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No. 11

DEPARTMENT OF DOCKS AND FERRIES  
Pier "A", North River  
NEW YORK CITY



REPORT  
ACCOMPANYING  
GENERAL DESCRIPTION  
OF  
THE HARBOR OF NEW YORK

By S. WILLETT HOAG, Jr., Deputy Chief Engineer

SUBMITTED BY  
CALVIN TOMKINS  
Commissioner of Docks

SEPTEMBER, 1911

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## INTRODUCTION.

By CALVIN TOMKINS, Commissioner,  
Department of Docks and Ferries.

Hon. WILLIAM J. GAYNOR,

Mayor:

SIR—The physical features of New York Harbor are so grand that they constitute a present embarrassment of opportunities. The port, for many years to come, cannot hope to plan its artificial development in such a manner as to take full advantage of the situation which nature has provided. In fact, this amplitude of natural harbor facilities has been the principal reason why New York, more than any other great seaport, has neglected (up to the present time) to provide an adequate plan of organization. So much room exists about the shores of the harbor for commercial and industrial development, that the need for economic planning has not begun to be felt until now; and, even at present, congestion as distinguished from inefficiency has only been manifested in one district, namely, along the west side of Manhattan, where the waterfront is most intensively used by steamships, railroads, and the requirements of local commerce.

The port is divided by the harbor waters into four divisions, namely: Long Island, Staten Island, Manhattan and The Bronx, and New Jersey.

The port problem presented is: To design each part for its best commercial or industrial use, and to connect all into an organic whole—first, through the instrumentality of car floats, ferries and lighters, and, subsequently, to bring the parts into more intimate correlation by railroad tunnels under the harbor waters.

Longer piers must be provided for ocean steamships of the first class at Manhattan, or this class of shipping must be moved to other docks about the harbor. The individualistic character of the present railroad terminals must give way to a system of terminals connected by marginal railroads, so that all terminals may be made accessible to all railroads.

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It has sometimes been stated that the transfer of goods by lighters and car floats about the harbor is more convenient and flexible than any arrangement of railway switching at other ports. It is true that great flexibility results from this water delivery, but this flexibility is of little use if it must stop at the pier instead of being continued to the manufacturer's warehouse and by convenient terminals to every consignee or shipper. All terminals should be accessible to all railroads. It is possible to materially decrease expenses by supplementing the present method by lines of marginal railroads which shall connect the terminals, and, ultimately, it will doubtless be found economically advantageous to tie together these connected terminals by tunnels in place of car floats, as above suggested.

The City has acquired most of the waterfront where docks are intensively used at Manhattan and elsewhere, and it is becoming apparent that a policy involving the progressive municipalization of the entire waterfront will be forced upon the community, since private waterfront improvements cannot be expected to compete successfully with municipal improvements. Already at South Brooklyn the necessity for this policy has become manifest. The reasons for this are noted in the Department's Report on South Brooklyn Development.

The City should seek, through gradual extension of municipal ownership, to control all its waterfront in the interest of its commerce and manufactures; and, in addition, to retain such control of the marginal lands immediately back of the waterfront as will facilitate their best use, under private operation and development, for warehousing and manufacturing purposes.

The Port of New York, including the New Jersey District, is the greatest manufacturing community in North America, and its continued industrial pre-eminence will hereafter be dependent upon the convenient use, through proper co-ordination, of its railroad and waterfront terminals. Every possible factory and warehouse site, in proximity to the waterfront, or along the lines of railroad leading to it, should be made possible of access by all lines of transportation. The convenient, industrial organization of the port, in these respects, is of much greater importance to the community about the harbor waters than is its organization for strictly commercial uses, incident to the terminal handling of goods in transit.

The financial success of the vast subway system which the City is now planning, involving an expenditure of over one hundred and fifty millions of dollars, will be dependent upon effective terminal organization more than upon any other one factor.

New York is the greatest city of America because it is the greatest terminal on the continent, but it must, from now on, supplement its natural opportunities by such artificial development as will best serve its commercial and industrial needs. Only in that way can it continue to attract enterprise, capital and population.

The new Erie Canal, which the State of New York is carrying to completion at an expense of over one hundred millions of dollars, and the Intra Coastal Canal, which is ultimately planned to connect the Hudson, Delaware and Chesapeake Valley cities, must also be provided with suitable terminals and shipping facilities at New York. These canals and the Panama Canal and also the easy grades across the State of New York to the Mississippi Valley will tend to depress railroad rates, and will increase the importance of New York as the Atlantic portal of North America.

To offset the natural opportunities of this port, the other Atlantic seaports, operating in conjunction with the railways leading to them, have for thirty years past succeeded in maintaining a differential freight rate against New York, amounting to three cents per hundred pounds, which the Interstate Commerce Commission is now asked to do away with. The Commission has recently been given power to establish freight rates, and it may be reasonably expected that this unfair discrimination will soon be terminated. The removal of this disadvantage will greatly stimulate New York's commerce and is an added reason why the port should provide in advance for its increasing trade.

The organization of the port to meet its increased responsibilities is not difficult except along the west side of Manhattan, where reorganization of existing facilities and the intense rivalries of the steamship and railroad companies there located have created unusual complications. This problem has been discussed and a remedy suggested in a series of Department reports having special reference to this section.

The State of New York has recently enacted laws which give large powers to the City, through the Dock Department, for creating terminals and controlling them, instead of merely building and leasing docks. A State Constitutional Amendment, adopted last year, also permits the City to exempt from its debt limit self-sustaining dock bonds. A credit equal to the amount represented by such bonds may be availed of, and new bonds issued, for waterfront improvements. The Comptroller of The City of New York estimates that, at the present time, this fund aggregates approximately seventy-three million dollars. The Appellate Division of the Supreme Court of the State will determine the precise amount this year, which, presumably, will not

materially differ from the Comptroller's figures, and, when this credit shall have been made available, the City will be in a position to enter upon a series of dock improvements on a scale commensurate with its immediate future needs. It is incumbent upon the City promptly to adopt a terminal plan and policy which it shall follow in carrying out its waterfront improvements.

In response to the continually increasing popular demand for information regarding the Port of New York, the following description of the port, by Mr. S. Willett Hoag, Jr., Deputy Chief Engineer, Department of Docks and Ferries, has been prepared for distribution.

CALVIN TOMKINS,  
Commissioner of Docks.



**DEPARTMENT OF DOCKS & FERRIES**  
 MAP OF THE  
**WATERFRONT OF THE CITY OF NEW YORK**  
 SHOWING  
 CONTEMPLATED IMPROVEMENTS FOR RAILROAD TERMINALS AND WATERFRONT DEVELOPMENT, INCLUDING THE PROPOSED IMPROVEMENT OF  
**JAMAICA BAY**  
 -1911-

SCALE  
 0 1 2 3 4 5 MILES

*Note: The New Jersey Section of the part west of the Hudson River is shown in white.*

