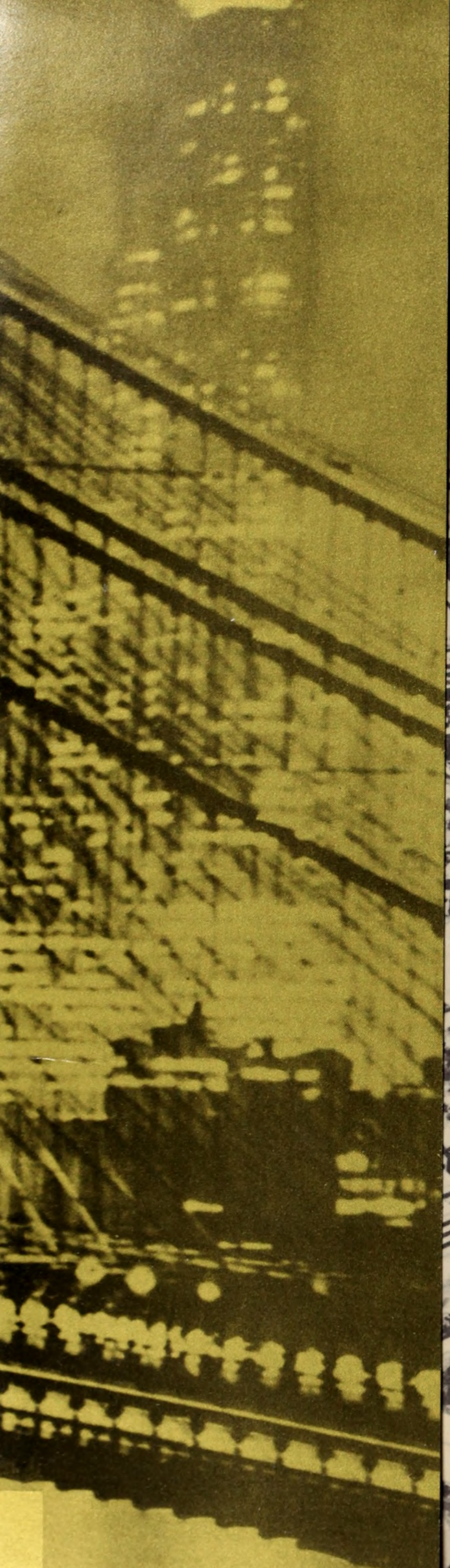
E. Frederick

-the similitudes of the past
d those of the future,
e glories strung like beads . . ."

new

old **BROOKLYN BRIDGE**





BROOKLYN CIVIC CENTER, *one of the greatest redevelopment projects in the country, involves not only modernization of Brooklyn Bridge and its approaches but also new traffic interchanges, widened streets, new public buildings, housing, parks and general beautification.*



modernized

Brooklyn Bridge

Souvenir Presentation

OFFICIAL OPENING

of Modernized Bridge

MAY 3, 1954

THE HON. ROBERT F. WAGNER, MAYOR
THE CITY OF NEW YORK

RECONSTRUCTION AND MODERNIZATION UNDER SUPERVISION OF
DEPARTMENT OF PUBLIC WORKS
FREDERICK H. ZURMUHLEN, P.E., R.A., COMMISSIONER
J. FRANK JOHNSON, P.E., DIRECTOR, DIVISION OF BRIDGES
DAVID B. STEINMAN, CONSULTING ENGINEER

PUBLISHED WITH THE COOPERATION OF CO-SPONSORS: DOWNTOWN MANHATTAN ASSOCIATION, INC.; DOWNTOWN BROOKLYN ASSOCIATION, INC.

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Crossing Brooklyn Ferry

Flood-tide below me! I see you face to face!
Clouds of the west—sun there half an hour high—I see you also face to face.
Crowds of men and women attired in the usual costumes, how curious you are to me!
On the ferry-boats the hundreds and hundreds that cross, returning home, are more curious to me than you suppose,
And you that shall cross from shore to shore years hence are more to me, and more in my meditations, than you might suppose.

The impalpable sustenance of me from all things at all hours of the day,
The simple, compact, well-join'd scheme, myself disintegrated, every one disintegrated yet part of the scheme,
The similitudes of the past and those of the future,
The glories strung like beads on my smallest sights and hearings, on the walk in the street and the passage over the river,
The current rushing so swiftly and swimming with me far away,
The others that are to follow me, the ties between me and them,
The certainty of others, the life, love, sight, hearing of others. ***

"The similitudes of the past and those of

Flow on, river! flow with the flood-tide, and ebb with the ebb-tide!
Frolic on, crested and scalloped-edg'd waves!
Gorgeous clouds of the sunset! drench with your splendor me, or the men and women generations after me!
Cross from shore to shore, countless crowds of passengers!
Stand up, tall masts of Manhattan! stand up, beautiful hills of Brooklyn!
Throb, baffled and curious brain! throw out questions and answers!
Suspend here and everywhere, eternal float of solution!
Gaze, loving and thirsting eyes, in the house or street or public assembly!
Sound out, voices of young men! loudly and musically call me by my nighest name!
Live, old life! play the part that looks back on the actor or actress!
Play the old role, the role that is great or small according as one makes it!
Consider, you who peruse me, whether I may not in unknown ways be looking upon you;
Be firm, rail over the river, to support those who lean idly, yet haste with the hasting current;
Fly on, sea-birds! fly sideways, or wheel in large circles high in the air;
Receive the summer sky, you water, and faithfully hold it till all downcast eyes have time to take it from you!
Diverge, fine spokes of light, from the shape of my head, or any one's head, in the sunlit water!
Come on, ships from the lower bay! pass up or down, white-sail'd schooners, sloops, lighters!
Flaunt away, flags of all nations! be duly lower'd at sunset!
Burn high your fires, foundry chimneys! cast black shadows at night-fall! cast red and yellow light over the tops of the houses!
Appearances, now or henceforth, indicate what you are,
You necessary film, continue to envelop the soul,
About my body for me, and your body for you, be hung our divinest aromas,
Thrive, cities—bring your freight, bring your shows, ample and sufficient rivers,
Expand, being than which none else is perhaps more spiritual,
Keep your places, objects than which none else is more lasting.
You have waited, you always wait, you dumb, beautiful ministers,
We receive you with free sense at last, and are insatiate henceforward,
Not you any more shall be able to foil us, or withhold yourselves from us,
We use you, and do not cast you aside—we plant you permanently within us,
We fathom you not—we love you—there is perfection in you also,
You furnish your parts toward eternity,
Great or small, you furnish your parts toward the soul.

—WALT WHITMAN

AVERY

he future, The glories strung like beads . . ."



Symbol of Greatness

By ROBERT F. WAGNER
Mayor, The City of New York



Among the relatively few historic structures remaining in our city there are a number older than the BROOKLYN BRIDGE. But there is none, I believe, which has so stirred the popular imagination – none which better symbolizes the unity and greatness of New York City.

When Brooklyn Bridge opened for traffic in 1883, the population of Manhattan was about 1,200,000 and of Brooklyn 600,000. The economic incentives which underlay the need for better transportation facilities between the old City of Brooklyn and the City of New York – then comprising only Manhattan, have persisted to this day. The people of Brooklyn demanded quicker and more reliable means of access to Manhattan. And as those improved facilities have been provided, beginning with the Brooklyn Bridge, the effect has been to further the growth and development of both boroughs . . . until the population of Brooklyn has far outstripped that of Manhattan, Brooklyn's now being estimated at 2,825,000 and Manhattan's at 2,004,000.

Brooklyn Bridge, its mighty arches carrying the multitudes from Brooklyn and the rest of Long Island to Manhattan, helped speed the inevitable consolidation of the present five boroughs of the City into Greater New York. Brooklyn Bridge was the first of the bridges which cemented the ties binding together the variegated interests of the millions who live and work together in the greatest city of the world.

As former Chairman of the City Planning Commission, as President of the Borough of Manhattan and member of the Board of Estimate, I have been intimately concerned with the problem of modernizing Brooklyn Bridge, providing modern access roads and traffic interchanges and planning for Manhattan Civic Center and related improvements. While I was Chairman of the Commission we prepared a plan for the Manhattan Civic Center, a similar plan for the Brooklyn Civic Center having been drawn previously. We noted in our report that the increased efficiency of Brooklyn Bridge resulting from its modernization would "aggravate the already vexatious congestion in the Manhattan Civic Center area if remedial steps are not taken." We pointed out that the existing street system was badly outmoded and that special opportunities existed for general replanning and correlation of public projects "in ways that would enhance civic values and stimulate private redevelopment."

Many of the improvements envisioned in that report already have been realized. Others are being progressed.

On the Brooklyn side, great advances have been made in constructing new approaches to Brooklyn Bridge, new expressways, redeveloping deteriorated areas and constructing new units in the beautiful Brooklyn Civic Center, including the new Domestic Relations Court Building, the Welfare Building, and the Remand Shelter and Jail. Construction of the new Supreme Court Building is to start this year.

We are well on the way toward realizing the dream of two great civic centers, fittingly and nobly joined together by the Brooklyn Bridge.

On behalf of the people of The City of New York I congratulate Borough President John Cashmore of Brooklyn, Borough President Hulan E. Jack of Manhattan, Construction Coordinator Robert Moses, Commissioner Frederick H. Zurmuhlen of the Department of Public Works, and all the other officials and engineers who have shared in realization of these plans to date. My congratulations also to the people of our city. Brooklyn Bridge, better than ever, is completely at their service once more.



MODERNIZED **BROOKLYN BRIDGE**, *still "a symbol of greatness."*

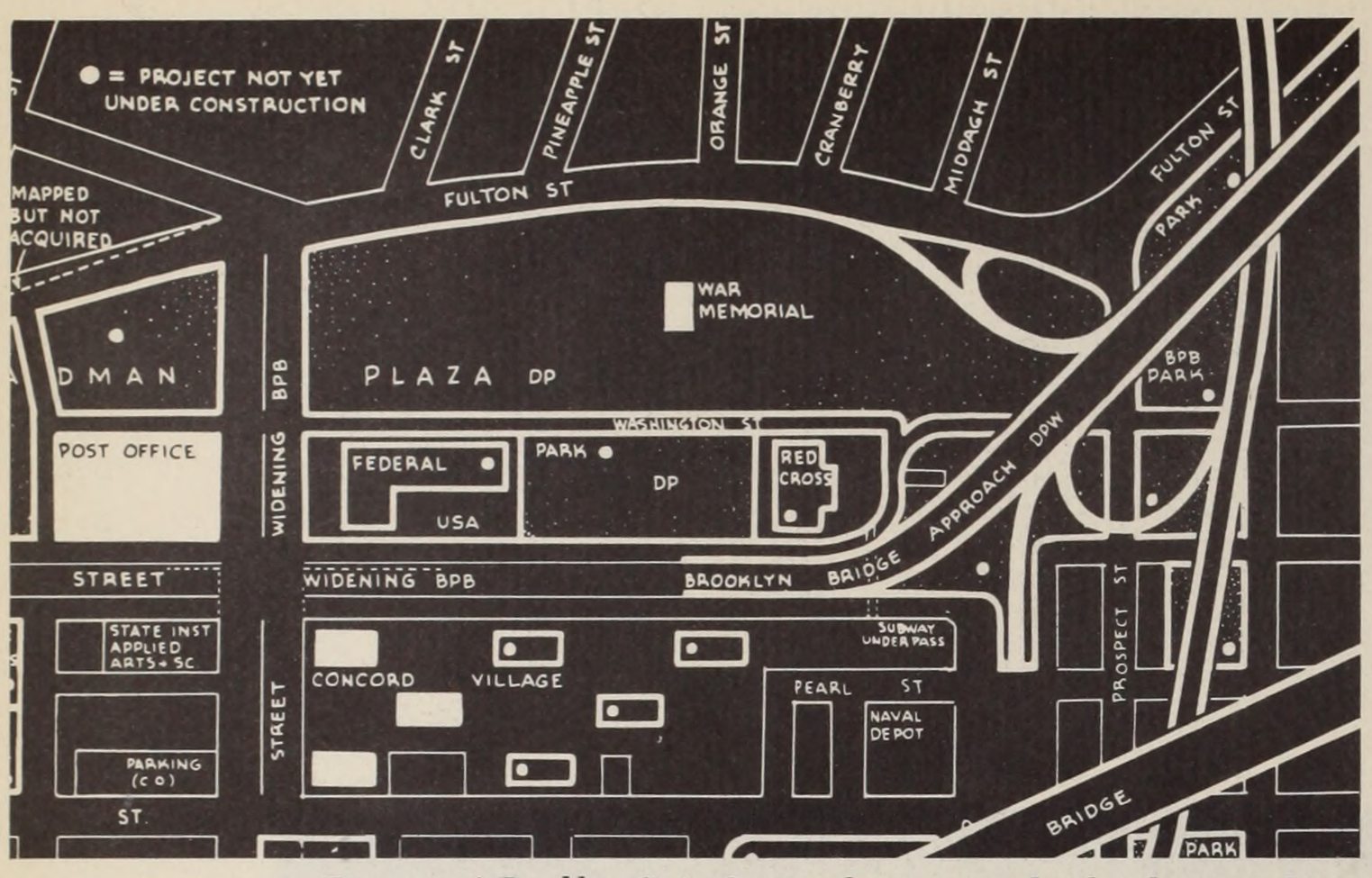




Diagram of Brooklyn Civic Center, showing completed and projected improvements, together with new Brooklyn Bridge approach link to widened Adams Street and connections to the Brooklyn-Queens Expressway. Above, artist's visualization of the completed civic center.

Magnificent Achievement

By JOHN CASHMORE
President, Borough of Brooklyn



The people of the Borough of Brooklyn have taken an intense interest in the reconstruction and modernization of the Brooklyn Bridge.

Like their fellow-citizens in the Borough of Manhattan, Queens, The Bronx and Richmond, they have realized the importance of this unique project and have eagerly awaited its completion.

Today, therefore, they are both pleased and proud to know that this magnificent improvement has been entirely completed and that this world-famous bridge, strengthened and rehabilitated and provided with new roadways, designed to carry three lanes of freely-flowing traffic in each direction between Brooklyn and Manhattan, is now being fully re-opened to the public.

As the President of the Borough of Brooklyn, I was particularly gratified at the opportunity to urge my colleagues in the Board of Estimate to authorize this improvement and to join them in providing the appropriations needed to allow this work to be performed.

Throughout the years since the opening of the Brooklyn Bridge on May 24, 1883, the people of Brooklyn have taken a great deal of pride in this graceful and beautiful structure, the first great suspension bridge erected by man and still regarded as one of the wonders of the world.

The people of what was then the old City of Brooklyn provided much of the enthusiasm for the construction of the bridge and were foremost in celebrating its completion after years of disappointment and great difficulties which its builders had to overcome before it became a reality.

For nearly 71 years Brooklyn and the Brooklyn Bridge have been inseparable. In an earlier period the bridge contributed much to Brooklyn's growth and development. Today, while newer and more modern facilities, like the Brooklyn-Battery Tunnel, serve to link Brooklyn with Manhattan and other parts of the metropolitan area, the Brooklyn Bridge is still an indispensable facility and continues to provide highly-essential service for the millions who use it throughout the year.

Although the modernization of the bridge is, of course, a city-wide improvement, which serves the entire city and, particularly, the city's business and industry, there is no doubt that this improvement is somewhat more important to Brooklyn than it is to the other boroughs.

The reasons for this are two-fold.

The reconstruction of the bridge coincides with vast improvements which the Office of the President of Brooklyn and other agencies of the city are making in Brooklyn's downtown section.

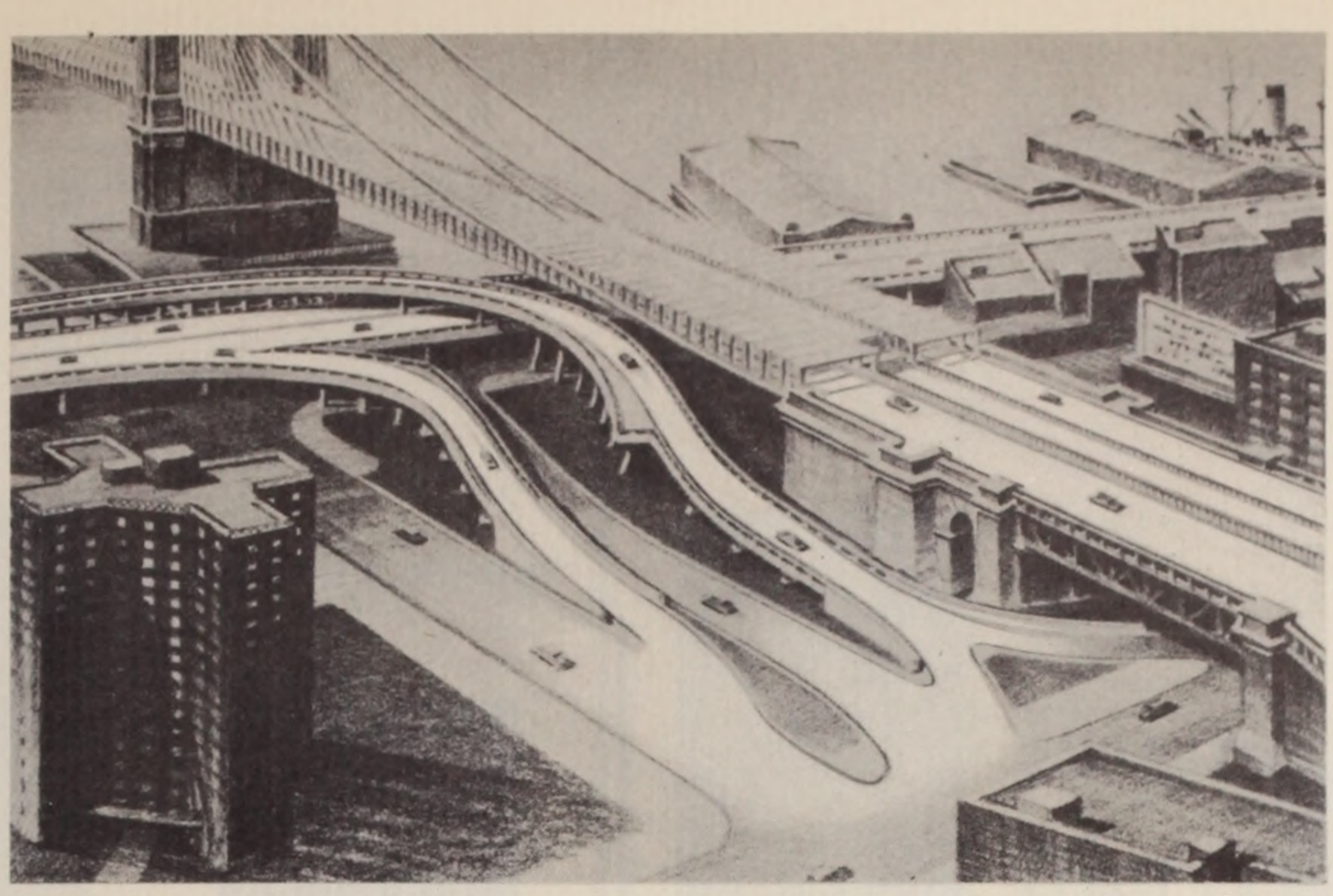
These improvements are taking place primarily in that part of downtown Brooklyn which lies between the century-old Borough Hall on the south and the newly-constructed approaches to the Brooklyn Bridge on the north. On the west this area is bounded by Fulton Street and on the east by Adams Street.

Today that area is becoming the new gateway to Brooklyn and forms the heart of the Brooklyn Civic Center. A huge civic transformation has taken place on a scale which few other municipalities have ventured to undertake and is converting this and other adjacent areas into one of America's finest examples of modern urban re-development.

It has been well stated that the Brooklyn Civic Center is more than a group of public buildings. Actually it consists of public buildings, expressways, public and privately-financed housing, parks and many other features.

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Construction of on and off-access ramps from the South Street Elevated Highway — bringing traffic to grade at Pearl Street, is expected to be undertaken in the coming year.

Modern Access to Brooklyn Bridge

By HULAN E. JACK
President, Borough of Manhattan

The Office of the President of the Borough of Manhattan has developed plans for the construction of traffic interchange facilities between the widened roadways of the BROOKLYN BRIDGE and the Borough street system. These facilities have been designed with the objective of taking traffic off the Bridge as expeditiously as possible.

Vehicles going downtown will swing to the right and pass under the Bridge through the Underpass to be built along the line of William Street and will continue up into Park Row without interruption to Broadway. Uptown traffic from the bridge will swing right into Lafayette Street or into Park Row going by way of New Chambers Street.

In order to remove the large volume of traffic which now moves north and south in front of the brideghead, Park Row traffic will pass under the bridge through the William Street Underpass. This will also take away from the Bridgehead the three bus lines that use Park Row to reach their southerly terminal at Broadway.

