Rochester, Syracuse, Utica, Albany, Troy and other New York cities along the canal route has been due in large measure to the commerce secured by the canals. No other State in the Union can show such wealthy or such large cities as New York. The cities of over 50,000 population in New York State (excluding New York City) aggregate 932,000 population, with an assessed valuation of $600,000,000, while those of Pennsylvania (excluding Philadelphia) aggregate but 772,000 population, with an assessed valuation of less than $500,000,000. And it is because of these large commercial centers, built up by the canals, that without the great mineral resources and manufacturing industries of Pennsylvania, New York State has been able to maintain its position as the most populous and the most wealthy State in the Union.

[1] These statistics represent the population of the respective port communities, and not merely the municipal population: For Philadelphia and Baltimore, the population of the respective counties is taken; New York includes New York City, Brooklyn, Long Island City, Yonkers, Staten Island and Hudson County, N. J.; Boston includes Suffolk County, Cambridge, Lynn, Salem, Chelsea, and, from 1850 on, Brookline, Everett, Malden, Medford, Melrose, Newton, Quincy, Milton, Watertown, Arlington, Hyde Park, Saugus, Swampscott and Nahant,—all of which are within ten miles of Boston City Hall and within the metropolitan area.

Table 61.

MILEAGE OF CANALS AND NAVIGABLE RIVERS.

From Mulhall: *Dictionary of Statistics* (1890), p. 102; *Annuaire Statistique de la France*, (1898), p. 290; and *Guide Programme to 7th International Congress of Navigation.*

	Canals.	Rivers.	Total.
Great Britain and Ireland	2,887	1,020	3,907
France	2,910	5,400	8,310
Germany	1,320	15,760	17,080
Russia	870	33,046	33,916
Austria	1,710	5,490	7,200
Italy	664	626	1,290
Spain and Portugal	270	1,285	1,555
Belgium	740	580	1,320
Holland	1,830	870	2,700
Scandinavia	390	300	690
All Europe	13,591	64,377	77,968
United States	3,064	15,502	18,566
Canada	535	2,820	3,355
Brazil		22,200	22,200
Argentine		2,200	2,200
India	2,240	2,600	4,840
China	5,270	3,800	9,070
Total	24,700	113,499	138,199

Table 62.

TRAFFIC ON GERMAN WATERWAYS—(1,000 TONS.)

Compiled from *Viertelsjahrhefte zur Statistik des Deutschen Reiches* (1898), I, 23.

	Spree, (Berlin.)		Elbe.		Rhine System.	
	Up Stream.	Down Stream.	Up Stream.	Down Stream.	Up Stream.	Down Stream.
1872–1875	2,008	742	469	685	2,156	2,778
1876–1880	2,215	733	835	1,650	2,811	3,901
1881–1885	1,916	1,043	1,713	2,899	5,985	5,529
1886–1890	2,594	1,556	2,190	3,737	7,664	5,934
1891	2,759	2,018	2,517	4,642	9,690	5,957
1892	2,332	1,900	2,611	4,086	10,351	6,291
1893	2,531	1,942	2,487	3,702	11,360	6,116
1894	2,715	1,820	3 020	4,837	13,409	6,557
1895	2,753	1,888	2,918	4,190	12,543	7,020
1896	2,914	1,882	3,481	4,984	15,841	6,939

Chart 33 (Table 62).

TRAFFIC ON GERMAN WATERWAYS.