COMPLEMENT BOND

COMPLEMENT BOND

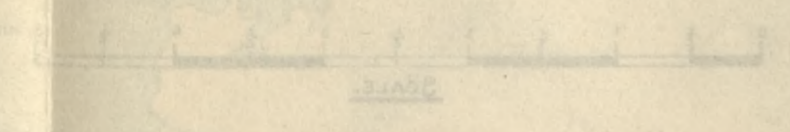
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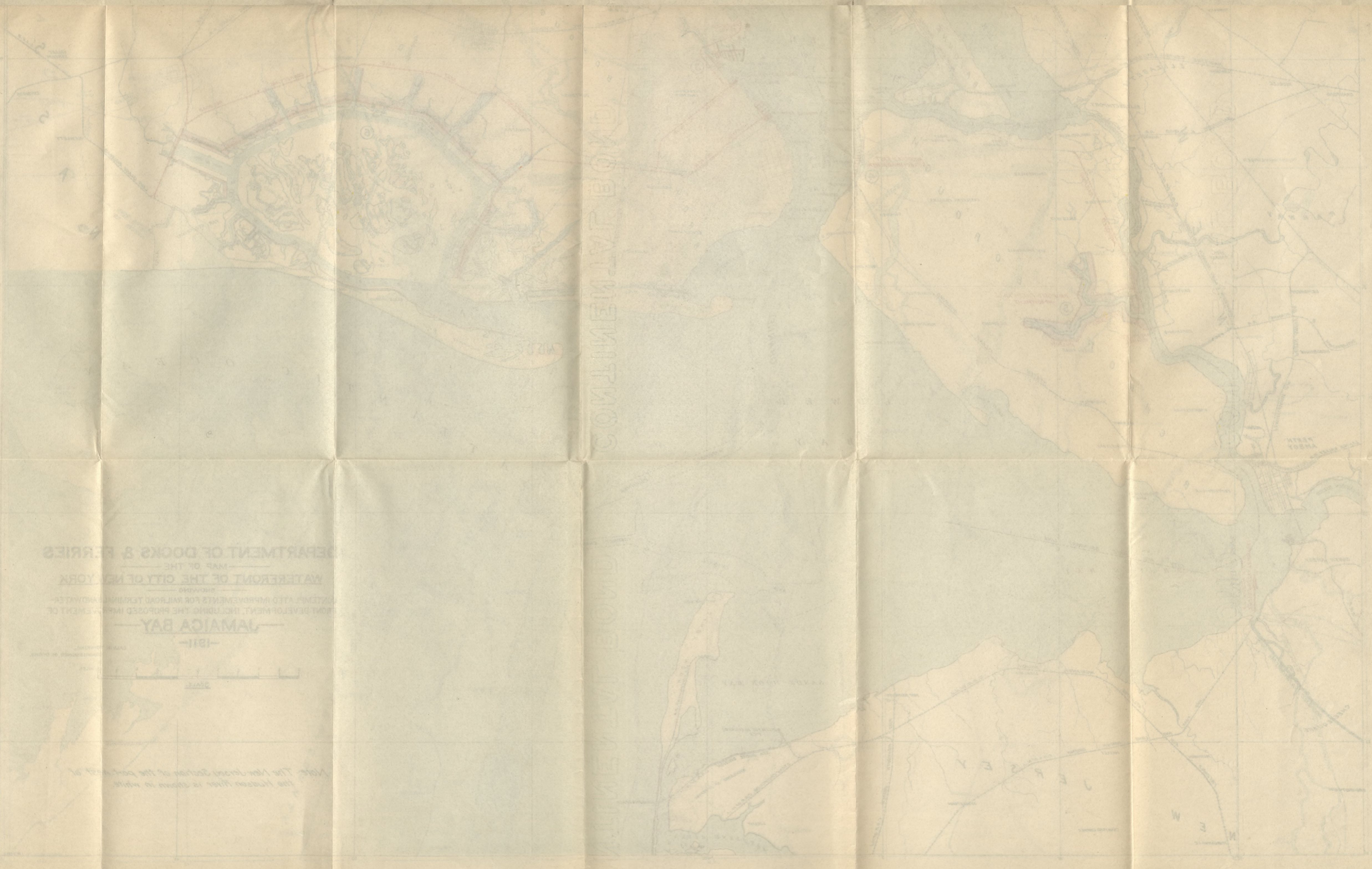
COMPLEMENT BOND

COMPLEMENT BOND

DEPARTMENT OF DOCKS & FERRIES  
 MAP OF THE  
 WATERFRONT OF THE CITY OF NEW YORK  
 SHOWING  
 PROPOSED IMPROVEMENTS FOR MARINE TERMINAL FACILITIES  
 AND DEVELOPMENT INCLUDING THE PROPOSED MARINE FRONT OF  
 JAMAICA BAY  
 1911



Note: The five-acre portion of the waterfront at  
 the Hudson River is shown in white.





# Summary Description of the Harbor of New York.

S. WILLETT HOAG, Jr., Deputy Chief Engineer.

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## I.—THE HARBOR.

The Harbor of New York is a locality situated at the apex of a funnel-shaped ocean approach which nature seems to have formed as an invitation to the world to concentrate its marine activity toward this particular point, and as though in response, there has grown up here the greatest port in all the world—great because of its strategic relation to land as well as sea, and great because of realization here of the largest expectations, purposes and demands of a port.

The Harbor of New York renders the same service to the commerce of this great nation as the heart does to the individual. It is hither that the great ocean carriers, transatlantic, world-wide and coastwise, gravitate, stopping long enough to start the labyrinthian distribution of their cargoes, and to receive in return, for distribution elsewhere, the concentrated energies of farms, mills and manufactories. In Northern Europe there are many large seaports; in North America there is only one at which commerce converges.

Where, then, does the activity and energy of the Harbor of New York begin and terminate?

Take away the functional activities of the Harbor of New York and the City of New York would essentially cease to exist. The effect of such an occurrence on the rest of the country may well be imagined. In short, it is New York Harbor that has made New York City possible.

The conservation of this great opportunity is of first importance, and is not to be subordinated to any of the other duties of the great municipality of the City of New York. It is a national trust, delegated to the City by the State and Federal Governments. Control, operation and the expansion in the way of betterments and improvements must be jealously maintained by the City of New York. Nature itself has provided the most

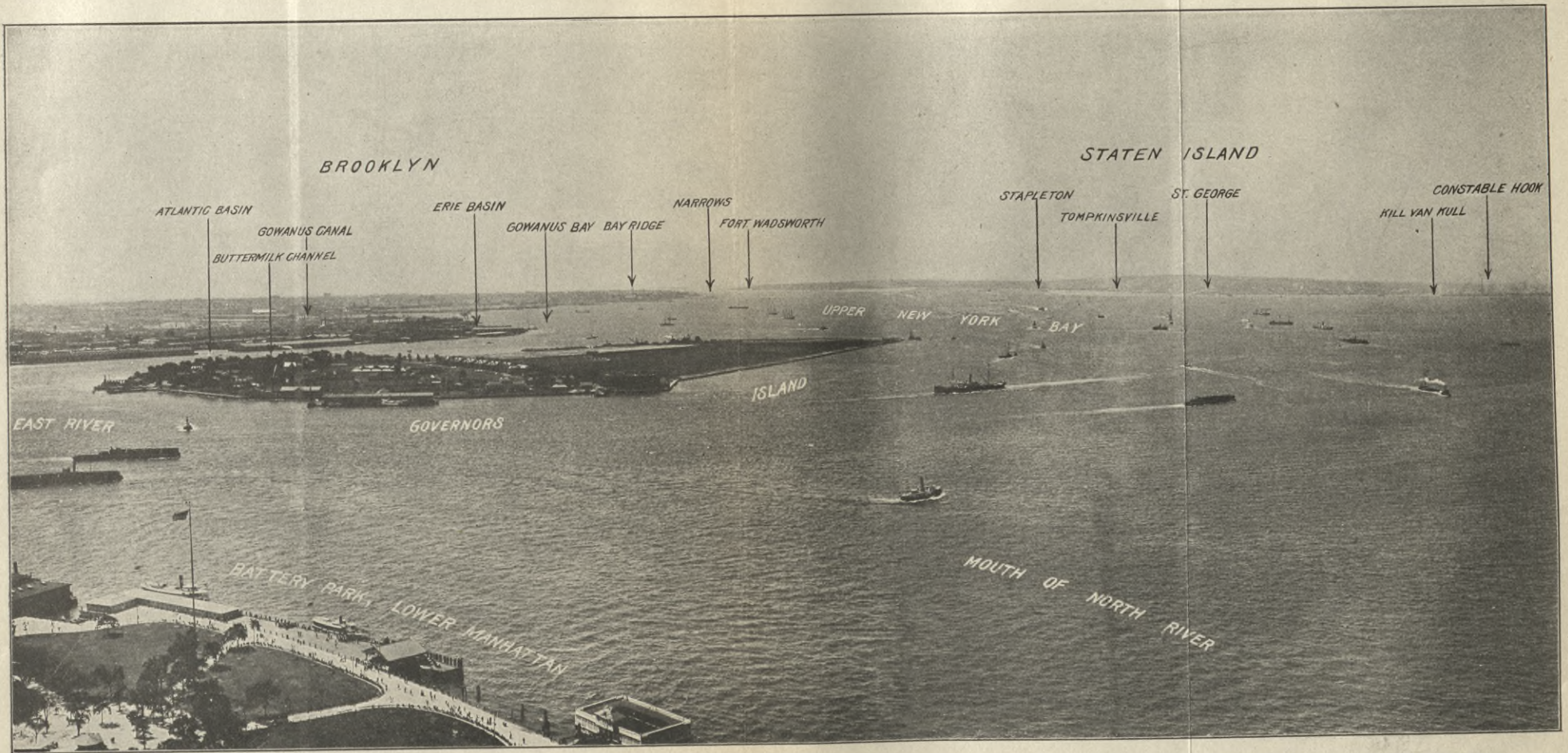
important feature toward the conservation of the port by creating a harbor world-renowned for its beauty and safety. Apparently land-locked as it is, the approach from the ocean offers no suggestion of what is revealed to the mariner after passing the main entrance to the harbor.

The outer limit is a line extending from the Life Saving Station at Rockaway to the Scotland Light Ship, and thence to the Atlantic Highland light. Within this line to the farther end of Raritan Bay is the lower harbor, which, with its contiguous shores and tributaries, form the outer portion of the Harbor of New York. The northerly shores of the lower harbor are entirely within the City of New York, and therefore the State of New York. The remaining shores are in the northern counties of the State of New Jersey, which, so far as concerns economic and social conditions, is an integral part of the port. The difficulties of administering the port are materially increased by the dual state control.

Passing the main entrance through the recently constructed Ambrose Channel, between Coney Island and Sandy Hook, vessels turn to the right through almost a right angle, and proceeding northward through the Narrows between Staten Island and Brooklyn, enter the Upper Bay, which for depth of water and absolute refuge, is unsurpassed by any other harbor in the world.