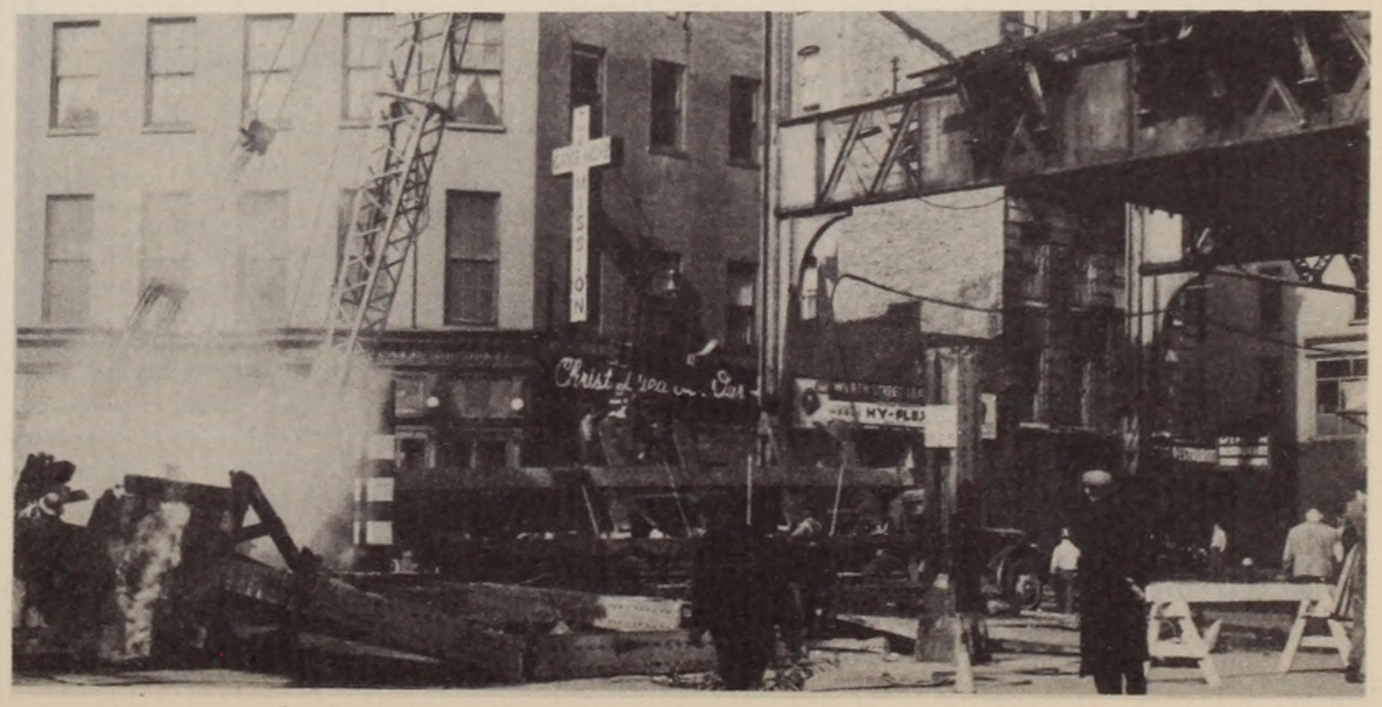
The presence of numerous public buildings and the stations of the IRT and BMT subway systems in this vicinity creates a large volume of pedestrian traffic which will be accommodated by the construction of underground passageways beneath the Bridge Plaza.

The development of the Plaza is further complicated by the necessity of reconstructing those areas of the roof of the subway structure which now support sidewalk areas and which will be required under the new plan to support highway traffic.

The Board of Estimate on January 15, 1953, authorized the acquisition of land required for the widening of Park Row, Chatham Square and Bowery, from New Chambers Street to Bayard Street, so that a roadway about 100 feet in width could be developed from the Brooklyn Bridge to the Manhattan Bridge. The old Elevated structure south of Chatham Square is now on its way to the scrap dealer's heap and the sun is now breaking through to lengthening stretches of the pavement along Park Row. Contracts for the demolition of buildings on the east side of the street are ready for advertising, and Park Row north of Chambers Street soon will be a greatly improved traffic facility.

Within the next few weeks, the South Street Viaduct will be opened to traffic. It is an elevated structure, a mile and a half in length, carrying six lanes of traffic over the busy East River Waterfront from the southerly end of the Franklin D. Roosevelt Drive at Jackson Street to the portal of the Battery Underpass at Coenties Slip. The elevated highway accomplishes a double improvement in traffic by providing for the rapid movement of through traffic and by simplifying the movement of trucks engaged in the various waterfront activities below the structure. We will have completed the highway belt around the southerly end of Manhattan Island by tieing the West Side Elevated Highway to the Franklin D. Roosevelt Drive.

Studies have been undertaken for the development of a means of providing for the uninterrupted flow of traffic between the West Side Highway and the Brooklyn Bridge. However, during the coming year, construction will be undertaken only of ramps required to bring traffic from the South Street Viaduct to grade at Pearl Street.



The light comes through as the Third Avenue Elevated is demolished from Brooklyn Bridge to Chatham Square.



Civic Center Milestone

By PERCIVAL ROBERT MOSES

President, Downtown Manhattan Association, Inc.

Reconstruction and modernization of BROOKLYN BRIDGE is one of the most important improvements in the redevelopment and beautification of the Manhattan and Brooklyn Civic Centers. Completion of this project carries lasting civic significance and benefits.

Our association was quick to recognize the importance of this project. We presented in 1950 the Association's Medals of Award to the Hon. Robert F. Wagner, who as Chairman of the City Planning Commission and Borough President of Manhattan, played so large a part in planning the Manhattan approaches; to Hon. Robert Moses, City Construction Co-ordinator, and to Dr. David B. Steinman, Consulting Engineer for the Bridge modernization.

Two years ago our William Randolph Hearst Gold Medal of Award was given to Hon. Frederick H. Zurmuhlen, Commissioner of Public Works, for his outstanding achievement of the year 1951 toward the "preservation and improvement of old New York in lower Manhattan" through modernization of the bridge.

In 1937 the City Hall Park Association (now the Downtown Manhattan Association) was incorporated. Its objectives have included the improvement of the entire downtown

(continued on page 20)



A Vital Transportation Link

By ROBERT E. BLUM

President, Downtown Brooklyn Association, Inc.

Brooklyn Bridge, once the "Eighth Wonder of the World," continues to symbolize the unity, the vast energy, the technical skill, and the spirit of progress which created and characterizes New York City.

At the time of its construction, this revolutionary bridge not only wrote one of the great chapters in the annals of engineering and building, but made an important contribution to our way of life by providing fast and convenient transportation between Manhattan and Brooklyn.

In 1883 few people could forsee how great an impact this structure of grace and beauty would have on both banks of the river. But soon, lower Manhattan mounted toward the sky and Brooklyn sprawled at a terrific rate in all directions – the man-made proximity of the two boroughs fostering their mutual growth.

Provision was made to permit elevated trains, trolleys and horse-drawn vehicles to cross the great Bridge, but there were no plans for adequate approaches on either side of the river. This, and a rapidly increasing population brought problems of nightmare proportions. Traffic soon flowed on two levels, through a narrow street system devised when Brooklyn was but a village. Twisting thoroughfares were choked with traffic and darkened by ungainly elevated structures. The resultant mixture of incompatible land uses and neighborhood deterioration caused blight and disorder in some of the best areas for over half a century.

Today we have a comprehensive plan for Downtown Brooklyn which is well advanced toward realization. The

(continued on page 20)



By ROBERT MOSES

City Construction Coordinator

Part of a Plan

Today we dedicate to the people of the City another completed link in the ever-expanding chain of arterial highways which skirt our shores, span our waterways and criss-cross our mainland.

The public officials entrusted with the construction of these improvements may be pardoned that certain sense of satisfaction which is theirs when a parkway, a section of expressway, a river crossing, or major reconstruction of existing facilities is completed. As these improvements take form and the pattern emerges it dawns on the public that each is part of an overall long range plan being completed uncompromisingly through the joint efforts of many public agencies, and by which the gap between mounting traffic and road construction is being slowly reduced.

BROOKLYN BRIDGE, the first bridge to connect Manhattan and Brooklyn, one of the first long-span suspension bridges to be built anywhere, and one of the City's historic landmarks, has been reconstructed at a cost of $7,000,000 by removing the old elevated and trolley tracks – relics of yesterday – and providing two new three-lane roadways. The characteristic aesthetic appearance of the structure, built into it with infinite care by its designer John A. Roebling, has been preserved practically intact. In spite of unavoidable delays, caused by strikes and material shortages, the Department of Public Works has done a most commendable job.

The Brooklyn approaches of the bridge are in the area around Cadman Plaza and Borough Hall designated as the Brooklyn Civic Center. The harmonious development of this Center with parks, street widenings, public and quasi-public buildings is well under way, and should progress at a more rapid pace. The Brooklyn Bridge connects with the Brooklyn-Queens Expressway, partly in use and partly under construction or being planned, which links the Gowanus Parkway in Brooklyn and the Grand Central Parkway in

(continued on page 19)



An Engineering Marvel

By FREDERICK H. ZURMUHLEN, P.E., R.A.

Commissioner, Dep't. of Public Works

The practiced eye of the engineer can discern many unusual elements in the design of the incomparable BROOKLYN BRIDGE. But even the engineer will fail to appreciate fully the significance of this beautiful suspension span – at one time the Eighth Wonder of the World – unless he is familiar with the dramatic achievements in bridge design and construction pioneered by the celebrated chief engineers of the bridge – the Roeblings, father and son.

The history of our country records many instances where necessity, the means and the man, obedient to some higher law, were brought together to make possible yet another deed of glory in the annals of mankind.

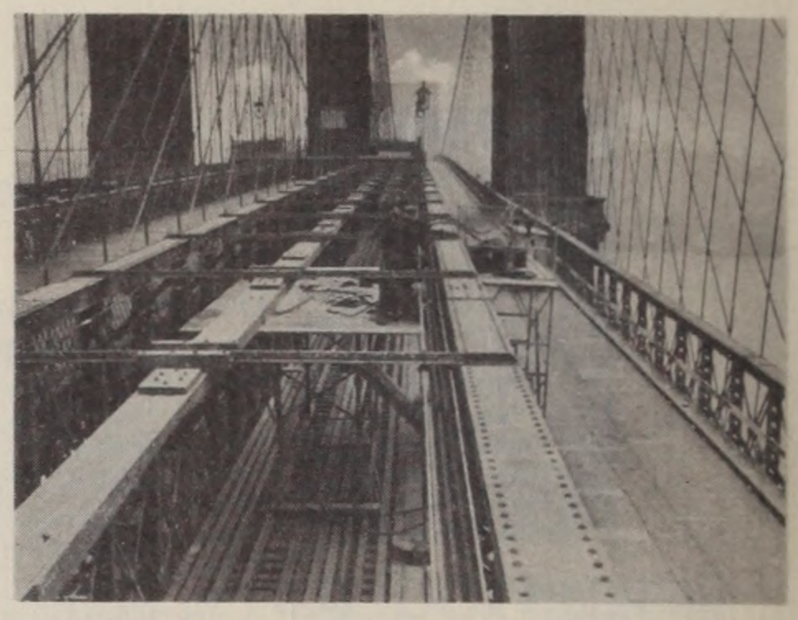
One such instance is to be found in the story of the Brooklyn Bridge. Destiny conjoined the need of the hour – a more expeditious and convenient form of transportation from the City of Brooklyn to the City of New York – with the technical advances adequate to the task and the man (for father and son can be regarded as one in this case) to carry the project to fruition.

Tremendous engineering problems had to be overcome at a time when the science of suspension bridge engineering was still in its infancy. The natural difficulties of building the tower foundations under water, constructing the timber caissons – the largest built up to that time, the methods devised for excavating and removing materials from the caissons, the design of the anchorages and securing the cables, the spinning and wrapping of the cables, the means for supporting and bracing the superstructure . . . all without the benefit of modern machinery, are not to be perceived by the naked eye. But these are some of the things which always will make the Brooklyn Bridge a monument to the

(continued on page 19)



Entrance to the Bridge from the Manhattan end, prior to reconstruction, with trolley turnaround in background.



Workmen remove rivets in the top chord splices in the middle truss for reuse on top of the outer truss, when rebuilt.

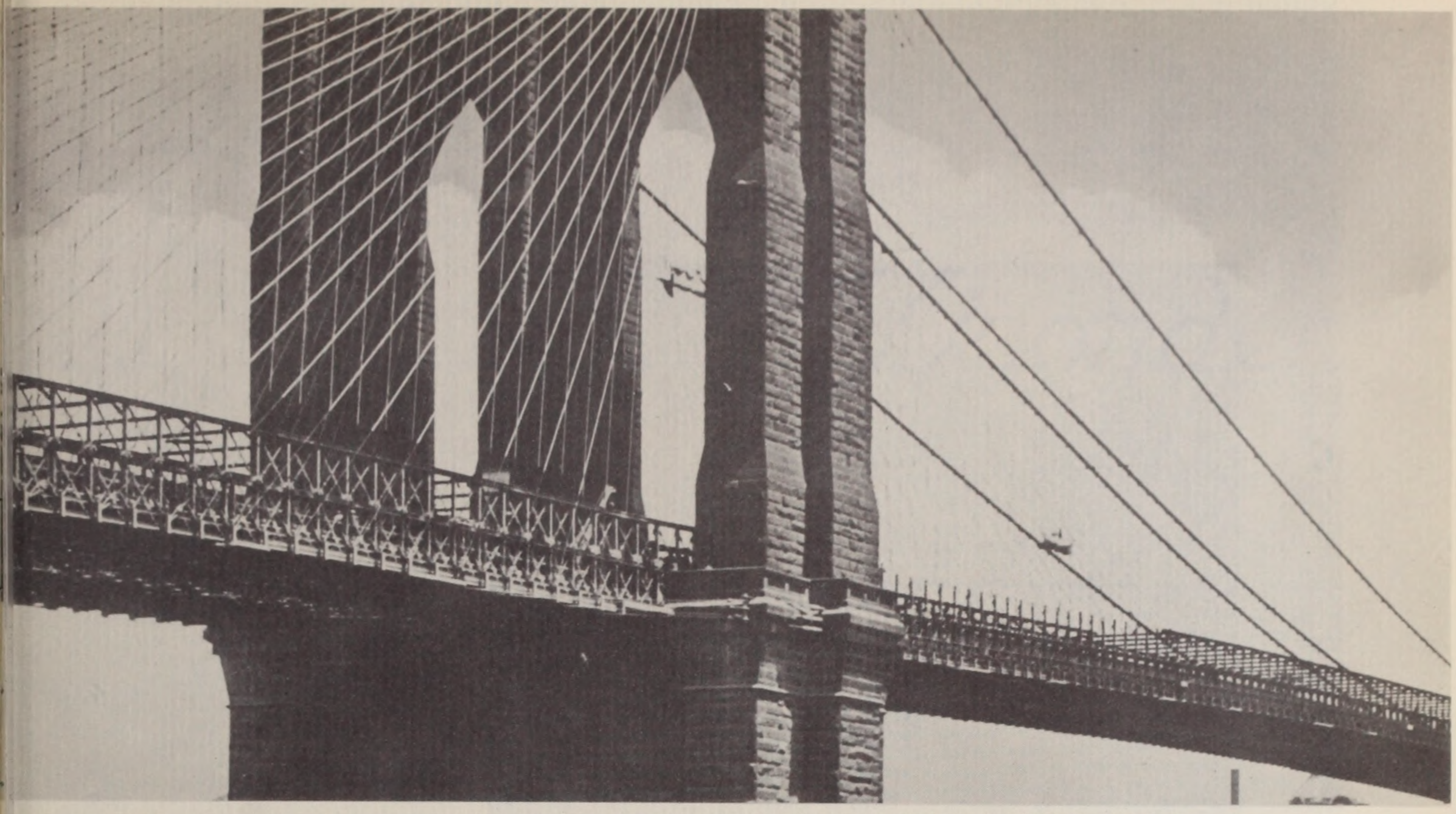
The New Truss System



DR. D. B. STEINMAN
Consulting Engineer
for Modernization of Brooklyn Bridge



Holes are drilled in the old top chords of truss prior to raising height of truss at outer edge of Bridge.



Brooklyn Bridge, before the heightened trusses along the outer edges were completed—note section immediately right of tower.

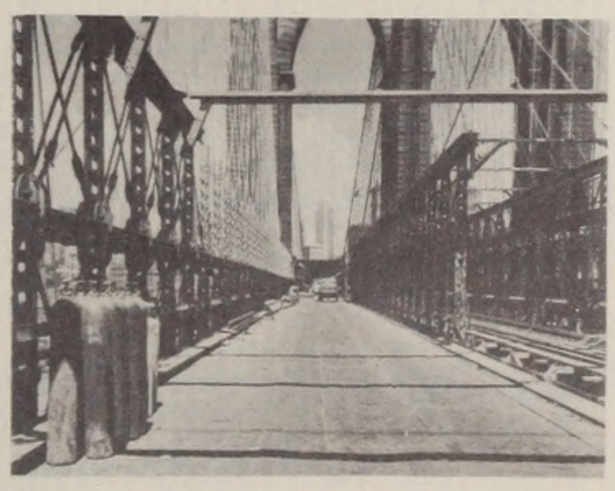




The truss at the outer edge of bridge was built up to the height of inner truss, extreme right.



The intermediate truss was removed, right, and the top chords reused on top of the outer truss, left.



The raised outer truss was braced with struts (horizontal beam) connecting to the inner truss.



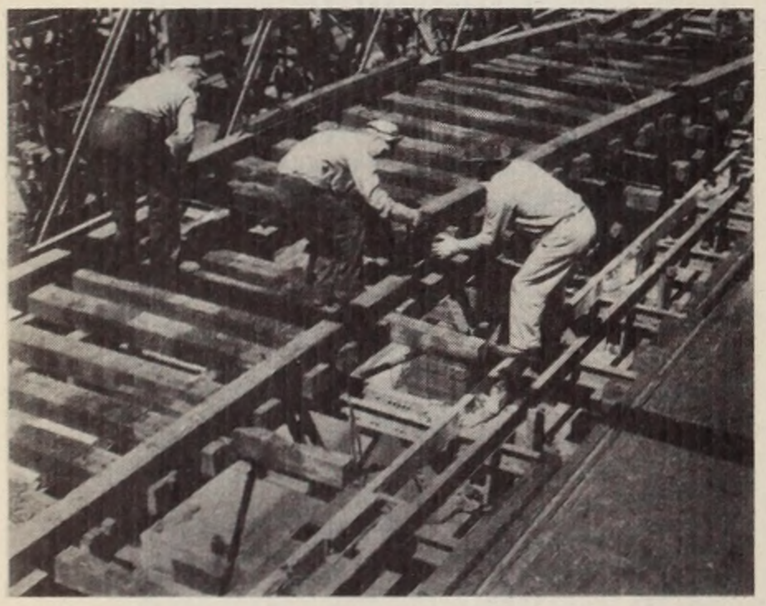
An outer truss unit on the north roadway is assembled for erection against the Manhattan tower.

The new vertical posts on the outer edge truss are ready for the installation of the top chord taken from the intermediary truss.

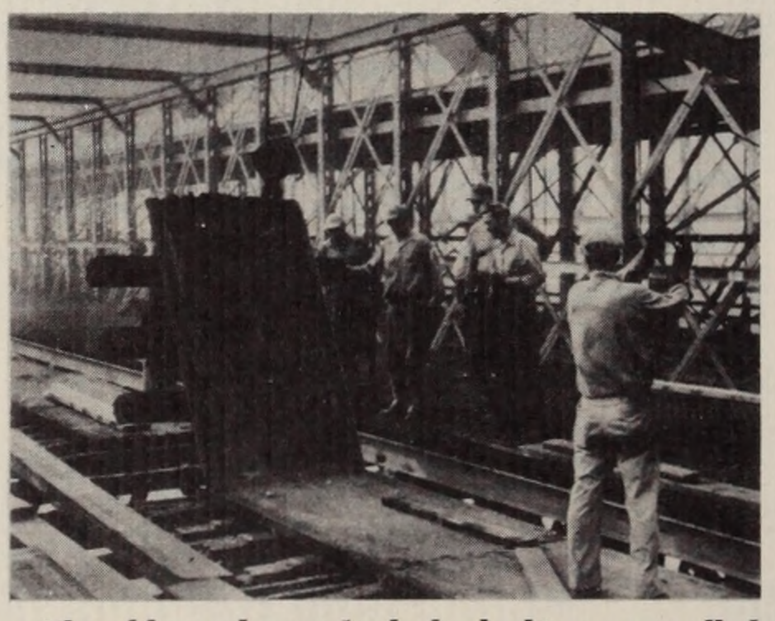


The completed north roadway was opened to traffic on Sept. 30, 1953. This is the beginning of the Manhattan Plaza.

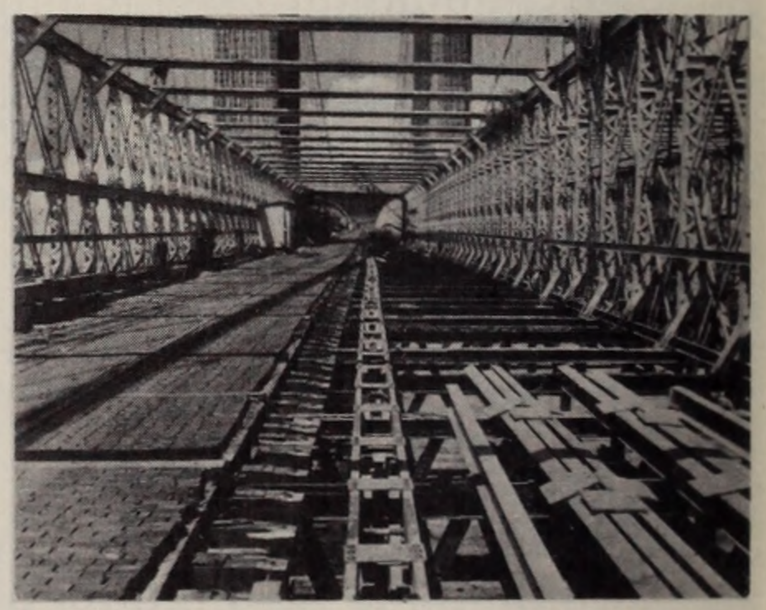
The New Roadways



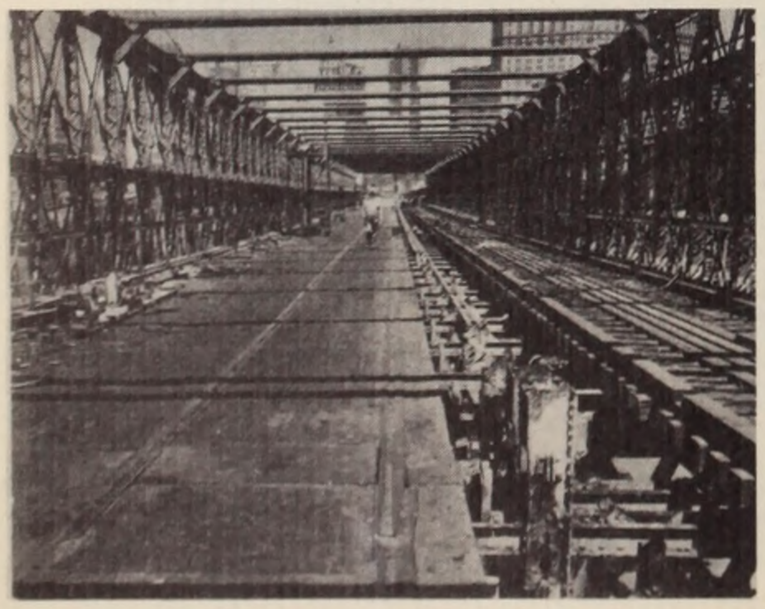
After removal of tracks, ties and guard timbers were taken out in sections.