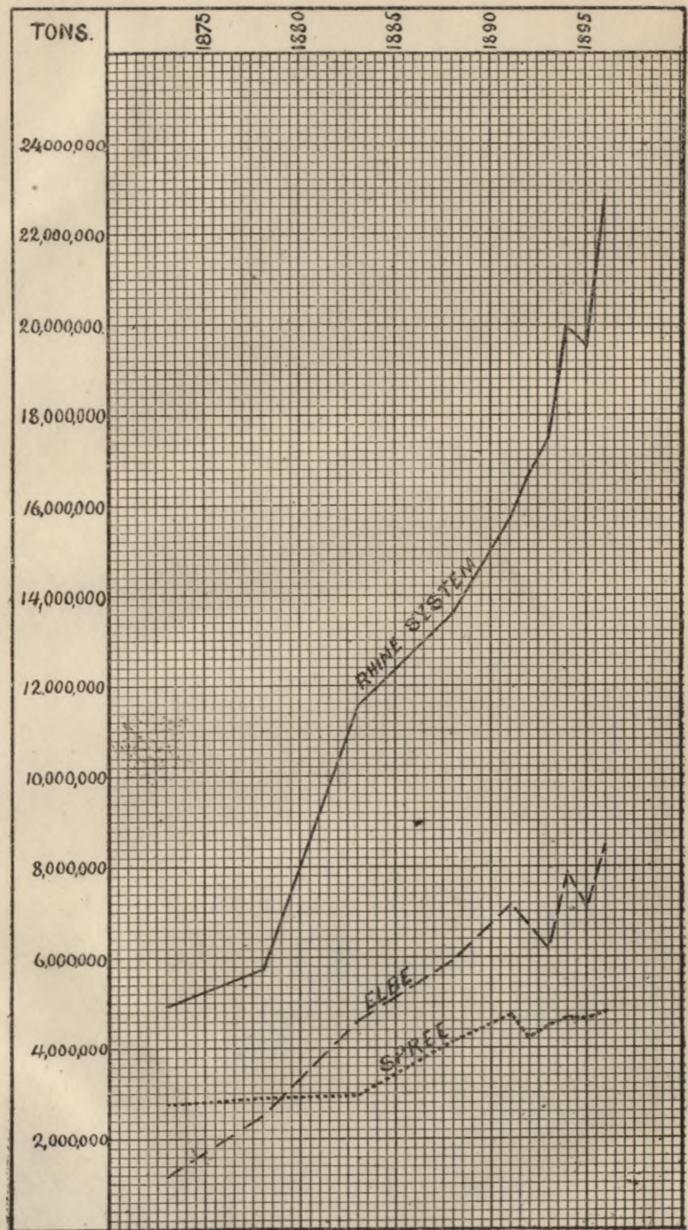


Chart 34 (Table 63).

TRAFFIC ON BELGIAN CANALS.