This portion of the harbor is marked at its northerly end by the confluence of the North and East Rivers. Within City limits the North River forms the boundary between the states of New Jersey and New York, New Jersey extending along the westerly shore. Arthur Kill and the Kill Von Kull, which together with the Upper and Lower Bays make the Borough of Richmond an island, known as Staten Island, separate the two states. The North and East Rivers extend generally in a northerly direction, with the Borough of Manhattan lying between and made an island by these and the Harlem River, which extends at Spuyten Duyvil from the North River to the East River at Hell Gate, and separates the Boroughs of Manhattan and The Bronx. From Hell Gate the East River extends in an almost easterly direction to Long Island Sound, entering the latter at Throggs Neck, and dividing the Boroughs of The Bronx and Queens.

The North or Hudson River forms the principal medium for waterway traffic and communication with the interior of the state and the Great Lakes, through the Barge Canal, which discharges into the Hudson River near Albany. The East River is the principal means of communication with Long Island Sound and New England ports. The Erie or Barge Canal, a level waterway leading through the Hudson and Mohawk valleys to the west,

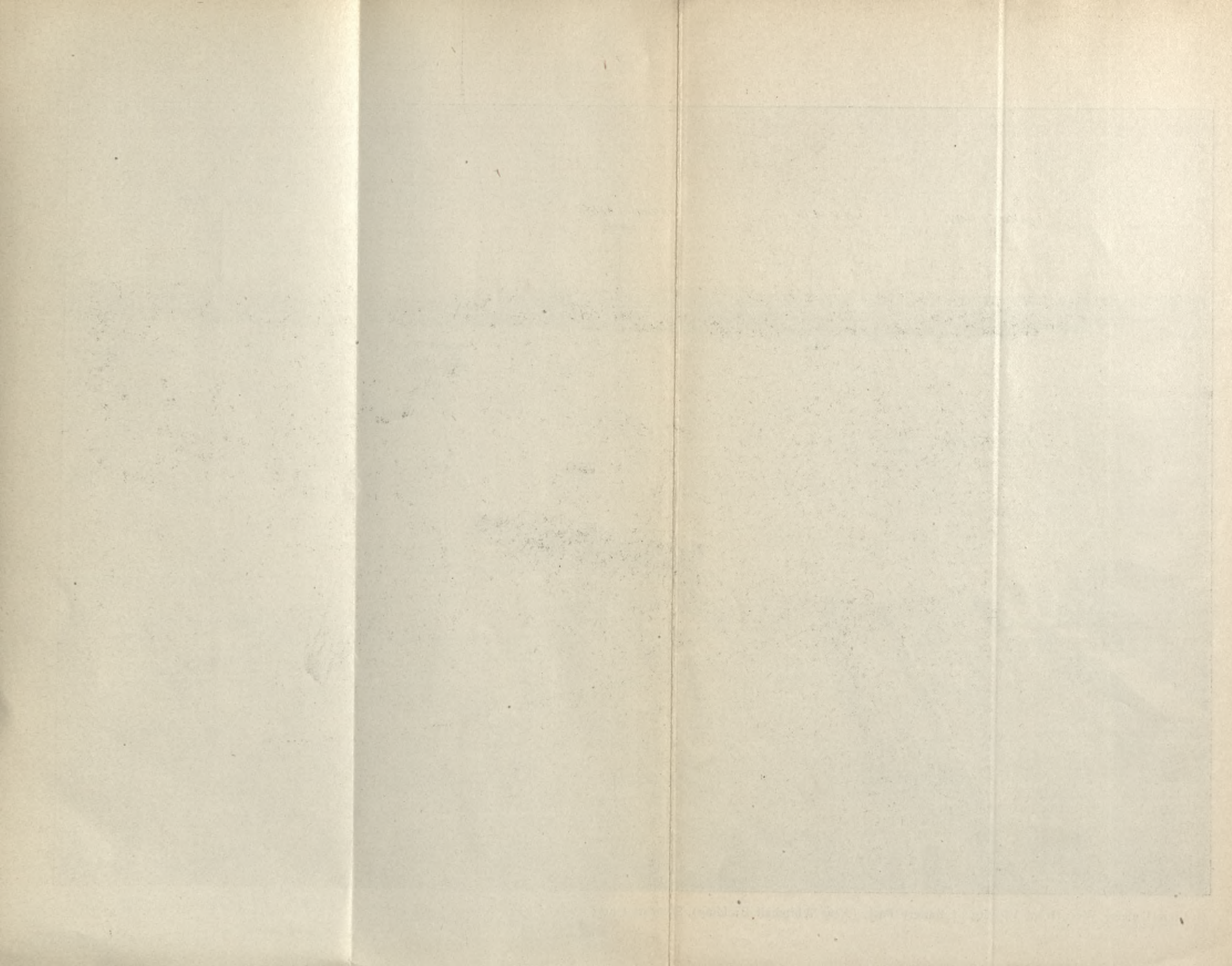


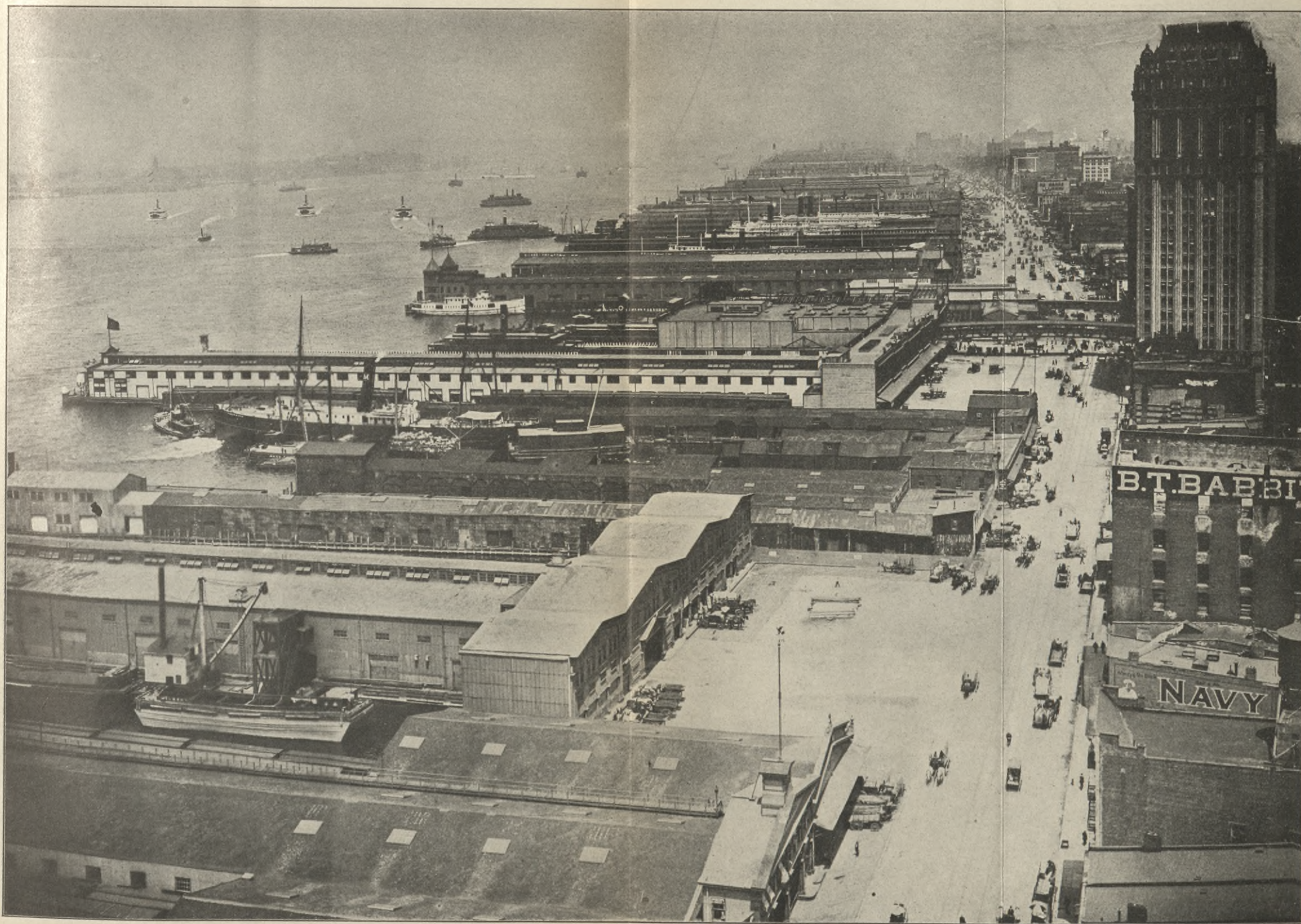
View of New York Harbor Looking South from Vicinity of Battery Park (Top of New Whitehall Building), Through the Narrows to Atlantic Highlands in the Far Distance.