The old wooden underdeck planking was pulled out.



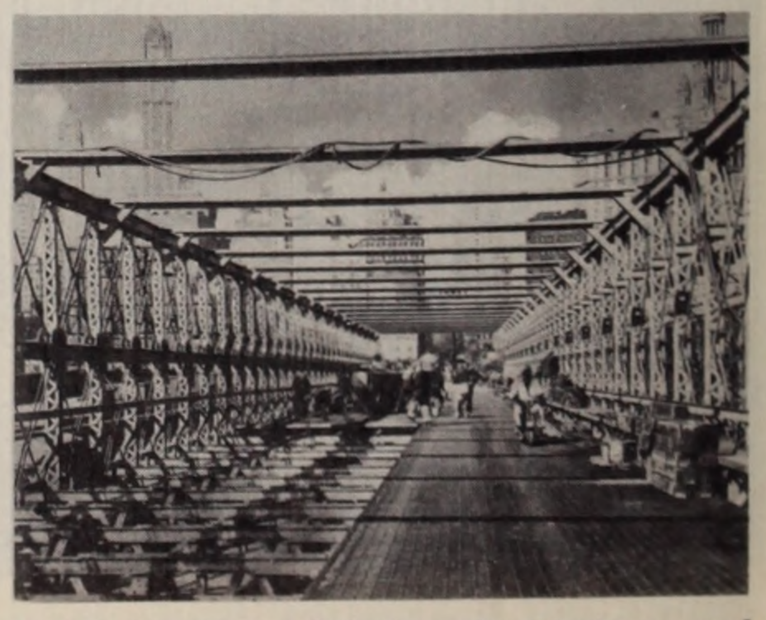
After removal of tracks, new steel stringers were laid.



The intermediate truss completely removed, the outer truss in position and overhead struts all in place, old roadway untouched as yet.



The new steel grid deck begins to take shape on the main span.



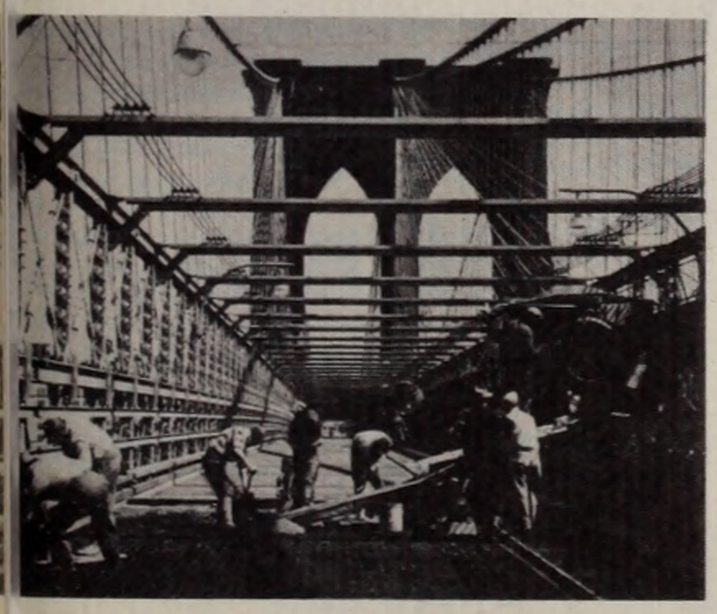
Half the steel grid deck on the Manhattan end span is completed and the other half approaches.



The completed south roadway, ready for three lanes of traffic, each lane 10 feet wide.



Elevated rail tracks ready for removal, the trolley tracks still in place.



Concrete is poured for the roadway surface on the main span. The view is toward Brooklyn.



The promenade, as it passes over Franklin Street, receives a new concrete surface.

The Great Harp

By MEYER BERGER

For more than seventy years, now, BROOKLYN BRIDGE has arched gracefully across East River between lower Manhattan and downtown Brooklyn. Poets have sung to this thing of beauty. Great artists have painted it, and men have come from the most remote corners of the earth to look upon it and to know the lyric impulse it inspires.

It has been compared to all things lovely, but perhaps the most apt image it has conjured is the image of the Great Harp. You come to understand that more easily if you walk its length in silver moonlight and hear the night wind play upon its mighty strings. You understand it when you see it in velvety silhouette in flushed or golden twilight, from the north or from the south. It is a harp for gods to play upon.

The bridge is the more remarkable in its beauty because it was spun across the flood in an age when American architecture was in a kind of dark-brown stage; brooding and somber. For that reason alone it might have been counted the nation's most significant monument after the Civil War was ended. Something in its slender, soaring lines, must have inspired architects of the succeeding generation to build the gray and ghostly skyscrapers to go with it. Anything less would have shamed it.

Harold Hart Crane the poet vibrated to the Great Harp's music. He saw the arching span as the perfect symbol of all that was good and powerful in the United States and wrote its striding dynamism into everlasting literature. It haunted him as it does most mortals who are exposed to its ageless charm.

The structure has that siren seductiveness; possessed it when John A. Roebling had just begun to frame it forever above East River's tides. When the first enormous cables

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"The similitudes of the past . . ."

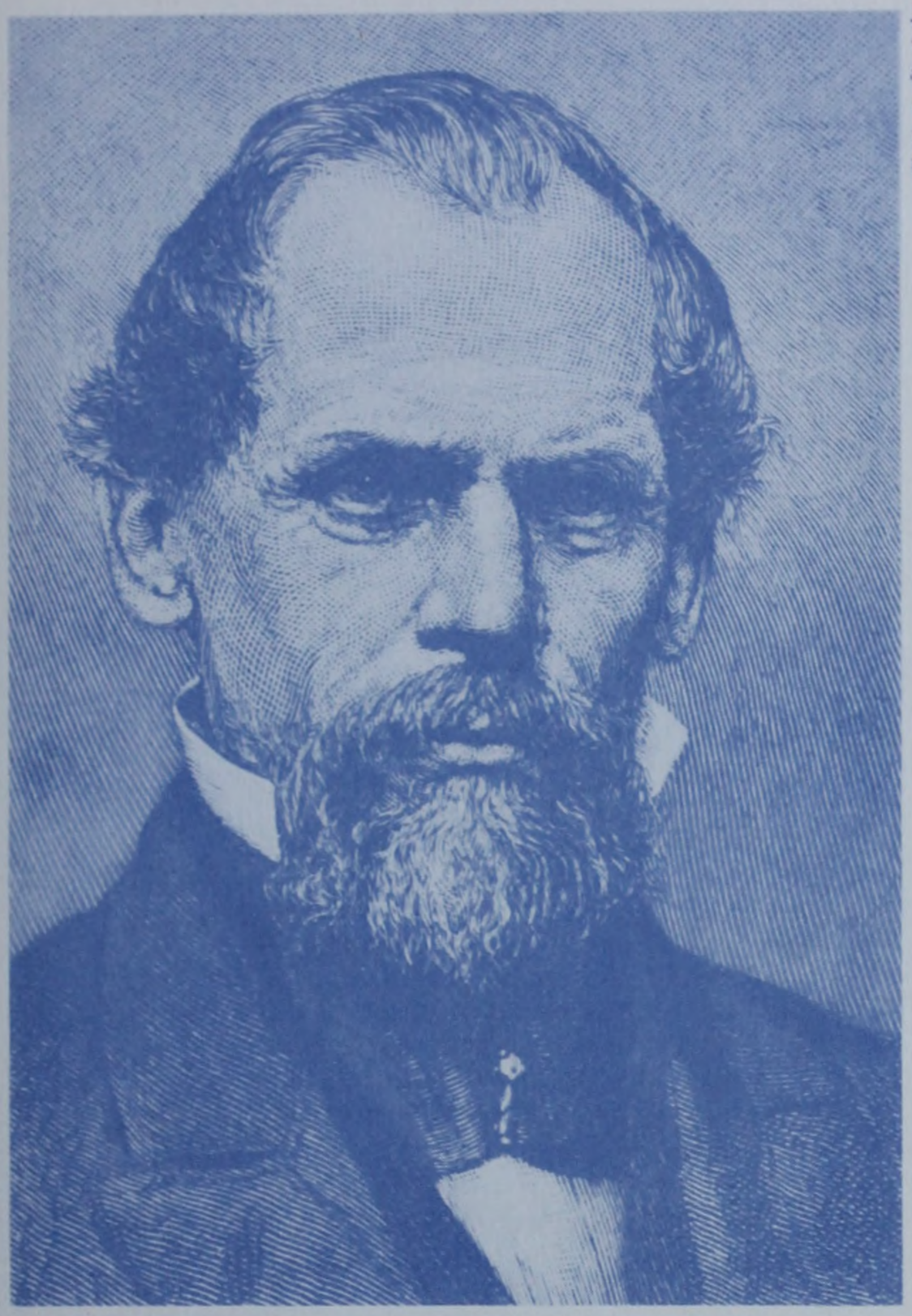


The approach to the bridge from Manhattan as it appeared in 1883, pedestrian walk crowded despite the one-cent toll per head. The fee for sheep and hogs was two cents.



4B

Colonel Washington A. Roebling, after his nervous system was shattered by "caisson disease" watched progress on the bridge from the window of his home overlooking the East River. This engraving originally appeared in "Frank Leslie's Illustrated Newspaper," May 26, 1883.



John A. Roebling, immigrant, inventor, innovator—the engineer who conceived wire "rope" and designed the "Eighth Wonder of the World," the longest suspension bridge up to that time. Below, his son, Colonel Washington A. Roebling, who succeeded him as chief engineer and completed the project despite confinement to his home following an attack of "the bends" incurred while supervising the work.



Emily Warren Roebling, who, after her husband became incapacitated after prolonged exposure under compressed air, assisted him in carrying the undertaking to completion.

The Remarkable Roeblings

JOHN A. ROEBLING was born in the city of Muehlhausen, Prussia, on June 12, 1806. At an early age he displayed an eager desire to learn. After attending the city public schools he entered the city "gymnasium," or high school. He qualified for entrance to the famous Polytechnic Institute in Berlin and was graduated as a Civil Engineer. During his college days he devoted much of his time to the study of suspension bridges, making them the subject of his graduating thesis. The day of wire cable bridges had not yet arrived. Chains were the accepted means of suspension. John Roebling attended the lectures of the world famous philosopher, Hegel, and the influence of the Hegelian philosophy dominated his intellectual life.

Following the stern requirements of the Prussian administrative system, he served for three years after graduation on government works, particularly road building, although his interest tended toward bridge construction. But the rigid discipline under which he worked afforded him no opportunity to accomplish anything original in connection with suspension bridges. With hope of greater possibilities in America, he came to the United States at the age of twenty-five.

HIS BROTHER, KARL, and a group of fellow countrymen, dissatisfied with conditions in their country, accompanied him. They settled on a tract of farm land in Pennsylvania, about tweny-five miles from Pittsburgh. With vigor and persistence by the two brothers, the venture in two years became a thriving farming community, later named Saxonburg.

About this time the energies of the Middle Atlantic States were being exerted in the direction of improving transportation by a system of canals and slack water navigation on the rivers. Accordingly, in 1837, he entered the service of the State of Pennsylvania as an engineer and was assigned to the Sandy and Beaver Canal, where he built dams and locks.



The Remarkable Roeblings

He was later employed on the feeder of the Pennsylvania Canal on the Allegheny River. He then surveyed a railroad route over the Allegheny Mountains which later became a part of the Pennsylvania Railroad System.

The method of transportation over the Allegheny Mountains employed in those days was to lay tracks up the mountain side. After being dismantled, the canal boats were placed on cars and hauled to the top by means of huge hemp cables propelled by a stationary engine. The clumsy and expensive cables often became frayed and had to be replaced. Roebling thought of substituting stronger and more lasting material. As a result, a number of wires twisted into one strand, producing wire rope of great strength and flexibility, soon displaced the hemp cables.

MR. ROEBLING created the machinery for the manufacture of wire rope, and his first factory was established in Saxonburg in 1841. Soon wire rope was adopted for other purposes besides portage railways, including rigging of vessels and for ferries, tow lines and dredges. He believed in the efficacy of wire for purposes of bridge construction, and in 1844 built a wooden aqueduct across the Allegheny River, supporting the aqueduct by continuous wire cables on each side.

After completing the aqueduct, he erected a bridge over the Monongahela River at Pittsburgh, and this job was his first wire cable suspension bridge. In 1848, Mr. Roebling built four suspension aqueducts on the line of the Delaware and Hudson Canal, similar to the one constructed across the Allegheny River.

Because of the great demands which arose for wire rope, Mr. Roebling in 1849 established a suitable factory in Trenton, N. J. Transportation facilities were more beneficial in the new location, affording increased sales of his product in the eastern markets.

IN ADDITION to operating the wire factory, he found time to prepare papers on engineering and scientific subjects and in some instances to deliver these before learned societies and public bodies. His ability as an engineer was fast becoming recognized. In 1852, Mr. Roebling was called upon to undertake the construction of a railway suspension bridge at Niagara Falls. Two years later the structure was completed – the first wire cable suspension bridge capable of bearing the weight of a moving locomotive and train. The bridge had a span of 825 feet, with two decks, the lower one carrying a highway and the upper one a single track in the center. The bridge had four cables. Mr. Roebling invented and used a machine for winding small wire around each cable from end to end so as to bind the cables tightly together and protect them from the action of the elements.

The successful completion of this bridge brought Mr. Roebling great fame. He next engaged in the construction of a wire cable suspension bridge over the Allegheny River at Pittsburgh, completing this structure in 1860. He then started to build a suspension bridge over the Ohio River between Cincinnati and Covington. Work on this enterprise was retarded during the Civil War but was finally completed in 1867. This bridge was characterized by Mr. Roebling at that time as the foremost bridge on the continent in extent of span, massiveness, strength and style of execution, with a main span of 1,057 feet and elevation of the floor above low water at the center of 103 feet. The excellence of that structure had much to do with the selection of Mr. Roebling as Chief Engineer of the Brooklyn Bridge. He was admirably fitted for this task.

It was undoubtedly Mr. Roebling's desire to complete the first East River span as the crowning achievement of a long and useful career. It was through his untiring efforts on behalf of the enterprise in persuading the public of the feasibility of the project that faith in its success was obtained. Unfortunately, after having completed the preliminary designs and surveys, he was injured in June, 1869, while engaged in his work. As a result, he died on July 22, 1869, at the age of 63.

COL. WASHINGTON A. ROEBLING

COL. WASHINGTON A. ROEBLING, Chief Engineer of the New York and Brooklyn Bridge during its construction, was born in Saxonburg, Butler County, Pa., on May 26, 1837. When his father perceived his mechanical aptitude, it became his wish to have his eldest son follow in his footsteps as an engineer. Accordingly, Washington Roebling attended Rennselaer Polytechnic Institute, graduating as a Civil Engineer in 1857.

He began his professional career in 1858 by assisting his father, who was then engaged in erecting a bridge over the Allegheny River at Pittsburgh. Shortly after the completion of this bridge, Washington Roebling enlisted as a private in response to President Lincoln's call for volunteers following the attack on Fort Sumter. Because of his ability and training as an engineer, he was transferred to staff duty in 1862 and assigned to construction of a suspension bridge across the Rappahannock River. He was on Gen. Pope's staff during the campaign ending in the second battle of Bull Run. He built a suspension bridge across the Shenandoah River at Harper's Ferry.

After the battle of Chancellorsville, he used to ascend every morning in a balloon to reconnoiter the position of the enemy. As a result of one of these flights, he discovered the movements of Gen. Lee's army toward Pennsylvania.

COL. ROEBLING served with honor and distinction in the Army of the Potomac, receiving three brevets for gallant conduct. In January, 1865, he resigned his commission in the Army and went out to Cincinnati to assist his father in completing the Cincinnati and Covington Bridge over the Ohio River. He remained there until the early summer of 1867, taking practically complete charge of the construction of the project. During this time John A. Roebling was busily engaged on plans for a bridge across the East River.

When the father was appointed chief engineer of the Brooklyn Bridge, Col. Roebling visited England, France and Germany for about a year to study the principles of caisson foundations, consulting the ablest engineers of these countries to obtain knowledge which was necessary before undertaking the difficult task of sinking the foundations of the East River Bridge.

Upon his return, Col. Roebling became his father's chief assistant. He was thoroughly and intimately familiar with the general scheme of the Brooklyn Bridge project. Upon the death of John A. Roebling in July, 1869, the son was the logical man to succeed him and carry on the work. The details of the design had not been completed at that time and no actual construction work had been performed. The difficult task of completing the detailed design of the bridge and beginning construction devolved upon him.

WHILE THE CAISSONS of the tower foundations were being sunk, Col. Roebling was always on hand. His constant attendance under compressed air in the caisson chambers affected his health. In the spring of 1872 he was brought up out of the New York caisson nearly insensible, a victim of the "caisson disease." His nervous system was affected and it was necessary for him to remain at home, which was near the bridge site, and supervise the construction of the bridge from there.

He gave orders and directions as to the design and erection to a competent and able staff of assistants. Their unselfish devotion in carrying out the plans and wishes of Col. Roebling resulted in the successful completion of the enterprise. Although physically incapacitated, his mind remained keen, his brain active. His wife, Emily Warren Roebling, ably assisted him in supervision and direction of the work.

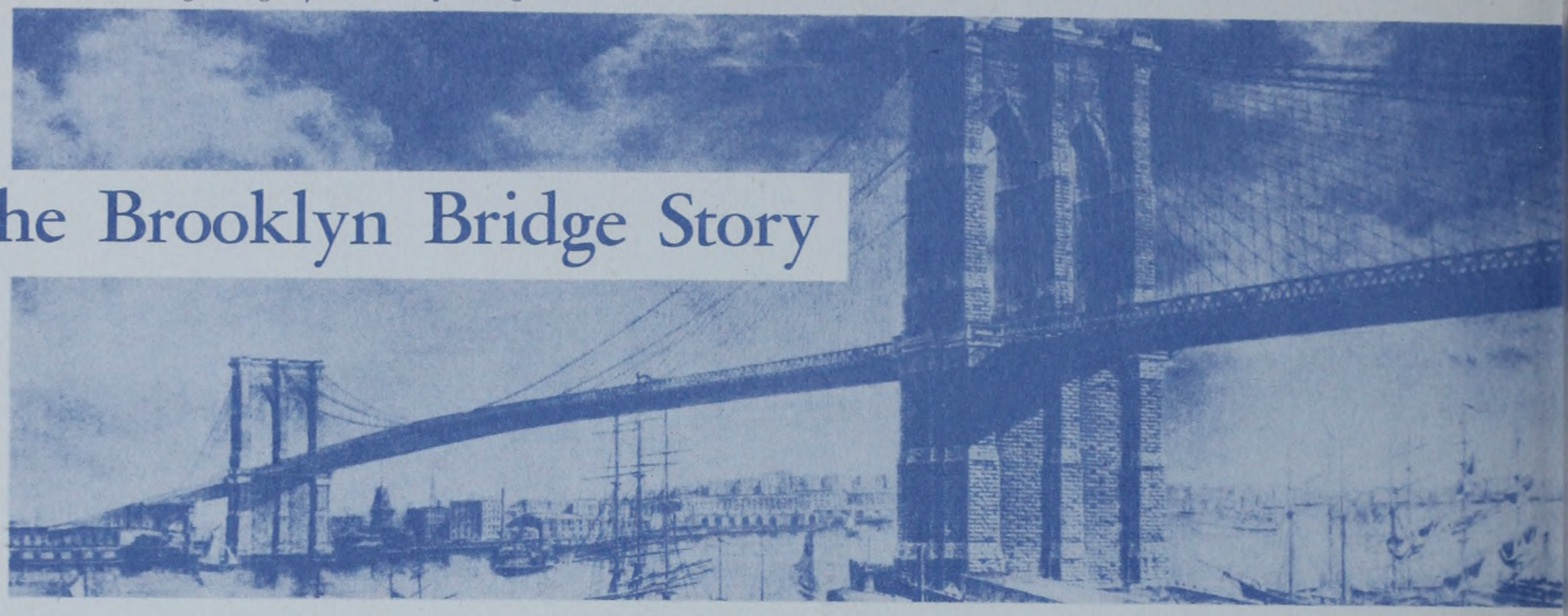
There is scarcely a feature in the whole work of the bridge that did not present new and untried problems, particularly the method used to get the excavated material out of the caissons, lighting the caissons, filling them through the supply shaft, and the machinery for raising the stones on the tower, all successfully accomplished through Col. Roebling's designs. Col. Roebling built the anchor bars much larger than his father had intended, and steel wire cables were utilized for the first time, iron wire having been used previously.