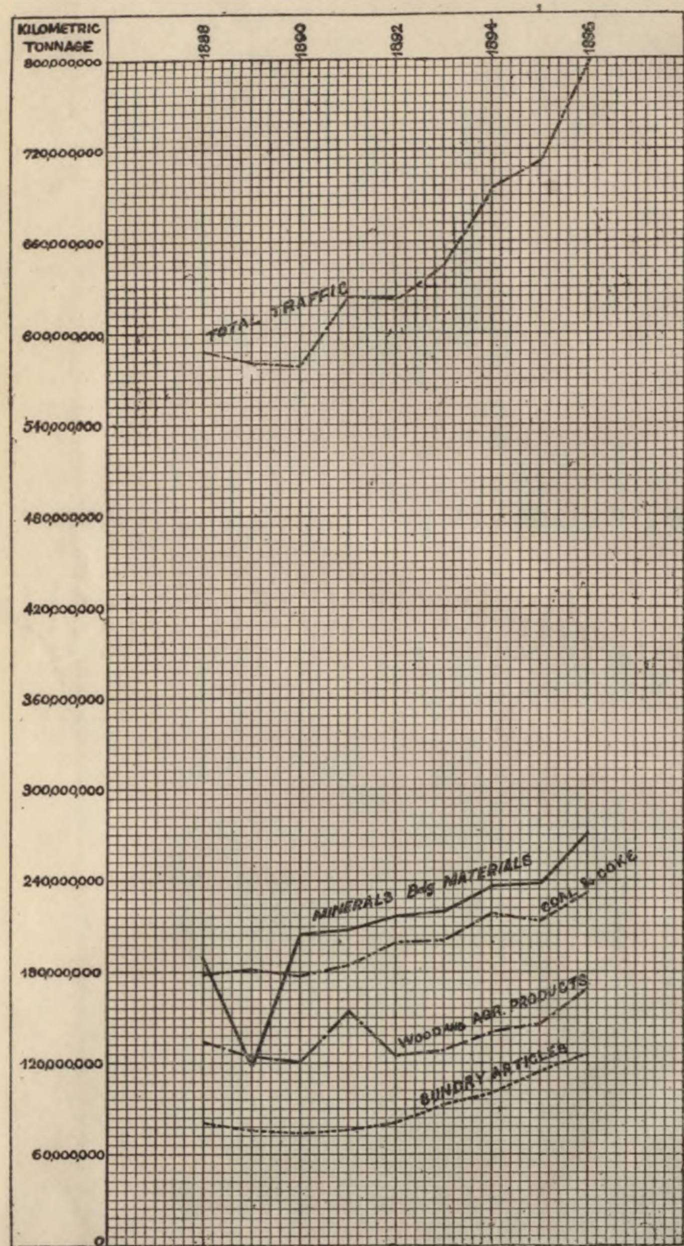


Chart 34 (Table 63).

TRAFFIC ON BELGIAN CANALS.

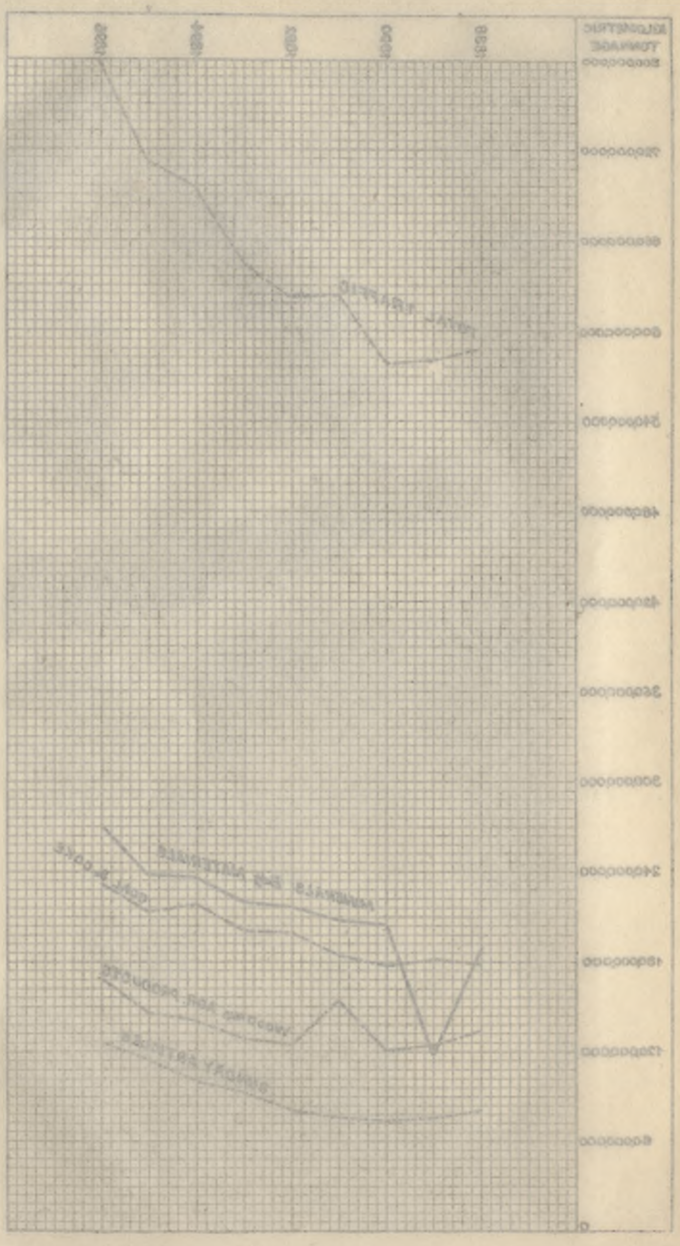


Chart 33 (Table 62).

TRAFFIC ON GERMAN WATERWAYS.