View Looking West, from Vicinity of Battery Park (New Whitehall Building), Showing Outer Ends of Piers in Foreground with Jersey City in the Middle and Far Distance.





View Looking North from Battery Park (from Top of Whitehall Building), Showing the Marginal Street on the Right, Downtown Piers in the Middle of Photograph and the North River on the Left.





is the only route to and from the sea which avoids climbing the Allegheny Mountains. It provides the cheapest haul, and compels all other east and west railroads and coastwise steamship lines to come to New York, so that they may connect there with the ocean ferry service to the seaports of the world.

New York is preeminently the great port for partial cargoes and package freight by regular liner service. Comparatively few tramp ships come to New York to pick up cargoes; for this purpose they go to other Atlantic seaports. The special service which New York renders is that of providing ocean service at periodic sailing dates, to all parts of the world. This comprehensive and regular service has had the effect of attracting to New York, by all the rail and water lines leading to it, a preponderating proportion of the exports and imports of the country.

The port limits comprise both shores of the Lower and Upper Bay, with Arthur Kill and Kill Von Kull, and both shores of the North and East Rivers as far as and including the City of Yonkers on the North River, and as far as Port Morris on the East River.

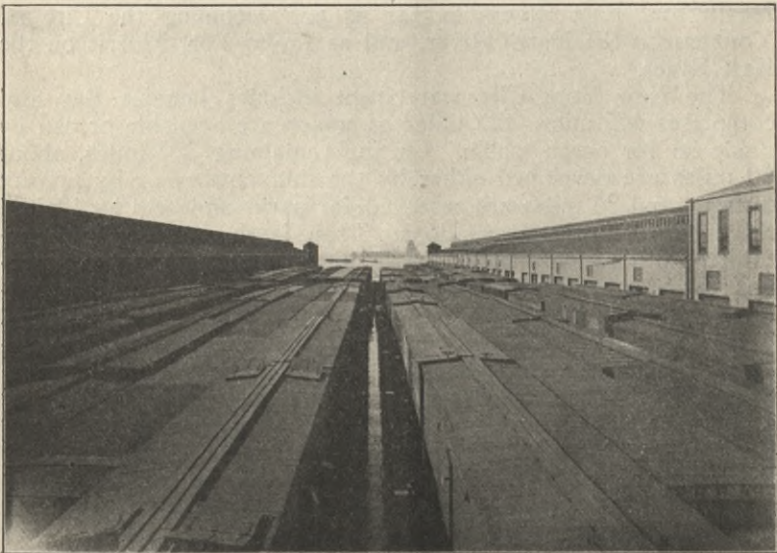
The New York City waterfront includes Jamaica Bay and comprises 445 miles, 125 miles of which are available or can be made so for ocean traffic. Of the remaining 320 miles, about 60 miles are developed either by the municipality or by private owners, and 26 miles are reserved for parks and held by United States Government reservations. There is, therefore, vast opportunity for development on more modern lines than have prevailed or been essential during the first forty years of port administration by New York City, through its Department of Docks. To meet this more modern idea of port development, the Commissioner of Docks has now under consideration extensive improvements, notably at South Brooklyn; at Brooklyn and Erie Basins; at Jamaica Bay; from Stapleton to St. George, Staten Island; at Fresh Kills, Staten Island, and along the lower and middle North River waterfront of Manhattan.

## II.—THE ACTIVITIES OF THE PORT.

These include the most extensive manufacturing industries in the United States; the handling of their raw materials and finished products of their manufacture. New York is a receiving and distributing station both for local consumption and for interior, coastwise, transatlantic and foreign commerce, and requires the co-ordinated use of its waterways by every imaginable class of floating craft from the mammoth transatlantic liner to the smallest launch.

Here, too, the great marine terminals crowd each other for passengers and freight, together with the great railroad terminals

of the principal trunk lines. The main railroad terminals, with the exception of the New York Central and the New York, New Haven and Hartford, are distributed along the New Jersey shores of the port, and must use the waterways of the port for transport between the train (New Jersey) terminals and the corresponding water stations, freight yards, etc., in the boroughs which make up the Greater City of New York, principally in Manhattan. Car floats, operated by tugs belonging to the different railroads, carrying trains of as many as twenty-two freight cars each, afford the principal means for this transportation. Cars arriving from all over the country in the morning are received at the local water stations, unloaded and loaded again, returning to the main terminals in the late afternoon. The railroad companies also use covered barges, operated by tugs, for local transportation—principally of flour, hay and grain.



Congestion of Slip Between Two North River Piers by Car Floats.

In addition to the traffic of coastwise, transatlantic and foreign shipping vessels, steam and sailing, the activities of the port include the shipment and receipt of local traffic by barges, canal boats, the regular line of steamboats operating on the North and East Rivers, and Long Island Sound, lighters, ferryboats, floating elevators, and a large variety of river and harbor craft, not to speak of the innumerable pleasure craft and excursion steamers

carrying passengers and freight to the pleasure resorts in and adjacent to New York Harbor.

The volume of tonnage engaged in the foreign trade is one of the principal standards for measuring the greatness of a seaport. During the decade ending in 1910, the total net tonnage of vessels entered and cleared at the Port of New York increased from 16,800,000 in 1901 to 25,600,000 in 1910, or an increase of 65 per cent. For the year ending June 30, 1911, the net tonnage entered was 13,428,950, and the net tonnage cleared was 13,366,893, or a total net tonnage of 26,795,843. The apparent increase therefore is at the rate of about one million tons per year. In so far as the volume of tonnage is concerned, the Port of New York is without a rival. It handles four times that of Boston, the second port in the country. The total value of exports and imports is nearly eight times that of any other port in the country, and its actual annual value during the year 1910 was \$1,587,977,314.

The increase in value of foreign commerce of the Port of New York in 1910 over that of 1909 exceeded the total foreign commerce of Boston for that period, and completely demonstrates the relative importance and position of New York compared with other American ports.

Compared with the whole United States, New York's share of the exports for the fiscal year ending June 30, 1911, was 37 per cent. Its share of the imports during the same period was 57 per cent., and of exports and imports, 46 per cent.

In comparison with the tonnage entered and cleared and the value of foreign trade of other leading ports of the world, the following statement from "Statistical Abstract of United States, 1910," will show where New York stands in these two important indications of port activity.

(The figures shown are for the latest available year, generally 1910, furnished by A. R. Smith, Secretary to the Barge Canal Commission.)

Port.	Tonnage.		Value of Foreign Trade.		
	Entered.	Cleared.	Imports.	Exports.	Total.
London .....	11,605,698	8,622,316	\$1,000,746,471	\$569,256,326	\$1,570,002,797
Liverpool .....	7,747,994	6,593,094	723,146,970	728,131,030	1,451,278,000
Hamburg .....	11,061,041	11,247,191	810,179,970	578,343,753	1,388,523,723
Antwerp .....	11,907,689	11,894,492	529,626,422	444,845,196	974,471,619
New York.....	13,042,818	12,541,903	935,990,958	651,986,356	1,587,977,314

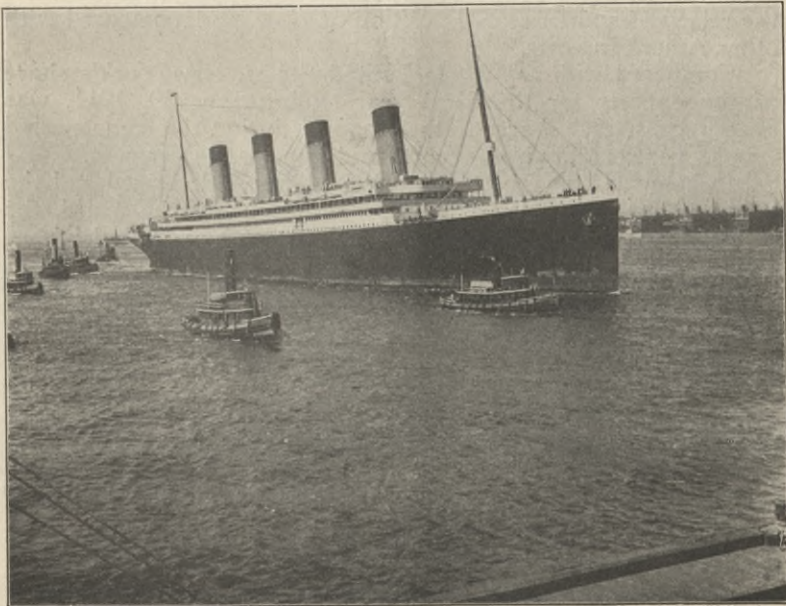
Of the ocean passenger traffic of the entire country, about 90 per cent. passes through the Port of New York.

An estimate of the total water movement in the port, that is, shipments and receipts, taken from the United States 1906 Census Report on "Transportation by Water," the most recent authoritative statement in this respect, shows a total annual ton-

nage of every description of 113,969,000 tons, of which 25,000,000 tons represents the traffic in exports and imports, 34,000,000 tons the traffic in American vessels, and 55,000,000 the harbor traffic.

