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## THE PROGRESS OF ELEVATED RAILWAYS.

The ancient story of the intruding camel, who begged a shelter for his head in his master's tent and ultimately crowded in his unshapely body, to his master's great discomfort, is paralleled in the history of elevated railways in this city.

The main reason for the adoption of this form of rapid transit was the cheapness with which it could be supplied. The camel's head was not attractive, but it was easily let in, and promised an easy removal should such an issue prove desirable. Fig. 1, page 258, shows what an early form of the original West Side elevated road was like; not the earliest form, however, for that was of considerably lighter construction. The large engraving presented below gives a hint of the enormous possibilities of the structure which has taken possession of so much of the city. As a specimen of bold, clever, and original engineering it is admirable. Its effect upon the fine avenue it overshadows is quite another matter. So, too, is its probable influence upon the region it traverses as a site for dwellings. The utter inadequacy of any cheap structure of slight capacity (such as the elevated

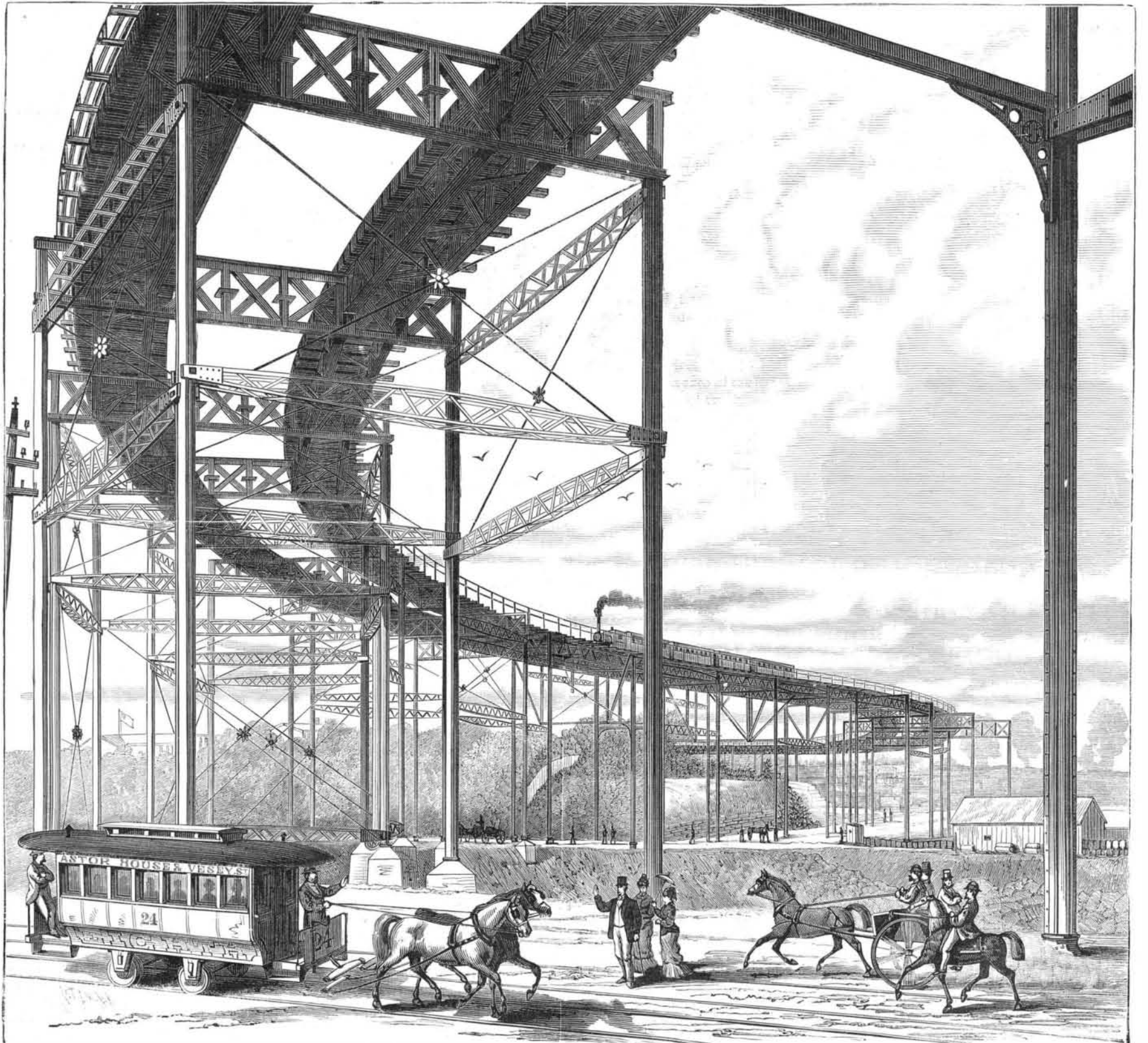
roads were at the start) to meet the wants of a city like New York, and the fallacy of the assumption that such a rapid transit road was advisable on the score of economy, were repeatedly enlarged upon by the SCIENTIFIC AMERICAN in the early days of the system; and the result has more than justified the position then taken. During the past five years, indeed during the past three years, the system has expanded from four or five miles of roadway of the lightest description, supported by single posts, to ten times as many miles of massive and costly structure already in operation, and nearly twenty miles more approaching completion—structures which almost monopolize four of our principal avenues and large portions of several down-town streets, and represent an investment of \$43,000,000.