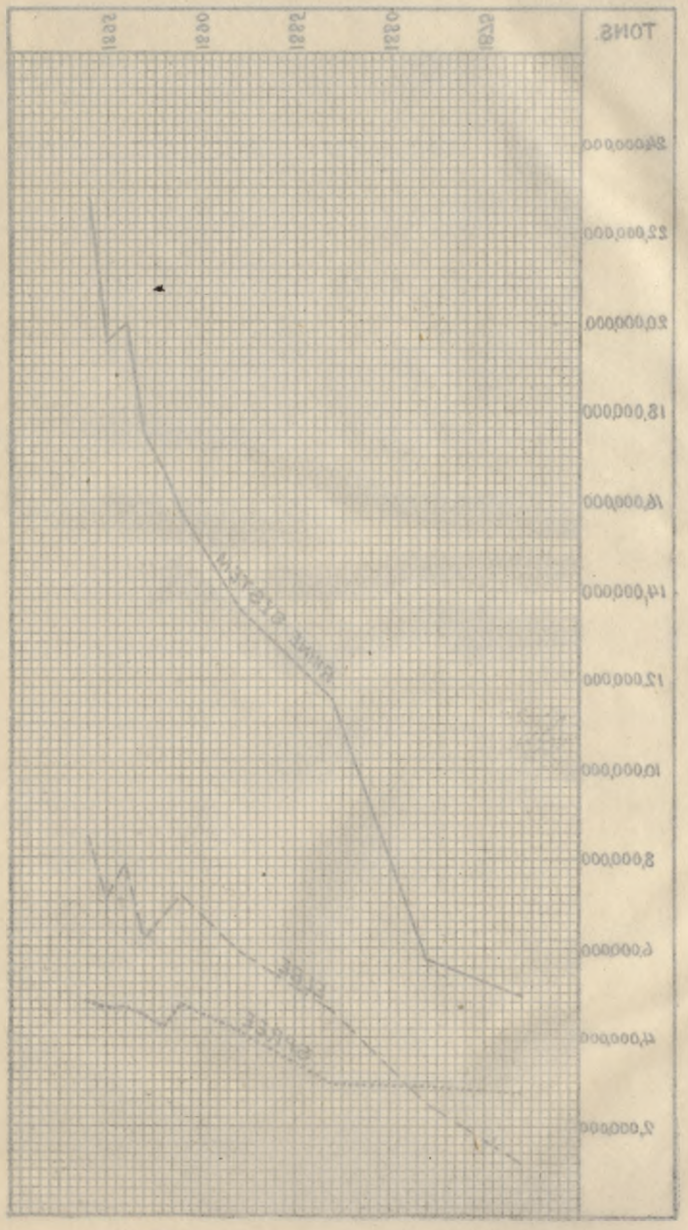


Table 63.

KILOMETRIC TONNAGE ON BELGIAN CANALS.

From *Guide Programme to 7th International Congress of Navigation*, p. 204.

Year.	Coal and Coke.	Minerals and Building Materials.	Wood and Agricultural Products.	Sundry Articles	Total.
1888	179,844,411	191,304,537	134,381,919	82,431,058	587,961,925
1889	180,212,189	119,226,178	124,916,264	77,216,762	581,571,393
1890	178,119,109	204,500,591	121,695,820	73,353,607	577,669,127
1891	184,695,031	208,355,479	153,533,962	77,254,899	624,139,371
1892	200,610,754	216,155,218	125,366,507	81,301,632	623,434,111
1893	201,594,004	221,306,262	128,978,811	93,105,663	644,981,740
1894	218,183,406	236,355,326	139,763,419	101,476,529	695,778,770
1895	214,394,882	238,920,422	144,988,274	114,987,113	713,290,691
1896	232,263,653	272,157,077	168,933,964	126,192,589	799,546,683

Table 64.

TRAFFIC ON RIVERS OF EUROPEAN RUSSIA,

EXCLUSIVE OF POLAND, FINLAND AND CAUCASIA.

From *Statesman's Year-Book*, (1899), p. 961.

Year.	Corn.	Firewood.	Timber.	Naphtha.	Total.
	Tons	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1891	1,996,000	3,705,000	6,470,000	1,153,000	16,710,000
1892	1,482,000	3,282,000	7,011,000	1,378,000	16,480,000
1893	2,390,000	3,240,000	7,604,000	1,256,000	19,040,000
1894	3,680,000	3,822,000	9,209,000	2,022,000	23,290,000
1896					27,716,000

Table 65.