HIS HEALTH SHATTERED, Col. Roebling, after the completion of the Brooklyn Bridge in 1883, lived in semi-retirement, though never idle. He established his home at Trenton, N. J., and continued to be deeply interested in the affairs of the Roebling Company, always at the disposal of his brothers when advice was necessary in the conduct of their business. He was an avid reader, including works of fiction, theology, history, physics and the latest books on scientific subjects. He was considered an authority on mineralogy, having collected specimens in his youth. He acquired 150,000 during his lifetime, which were later presented to the Smithsonian Institute.

In 1921, when Col. Roebling was in his 84th year, the death of his nephew, Karl G. Roebling, then the president of the Roebling Company, made it necessary for him to assume charge of the affairs of the company.

He died on July 21, 1926.

John A. Roebling's design of the Brooklyn Bridge.



The Brooklyn Bridge Story

Construction of a bridge over the East River to connect New York and Brooklyn – separate cities then, was first suggested early in the 19th century. However, engineering science had not developed sufficiently at that time to make possible the design of a structure of the required length of span and capable of accommodating traffic between the two cities. About 1840 considerable public attention was given to the subject, but no definite steps were taken and interest waned.

Public interest was revived, however, when John A. Roebling, who had completed a suspension bridge over Niagara River in 1854, sent a letter on June 19, 1857, to Abram S. Hewitt, suggesting the feasibility of a bridge between the two cities without impairing the freedom of navigation. Mr. Hewitt was associated with Peter Cooper in the iron business. They had a rolling mill in Trenton, N. J., where Mr. Roebling's wire cable plant was located. Speaking at the bridge opening ceremonies, Mr. Hewitt said that he had Mr. Roebling's letter printed in the *New York Journal of Commerce* "where it attracted great attention, because it came from an engineer who had already demonstrated by successfully building suspension bridges . . . that he spoke with the voice of experience and authority."

But the project lagged. The Civil War necessarily diverted the activities and attention of the people. After the war interest in the project was revived. Officials of the two cities did not take any determined initiative for the construction of a bridge, although they were enthusiastic about the proposal. A group of citizens in the City of Brooklyn proceeded to organize the enterprise.

The Need for the Bridge

A strong impetus was given the project by the ice conditions in the East River in the winter of 1866-1867, when the river was so choked with ice that ferry boats could not even put out from their slips. There were days when people from Albany were getting into Manhattan in less time than Brooklynites. A demand for the immediate construction of the bridge arose and the newspapers took up the subject with fervor. With public opinion behind him Mr. Murphy, who was a State Senator and who had been formerly Mayor of Brooklyn, devised the legislation which resulted in the passage on April 16, 1867, of "An act to incorporate the New York Bridge Company, for the purpose of constructing and maintaining a bridge over the East River, between the cities of New York and Brooklyn."

The first meeting of the incorporators of the company was held on May 13, 1867. At the second meeting held on May 16, 1867, Henry C. Murphy was elected president and three committees were appointed: Committee on By-Laws, a temporary Finance Committee and Committee on Plans and Surveys.

The Committee on Plans and Surveys selected John A. Roebling as the Chief Engineer, his appointment to take effect May 23, 1867. Mr. Roebling was nearly 61 years old. The committee reported that it was guided in its choice of Mr. Roebling by the consideration that the construction of a suspension bridge of a magnitude unprecedented in history demanded the greatest experience and ability that could be obtained. The committee was satisfied that the constructor of the Niagara River Suspension Bridge and of the Ohio River Suspension Bridge at Cincinnati was that person. The Niagara River Bridge, main span 825 feet, was completed in 1854 and the Ohio River Bridge, main span 1,057 feet, was completed in 1867. The committee stated that confidence on the part of the public and of those whose money was to be invested in the undertaking would best be insured by employing the engineer who had achieved the most successful results and who was thus most likely to accomplish this great enterprise.

John Roebling's Plan

Mr. Roebling proceeded to make the necessary surveys and prepared plans and estimates of cost. Three routes were reported on by Mr. Roebling, namely, the City Hall Park line or route, the Chatham Square route and the Bowery-Canal Street route. He recommended the City Hall Park line because it would command the uptown travel and the greater portion of the downtown travel and thus do a full and remunerative business at the outset, in spite of competition from the ferries.

Mr. Roebling predicted that if a first bridge were built, the erection of a second one and third one would follow sooner or later. The second one, he suggested, would connect to Williamsburg and a proper route for the third one would be across Blackwell's Island (now called Welfare Island). The first bridge, if built on the City Hall Park line, would not lose as much traffic when the second bridge were built as if the first bridge were located farther north. The estimated cost of the bridge was given as $7,000,000, exclusive of the cost of land for the approaches.

The Committee on Plans and Surveys on October 19, 1867, submitted to the Board of Directors of the bridge company its report including the report of Mr. Roebling. The Committee recommended adoption of the route with the City Hall Park terminus in New York. In regard to the structural plan of the bridge submitted by Mr. Roebling, the committee

recommended its adoption subject to such modifications as further study or other circumstances might prove to be advisable. The committee further recommended the immediate commencement of the work and that a committee be appointed to take the necessary steps to raise the capital from the public, financiers and the cities of New York and Brooklyn. The Legislature in 1867 authorized the cities of New York and Brooklyn to subscribe to the capital stock of the bridge company.

The Board of Directors on October 24, 1867, authorized the chairman to appoint a Committee of Ways and Means and an Executive Committee. At the third meeting of the incorporators of the bridge company held January 12, 1869, the Executive Committee reported that soundings had been made and that the City of Brooklyn had subscribed for stock to the amount of $3,000,000, and the City of New York had subscribed for stock to the amount of $1,500,000, conditioned upon each city having three representatives on the Board of Directors of the company. The reason for the larger subscription by Brooklyn was the conviction that the bridge would be more beneficial to Brooklyn than to New York. In 1869 the law was amended to provide for representatives of each city on the Board of Directors of the bridge company.

Of the total capital stock of the bridge company consisting of 50,000 shares of the par value of $100 each, the City of Brooklyn subscribed $3,000,000, the City of New York $1,500,000. Individuals took stock in the amount of $500,000.

An Act of Congress in 1869 established the bridge, when completed, as a lawful structure and post road. It was provided in the Act that the bridge should not obstruct, impair or injuriously modify the navigation of the river and that the plan and location of the bridge be subject to the approval of the Secretary of War.

At the request of Mr. Roebling a commission of engineers was authorized by the bridge company in January, 1869 to review the plans. Seven of the most eminent engineers of the profession were invited by Mr. Roebling to sit in judgment upon his work.

Mr. Roebling expressed the view that the action of the board of engineers upon his plans was very important, that the public was not a believer in the project and that men like Horace Greeley and Mayor Kalbfleisch of Brooklyn had doubts about the success of the venture. An inspection trip was made to Cincinnati and Niagara Falls to view the suspension bridges there erected by Mr. Roebling and an opportunity was thus afforded the members of the board to visualize the appearance of the new bridge when built and convince them that the principle of the design embodied in these bridges could be applied to a span of 1,600 feet. After two months of consideration a report was issued, in May, 1869, unanimously concurred in by all members, "that it is beyond doubt entirely practicable to erect a steel wire suspension bridge of 1,600 feet span, 135 feet elevation, across the East River, in accordance with the plans of Mr. Roebling and that such structure will have all the strength and durability that should attend the permanent connection by a bridge of the cities of New York and Brooklyn." The fact that a public project of such magnitude was unanimously approved by recognized experts was a tribute to the remarkable manner in which Mr. Roebling was able to convince them of the thoroughness of his design and its practicability.

War Department Approves Bridge

A commission consisting of three Army engineers appointed by the United States War Department to report upon the bridge submitted its report on May 22, 1869, to the Chief of Engineers of the U.S. Army. The commission recommended an increase of five feet, from 130 to 135 feet, in the clear height of the bridge and stated that there was no doubt of the practicability of the structure, nor of its stability when completed. Accordingly, the War Department on June 21, 1869, approved the plan and location of the bridge at the increased clear height.

To avoid an increase of grade due to the change in height and also to save an increase in the amount of masonry in the towers and approaches, it was determined to obtain the greater height by changing the plan of the superstructure so that the trusses would be above the floor instead of partly above and partly below the floor as was contemplated in the original design.

The plans for the bridge having been accepted and approved, Mr. Roebling, who had now won the confidence and hearty support of the public, felt justified in proceeding with the construction work. On June 28, 1869, while making surveys on the Brooklyn front of the river, a boat coming up to the bulkhead caused his right foot to be caught between the timbering, crushing his toes. He was taken to the house occupied by his son, Colonel Washington A. Roebling, who was associated with him in the bridge work and who was then living at 137 Hicks Street, Brooklyn. At first his condition was not considered serious, but later tetanus developed, and he died on July 22, 1869, at the age of 63.

Colonel Roebling Succeeds Father

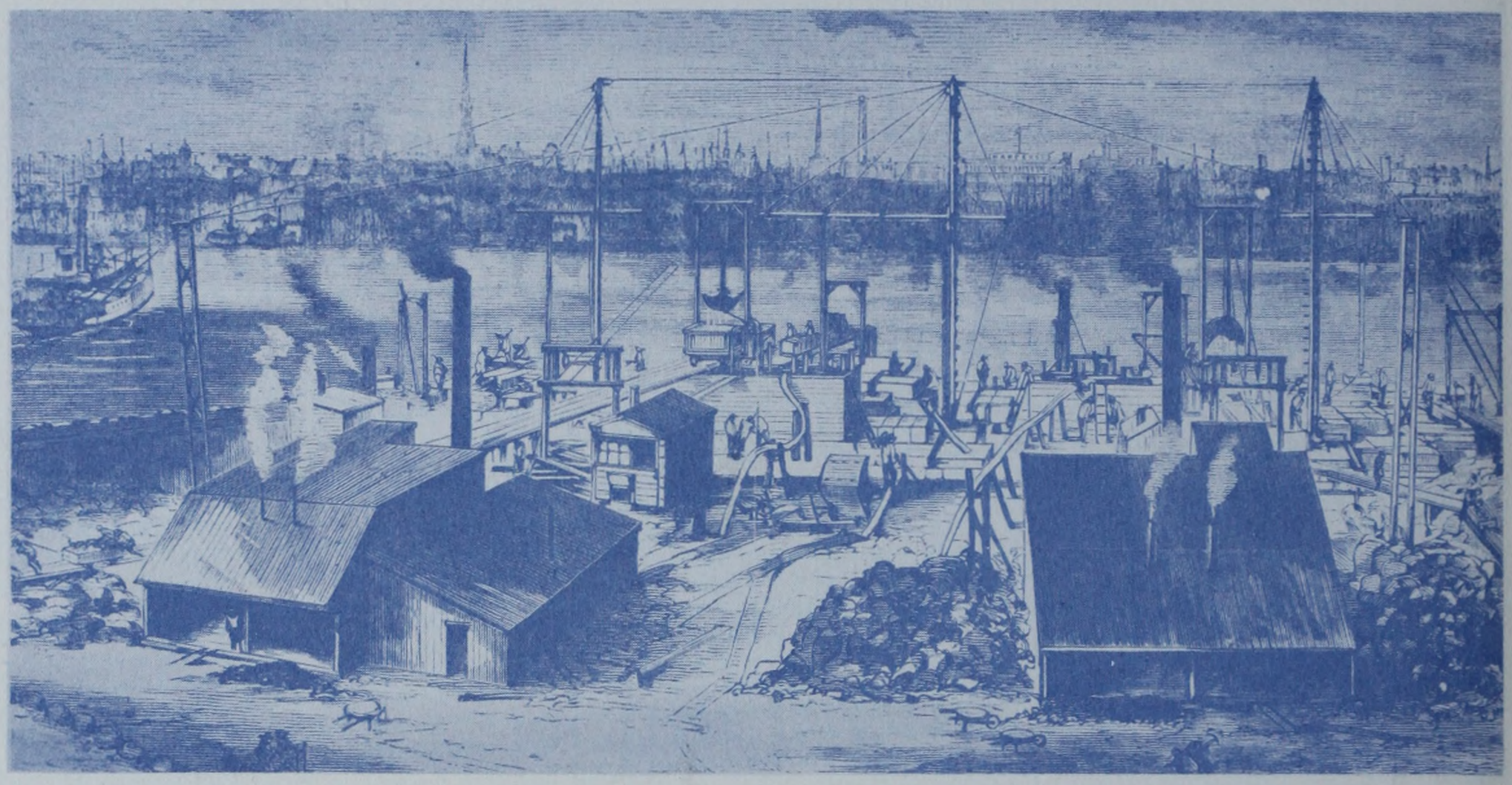
The death of John A. Roebling necessitated the immediate appointment of a successor. His son, Colonel Washington A. Roebling was chosen Chief Engineer on August 3, 1869. The son had shared for years in his father's professional confidences and activities. Colonel Roebling had received technical training at the Rensselaer Polytechnic Institute, Troy, New York, from which he was graduated in 1857 as a Civil Engineer. He was grounded in the science of design and construction of bridges by his work with his father. The elder Roebling, according to his own statement, would not have undertaken the conduct of this work at his age if it were not for the fact that he had a son who was entirely capable of building the bridge. However, the main designs were practically completed before the father died.

On the date of Colonel Washington's appointment the subscriptions to the capital stock of the New York Bridge Company were filled. The Board of Directors, led by its President, Henry C. Murphy, was now ready to proceed with construction of the bridge. On October 14, 1869, William C. Kingsley was appointed general superintendent of the work. He had been active in promoting the project. Just as the inception and leading features of the work were due to the genius of John A. Roebling, so was the enormous labor connected with the preliminary legislation and organization credited to the effort of Mr. Kingsley. He had staked a large part of his personal funds on the success of the enterprise and was greatly interested, therefore, in its management.

A few weeks later a contract for building the timber caisson for the Brooklyn tower was awarded and work began immediately. It was the first construction work done upon the bridge. The caison with a length of 168 feet and a width of 102 feet, the largest ever constructed up to that time, was towed to the tower site on May 3, 1870. Building of the caisson for the New York tower was begun in October, 1870. This caisson was 172 feet long and 102 feet wide.

The sinking of the caissons for the tower foundations entailed many dangers. The caisson for each foundation was

The Brooklyn pier begins to take shape, the first courses of stone being placed on top of the timber caisson.



a large inverted vessel or pan, resting bottom up, into which air was forced under sufficient pressure to drive out the water. It was necessary to increase the air pressure as the work in sinking the caissons progressed to the bearing strata previously determined upon by test borings. The men working in the air chambers of the caissons in removing the excavated material had to withstand the effects of working under heavier-than-atmospheric air pressure. Shorter working periods were adopted to reduce exposure of the men to the dread "caisson disease."

The danger of fire to the timber caissons also was ever present, since illumination was by means of gas supplied by the local gas companies and by candles. Several fires were discovered in the Brooklyn caisson but were extinguished through the heroic efforts of the men including Col. Roebling.

Victim of "Caisson Disease"

During the days and nights that the work was going on within the caissons under the bed of the East River, Col. Roebling devoted nearly all his time directing the efforts of his men, mindful of the fact that any slip, no matter how trivial, at this stage of the work, might prove to be disastrous. He spent more hours in the compressed air of the caissons than anyone else and wore out his strength. One afternoon in the spring of 1872 he was brought out of the New York caisson nearly insensible from an attack of "caisson disease," which had proved fatal to several of the workmen. As a result, Col. Roebling who was full of life and hope and daring at the inception of the work, became an invalid confined to his home. Although his nervous system was shattered, his mind was not affected. Indeed, his intellect appeared to be quickened, for realizing how incomplete the plans and instructions for the completion of the bridge were at that time and fearful that he might not live to finish the work himself, he spent a large part of his time in his sick room writing and drawing. The papers contained the most minute and exact directions for making the cables and erection of all the complicated parts which compose the superstructure.

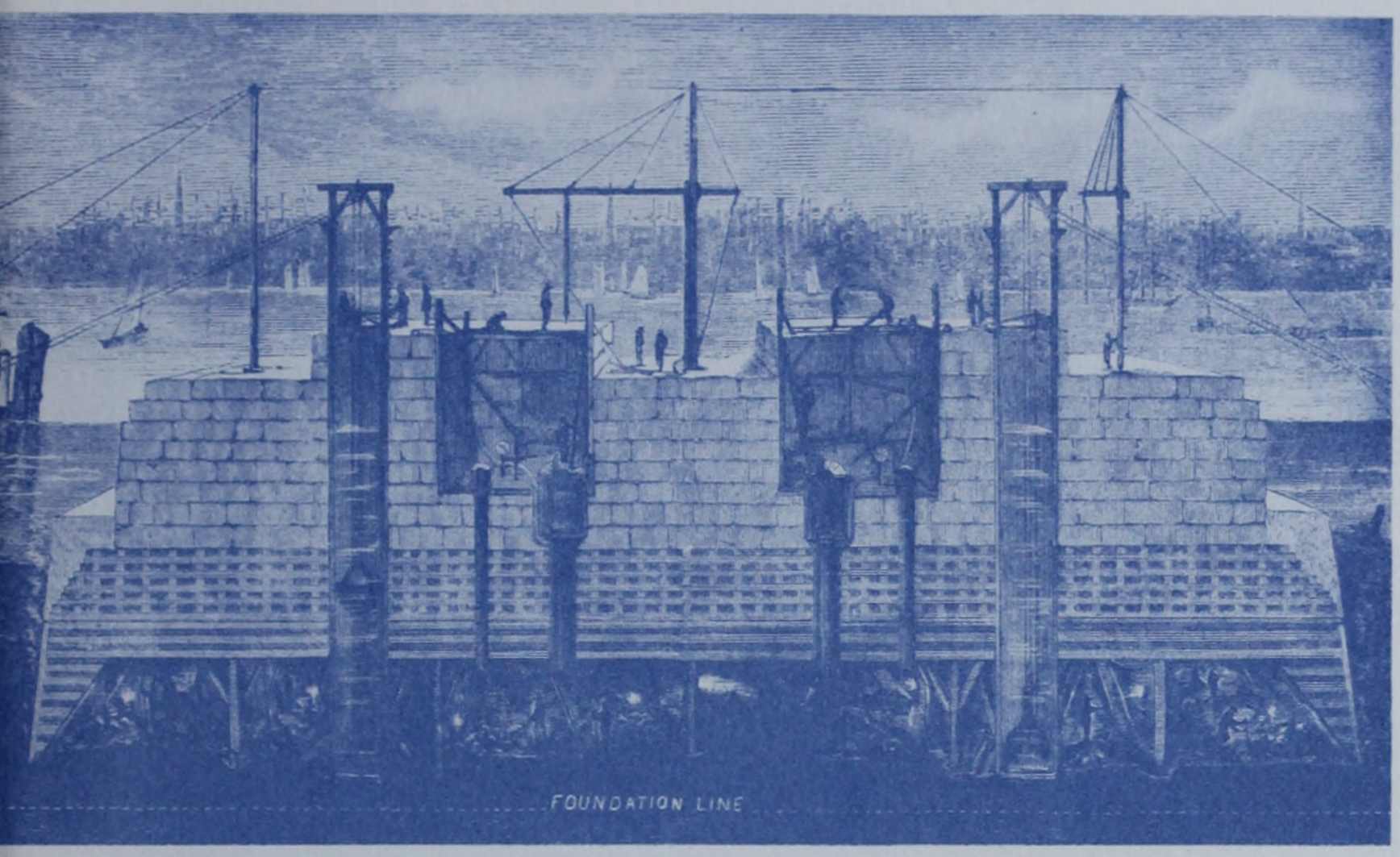
The work continued, directed in this manner. It can safely be said that no great project was ever conducted by a man who had to work under so great a handicap. So much writing in his enfeebled condition impaired Col. Roebling's eyesight, and he became too weak to carry on a long conversation with his assistants. The work could not have been accomplished but for the unselfish devotion of his wife, Emily, and his assistant engineers. Each of his assistant engineers had charge of a portion of the work and they united in carrying out their assignments properly performed in accordance with Col. Roebling's plans and wishes. Charles C. Martin, Engineer-in-charge, had general supervision of the whole work. Col. W. H. Paine, Francis Collingwood,



The men in the caisson excavate the rock with chisel and sledge hammer, pick and shovel by the light of a gas flame. Fire was a constant danger in the timber caissons.



After several fires in the Brooklyn caisson, the Manhattan caisson was lined with steel plate. Excavated material under the caissons was sent up through water shafts.



Sectional view shows method of excavating under caisson while the courses of stone for the pier are built up, their weight gradually pressing the caisson down to a depth of 45 feet below mean high water on the Brooklyn side.

George W. McNulty and Samuel R. Probasco were assistant engineers-in-charge of the drafting room and E. F. Farrington was master mechanic. All of these men were engaged on the bridge from its inception to its completion. Col. Roebling acknowledged their splendid cooperation and unhesitatingly credited the ultimate success of the work to their ability.

Although the work was of unexampled proportions and encountered many difficulties, its progress appeared unnecessarily slow to the impatient public who longed for its completion. Many voiced the opinion that the direction and control of the project by the New York Bridge Company was influenced by political and other complications prevalent at that time. The large prices paid for land, taken for the approaches and the estimated increased cost of the structure beyond the figure fixed at the outset, gave rise to suspicions, accusations and aspersions. There was strong sentiment to have the enterprise taken over as a public project by the cities of New York and Brooklyn. Accordingly steps were taken to obtain the necessary legislation. Later investigation showed, however, that the funds had been expended properly.