The system which has attained such stupendous results began in an extremely modest way in 1868, and for several years it was represented by half a mile of experimental road on Greenwich street. The New York Elevated Railway Company was organized in 1872, and during the summer of 1873 the road slowly crept up Greenwich street and Ninth avenue as far as 30th street. In 1876 it extended from the

Battery to 61st street, and during the succeeding years it was further extended to Central Park, and to a considerable extent was made a double track. Though the new road was heavier than the parts of the line first constructed, the system of single supports was adhered to, and the general character of the road was sustained. During the early part of the current year the track was extended to 83d street, and the original track on Greenwich street has recently been replaced by the heavier structure of the later road.

In 1878 the Gilbert, afterwards known as the Metropolitan road, was completed to 59th street—a double track occupying the whole of the narrower streets down town and the middle of the wide Sixth avenue, and surpassing in solidity and cost anything previously dreamed of in the way of high level road making. The cost of constructing and equipping the five miles from Morris street to 59th street, with half a mile of road from Sixth avenue to Ninth avenue, through 53d street, was officially reported in March last as \$10,300,000.

During the same year the New York Elevated Railway  
[Continued on page 258.]



THE ELEVATED RAILWAY AT 110TH STREET AND EIGHTH AVENUE, NEW YORK CITY.

## THE PROGRESS OF ELEVATED RAILWAYS.

*[Continued from first page.]*

Company constructed their east side or Third avenue road from the Battery to 129th street, with branches to City Hall, to 34th Street Ferry, and to the Grand Central Depot at 42d street, making some nine miles of double track, the character of which is shown in Fig. 2.

During the year ending Sept. 30, 1878, the New York Elevated Road carried 4,000,000 passengers; during the next six months, owing to the enormous traffic on the Third avenue branch, there were carried nearly 14,000,000 passengers.

On the 20th of May, 1879, the Metropolitan and the New York Elevated Railways were leased to the Manhattan Company, thus bringing both roads under one direction. Since that date the extension of the system has gone on rapidly. On the west side the continuation of the New York road above 59th street has been merged in that of the Metropolitan, and above 83d street the road is continued in the style of the Metropolitan. Trains are now running as far as 135th street and Eighth avenue, and in a little while the road will have reached its northern terminus at 158th street and Harlem River. The splendid illustration on our front page shows the road as it curves from Ninth avenue and traverses 110th street eastward to Eighth avenue. Fig. 3 is a view in the same neighborhood. It is to such imposing dimensions that the original "cheap and simple" elevated road has grown. The posts in the foreground are 57 feet in height above the massive iron shoe on which they rest. This is raised on a tower of masonry rising some twenty feet or more above the original level of the land (the avenue having been filled in nearly to that height), and the masonry rests on a foundation of piles driven in to the depth of 40 feet. The engineering features of this gigantic, though seemingly slight and airy roadway, we purpose giving in a later issue. It is enough to say here that even those who are most familiar with high level transit can scarcely help a feeling of awe as the train sweeps out over the valley in its sinuous course in mid air. From the 110th street curve to 135th street and beyond, the road is perfectly straight, and the grade slowly descends to the normal altitude. Fig. 4 shows the construction of the base of the supports under ordinary conditions; those in the foreground of our large illustration

to get proper bearings, and to use 130 cubic yards of concrete, a massive cast iron bed plate, and 80,000 bricks.