INLAND WATER TRAFFIC IN AUSTRIA-HUNGARY.

From *Statesman's Year-Book*, (1899), pp. 384, 400.

Year.	Danube Steam Navigation Co.	Austrian N. W. Steam Nav. Co. (River Elbe.)	Aggregate.	Hungarian River Traffic. (*a*)
	Metre centners.	*Metre centners.*	*Metre centners.*	*Tons.*
1892.............	18,303,740	5,882,172	24,185,912	
1893.............	21,785,290	5,462,964	27,248,254	3,071,590
1894.............	20,301,750	7,268,500	27,570,250	2,906,251
1895.............	19,631,340	6,403,829	26,035,169	2,520,504
1896.............	22,405,190	8,837,390	31,242,580	3,842,679
1897.............				3,265,758

(*a*) Including the Hungarian traffic of the Danube Steam Navigation Co.

Table 66.

WATER AND RAILROAD TRAFFIC IN FRANCE.

From *Annuaire Statistique de a France*, 1898, pp. 290, 295.

Year.	Length of Route, Myriameters.				Kilometric Tonnage, 000,000's.			
	Rivers.	Canals.	Total Water Routes.	Railroads.	Rivers	Canals.	Total Water Routes.	Railroads.
1860...	670	440	1,110		858	1,043	1,901	
1861..	670	440	1,110		856	1,080	1,936	
1862...	670	440	1,110		898	1,194	2,092	
1863...	670	441	1,111		879	1,253	2,132	
1864...	670	441	1,111		866	1,216	2,082	
1865...	670	441	1,111		837	1,222	2,059	
1866...	670	449	1,119		904	1,321	2,225	
1867...	670	455	1,125		792	1,232	2,024	
1868...	670	455	1,125		825	1,347	2,192	
1869...	670	456	1,126		804	1,195	1,999	
1870...	670	456	1,126		549	899	1,448	
1871...	659	416	1,075		599	959	1,558	
1872...	659	416	1,075		869	967	1,836	7,600
1873...	659	416	1,075		873	974	1,847	8,200
1874...	659	416	1,075		833	962	1,795	7,900
1875...	659	418	1,077		910	1,054	1,964	8,200
1876...	659	420	1,079	2,003	890	1,063	1,953	8,325
1877...	659	420	1,079	2,053	905	1,129	2,034	8,185
1878...	659	421	1,080	2,143	928	1,077	2,005	8,399
1879...	659	435	1,094	2,225	910	1,104	2,014	8,999
1880...	659	435	1,094	2,309	903	1,104	2,007	10,350
1881...	732	465	1,197	2,425	1,027	1,147	2,174	10,752
1882...	758	465	1,223	2,557	1,051	1,214	2,265	10,835
1883...	783	471	1,254	2,669	1,092	1,291	2,383	11,064
1884...	783	471	1,254	2,872	1,126	1,326	2,452	10,478
1885...	772	466	1,238	2,984	1,123	1,330	2,453	9,791
1886...	774	466	1,240	3,069	1,251	1,547	2,798	9,314
1887...	774	473	1,247	3,145	1,366	1,707	3,073	9,918
1888...	774	476	1,250	3,213	1,429	1,751	3,180	10,409
1889...	766	481	1,247	3,291	1,449	1,789	3,238	11,052
1890...	756	481	1,237	3,328	1,415	1,801	3,216	11 759
1891...	752	481	1,233	3,388	1,537	2,000	3,537	12,294
1892...	759	481	1,240	3,488	1,526	2,083	3,609	12,119
1893...	751	481	1,232	3,535	1,539	2,065	3,604	12,274
1894...	747	478	1,225	3,597	1,652	2,260	3,912	12,482
1895...	750	478	1,228	3,624	1,608	2,158	3,766	12,898
1896...	751	485	1,236	3,706	1,725	2,466	4,191	13,217
1897...	741	485	1,236	3 730	1,826	2,540	4,366	

Chart 35 (Table 66.)

INLAND WATER TRAFFIC IN FRANCE.