On June 5, 1874, the Act of 1867 to incorporate the New York Bridge Company was amended to authorize the cities of New York and Brooklyn to acquire the stock held by private stockholders and authorized the City of New York to acquire additional stock to the amount of $1,000,000 and



This old print from "The Daily Graphic" of May 2, 1873, shows the method of removing material from the site of the Brooklyn anchorage.



The men working under compressed air entered and left through air locks. Many were victims of "caisson disease." All together, the bridge claimed 20 lives.

Caissons and Foundations



Fulton Ferry House, Brooklyn, 1874, the chief traffic link in those days between Manhattan and Brooklyn. Tower of Brooklyn Bridge is in background.

the City of Brooklyn to acquire additional stock to the amount of $2,000,000.

On October 14, 1874, the Board of Directors of the bridge company adopted a resolution directing that the mayor and comptroller of each of the cities of New York and Brooklyn be notified that the owners of two-thirds of the private stock of the company had agreed to sell their stock to the cities.

As provided by the revised Act, new directors were appointed by the mayor and comptroller of the Cities of New York and Brooklyn. On February 23, 1875, Henry C. Murphy was elected President and Abram S. Hewitt, Vice-President.

The new Board of Directors favored further legislation to entirely eliminate the bridge company and have the construction work finished by trustees acting for the two cities. A bill to this end was presented to the State Legislature.

New legislation adopted on May 14, 1875, provided that when two-thirds of the private stock of the New York Bridge Company was retired, the company should be dissolved and the bridge be completed by the cities. The law further provided that two-thirds of the expense be defrayed by the City of Brooklyn and one third by the City of New York.

At the first meeting of the new board of trustees of the New York and Brooklyn Bridge, as the bridge was officially named, Henry C. Murphy and Abram S. Hewitt were re-elected president and vice-president. By this time the masonry towers were nearly finished and work was well advanced on the construction of the anchorages. There was a large quantity of limestone and granite on hand, remaining from the supply bought by the bridge company from about twenty-five different quarries along the Atlantic Coast. The masonry tower in Brooklyn was completed in June, 1875, and the masonry tower in New York was finished in July, 1876. The Brooklyn anchorage which had been started in February, 1873, was completed in October, 1875. The New York anchorage which had been started in October, 1871, was finished in July, 1876.

Work on Cables Starts

During the winter of 1875-76 work was delayed due to lack of funds. With the completion of the towers and anchorages in the summer of 1876, everything was ready for – what seemed to lay observers – the most picturesque and most ingenious stages of the project . . . the erection of the temporary foot bridge across the river and the spinning of the main bridge cables. The first wire rope for the temporary foot bridge was run over on Aug. 25, 1876.

The Board of Trustees on Jan. 15, 1877, awarded a contract for the steel wire for the main cables at a price of 8.7 cents per pound, the lowest bid for crucible cast steel wire. This was the first time that steel wire was used in the con-



New York Harbor as seen from the Brooklyn tower in 1873.



Towers



The U. S. Steamer "Swatara" passing the piers, of Brooklyn Bridge returning ex-Confederate refugees in 1875.



Rare photograph shows Colonel Washington A. Roebling, extreme upper left, supervising construction of towers in 1872.

As work progresses on the cables for the bridge—1877—buildings in the way of the New York approach are demolished.

Cables

struction of the main cables of a long span suspension bridge, iron wire having been used previously. The first cable wire was run on April 5, 1877, and the last on Oct. 5, 1878.

Only July 1, 1879, the trustees awarded a contract for the steel and iron for the suspended superstructure. The construction of the suspended superstructure was begun in January, 1881. The approaches were started three and a half years earlier and were completed in July, 1882.

In August, 1882, a contract was awarded for constructing the viaduct and station building at the Brooklyn Terminal of the bridge and another contract for constructing the viaduct and station building at the New York Terminal.

While the bridge was nearing completion, the President of the Board of Trustees, Henry C. Murphy, died – Dec. 1, 1882.

In the course of erecting the superstructure the work was greatly impeded by lack of funds. It was necessary to make application time and again for additional money to carry on the work. The increased cost was due to changes in design as the work progressed as well as the increase in the prices of material. But much criticism was directed by the public and press toward the management of the enterprise and a good deal of it at the engineers. Col. Roebling, being physically incapacitated and therefore unable personally to direct the operations of the work, was charged by some of the trustees with the delay in completion of the bridge. An attempt was made in the summer of 1882, to displace him as Chief Engineer of the bridge. To place the blame upon him for the delays occasioned by the failure to continue deliveries of materials was a charge which Col. Roebling was constrained to disprove. He showed to the satisfaction of the majority of the Trustees that though his absence from the site of the work caused suspicions of neglect of duty to arise, his instructions, capably carried out by efficient assistants, would carry the bridge to completion more rapidly than if there were a change in the personnel of the organization.

In connection with his defense against these charges, his wife's assistance was invaluable. With devotion and tact she kept him in touch with the work through its various stages. He dictated to her a statement telling what he was







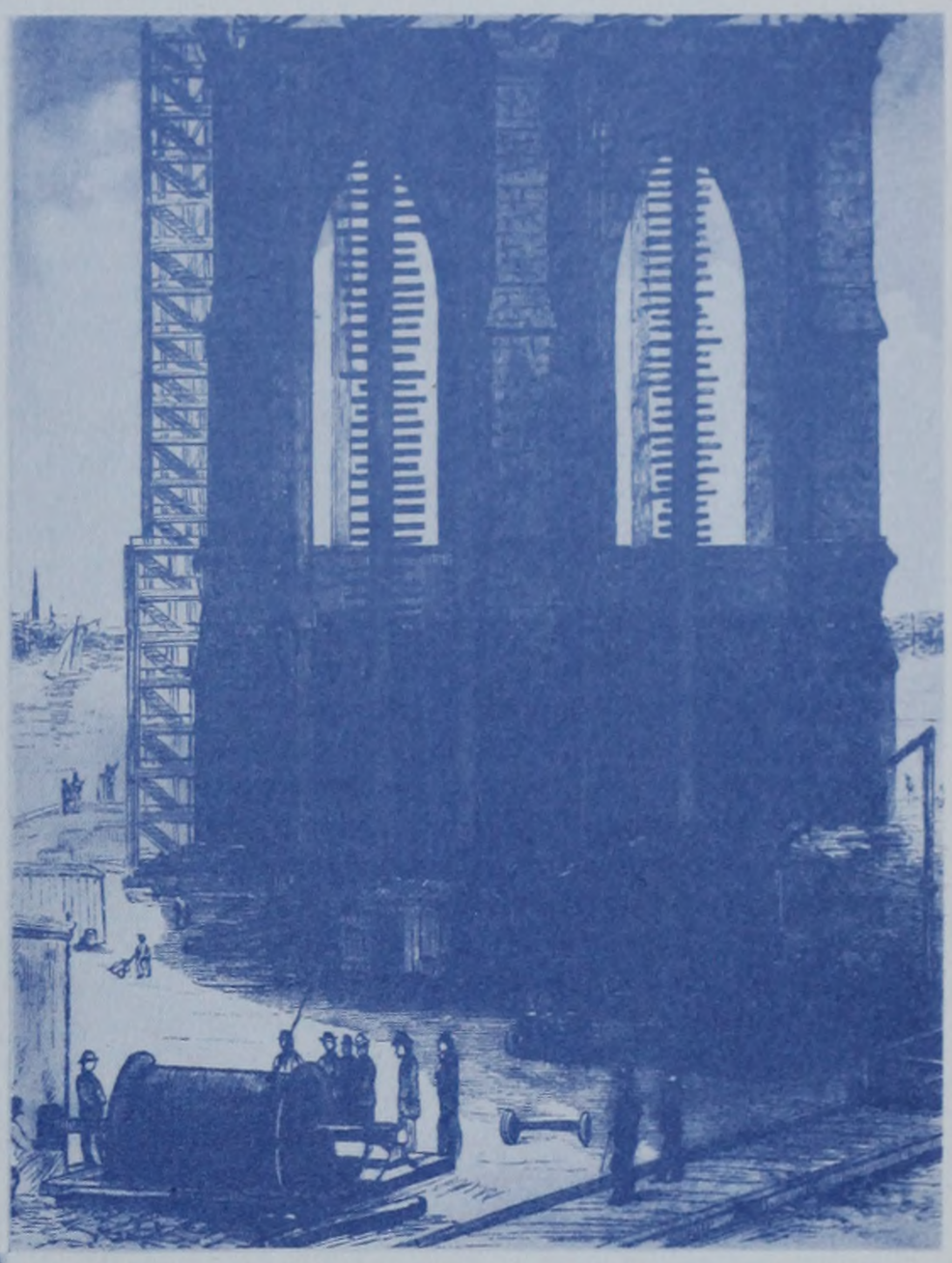
These views of the bridge about 1879 show the completed cables.



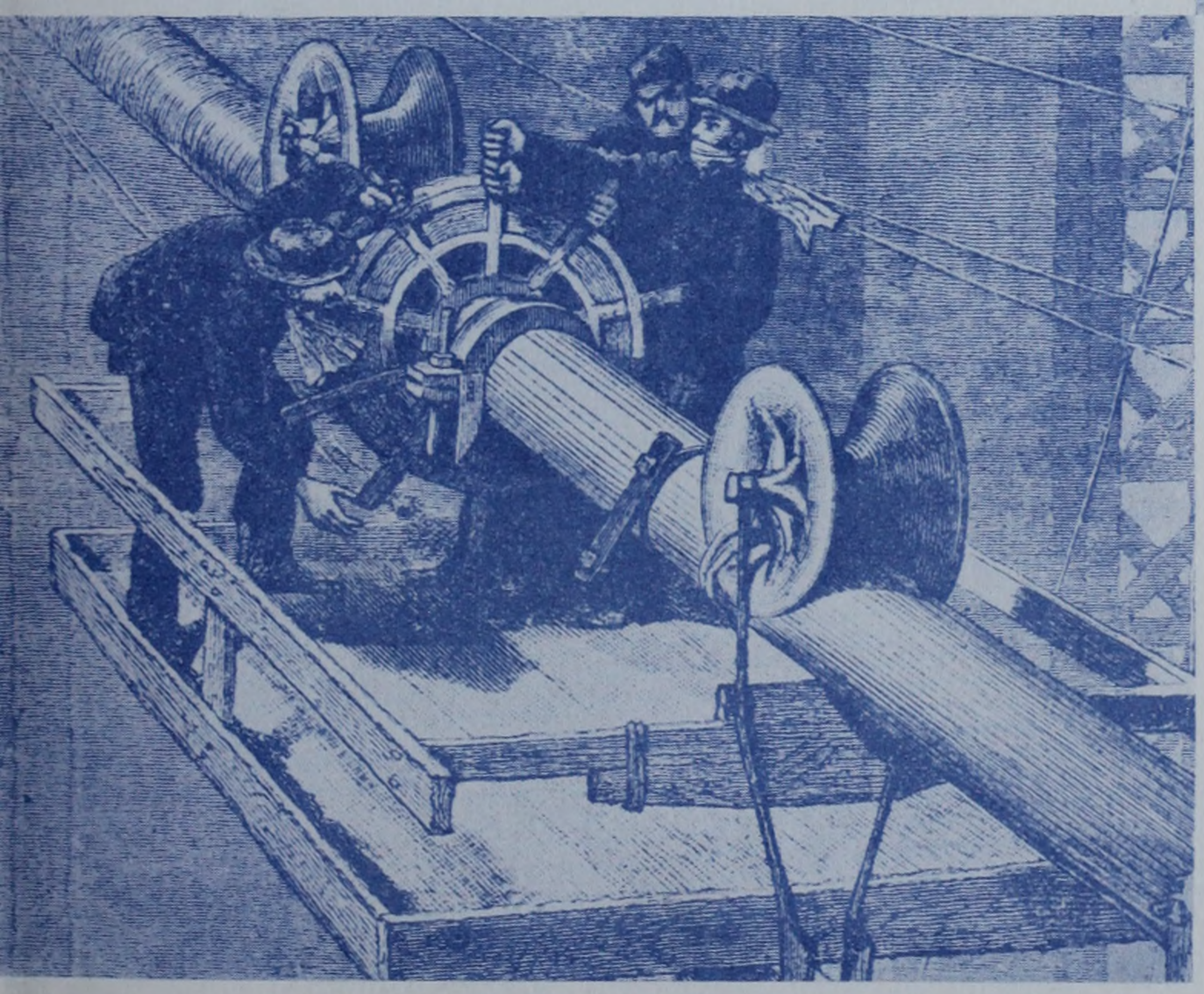
The 19 strands in each cable make a bundle 15¾ inches thick. After being strung, the strands were compressed into cylindrical form by large clamp tongs.



Footwalk to the tower, with steel anchor bars in foreground which linked the cable strands in each anchorage to four 23-ton cast iron plates, one for each cable.



Each cable is made up of 5,296 one-eighth-inch diameter wire, bound in strands, each strand being a continuous wire nearly 200 miles long, passing from anchorage to anchorage, back and forth 278 times. Stretching of the first wires began in 1876.



The final job of wrapping was done from a board seat slung on ropes from a grooved wheel. The wrapping machine consisted of an iron cylinder cast in halves, bolted together around the cable, compressing it firmly. A drum of wire encircles the cylinder and the wire winds off the drum and around the cable.

doing on the bridge and why he should not be displaced. Mrs. Roebling read this paper before the American Society of Civil Engineers and produced a sensation. The statement was also well received by the general public. Mrs. Roebling's self-sacrificing devotion and the profound intelligence displayed by her greatly aided in the consummation of his ideas.

The bridge was now nearly finished and on May 14, 1883, the tolls for the use of the bridge were fixed by the trustees as follows:

(1) Foot passage, one cent.

(2) Passage in railway cars, five cents.

(3) Tolls for animals and vehicles:

One horse or horse and man	5 cents
One horse and vehicle	10 cents
Two horses and vehicle	20 cents
Additional horses, each	5 cents
Neat cattle, each	5 cents
Sheep and hogs, each	2 cents

Bridge Officially Opened

The bridge was opened to the public on May 24, 1883. Its completion was recognized as of national importance. Nearly every state contributed its representatives to the throng that attended the opening. The day was clear and the cities were decorated. Business was generally suspended and the people turned out *en masse*. Excursions were run by the railroads from neighboring cities and towns bringing thousands to see the "Eighth Wonder of the World."

Early in the afternoon, the President of the United States, Chester A. Arthur, and the Governor of the State of New York, Grover Cleveland, the former accompanied by members of his cabinet, and the latter by officers of his staff, were escorted from the Fifth Avenue Hotel in New York to the New York City Hall, where they were met by the Mayor of New York, Franklin Edson, and other New York City officials. They proceeded to the bridge, accompanied by the Seventh Regiment of the National Guard of the State and a band of seventy-five pieces, and walked onto the bridge promenade. At the New York Tower a battalion of the Fifth United States Artillery joined the escort. The arrival at the New York tower was proclaimed to the multitudes on shore by the thundering of many cannons. Salutes were fired from the forts in the harbor, from the United States Navy Yard and from the summit of Fort Greene. Five boats of the United States fleet were anchored in the river below the bridge and joined in the salute. As the procession moved over the bridge whistles were blown, and the chimes of Trinity Church rang out.

The opening exercises were held in the railway terminal at the Brooklyn end of the bridge. The escort at the Brooklyn side was transferred to the 23rd Regiment of the National Guard of the State. Besides the President and his cabinet and the Governor of New York and his staff, there were present governors of several states, the mayors of nearly all the cities in the vicinity and many Army and Navy officers.

James S. T. Stranahan, one of the Trustees presided at the ceremonies. The speakers were William C. Kingsley, Vice-President of the Board of Trustees, Seth Low, Mayor of Brooklyn, Franklin Edson, Mayor of New York, Abram S. Hewitt, orator for New York, and Rev. Richard S. Storrs, orator for Brooklyn.

After the exercises, the President, the Governor of New York, the speakers of the day and the trustees were driven to the residence of Washington A. Roebling, on Columbia Heights in Brooklyn, to offer him their felicitations on completion of the bridge. Col. Roebling, owing to his disabilities, could not attend the ceremonies.

At night there was an elaborate display of fireworks on the bridge. A reception was given to President Arthur and Governor Cleveland in the Academy of Music, Brooklyn. Buildings were illuminated and concerts were held in various city parks.

Cost of the Bridge

The construction of the bridge, so vital to the interests of both cities, entailed an expenditure greatly in excess of the original estimate of $7,000,000, exclusive of land. The expenditures to May 31, 1883, amounted to $15,211,982.92, of which $483,299.77 was for acquisition of privately owned stock of the New York Bridge Company; $3,886,544.53 for acquisition of property; $504,572.07 for engineering and $10,337,566.55 for construction, equipment, etc. There was due on contracts at that time $23,141.74.

The increase in the cost of construction over the original estimate of John A. Roebling was due to an increase in size and clear height of bridge, to changes in plans made necessary as the work progressed, to increased costs of materials and labor, to losses occasioned by delays in construction and to various incidental charges not originally contemplated.

The bridge railway with cars operated by endless wire cables driven at a rate of ten miles per hour was opened for use Sept. 24, 1883. The wire cables were driven from the power house located between Main and Prospect Streets, Brooklyn. The trains at first consisted of one- and two-car trains and were switched at the terminals by steam locomotives. In the beginning these cars were not operated in the early morning hours. There was later a demand for cars to be run all night and in 1885 trains were operated across the bridge by locomotives at intervals of 15 minutes between the hours of 1 A.M. and 5 A.M.

It was evident from the opening day that the bridge would be profitable, as had been predicted by John A. Roebling.

On December 9, 1884, the tolls were revised:

Foot passengers	1 cent
Railroad fare	5 cents
One horse or horse and man	3 cents
One horse and vehicle	5 cents
Two horses and vehicle	10 cents
Additional horses, each	3 cents
Neat cattle, each	2 cents

Beginning Feb. 1, 1885, packages of 25 tickets for the promenade were placed on sale for 5 cents a package, single fare remaining at one cent.

On March 1, 1885, the railroad fare was reduced to 3 cents and packages of 10 tickets were sold for 25 cents.

In 1886 the Trustees were authorized by law to erect an elevated platform across Chatham Street (now Park Row) and a footpath to the westerly side of Center Street. The purpose of the elevated platform was to provide a track for switching trains conveniently at the New York Terminal.

Bridge Traffic Increases

Traffic on the bridge railway increased rapidly. As early as 1887 agitation arose for more commodious facilities. Subsequent laws authorized improved terminals.



17B

"Under the Towers," an engraving from a water color painting reproduced in "Harper's Weekly" on Feb. 18, 1882, shows work progressing on the bridge decking.



Fireworks, naval and shore batteries, church bells hailed the opening of the bridge. The people of the Cities of New York and Brooklyn took the day off to celebrate.

The trustees later were authorized to make the footwalk on the bridge free to pedestrians, and tolls were abolished on May 31, 1891.

To double the facilities for railway traffic, which were inadequate, plans were prepared in 1892 for building new and enlarged stations, one at the New York Terminal and one at the Brooklyn Terminal, extending the car storage yard from Concord Street to Tillary Street in Brooklyn, and duplicating the cable driving plant. The contract for the new Brooklyn Station was let February 18, 1893, and the contract for the reconstruction of the New York Station was entered into on June 7, 1893. Due to modifications in plans, the stations were not completed until 1896.

Arrangements were made to have trains switched at the terminals by means of passenger cars fitted with electric motors, instead of steam locomotives, and also to have the tracks equipped with third rails and electric feeders so that if the hauling cables failed or were out of use, the trains could be operated across the bridge by electric power. Twenty new railway cars, each equipped with four motors and cable grips, were purchased. The trains were run with one motor car and three trailers. Use of the motor cars began on Nov. 30, 1896. On January 23, 1897, enough motor cars were in service to permit abandonment of the locomotives. In the early morning hours, to save expense, the hauling cables were not used and the motor cars pulled the trains across the bridge.

In 1896 the Brooklyn Elevated Railroad Company and the Kings County Elevated Railway Company sought permission to run through trains from their elevated lines over the bridge to and from New York.