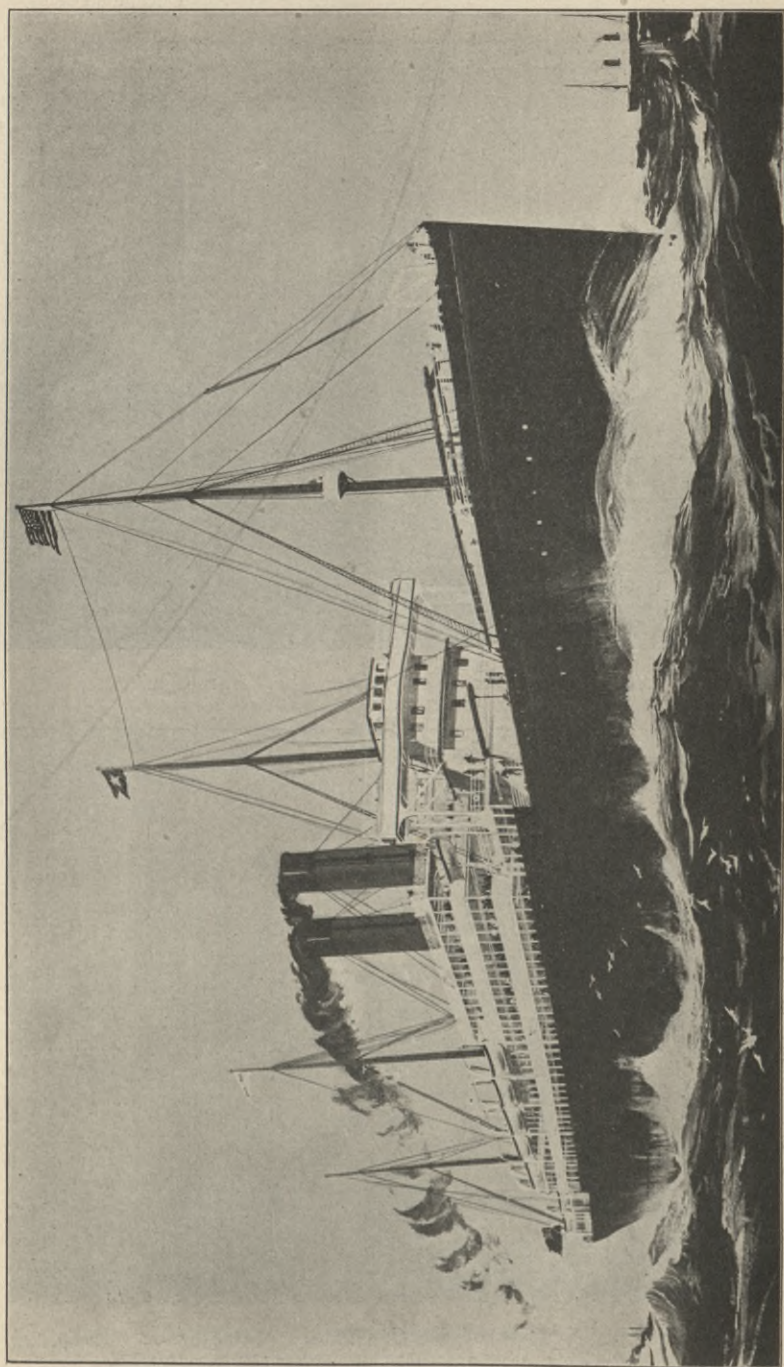
The largest transatlantic freighter, such as the "Baltic," the "Cedric," or the "Minneapolis," has a cargo carrying capacity of about 12,000 tons, and if the aforesaid annual tonnage of the port were concentrated in the transatlantic freight carrying business, it would require 9,500 steamers of the "Baltic" type to carry this annual tonnage in one trip, or 280 steamers of this type, making continuous round trips throughout the year without laying up for repairs.

As before stated, the water movement of the traffic and commerce of the Port of New York is carried on by every conceivable type of craft, the most important of which are the transatlantic liner, the transatlantic freighter, the coastwise steamer, and the foreign or tramp steamer. The photographic illustrations show one of each of these types. In addition to these are



White Star Steamship "Olympic."

various types of sailing vessels, from the full-rigged ship down to the common sloop, tank steamers for oil, sailing lighters, steam lighters, floating grain elevators, floating coal conveyors, coal barges, canal boats of every description, covered barges for trans-



A White Star Transatlantic Freight Steamer, the "Baltic."



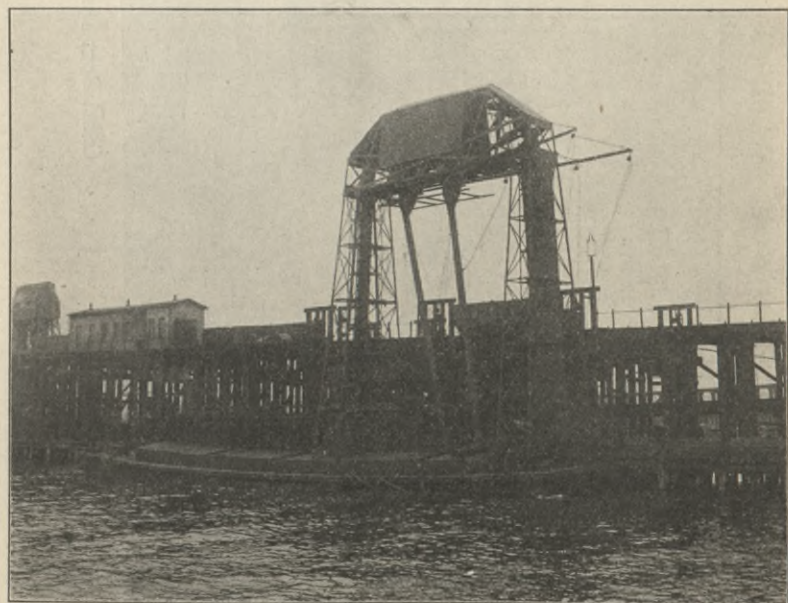
Ward Line Coastwise Steamer, the "Saratoga."



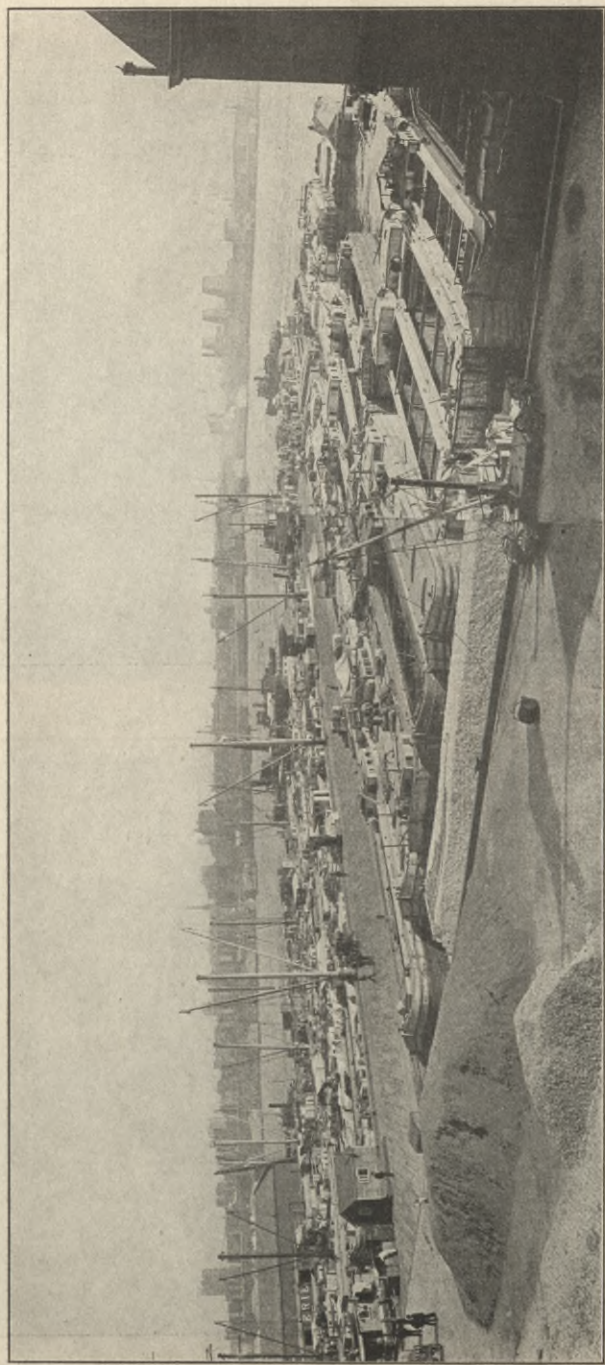
Steamer "Irak," Type of Foreign Freight Steamer or Tramp.



Type of "Steam Lighter."



Type of Floating "Coal Conveyor."