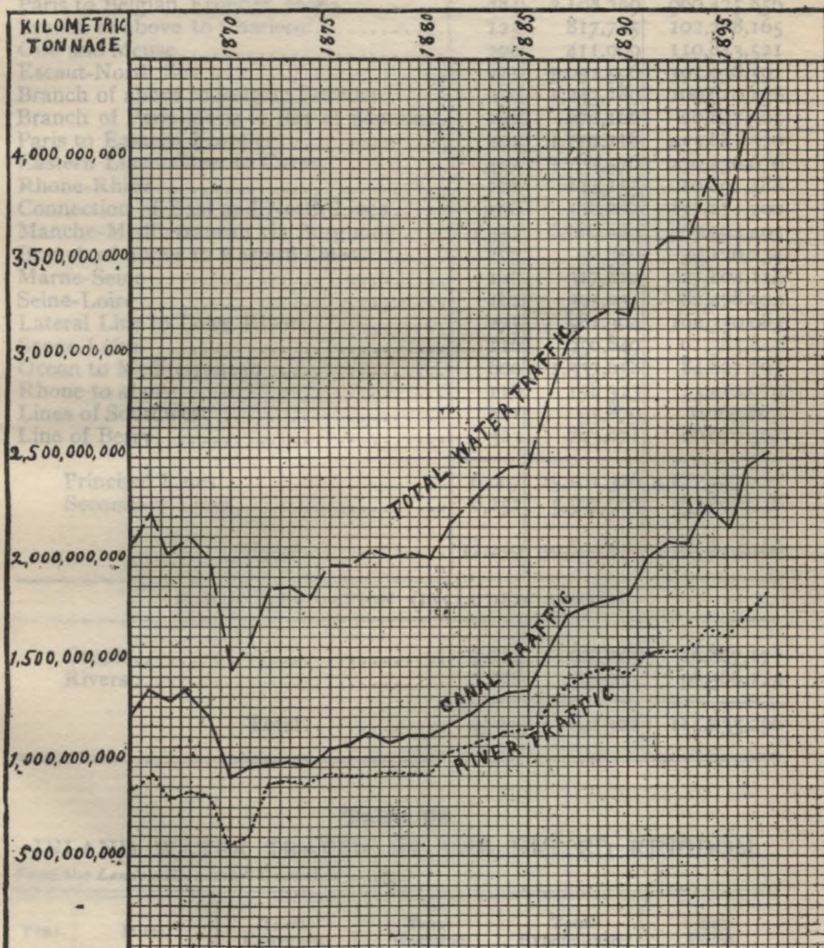


Table 66.

WATER AND RAILROAD TRAFFIC IN FRANCE.

From Annuaire Statistique de la France, 1896, pp. 304, 305.

Year.	Length of [illegible]				[illegible] 000,000's.			
	Rivers.	Canals.	Total Water.	Rail-roads.	Rivers.	Canals.	Total.	Rail-roads.
1860–1893	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1894...	747	478	1,225	3,597	1,652	2,260	3,912	12,462
1895...	750	478	1,228	3,624	1,608	2,158	3,766	12,898
1896...	751	485	1,236	3,706	1,725	2,466	4,191	13,217
1897...	741	485	1,236	3,730	1,826	[illegible]	4,366	

Table 67.

WATER TRAFFIC IN FRANCE, 1897.

From *Annuaire Statistique de la France*, 1898, p. 291.

Lines.	Length Kilo-metres.	Tonnage.	Kilometric Tonnage.
Paris to Belgian Frontier, Mons..........	284	2,108,289	960,425,856
Branch of above to Charleroi............	125	817,785	102,278,165
Oise and Meuse........................	208	411,999	110,843,521
Escaut-North Sea......................	221	5,051,596	395,938,592
Branch of above to Belgian Frontier......	250	1,243,789	109,610,438
Branch of Paris-Mons to Bay of Somme....	156	270,166	20,847,325
Paris to Eastern Frontier...............	494	1,719,718	455,881,320
Eastern Line—Givet to Carre............	432	1,782,576	270,436,676
Rhone-Rhine..........................	186	144,155	10,691,488
Connection of East and North Lines.....	106	136,667	177,271,200
Manche-Mediterranean via Burgundy	1,354	6,686,249	999,994,495
Branch of above to Eastern Lines........	163	92,350	39,126,234
Marne-Seine	186	317,812	27,804,114
Seine-Loire	182	395,031	82,478,922
Lateral Line to Loire River.............	275	581,364	162,350,083
Saone-Loire	116	956,849	61,385,845
Ocean to Mediterranean	609	1,337,658	84,827,797
Rhone to above........................	116	158 323	13,412,079
Lines of Southwest	221	95,879	6,263,607
Line of Berry.........................	323	793,071	80,079,467
Principal Lines	6,007	25,101,326	4,171,947,224
Secondary Lines......................	6,252	5,507,900	193,807,236
Total.............	12,259	30,609,226	4,365,814,460
STEAM NAVIGATION (INCLUDED ABOVE.)			
Canals..............................	2,004	246,088	16,867,171
Rivers..............................	2,711	346,233	98,366,125
Total.............	4,715	592,321	115,233,296