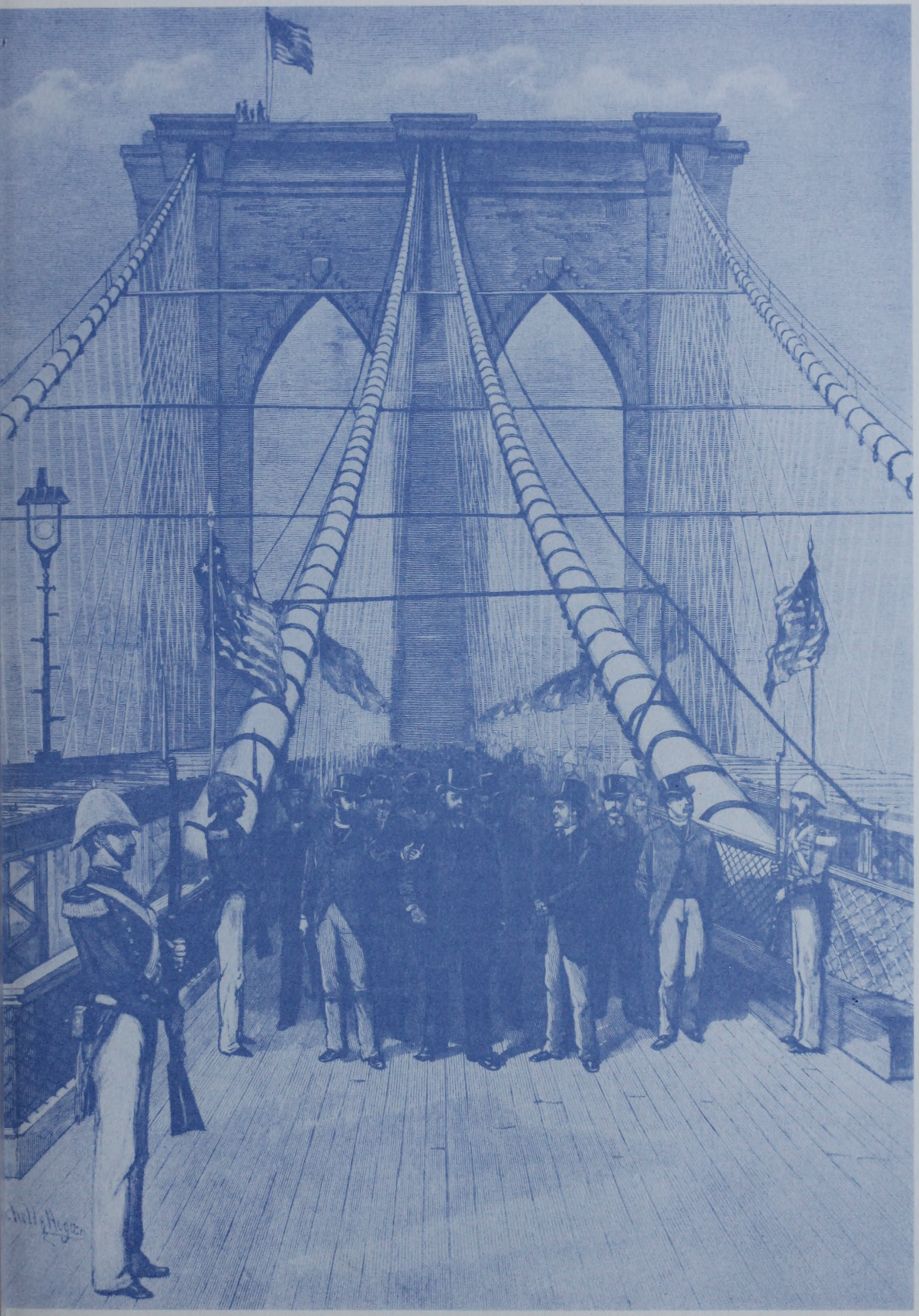
On August 23, 1897, an agreement was made between the trustees and the Brooklyn Elevated Railroad Company, the Kings County Elevated Railway Company, the Brooklyn Heights Railroad Company, Coney Island and Brooklyn Railroad Company, Brooklyn City and Newtown Railroad Company, and Nassau Electric Railroad Company, to permit operation of elevated trains and trolley cars across the bridge.

The pressure of economics and convenience which impelled construction of the Brooklyn Bridge to join the municipalities of New York and Brooklyn were continuing and led to a movement for consolidating into one city the present five boroughs of Greater New York. Consolidation took effect Jan. 1, 1898. Under the City Charter, a Department of Bridges was created, its head designated Commissioner of Bridges. The offices of the Trustees of the New York and Brooklyn Bridge were abolished, and all their powers and duties devolved upon the new commissioner and the Municipal Assembly.

Through Train Service Begins

Operation of trolley cars was begun on Jan. 23, 1898, in accordance with the 1897 agreement. A track had been laid by the companies on the inner side of each roadway for use of the trolley cars.

A modified agreement more advantageous to the City was entered into on June 23, 1898, between the Commissioner of Bridges and the Brooklyn Elevated Railroad Company for the operation of elevated railroad cars or trains across the bridge and also for the operation of the bridge railroad. The Commissioner of Bridges stopped the operation of the bridge railroad on June 30, 1898, and the Brooklyn Elevated Railroad Company began operation of the bridge railroad and of through trains from Brooklyn across the bridge on July 1, 1898.



President Chester A. Arthur and his cabinet, Governor Grover Cleveland and his staff, examine the bridge upon opening day, traversing the pedestrian walk.

The Kings County Elevated Railway Company began operation of through trains from Brooklyn across the bridge on Nov. 1, 1898.

Four new loops were built at the Manhattan Terminal for the trolley cars, making eight loops in all. These new loops were put in service on Nov. 15, 1903, and reduced the crowding at the terminal. An extension of switching tracks and platform for elevated trains was completed in February, 1906. This extension permitted the operation of five-car elevated trains across the bridge. Further extension to the west of the tracks and platforms for elevated trains was, however, deemed necessary. A law in 1907 authorized the Commissioner of Bridges to construct an extension to the Manhattan Terminal to permit operation of six-car trains across the bridge. The old foot-bridge over Centre Street, in use since 1886, was removed and a structure over Centre Street was built in 1907 and 1908.

Operation of six-car, through elevated trains began on Jan. 27, 1908, and through service on the elevated lines at all hours began on that day. To distribute the additional weight and impact caused by the six-car elevated trains the wooden track stringers were replaced with steel stringers, and the bottom chords of the stiffening trusses and the cross girders were reinforced by adding steel cover plates to them. The use of the hauling cables for bridge local trains was discontinued on Jan. 27, 1908. The local service was transferred from the elevated railroad to the trolley cars on Jan. 26, 1908. New approaches for trolley cars at the Brooklyn Terminal were built in 1907 and 1908 so that certain of the trolley lines could cross over Sands Street at the Brooklyn Terminal. Use of these new approaches was begun on Sept. 28, 1908.

The first rapid transit subway under the East River was opened on Jan. 9, 1908, to Borough Hall, Brooklyn, and on May 1, 1908, operation was extended to Flatbush Avenue.

This subway diverted railway passenger traffic and reduced congestion at the Brooklyn Bridge. The Manhattan Bridge located a short distance north of the Brooklyn Bridge was opened December 31, 1909. Owing to the opening of the new lines of travel between the Boroughs of Manhattan and Brooklyn and the consequent reduction of traffic on the Brooklyn Bridge, agitation for enlarging the Manhattan Terminal died down.

Brooklyn Bridge Becomes Official

By ordinance of the Board of Aldermen the name of the bridge was changed on January 26, 1915, from New York and Brooklyn Bridge to Brooklyn Bridge. The law had caught up with custom. The public had called it Brooklyn Bridge from the beginning.

On July 18, 1911, the roadway tolls were abolished.

In the early part of 1925 roadways on the suspended structure were paved with wood blocks replacing the spruce plank wearing surface. This effected a saving in maintenance costs, since the planks required renewal twice a year on the average. The wood blocks remained until modernization of the bridge, begun in 1950. In 1921 a steel underfloor was placed adjacent to the outer curb on each roadway and wood blocks were laid over it. When the roadways were reconstructed early in 1925, a second line of steel underfloor was placed along each roadway with its center six feet six inches from the outer curb, thus providing steel instead of plank underflooring for the wood block paving where the wheels of the outside lines of vehicles traveled. In connection with the reconstruction of the roadways, the old four and five-eighth-inch tee rails of the trolley car tracks were replaced with new seven-inch girder rails resting on new timber ties.

When the operation of the bridge railway was taken over in 1898 by the Brooklyn Elevated Railroad Company and surface cars began running across the bridge in January 1898, passengers could cross the bridge without payment of extra fare. This saving concentrated upon the bridge the major portion of the passenger traffic between the Boroughs of Manhattan and Brooklyn. As the volume of traffic increased, the trains were increased to five-car trains then to six. Local or bridge railway trains were run during rush hours on a headway of one minute, making sixty trains per hour crossing the bridge in each direction. The count of traffic for one day in 1907 showed a maximum of 265,636 persons using the elevated railway. During one rush hour 46,256 were carried.

As the pressure of traffic increased it became clear that the Brooklyn Bridge would have to be modernized to derive from it its full potential in carrying capacity.

For years elevated railroad operation across the Bridge had been decreasing. In 1944 this traffic was eliminated and the trolley cars rerouted over the rapid transit tracks. In this way the trolley roadways were freed for vehicular traffic and the elevated railroad terminals at the Manhattan and Brooklyn ends of the Bridge were removed.

Demolition of these terminals improved the appearance of the areas leading to the Bridge, particularly in Manhattan. It became possible to see the magnificent masonry towers of the Bridge and the structure itself from any part of the City Hall area.

In August, 1945, a contract was let to remove the tracks and widen the vehicular roadways at the Manhattan end from a point near the New York anchorage to Park Row. This provided some relief for traffic and removed some congestion especially in getting on the south roadway from Manhattan to Brooklyn.

A comprehensive study of the bridge was under way regarding its safety and ability to carry greater vehicular traffic. Plans had been formulated for a Brooklyn-Queens highway to provide for continuous express travel around the rim of these boroughs. It was desirable to have exit and entrance facilities for this expressway at or near the vicinity of the Brooklyn side of the Bridge. But the Bridge, in its old state could not be expected to handle the anticipated increase in traffic. Cars inevitably would pile up at both approaches to the Bridge. Something had to be done to meet this contingency.

On January 26, 1943, a contract was signed between the City of New York and a board of consulting engineers consisting of Holton D. Robinson, Othman H. Ammann and Leon S. Moisseiff, specialists in suspension bridges, providing for close collaboration with the engineering staff of the Department of Public Works in its technical survey and examination of the Brooklyn Bridge. The purpose was formulation of recommendations regarding the adequacy of the Bridge for its load and the expansion of its vehicular traffic capacity.

The study included among other things, physical and chemical tests of cable wire, structural steel and wrought iron to determine their condition and load carrying capacities. Sections of these materials were removed from various portions of the bridge and tested. They were found in good condition. The cables proved to have a considerable reserve capacity of strength and together with the capacity of the present anchorages and towers, justified the conclusion that it was feasible to redesign the structure to carry greater vehicular traffic.

At that time the bridge had six trusses – two inner trusses, two intermediate trusses and two outer trusses, the outer trusses being one-half the height of the others. The overall width between the inner and outer truss on each side of the Bridge was approximately 33 feet, covering the spaces occupied by the roadway and elevated railroad tracks. In order to furnish greater vehicular service, the board of consultants recommended that the railroad track lanes be converted to roadways that the intermediate trusses be removed and the outer trusses built to the height and strength of the inner trusses.



The Manhattan terminal of the bridge after reconstruction, which was started in 1893 and completed three years later. Trains were switched at the terminal by steam locomotives. After the cars were electrified, the locomotives were abandoned in 1897.

The removal of the intermediate trusses would leave one truss at each of the four cables, so that the live load of traffic would be transmitted from the roadway floor to the stiffening trusses and then directly to the cable. With the added space of the railroad lanes, the reconstructed roadways would each have a width of not less than 30 feet between curbs.

The demands of traffic made it imperative that something be done to modernize the structure without delay. With the studies of the engineering staff of the Department and the report of the Board of Consultants as the basis, a contract was awarded to Dr. D. B. Steinman, as consulting engineer, to:

1. Prepare plans and specifications for eliminating the intermediate trusses on the suspended span.

2. Remove the elevated and trolley tracks.

3. Reconstruct the roadways to replace the four lanes with six wider lanes of steel grating floor filled with concrete.

4. Widen the Manhattan and Brooklyn approaches and provide direct connection to the future Brooklyn-Queens Expressway, as well as Adams and Fulton Streets.

These plans in the main, followed out the recommendations of the Department engineers and the board of consultants.

The project was designed to double the vehicular capacity of the Bridge and was estimated to cost $7,000,000. Work was begun in 1950 on the first phase, which involved the rebuilding of the south roadway of the main span. During the reconstruction of the Bridge, traffic was maintained at all times on one roadway, with movement to Manhattan in the morning hours and to Brooklyn in the afternoon and evenings.

In connection with the reconstruction of the main spans, it was necessary to avoid unequal loading of the inner and outer stiffening trusses, and cables, and local distortions of the structures. Great care had to be exercised.

An extensometer for measuring the stresses in the new diagonals of the trusses was used in order to put these members under equal and balancing stresses throughout.

During modernization it was necessary to construct the end spans, that is the section of the Bridge between the towers and the anchorages, with a concrete deck to avoid objects falling to the streets below. To balance the pull of the cables on the main saddles and towers by reason of the concrete end span roadways, it became necessary to fill the steel grating of the main span with concrete. This measure would tend to avoid the shifting of the saddles on top of the towers, such as occurred in 1922.

The reconstruction of the Bridge, and its opening to traffic on May 3, 1954, will provide three lanes of vehicular traffic in each direction, comparing favorably with the most modern bridges.

To protect the Bridge against excessive loads, no trucks or buses will be allowed on the Bridge.

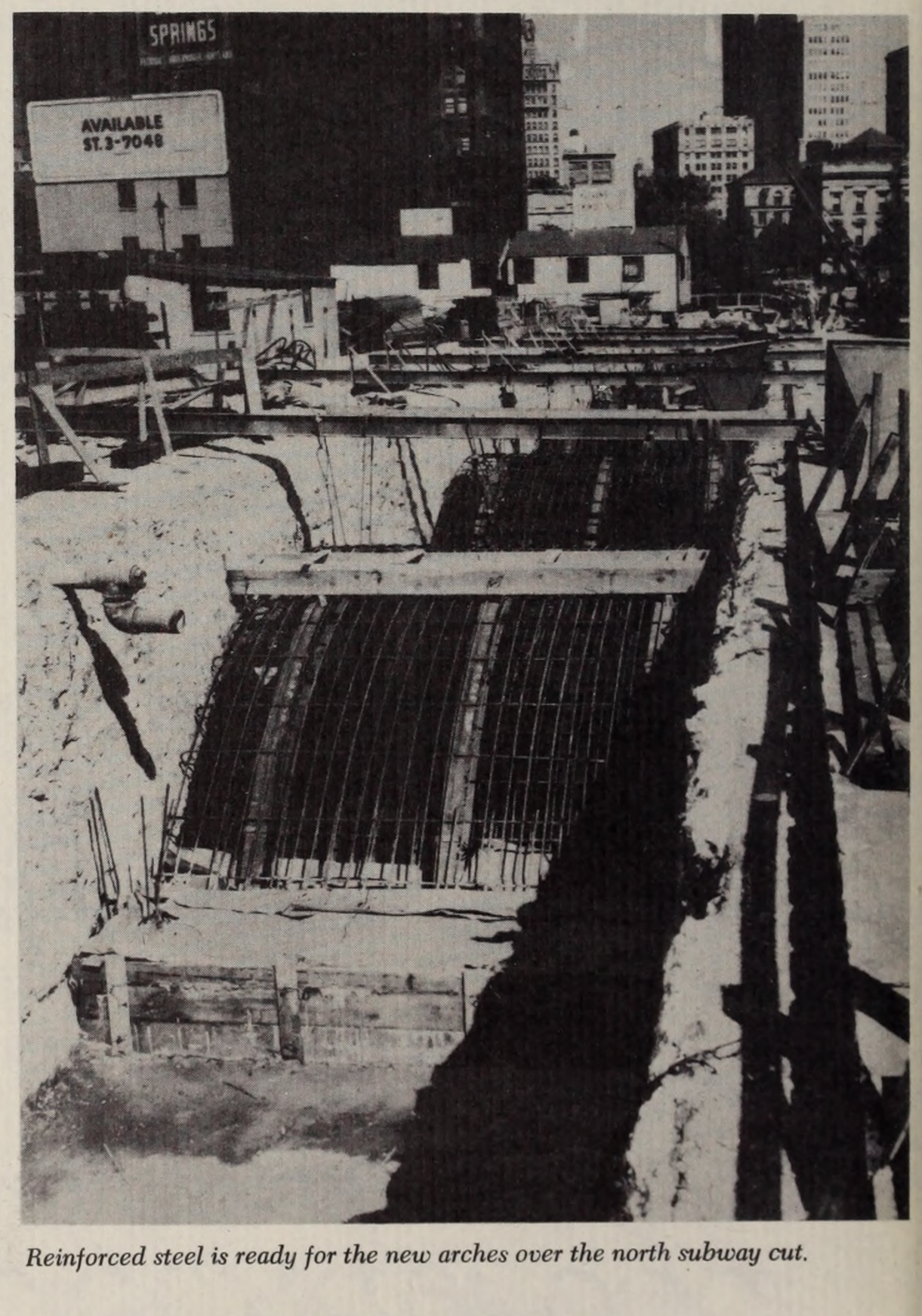


The bridge approach from Manhattan in 1899, showing wagon road, trolley line, elevated cars and promenade.

Bird's eye view of Brooklyn Bridge linking the teeming downtown areas of Brooklyn and Manhattan.



Arches of the old subway cut on the Manhattan side were removed preparatory to replacement with stronger arches to support traffic.



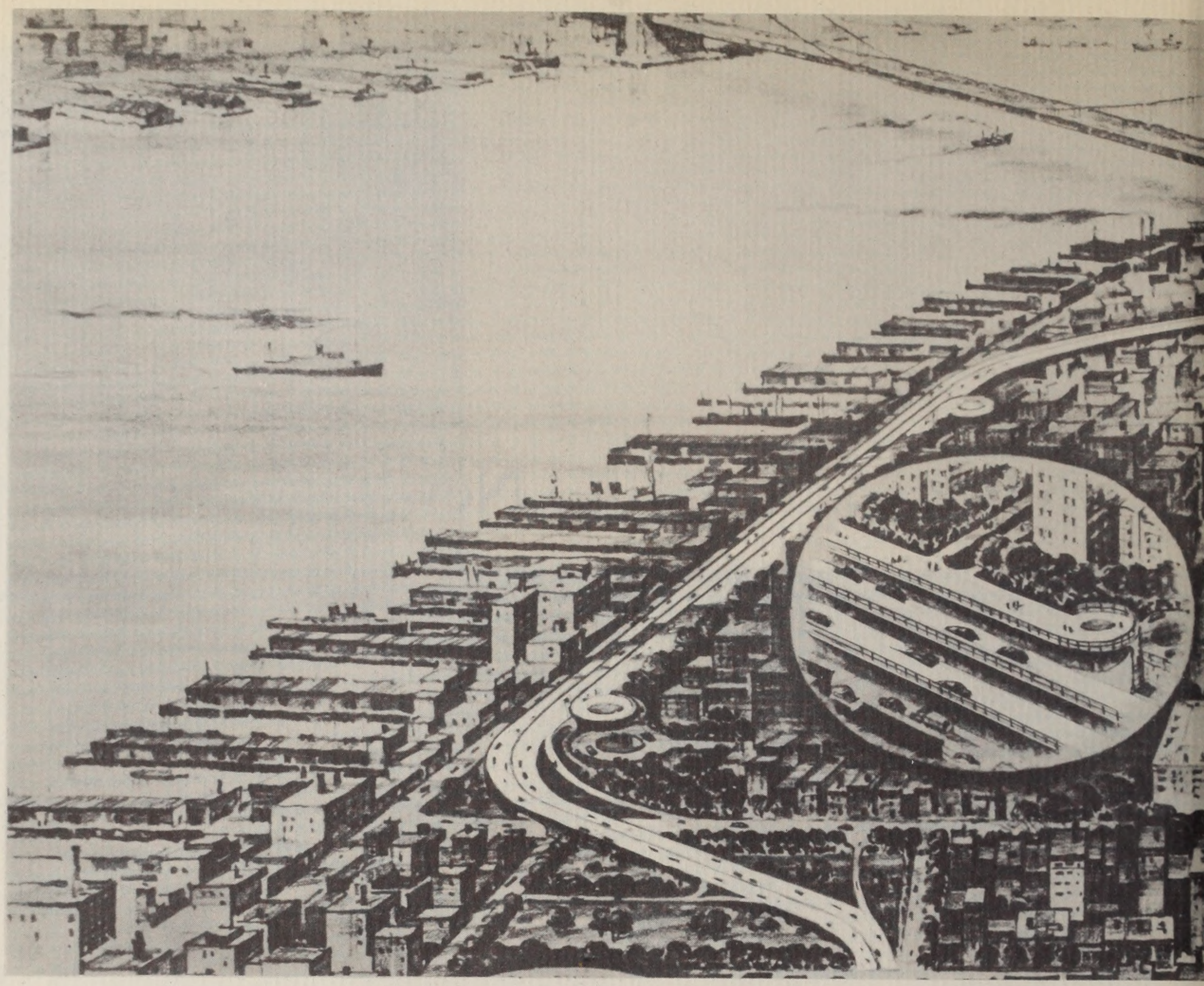
Reinforced steel is ready for the new arches over the north subway cut.

New Arches

New Lighting



New lighting fixtures and cables were installed on the roadways but the old-fashioned lamps were retained on the pedestrian walk.