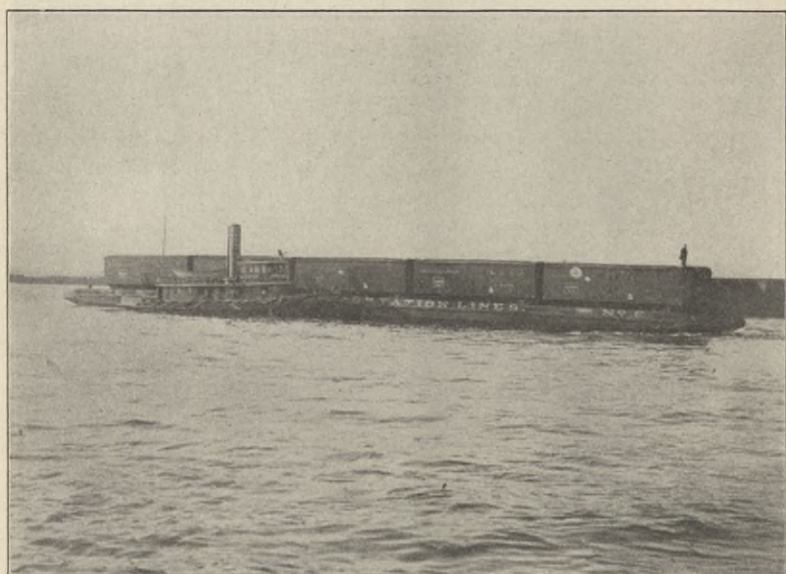


Canal Boat District, Lower East River.

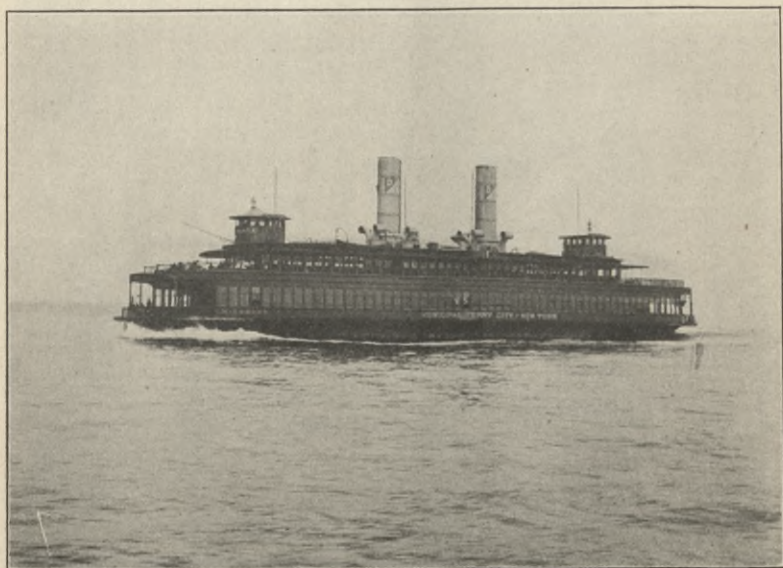




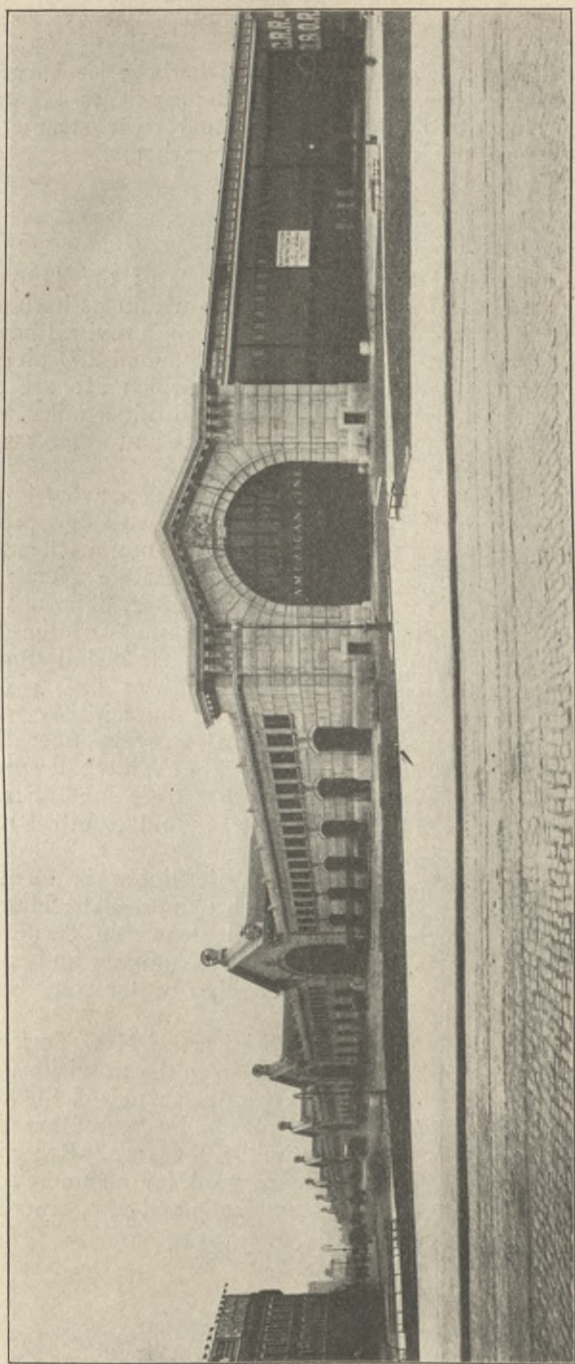
New England Navigation Company's Steamboat, the "Commonwealth," Passing up the East River.



Type of "Car Float."



Municipal Ferryboat "Richmond."



25 Chelsea Section Steamship Terminal on the North River, Manhattan; View of Street Front Looking South from West Twenty-third Street.

porting flour, hay and grain within the harbor; ice barges and scows for broken stone, sand and cement; car floats, ocean tugs, river tugs, dynamite launches, sound and river steamers and many types of excursion steamers and ferryboats.

### III.—FACILITIES OFFERED.

For the accommodation of great vessels of the "Olympic" type down to the smallest vessel that plies within its harbor, The City of New York has up to the present time provided bountiful wharfage facilities. It has built and maintained 260 piers, distributed among the several boroughs, of which 215 are on the shores of Manhattan; between eight and nine miles of sea wall bulkhead, with numerous freight sheds and other essentials of up-to-date wharfage requirements.

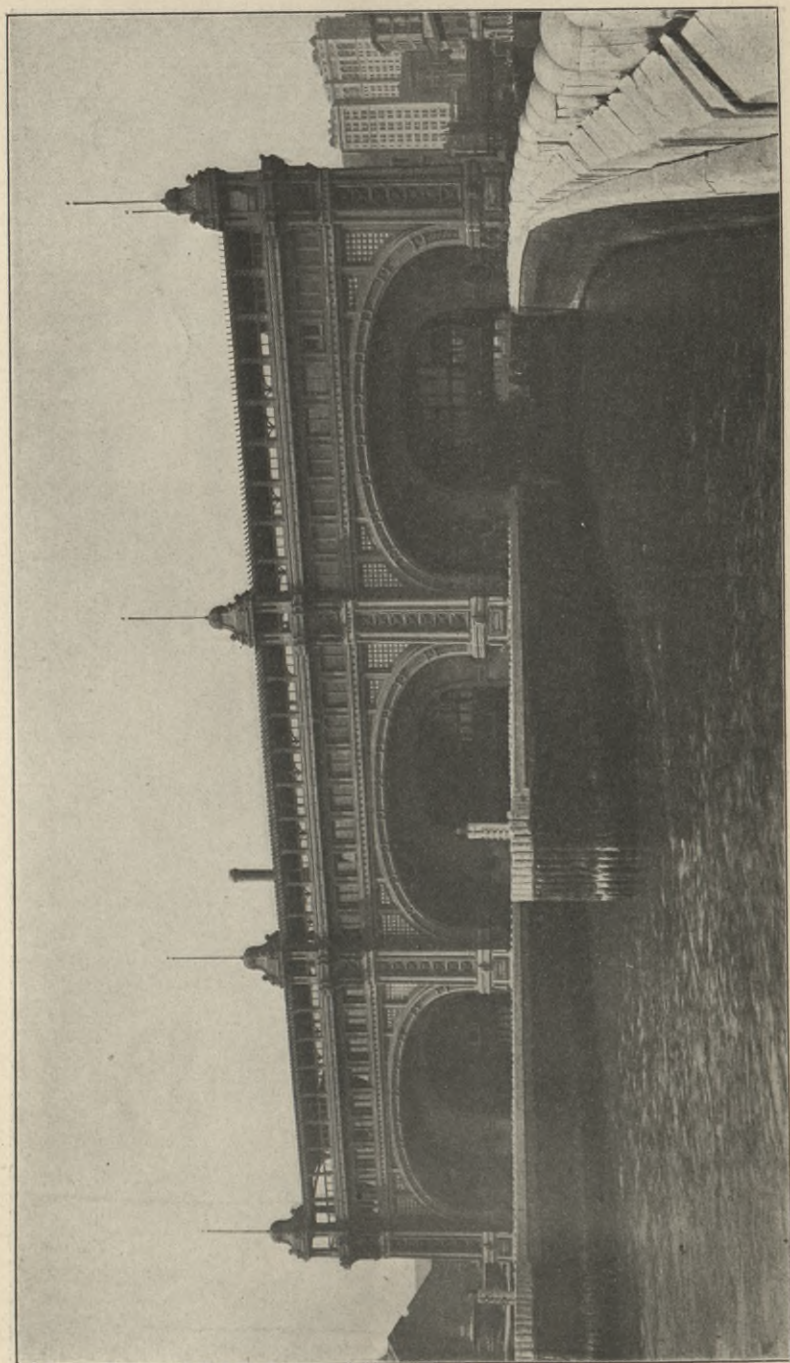
The highest type of this development exists at what is known as the Chelsea section, where nine large two-story piers are installed, connected at the inshore by a continuous head-house covering a half mile of the Manhattan middle North River waterfront. These piers are equipped with heat, light and power for unloading and loading vessels; and steamers of the "Lusitania" type are berthed with ease, the complete installation being probably the finest steamship terminal in the world.