Table 68.

INLAND WATER TRAFFIC IN THE UNITED KINGDOM.

From the *London Economist*, December 30, 1899.

Year.	Miles.	Traffic Conveyed.	Total Revenue.	Total Expenditure.	Net Profit.
		Tons.			
1888	3,814	36,301,120	£2,041,476	£1,315,253	£726,223
1898	3,907	39,358,394	2,408,534	1,764,037	644,497

Table 69.

SHIP CANAL TRAFFIC.

A—TRAFFIC THROUGH SUEZ AND ST. MARY'S FALLS CANALS.

Year.	St. Mary's Falls Canal.		Suez Canal.	
	Ships.	Tonnage.	Ships.	Tonnage.
1855		106,296*		
1860		403,657		
1865	997	409,062		
1870	1,828	690,826	486	436,609
1871	1,637	751,101	765	761,467
1872	2,004	914,735	1,082	1,160,743
1873	2,517	1,204,446	1,173	1,367,767
1874	1,734	1,070,857	1,264	1,631,650
1875	2,033	1,259,534	1,494	2,009,984
1876	2,417	1,541,676	1,457	2,006,771
1877	2,451	1,439,216	1,663	2,355,447
1878	2,567	1,667,136	1,593	2,269,678
1879	3,121	1,677,071	1,477	2,263,332
1880	3,503	1,734,890*	2,026	3,057,421
1881	4,004	1,567,741*	2,727	4,136,779
1882	4,774	2,029,521*	3,198	5,074,808
1883	4,315	2,267,105	3,307	5,775,861
1884	5,689	2,874,557	3,284	5,871,500
1885	5,380	3,256,628	3,624	6,335,752
1886	7,424	4,527,759	3,100	5,767,655
1887	9,355	5,494,649	3,137	5,903,024
1888	7,803	6,411,423	3,440	6,640,834
1889	9,579	7,516,022	3,425	6,783,187
1890	10,557	9,041,213	3,389	6,890,094
1891	10,191	8,888,759	4,207	8,698,777
1892	12,580	11,214,333	3,559	7,712,028
1893	12,008	10,796,572	3,341	7,659,068
1894	14,491	13,195,860	3,352	8,039,175
1895	17,956	15,062,580	3,434	8,448,383
1896	18,615	16,239,061	3,409	8,594,307
1897	17,171	18,982,755		7,899,373
1898	17,161	21,234,664		

* Before 1881 the figures for St. Mary's Falls Canal are gross tons; after 1881, and all figures for Suez Canal, are net tonnage.