Magnificent Achievement

(continued from page 4)

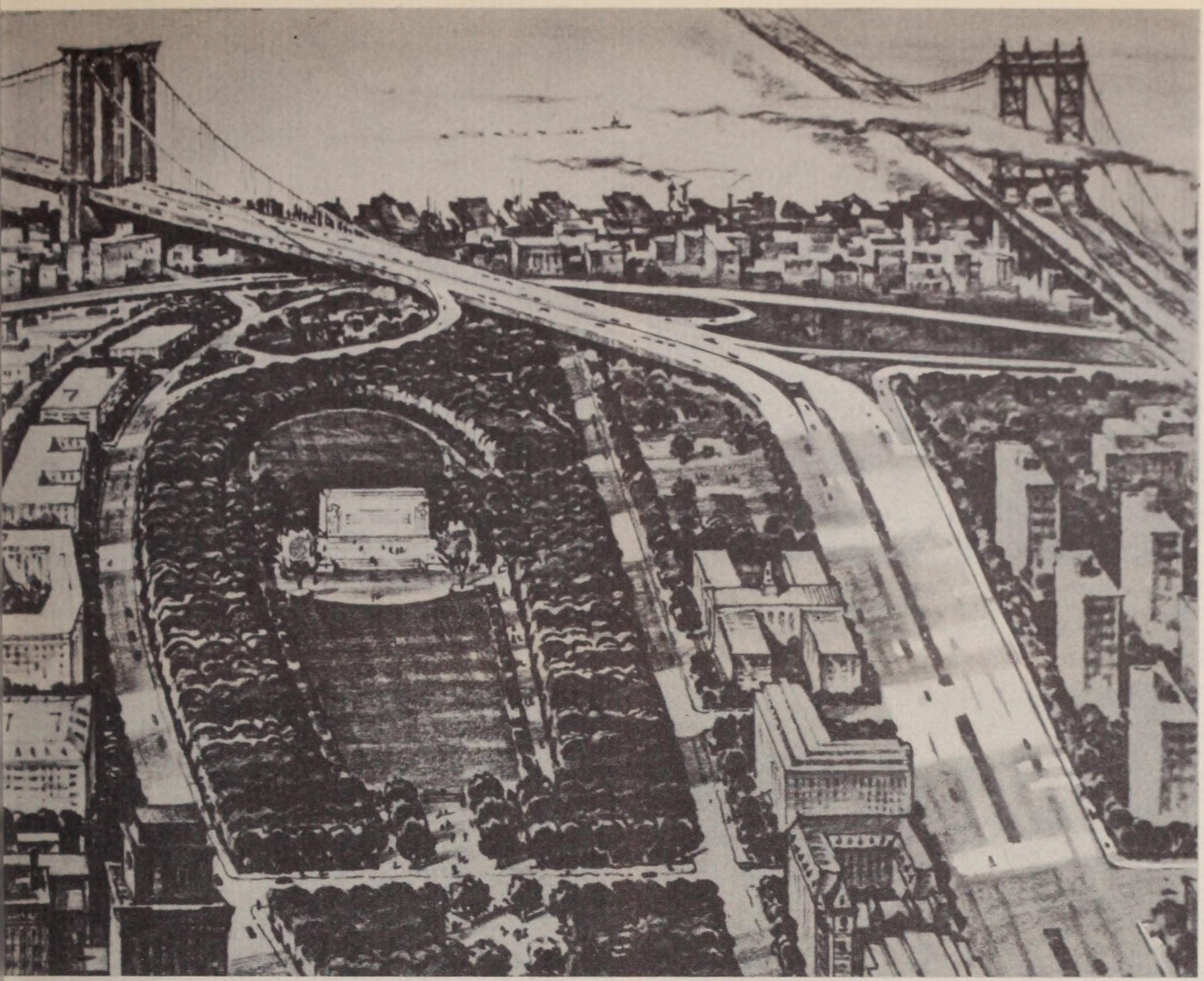
In the development of the Civic Center, entire blocks of buildings, formerly used for business or residential purposes, have been razed or are now in the process of demolition to permit the formation of super-blocks which have become the sites of public buildings, housing developments and parks and park-like areas.

Meanwhile, a number of streets which were laid out originally in the horse-and-buggy age, have been eliminated completely or have been substantially widened and improved for the unhampered flow of traffic around the Civic Center.

In the improvement of these highway facilities, an outstanding example is the widening of Adams Street, between Sands Street and Fulton Street, from a width of 60 feet to an overall new width of 160 feet. This improvement has been completed from Tillary Street to a point south of High Street where it connects directly with the new Brooklyn Bridge approach.

This new traffic thoroughfare, designed on classical boulevard lines, consists of two 32-foot center roadways together with easterly and westerly service roadways. Thus, traffic is enabled to move freely between the Brooklyn Bridge and Tillary Street which connects with the highway facilities leading to and from the many residential, business and industrial areas of the borough.

The work of clearing encroachments to permit the widening of Adams Street to a width of 160 feet from Tillary



The new 100-foot wide Adams Street connection to the Bridge is visualized in this artist's rendering. Building in park is Brooklyn War Memorial.

Street south to Willoughby Street is now in progress. The widened Adams Street will be extended from this point to Fulton Street and later will be joined to a widened Boerum Place.

The reconstruction of the Brooklyn Bridge is timely from another and perhaps more important standpoint.

The Borough President's Office is now completing the new section of the Brooklyn-Queens Expressway in the area between Middagh Street on Brooklyn Heights to Main Street at the Brooklyn Bridge, where connections between the expressway and the bridge will enable through traffic to by-pass the local street system and move freely toward Manhattan or toward the areas in Brooklyn itself which are served by the expressway, the Gowanus Parkway and the Belt Parkway.

At York Street the expressway is being built under the Brooklyn Bridge to Main Street from which it will be extended through the Navy Yard district and along Park Avenue and Kent Avenue to the Williamsburg area, where it will connect with another section of the expressway to Queens which is now in use.

The section of the expressway between Middagh Street and the Brooklyn Bridge will be completed within the next few weeks.

Two additional sections of the expressway including a vehicular bridge across lower Atlantic Avenue and a viaduct along Furman Street to a point just north of Joralemon Street have been recently completed.

For some time the cantilevered section of the expressway from Joralemon Street to Middagh Street has been in readiness and has been awaiting the completion of the Atlantic Avenue bridge, the viaduct to Joralemon Street and the section from Middagh Street to the Brooklyn Bridge.

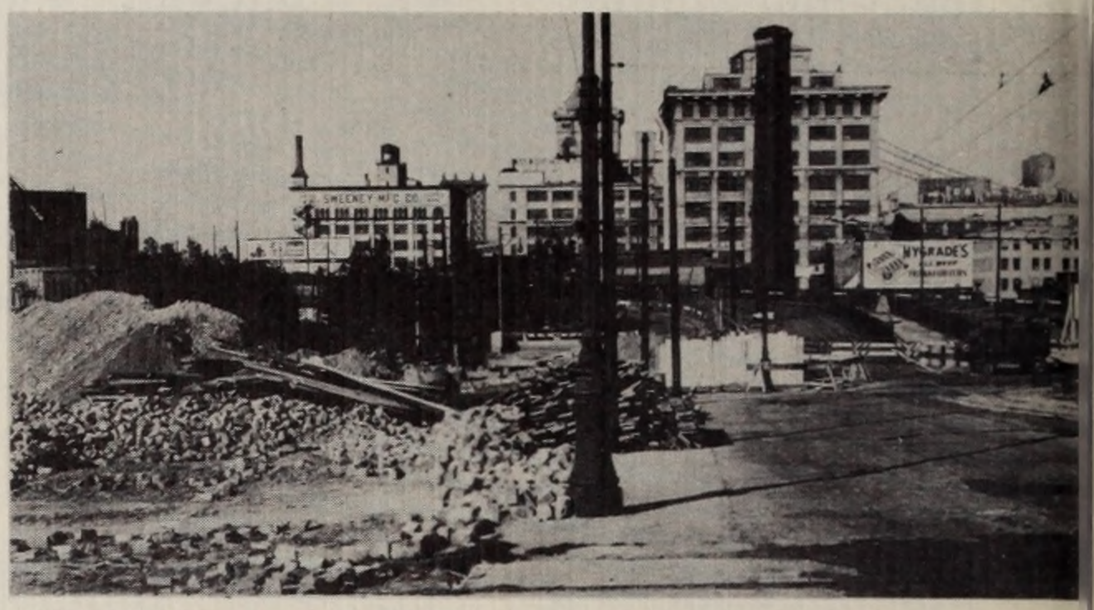
During the summer these sections will be opened to the public and will enable vehicles to use the expressway for the entire distance between Hamilton Avenue and the Brooklyn Bridge. At Hamilton Avenue the expressway connects with the Gowanus Parkway and with the Brooklyn-Battery Tunnel.

These improvements, considered in conjunction with the reconstruction and modernization of the Brooklyn Bridge, constitute far-reaching progress in providing business, industry and the motoring public with new and modern highway facilities whose importance cannot be over-emphasized.

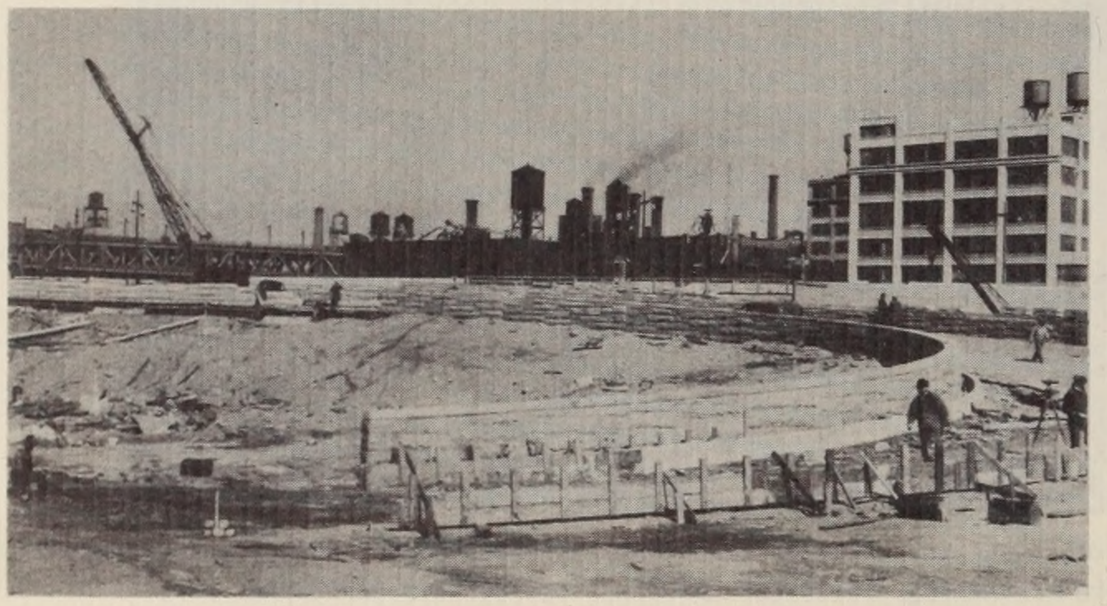
In behalf of the people of the Borough of Brooklyn it is a pleasure for me to extend congratulations to Mayor Robert F. Wagner, the members of the Board of Estimate and the Department of Public Works, as well as all others, who have helped to make the Brooklyn Bridge reconstruction and modernization project the splendid and highly-useful improvement which is being dedicated and opened to the public today.



The old brick arches between Prospect Street and Sand Street are removed preparatory to changing the direction of the approach to come to grade at Adams Street instead of Fulton Street, the former approach street.



The Bridge approach prior to reconstruction, excavation for north roadway in progress.



The new exit for the south roadway into Fulton Street takes shape.



Excavation and grading of widened Adams Street, the new route to the Bridge.

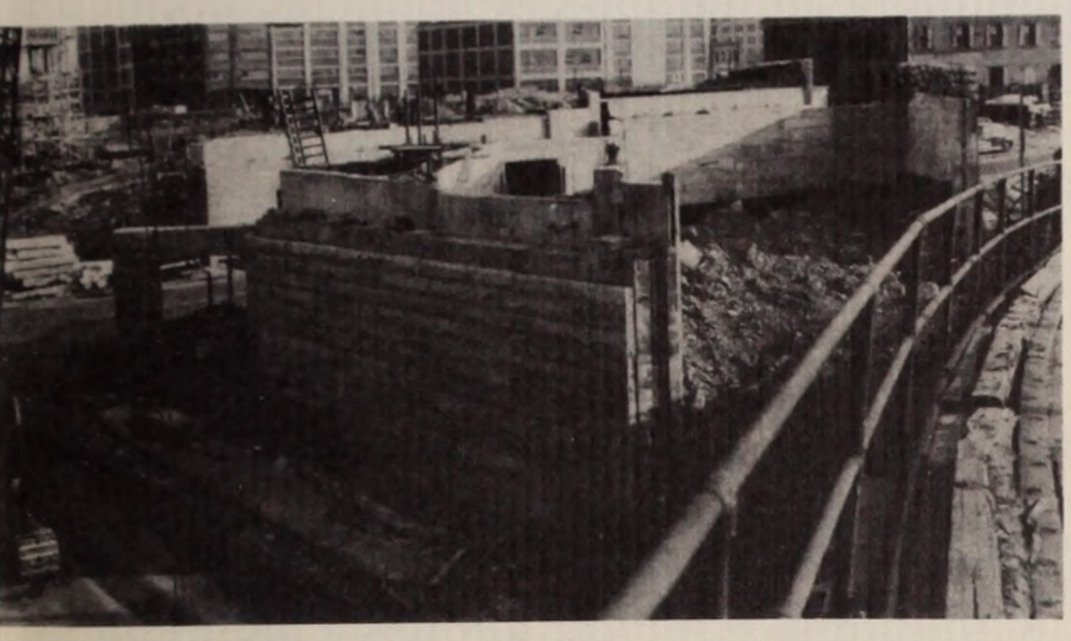


Temporary paving, to allow for settling of the fill, is laid on north roadway approach.

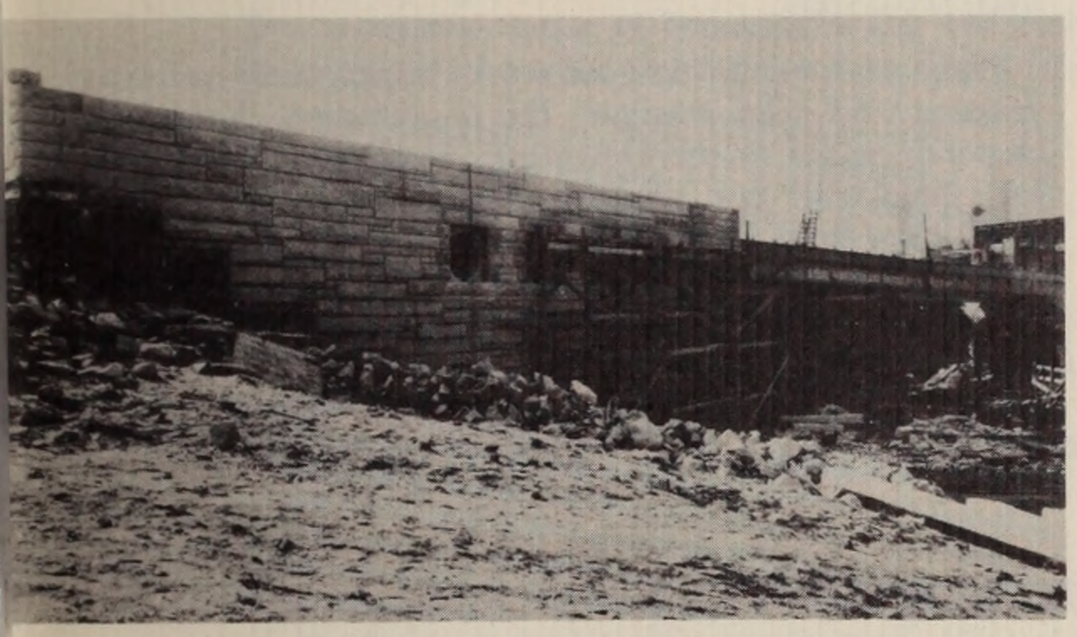


A granite wall separates the north and south roadways, the north roadway shown completed and ready for traffic.

The Brooklyn Approach



View shows the east wall of Prospect Street under construction, as it appeared in December, 1952.



Wall at northwest abutment of Washington Street, showing intake and exhaust openings of new air compressor plant for maintenance operations on the Brooklyn and Manhattan Bridges.



The repaved roadway of the Brooklyn approach, Manhattan-bound. Chimney stack is part of the old power house for cable-car operation which started in 1883. The building in recent years has been used as a Department of Public Works Shop, which is scheduled to be torn down in the near future.

Part of a Plan

(continued from page 7)

Queens with connections to the Brooklyn-Battery Tunnel, the Manhattan and Williamsburg Bridges, the Queens-Midtown Tunnel and Expressway and the Triborough Bridge.

The Manhattan end of the bridge is at the newly planned Manhattan Civic Center where the decrepit Third Avenue "El" is being demolished, streets are being widened and new open areas created, and connections planned to the South Street Viaduct.

There are still many gaps in the comprehensive arterial system of the City. Some of these will be closed with the completion of the Brooklyn-Queens Expressway, Horace Harding Expressway, Prospect Expressway, Major Deegan Expressway, Cross Bronx Expressway, Sheridan Expressway, Bruckner Expressway, the reconstruction of Conduit Boulevard and the completion of the East and Harlem River Drives as an express artery, all of which are under construction or in planning with City, State, Federal and Triborough Bridge and Tunnel Authority funds.

The final gaps are the Lower Manhattan Expressway, the Mid-Manhattan Expressway, the Narrows Bridge, a new Hudson River bridge in the vicinity of 125th Street, a second deck to the George Washington Bridge, all of which, with suitable approaches, are under study jointly by the Port of New York and the Triborough Bridge and Tunnel Authorities and all of which, it is hoped, the Authorities will be able to finance in the not too distant future.

An Engineering Marvel

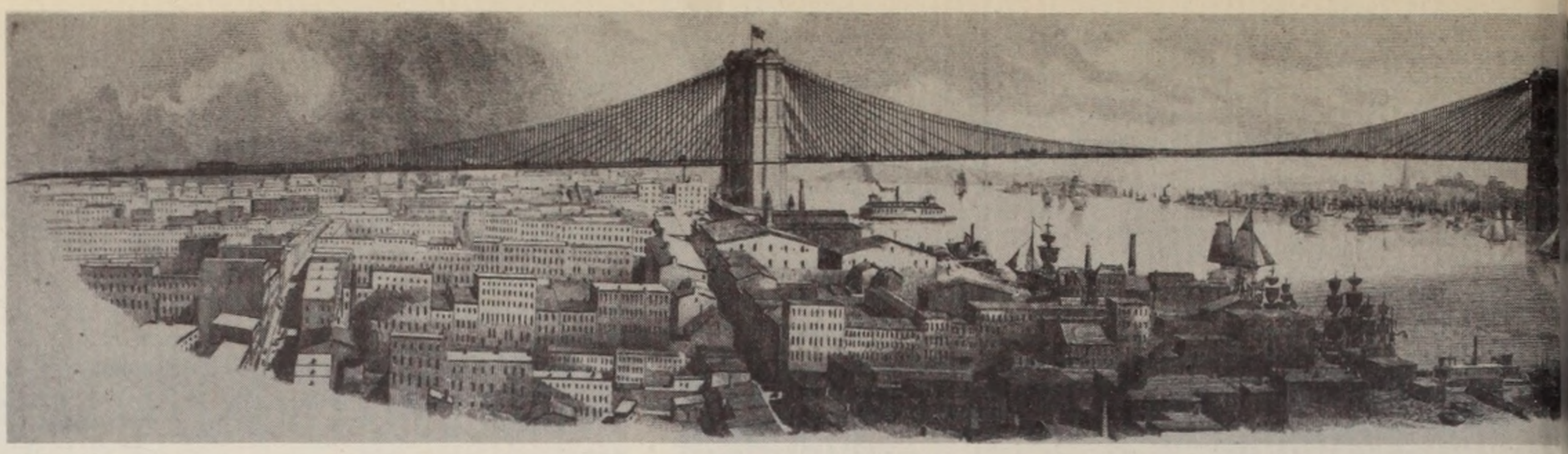
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mind, courage, resourcefulness and determination of man — and in particular, to John A. Roebling, Col. Washington A. Roebling and his wife, Emily.

We of the Department of Public Works have taken this historic bridge, still full of life after 70 years of invaluable service to the people of New York City, and through careful changes assured its continuing and increased usefulness. At "one stroke," Brooklyn Bridge has been brought from the era of wooden paving blocks, cobblestones and trolleys into the age of modern automotive traffic.

We have dealt kindly with Brooklyn Bridge, recognizing its claims on our respect and affection. So, while we have built modern concrete-paved, three-lane roadways to replace the old, while we have moved trusses, installed new struts, new light fixtures, improved the Brooklyn approaches, we have been careful to preserve the essential character and appearance of the bridge.

The work has taken much longer than expected, due to unforeseeable delays. But at last, proud old Brooklyn Bridge is rejuvenated . . . developed to its full potential to help meet the demands of 20th Century traffic . . . competent to serve for decades to come.



The day of the skyscrapers lay in the future and the low skyline of Manhattan and Brooklyn was easily dominated by the Brooklyn Bridge, as shown by this engraving published in 1869 of the "contemplated bridge."

Civic Center Milestone *(continued from page 6)*

Manhattan Civic Center Area and creating an integrated plan for its accomplishment. Demolition of the obsolete and obstructing old United States Post Office Building at Broadway and Park Row made possible the restoration of the southern portion of City Hall Park.

In 1946 followed the "Re-Unveiling of Brooklyn Bridge" on the Manhattan side with the razing of the unsightly Third Avenue Elevated Station straddling Park Row. The final stage of removal of the Third Avenue "El" structure and spur from City Hall to Chatham Square is now nearing completion. It was Mayor Fiorello H. LaGuardia who first recognized the accomplishments of our Association by inviting us to sponsor both the Post Office Demolition and Brooklyn Bridge "Re-Unveiling" ceremonies, at which I spoke as President.

It would seem that another of our civic improvement and preservation objectives is about to be realized. Last month Commissioner Zurmuhlen requested $2,250,000 of the Board of Estimate to replace the crumbling stonework of beautiful, historic, 151-year-old City Hall, as earmarked in the 1954 Capital Budget. This year the designing of the long-needed City-Municipal Courts House to be erected on the old Tombs site is officially underway, to be followed by the demolition of the Court House at the rear of City Hall. Then City Hall Park can be completely restored to the City and to downtown Manhattan.

Three years ago as our good works became more and more manifest and acknowledged, the organization changed its corporate name to the Downtown Manhattan Association, Inc. Regionally our intensive efforts are exerted in lower Manhattan from Canal Street to the Battery, but with the Greater New York (Manhattan) Civic Center in our midst, our efforts are to work for the betterment of "The Greatest City in the World" and its environs.