In all nearly a thousand tons of iron are said to have been required in arching over pipes in the 2,400 foundations for piers. In making these foundations 60,000 cubic yards of rock had to be blasted and removed under the most exacting conditions, and 80,000 cubic yards of earth. Five steam pile drivers were employed in driving 300,000 lineal feet of piles for foundations in marshy places. The engineer in charge gives the amount of lumber used in the piers at 800,000 feet board measure; there were required, in addition,



Fig. 2.—VIEW OF THE ROAD AT COOPER INSTITUTE.

50,000 cubic yards of sand for mortar, 30,000 cubic yards of broken stone for concrete, 70,000 barrels of cement, and 21,000,000 bricks. One contract for iron for the superstructure called for 80,000,000 pounds.

This road, which is nearly completed, is intended mainly for through passengers, the local east side traffic to be given to the Third avenue road. The amount of travel on these elevated roads can be partly estimated from the figures already given. The regular time on the Third avenue road is 42 minutes from the Battery to Harlem, 8½ miles, including stoppages. Trains are run every four minutes, and commonly include four cars. The time of the Metropolitan (Sixth avenue) line is 20 minutes from Rector street to 58th street, about five miles. The time to 104th street is 32 minutes, to 135th St. about ten minutes more, allowing for slackened speed around the 110th street curve. Trains run to 58th street at intervals of two to four minutes, according to the hour; and to 104th street and beyond at intervals of six minutes.

The fare is ten cents, except during two hours in the morning and two in the evening, when it is five cents.

During the workmen's hours a passenger may ride on the Metropolitan division, ten miles, for five cents, in palace cars fitted up in the finest style. Of the favorable and unfavorable influence of these elevated roads upon property along their routes, and on the convenience and comfort of living in the city, it is not our purpose here to speak.

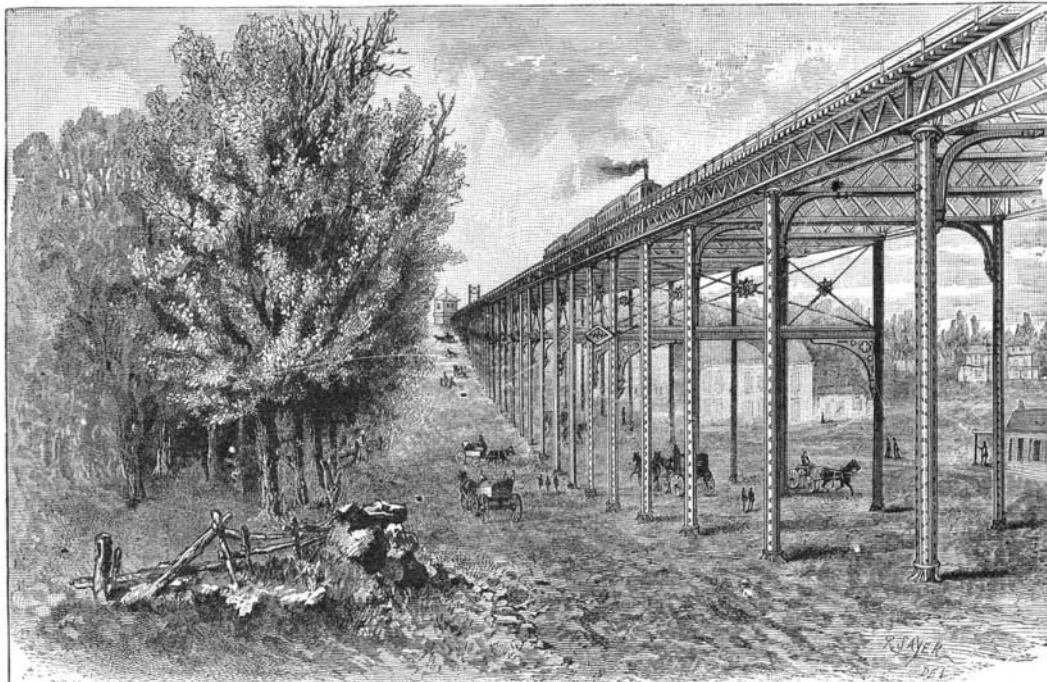


Fig. 3.—PORTION OF THE ROAD BEYOND CENTRAL PARK ON POSTS FIFTY-SEVEN FEET HIGH.