In addition to its piers and slips, the municipality of New York has built five large ferry terminals for the operation of the municipal ferry service between the Whitehall and St. George Terminals; between the South street and Stapleton Terminals, and between the South street and South Brooklyn Terminals.

A large installation for transatlantic liners is located in Hoboken (New Jersey shore), at which point are the Hamburg-American and the North German Lloyd Steamship Terminals.

The miscellaneous foreign steamship commerce finds accommodation principally along the Brooklyn waterfront between Bay Ridge and the Navy Yard.

A description of the features of the Port of New York would hardly be complete without some allusion to the provisions which The City of New York has made for its people of the thickly populated districts, who have few means for recreation during the summer season. The City has built eight large "Recreation" piers, the lower stories of which are used for commercial purposes and the upper stories for promenade and rest, where band concerts are regularly conducted.



River Portal of the South Street Municipal Ferry Terminal.



Promenade Deck of a Recreation Pier During Dancing Exercises.

## IV.—POLICY AND CONTROL.

Outside of the matter of administrative jurisdiction the absolute control of waterfront property depends, of course, upon ownership. In so far as The City of New York is concerned, this ownership is divided between private individuals and the municipality. Up to the present time the City holds 18 per cent. of the entire waterfront of Greater New York—52 per cent. of which is in the Borough of Manhattan. Its ownership comprises the land under water as well as the contiguous upland or right of wharfage, and has been established through Colonial charters, namely, the Dongan, the Cornbury and the Montgomerie Charters; by legislative enactments from time to time; by grants from the Commissioners of the Land Office, whereby the State has relinquished land under water to the City; by cession from private owners; by purchase under agreement and by "condemnation" or expropriation.

From 1665, when the City government, under a Mayor, Alderman and Sheriff, was established by the English Governor Nicoll, to 1798, substantially nothing was done by the City itself in the matter of waterfront improvement. Subsequent to 1798, however, the City attempted such improvements as West street and Thirteenth avenue along the North River waterfront, and South street and Tomkins street along the East River waterfront, but for a long time was in no financial condition to undertake any systematic improvement. Most of the wharves, piers and slips built during the period comprising the century preceding the creation of the Department of Docks were, therefore, built by private parties or individual owners, the land under water having been conveyed by the City for this purpose to individuals in the name of water grants. During this period the City relinquished about 95 per cent. of its waterfront on both rivers by this practice.

This policy, however, was reversed when the Dock Department was organized in 1870, and continuous efforts have since been made to obtain absolute control through ownership of the waterfront by The City of New York. The City is now engaged from time to time, as necessary improvements demand it, in the endeavor to acquire either by private purchase or by condemnation proceedings the very property that in former years it surrendered to private owners, as well as property outside of Colonial grants to the City which private owners have acquired from the State of New York.

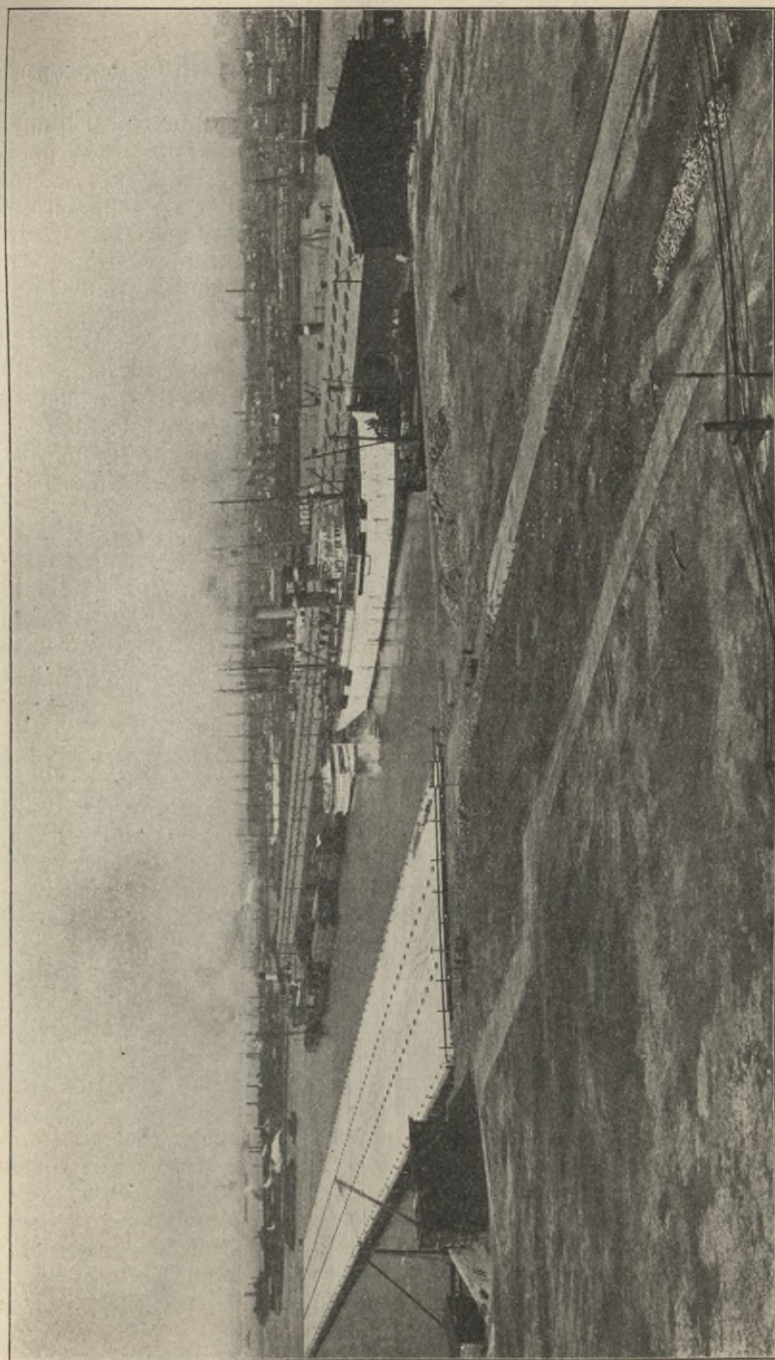
In somewhat like manner The City of New York has been obliged to learn by experience the folly of making long-term leases of its improved property, as had been done up to the year 1910. But when in that year it became necessary to modernize

already completed portions of the waterfront the City was confronted with the alternatives of postponement or the cancellation of some of these leases. As a consequence, the policy of long leases has been changed for that of leases for ten years with privilege of renewal (where the lessee makes permanent and extensive improvements on leased property), with the condition that the City may at any time, before the expiration of ten years, take back the leased property on payment of a proper and equitable portion of the cost of such improvements. Yearly permits are issued for the occupancy of City improved waterfront, revocable at any time at the will of the Commissioner. In this way, supreme control and authority in the initiative and execution of improvements of the New York City waterfront is concentrated in the hands of the Dock Commissioner, subject to the approval, in certain matters, by the Commissioners of the Sinking Fund, or by the Board of Estimate, the financial representatives of the City.