Modernization of Brooklyn Bridge has brought us one step – an important step – nearer to that goal.

A Vital Transportation Link *(continued from page 6)*

reconstructed bridge, with new approaches, a part of Brooklyn's growing Civic Center, forms a vital link in a gigantic system of modern parkways, expressways, and highways designed to integrate the entire city, other counties and nearby states.

We can begin to see the new traffic pattern emerging. The Brooklyn-Queens Expressway, circling Columbia Heights, beneath the beautiful new promenade along Brooklyn's waterfront, and connecting with all of the East River bridges and tunnels, will take through traffic away from local streets. When a few gaps are closed, one will be able to get in a car in Downtown Brooklyn and drive a hundred miles or more in almost any direction without encountering a traffic light. Completion of these facilities for the smooth flow of traffic will free the core of the Civic Center for the orderly progress of public construction.

Opening the remodeled bridge will also accelerate the replacement of deteriorated buildings with modern housing, business construction, and the improvement of a number of the important educational and cultural institutions in Downtown Brooklyn. The end result will be perhaps the greatest redevelopment of the older section of any American city.

In his address dedicating Brooklyn Bridge, Abram S. Hewitt declared that the successful completion of the structure represented a triumph of two principles: "The organization of expert knowledge and the establishment of a fixed and centralized responsibility for results." Those principles have been re-affirmed in the rebuilding. Commissioner Zurmuhlen and his associates have done a splendid job, and we in Brooklyn are grateful to them.

We also pay tribute to Borough President Cashmore, the Mayor, and the other members of the Board of Estimate, to City Construction Coordinator, Robert Moses, and to the others who have helped in this undertaking. We appreciate their efforts, not only in the rebuilding of the bridge, but in furthering the entire Civic Center and Downtown Brooklyn Plan originating in the shadow of its eastern tower. We are confident that in the future, as in the past, the new utility and old beauty will stir the civic pride of many generations to come.



BROOKLYN BRIDGE CONSTRUCTION DETAILS

Construction began January 3, 1870.

CAISSONS: Size of caisson, Manhattan tower, 172 x 102 feet.
Size of caisson, Brooklyn tower, 168 x 102 feet.

TOWERS: Depth of tower foundation in Manhattan, 78 feet below mean high water.
Depth of tower foundation in Brooklyn, 45 feet below mean high water.
Size at mean high water line of Manhattan tower, 140 x 59 feet.
Size at mean high water line of Brooklyn tower, 140 x 56 feet.
Size at coping course of Manhattan tower, 136 x 53 feet.
Size at coping course of Brooklyn tower, 136 x 50 feet.
Total height of towers above mean high water, 272 feet.

ANCHORAGES: Size of anchorages at base, 129 x 119 feet.
Size of anchorages at top, 117 x 104 feet.
Height of anchorages, 89 feet in front, 85 feet in rear.

SPANS: Length of main span, 1,595 feet, 6 inches.
Length of each side span, 930 feet.
Length of Manhattan approach, 1,562 feet, 6 inches.
Length of Brooklyn approach, 998 feet.
Total length from Park Row, Manhattan, to Sands Street, Brooklyn, 6,016 feet.

ROADWAYS: Width over all, 86 feet.
As reconstructed, the roadways are each 30 feet wide, carrying three lanes of traffic, one footwalk 15 feet, 7 inches wide.
Height of roadway at towers, 119 feet, 3 inches above mean high water.
Clear height of bridge at center of main span, 132 feet above mean high water.
Roadway grade on each approach, 3.25 per cent.

CABLES: Number of supporting cables, 4.
Diameter of each cable, 15¾ inches.
Length of each single wire in cables, 3,578.5 feet at 70°F.
Total length of wire in four cables, 14,357 miles.
Each cable contains 5,296 galvanized steel, oil coated wires, laid parallel and closely wrapped to a cylindrical form.
Weight of four cables inclusive of wrapping wire and suspenders, 3,900 tons.

WEIGHT: Weight of remaining steel and iron in main bridge, 9,900 tons.
Weight of steel and iron in approaches, 10,200 tons.
Total weight of steel and iron in bridge and approaches, 24,000 tons.

OPENING DATES: Bridge opened for pedestrians and vehicles, May 24, 1883.
Elevated railway began operation Sept. 24, 1883.
Trolleys began operation Jan. 23, 1898.

COST: Original cost including land, $15,211,982.92.
Modernization cost, $7,000,000.

The Great Harp

(continued from page 12)

were looped through the saddles in the upper reaches of its Gothic towers, and before there were footwalks or roadways for men to tread upon, it lured a young newspaper reporter to its summit.

He was Arthur Henry Curtis of the New York Morning World, dead these many years, as is the great journal for which he labored. Night after night, he had stared at the bridge's frame in utter fascination. He felt unaccountably drawn to it, almost as to a woman warm and pulsing. Then, one night when he had sipped long at Park Row's headiest wines, he came to look again.

It was on a clear evening. The stars were brittle and winking. The moon was full. Its silver magic washed the unfinished bridge with seductive light and shadow. Young Arthur Henry Curtis moved toward an unguarded approach as if under a hypnotist's spell. No one saw him start up the cable from Manhattan shore. The pull lured him strongly upward until he dropped back, panting, inside the first granite tower.

The wine fumes drained away. Young Curtis, held in the siren's arms, looked down to the flowing river 272 feet below. It was a silver sheet in the moonlight. The city's lamps seemed incredibly far away. Fright seized young Curtis and he shook. He pulled up quaking knees, buried his head between them to shut out the dizzying map. He knew he could never make his way down without help. He tried to cry out, but no man heard. The siren held him.

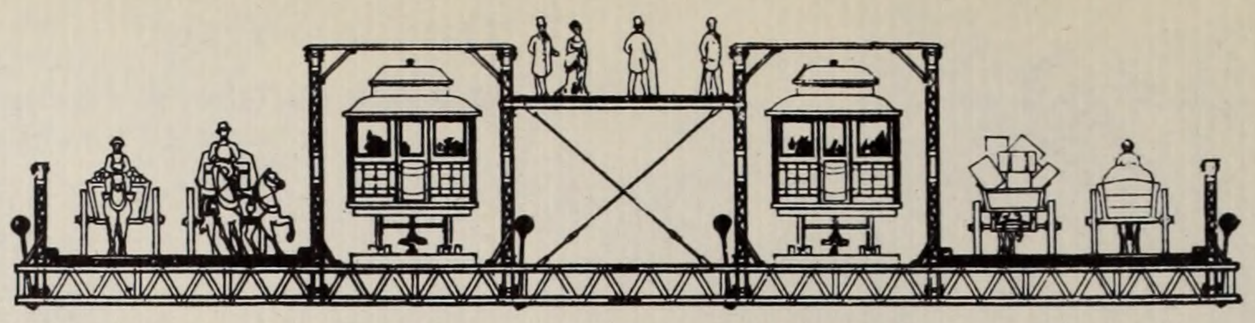
Astonished workmen took the reporter down at dawn. He lived for many decades after this weird experience, but the murmuring harp's fascination always clung. He would not look on it alone. To him she was always a Circe made of steel and granite, but irresistible. Her seventy years haven't aged her. Men, and women, still thrill to her mystic beauty, and probably always will as long as man-made structures last.

It is the men who tread her walks who change. In the beginning, when the bridge was new, her wooden promenades were always covered, in fair weather, by women in lacey dresses, prominent bustles, with waists caught in by whalebone stays. Their pretty bonnets, seen from above, were like masses of old-fashioned flowers oddly in motion. And the beginning was the era of the tight-fitting suit and the brown derby, the lush mustache and button shoes.

When the bridge was finished, New York had just collected enough money to pay for a pedestal high enough to support her sister, the Statue of Liberty. John Howard Payne who had written "Home, Sweet Home", was entering the harbor on the last lap of his long journey from Africa in a casket – home, then, forever. When the bridge was new, Chester A. Arthur was President. He came to her public debut because her coming-out party in May, 1883, was a national event. He worshipped her lines as all men did.

Now in May, 1954, the Great Lady extends her lovely arms again to her worshippers after brief retirement. The new changes have not altered her siren beauty. Man, who could only crawl in drays and in carriages when she was young now flashes high above her in sibilant jets, but winks down at her with silver wings. She still sings when the winds play among her strings. She still blushes when dawn and twilight kiss her. She still wears her starry evening gown when the moon smiles upon her.

And she serves her worshippers staunchly now as she did when she first dipped her toes in East River more than seventy years ago. Serves them, and with her harp, sings for them, and will, forever.



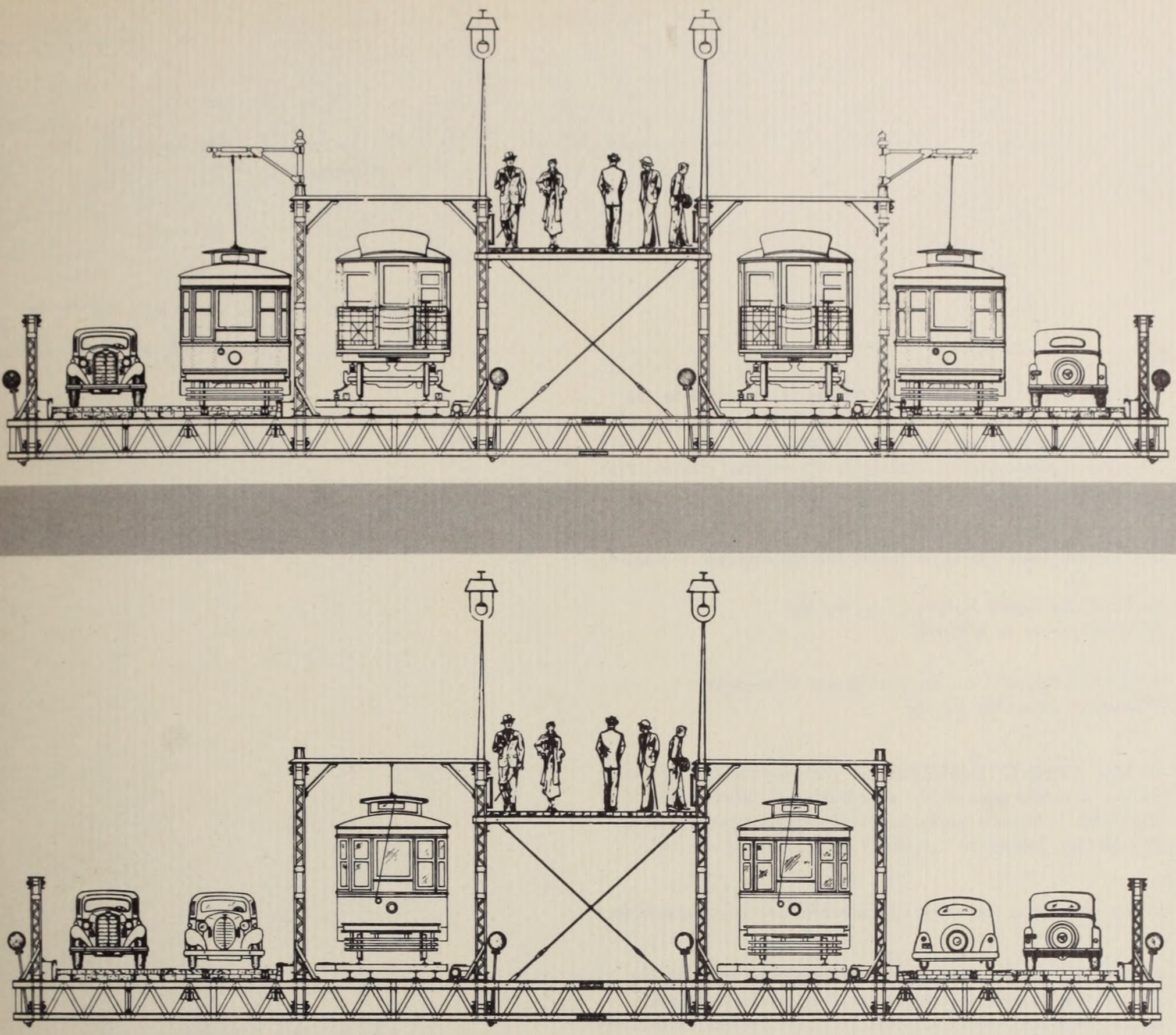
TRAFFIC HISTORY OF BROOKLYN BRIDGE

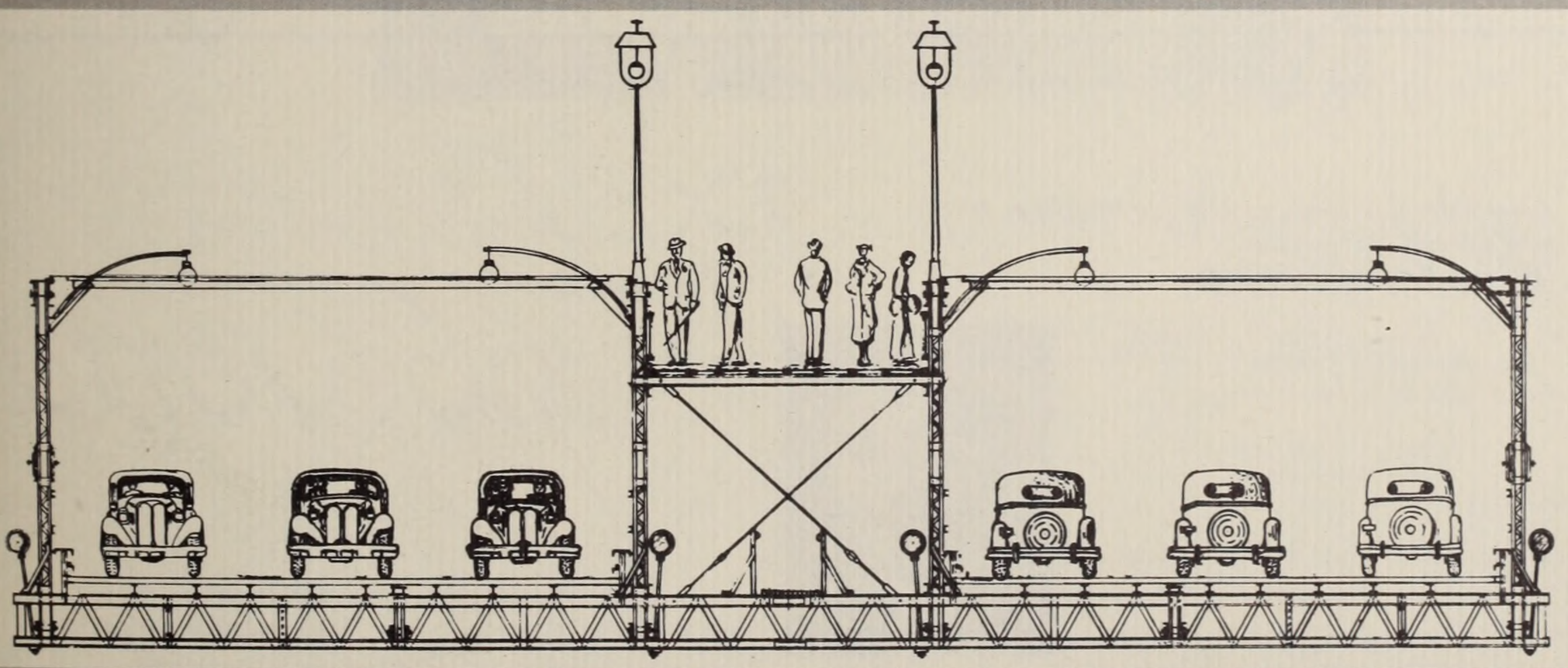
Counts for 24-hour Period in both directions.

Year	Trolley Cars	Elevated Cars	Vehicles	Passengers in Trolley Cars	Passengers in Elevated Cars	Passengers in Vehicles	Pedestrians	Total People
1883					16,500		13,500	
1884					25,300		12,800	
1885					36,500		12,040	
1886			3,728		70,237		7,839	
1887			3,391		91,130		6,488	
1888			3,587		98,127		9,582	
1889			3,661		110,234		8,975	
1890			4,535		122,298		9,842	
1891			4,025		123,966			
1892			3,824		129,382			
1893			4,166		127,237			
1894			4,925		135,549			
1895			4,773		133,077			
1896			4,350		131,281			
1897			4,694		144,509			
1898	No count taken							
1899	8,108		3,609		149,911			
1900	7,899	3,426	3,733	129,609	146,214			
1901	7,880	3,818	3,960	168,600	114,464			
1902	7,188	4,720	3,938	147,660	159,637	7,900	14,448	329,645
1903	7,614	4,880	3,677	147,994	173,435	6,026	9,045	336,500
1904	7,680	5,230	3,638	158,495	198,481	3,314	14,485	374,775
1905	7,946	5,755	3,726	150,953	205,355	3,080	8,370	367,758
1906	7,987	6,756	3,805	130,952	259,580	2,420	9,703	402,655
1907	8,587	6,676	3,625	144,831	265,636	2,777	13,054	426,298
1908	8,638	7,048	4,138	107,317	193,705		8,793	
1909	8,437	7,636	5,044	109,655	204,344	4,893	10,007	328,899
1910	8,257	7,406	3,116	119,580	211,619		9,726	
1911	8,500	7,913	3,574	114,049	217,110	5,404	5,714	342,277
1912	7,917	7,490	3,913	119,893	211,117	5,976	7,282	344,268
1913	7,725	7,352	4,214	106,489	184,886	7,304	8,166	306,845
1914	7,405	6,964	3,983	102,200	176,653	6,831	8,022	293,706
1915	6,705	6,624	4,359	89,616	138,856	7,552	7,593	243,617
1916	7,301	4,776	4,590	98,386	114,529	7,778	5,684	226,377
1917	6,421	4,458	5,068	114,742	118,022	8,767	5,303	246,834
1918	No count taken							
1919	6,213	4,911	6,605	130,356	106,240	9,707	2,299	248,602
1920	5,856	3,844	5,188	68,462	80,063	8,858	1,928	159,311
1921	5,431	4,208	8,529	103,228	96,988	13,444	3,263	216,923
1922	4,966	4,452	1,739	67,236	77,610	2,085	3,280	150,211
1923	4,868	4,622	1,341	67,584	75,298	1,708	3,474	148,064
1924	4,949	4,854	1,328	65,709	73,455	1,716	3,265	144,145
1925	4,763	5,092	9,261	52,214	74,975	18,522	2,956	148,667
1926	4,414	5,568	18,581	76,778	82,651	37,120	3,914	200,463
1927	4,400	5,524	22,669	74,525	69,463	45,268	3,978	193,234
1928	4,012	5,192	22,247	46,432	68,844	44,447	2,818	162,541
1929	3,142	5,552	29,992	55,300	74,397	59,963	3,047	192,707
1930	3,348	5,630	22,540	56,933	65,289	45,080	3,808	171,110
1931	3,351	4,467	24,888	41,338	51,869	48,808	2,242	144,257
1932	2,385	2,640	24,287	33,762	41,465	48,574	2,725	126,526
1933	2,345	2,730	22,585	28,289	36,068	45,170	3,371	112,898
1934	2,050	2,447	23,818	29,232	45,575	47,636	3,675	126,118
1935	2,122	2,406	24,518	29,356	32,560	39,308	2,937	104,161
1936	2,294	2,342	25,971	25,677	27,983	51,942	3,105	108,707
1937	2,270	2,180	25,940	24,729	21,053	51,880	1,894	99,556
1938	1,806	2,210	27,347	25,801	20,422	54,694	3,146	104,063
1939	1,790	1,994	27,757	25,188	23,821	55,514	2,357	106,880
1940	2,156	1,288	32,564	25,742	7,867	65,128	3,183	101,920
1941	2,110	1,304	30,466	26,679	8,032	60,932	1,909	97,552
1942	3,466[a]		23,735	48,870[a]		47,470[a]	[b]	96,340
1943	3,895[a]		26,327	47,138[a]		52,654[a]	[b]	99,792
1944	1,845		19,036	29,635	[c]	38,072	[b]	67,707
1945	1,573		25,068	26,588		50,125	359	77,072
1946	1,197		30,816	22,280		61,632	720	84,632
1947	[d]		33,140	[e]		[e]	[e]	
1948	1,074		37,011	22,126		74,016	[e]	96,142
1949	977		37,244	15,685		74,499	[e]	89,184
1950	[f]		13,397	[f]		26,794[g]	[h]	
1951			14,865			29,730[g]	[h]	
1952			16,907			33,814[g]	[h]	
1953			14,513			29,026[g]	[h]	

[a]Trolleys and elevated combined.
[b]Bridge closed to pedestrians.
[c]Elevated trains discontinued.
[d]No count for trolleys.
[e]No count for people.
[f]Trolleys discontinued.
[g]Vehicular traffic—one roadway.
[h]Pedestrian walk closed.

Bridge or elevated railway began operation Sept. 24, 1883.
Footwalk tolls abolished at close of May 31, 1891.
Vehicular tolls abolished at close of July 18, 1911.
Trolley car service began Jan. 23, 1898.
Local service transferred from elevated to trolley cars, Jan. 26, 1908.
Through service on elevated at all hours began and cable operation discontinued, January 27, 1908.





EVOLUTION IN USE

Top, opposite page, shows foot, cable car and carriage ways of bridge when it opened. Top of page, the bridge as of 1933, with elevated trains, trolleys and cars. Middle diagram, indicates conditions as of 1945 with cessation of elevated trains and transfer of trolleys to elevated tracks, making two lanes available for vehicular traffic. Bottom, the modernized bridge, with three lanes for passenger cars in each direction.

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old/new

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MANHATTAN CIVIC CENTER *redevelopment advances another step with reconstruction of Brooklyn Bridge. Studies are under way to provide for uninterrupted flow of traffic between the West Side Highway and Brooklyn Bridge.*