Chart 36. Ship Canal Traffic. **(Table 69.)**

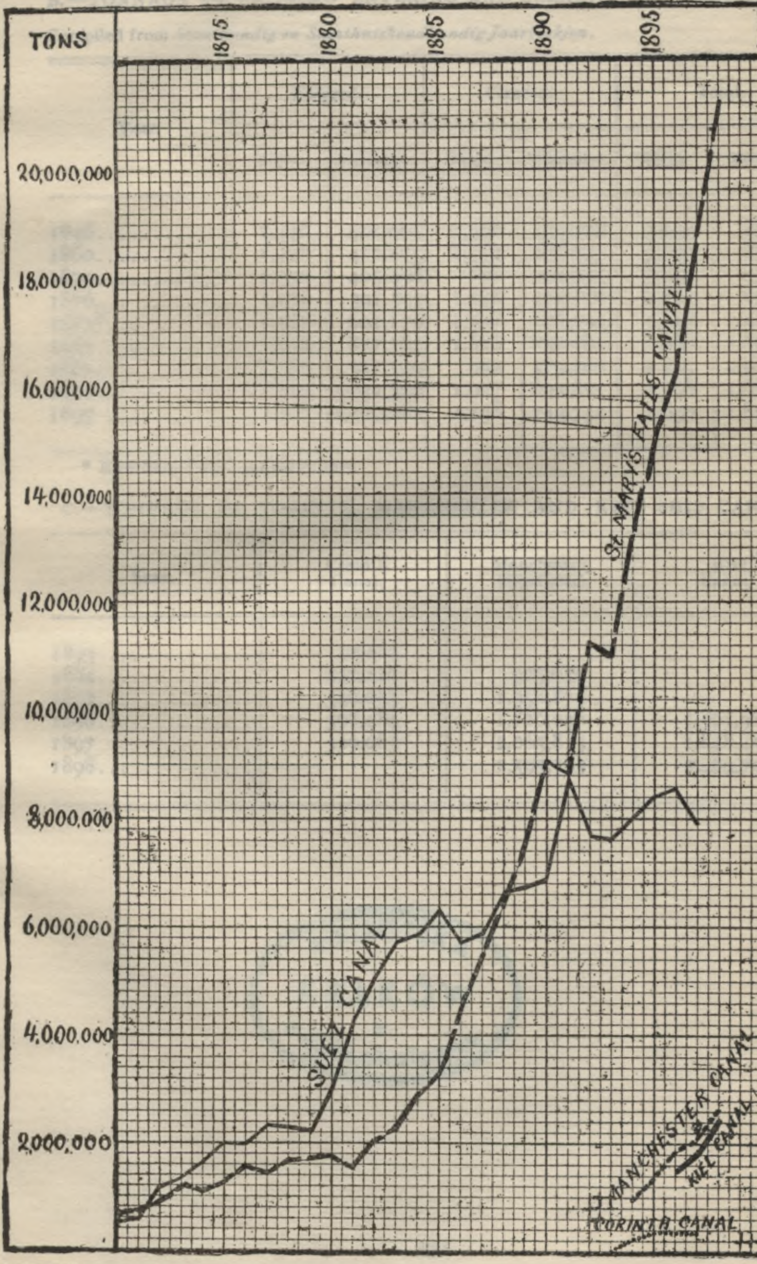


Table 69—Continued.

B.—TONNAGE OF SHIPPING ENTERING AND CLEARING AT AMSTERDAM.

Compiled from *Staatkundig en Staathuishoudkundig Jaarboekjen*.

Year.	Entered.		Cleared.		Total.	
	Ships.	Tonnage.	Ships.	Tonnage.	Ships.	Tonnage.
1856	1,596	401,961	1,458	279,208	3,054	681,169
1860	1,997	411,175	1,472	277,527	3,469	688,702
1870	1,330	405,498	808	225,958	2,138	631,456
1876	1,171	391,553	1,248	410,168	2,419	801,721
1877*	1,517	604,179	1,527	608,094	3,044	1,212,273
1882	1,632	877,182	1,628	856,084	3,260	1,633,266
1887	1,473	921,140	952	579,466	2 425	1,500,606
1891	1,569	1,051,526	1,027	632,821	2,596	1,684,347
1895	1,512	1,109,082	1,138	743,754	2,650	1,852,836

* New Ship Canal opened in 1876.

C.—TONNAGE OF CORINTH, MANCHESTER AND KIEL SHIP CANALS.

Year.	Corinth Canal.	Manchester Ship Canal.	Kiel Canal.
1893	10,183		
1894	240,122	925,659	
1895	346,033	1,358,875	
1896	368,484	1,826,237	1,505,983
1897	329,063	2,065,815	1,848,458
1898		2,595,585	2,469,795

Map 6. PRINCIPAL CANALS AND RIVERS IN EUROPE.

Map 7. THE CANAL DISTRICT OF EUROPE.