#### V.—CONSTRUCTION.

In carrying out this extensive work, the Department of Docks has adopted standards of construction for piers, bulkheads and sea wall, which are the result of long experience with the varying conditions controlling such work, using timber both for piers and sea wall in the sewage-tainted waters of the harbor. Below mean low water deterioration from decay is practically impossible, and this condition prevails in the filling in the rear of the sea wall, through which the tide ebbs and flows, as well as out in the open waters. Were it not for the ravages of the sea worm or teredo, this same construction could be used along the entire waterfront. But though the sea worm cannot and does not exist in those portions of the harbor affected by sewage pollution, wherever clean sea water predominates to such an extent as to make the dilution almost complete, steps are taken for the protection of piles and timber, so exposed, by creosoting. For such exposures, and latterly for the more extensive work on the entire waterfront, the use of concrete piles has been urged. But there are so many troublesome features attending the fabrication, the handling and the driving of concrete piles into bottoms of so greatly varying character as those which surround the waterfront of New York, as well as the necessity for so carefully constructing a concrete pile as to place the question of corrosion of the reinforcing steel beyond all doubt, that the question of expense becomes a most serious obstacle to their use. And outside of the question of percentage of revenue, the justification for such expense is questionable when, as a rule, timber piles will outlive the commercial life of such a structure.





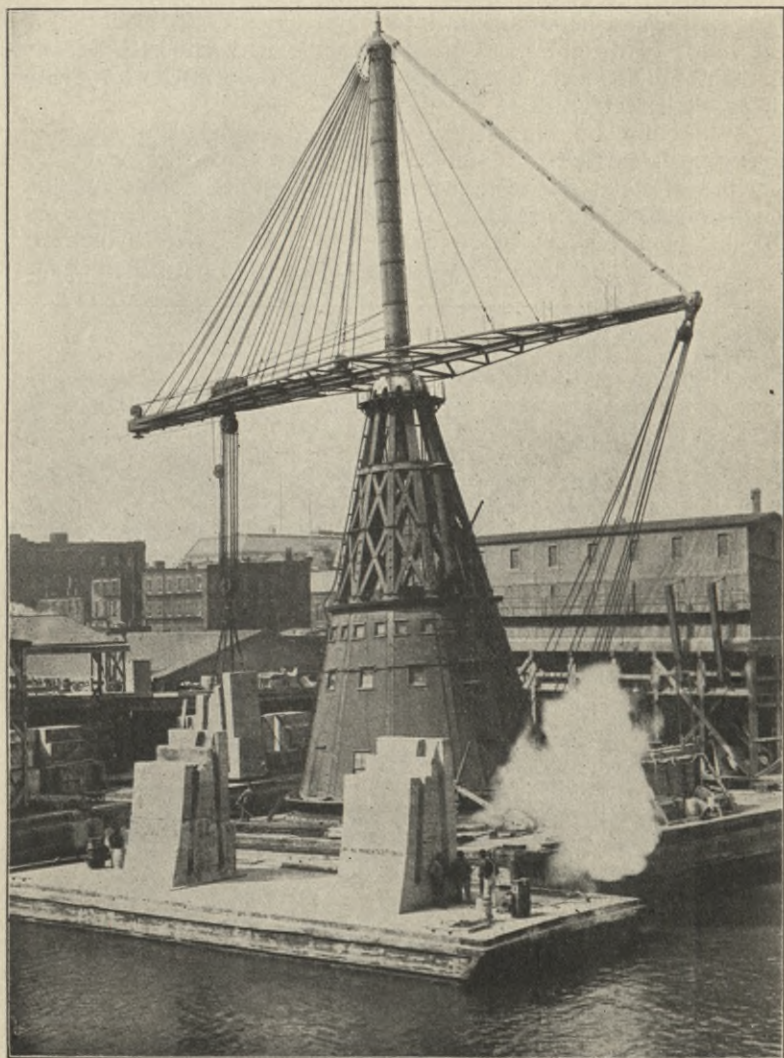
Two Recently Constructed Piers from 1,500 to 1,600 Feet Long at South Brooklyn, the one to the Right Covered with a Single Story Freight Shed, the Other One Ready to Receive a Freight Shed. The Decks of these Piers are Steel Reinforced Concrete,

A pier is ordinarily a wooden structure throughout, supported upon vertical piles braced with inclined piles. In a general way, the piles are capped or clamped in rows, braced with horizontal and diagonal bracing. Upon the cross caps, rangers or floor beams are laid, carrying the deck system or the pier floor construction. Thus a pier consisting of innumerable joints is a very elastic structure, and should be an elastic structure, for a vessel like the "Lusitania," for instance, moving with a tidal velocity alone during the operation of docking, would create an impact of several million foot pounds. This destructive energy must be stopped by something. Will the pier stop it? Or must the vessel itself meet and check it? With an elastic pier this work is distributed throughout the structure because of its elasticity and the vessel is saved from deformation.

There are four types of pier decks in use in the port. The deck may consist of a course of deck planking overlaid with a sheathing course for taking up the wear. Instead of the timber sheathing course the deck planking itself may be overlaid with six inches of concrete topped off with asphalt. A six-inch reinforced concrete deck, topped off with asphalt, may be laid directly upon the ranger or floor beam system. Or, the rangers may be entirely eliminated, and a 10-inch steel reinforced concrete slab, topped off with asphalt, may be laid directly upon the capping system. These various types of decks are used according to the importance of a pier structure.

Passing from piers to the sea wall, the construction of the latter is controlled almost entirely by the character of the river bottom. If the bottom is rock within 40 feet of the surface and the material over that rock is soft, the rock is dredged off, pumped clean and the sea wall based on a foundation of bag concrete brought up to construction level with the aid of divers. Upon this, successive tiers of concrete blocks are laid, up to about mean low water, also with the aid of divers. Above these blocks the wall is usually faced off with granite, backed up by mass concrete, carried up to the street grade. The concrete blocks used in the construction of the sea wall weigh from 25 to 95 tons each, are molded in air at the Department yards, shipped on scows to the work and handled with a 40-ton or a 100-ton derrick.

Where the river bottom is of such a character that piles can be driven into hard clay, sand or other hard bottom, the softer material is removed by dredging to about 30 feet below mean low water, after which piles are driven for foundation purposes, cut off at a grade of about 15 feet below mean low water and fortified by an embankment of riprap and cobble brought up to the grade of the tops of the sawed off piles. Upon these piles a



The Dock Department's 100-Ton Derrick Shifting Recently Fabricated Bulkhead Wall Blocks from Bulkhead to Scow for Shipment to Distant Points.

single tier of concrete blocks, weighing in the neighborhood of 80 tons each, is laid, with an intervening mattress of concrete on the heads of the piles. A granite facing with concrete backing is then built from the top of the blocks at about mean low water up to the street grade.

Where the bottom is soft beyond the penetration of piles, dredging is carried to about 35 feet below mean low water for a width of about 100 feet, and after a riprap and cobble embankment has been started the foundation piles are driven and cut off at about 15 feet below mean low water, after which the embankment is completed up to the tops of the cut off piles and



Congestion on the Marginal Street About 10 A. M.

finished with concrete blocks and granite facing. In this type the wall is relieved from the pressure due to filling by a platform in the rear supported upon vertical piles, braced with inclined piles and decked over at mean low water, forming an integral part of the wall. After the granite facing and concrete backing in all types are carried up to grade, a riprap embankment is deposited in the rear of the wall, with a top width of about 10 feet at a grade of about 5 feet above mean low water. Behind and over this the filling in the rear of the wall is deposited, carrying the filling shorewards from the wall. After the filling has ceased to settle the area in the rear is graded up, and upon this the permanent pavement is laid.

A general description of the sea wall construction as practiced by the Department of Docks in the Harbor of New York would hardly be complete without a reference to the surprisingly satisfactory results realized from the type of wall built on soft mud bottom. In one particular stretch of the waterfront, namely, the Chelsea and Gansevoort sections, the rock is 175 feet below low water, and consequently so far beyond the reach of pile penetration that the wall is a structure supported by mud flotation and has never given any trouble other than what was anticipated in the matter of settlement, which, during the period of settlement, amounting to four feet and over, was remedied by adding extra courses of granite to the top where required.

#### VI.—SCALE OF EXPENDITURE.

The City of New York has been and is so wide awake and alive to the principles of conservation of its natural opportunities that, covering the period of forty years marked by the organization and operations of the Department of Docks, it has spent \$32,260,000 for the acquisition of property; \$56,173,000 for the construction of piers and bulkheads; \$2,266,000 for the purchase of property for municipal ferry terminals; \$5,000,000 for the construction of ferry terminals themselves; \$3,000,000 for the construction and purchase of ferryboats, and \$2,500,000 for recreation piers, or a total of \$101,199,000.

This expenditure has been made at an ever increasing ratio. For instance, in 1871 the amount expended for the construction of piers and bulkheads was \$314,000. In 1909, the corresponding expenditure was \$6,754,000, and the Dock Department has now under study new facilities for handling the vast tonnage, not only of imports and exports, but of local commerce as well, which it is estimated will cost some \$70,000,000.

In a report by the Comptroller of The City of New York, dated June 7, 1911, to the Board of Estimate and Apportionment, he states: "The current net revenue received by the City from the operation of all the properties under the jurisdiction of the Department of Docks and Ferries, as of December 31, 1910, was \$3,068,672.13, this figure representing yearly gross revenues of \$5,521,901.08, less expenses of operation and maintenance and depreciation in the value of ferryboats and other floating plant for the year 1910, aggregating \$2,453,228.95."







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