## Nordenskjöld's Discoveries.

The discoveries of Professor Nordenskjöld in the Arctic regions are full of interest from a geographical and commercial point of view. The explorer in a recent letter states that the coast of Siberia west of the Lena River is a vast, treeless plain. There are no islands to prevent the wind from driving the ice floes down upon the shore, and the points where rivers empty into the Polar Ocean, and with their warmer currents maintaining open spaces, are separated usually by enormous distances.

For several hundred miles in the vicinity of the Lena, however, there are several great rivers, and a chain of islands acts as a barrier to the ice. Toward Behring Strait the frozen floes crowd closer to the shore, and are liable in the autumn and winter to bar the way to shipping.

The most important of Professor Nordenskjöld's discoveries, from a scientific standpoint, is that of a group of islands off the Siberian coast.

These islands, the New Siberian, open the book of the history of the world at a new place.

The ground there is strewn with wonderful fossils. Whole hills are covered with the bones of the mammoth, rhinoceros, horses, uri, bison, oxen, sheep, etc. The sea washes up ivory upon the shores. In this group is possibly to be found the solution of the question of the ancestry of the Indian elephant and important facts with regard to the vertebrates which existed at the time of man's first appearance on earth.

How came horses and sheep in a region now locked in the fetters of an eternal winter, uninhabited by man, not now supporting animal life in any form, and almost impossible of access?

Professor Nordenskjöld was unable to solve the question himself, and he suggests that it is of the utmost importance to science to send a light draught steel steamer to those islands for a thorough exploration.

The natives seen along the coast belong to a hardy, jovial race, dressing in furs, keen at barter, but ignorant of the value of money. They live in double tents, and expose themselves to very low temperatures with little clothing.

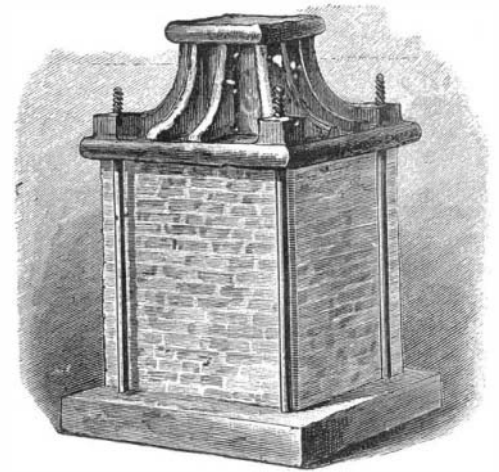


Fig. 4.—BASE OF COLUMN UNDER GROUND.

There is a great resemblance between the people and the Esquimaux or the North American Indians. Though armed with stone and bone weapons, and though wild and itinerant, they evidently have a history. They drove off the original inhabitants of the region 200 years ago, the Onkilons,

whose houses, places of sacrifice, circles of moss grown bear skulls, and weapons are still to be found almost everywhere on the coast.

There is no trace of any religious belief in their customs. East of the Lena the explorers found scattered blocks of stone, bearing evidence of glacial action and pointing plainly to the presence of land to the north. Another peculiarity of the Siberian coast is the gradual elevation of the land above the level of the sea, so that the inhabitants have been obliged to shift their villages nearer to the water's edge, which is gradually receding. Professor Nordenskjöld's explorations when published in full will undoubtedly excite much interest, and lead to the anticipation of possibly more valuable discoveries on the part of the Jeannette.—*Boston Traveler.*

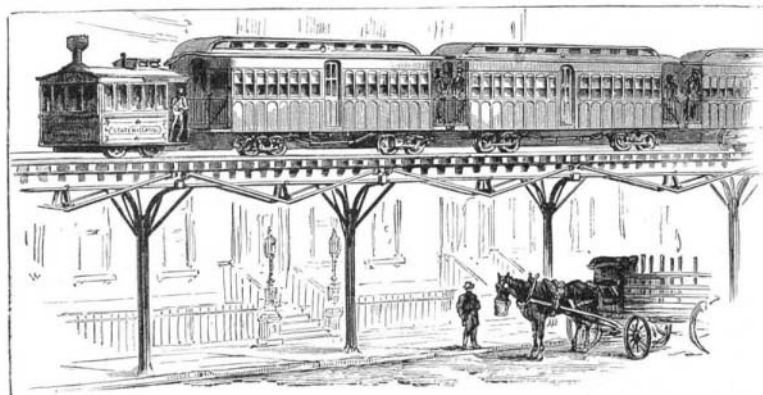


Fig. 1.—THE FIRST ELEVATED ROAD, WITH ITS LINE OF SINGLE POSTS.

are much deeper, pyramidal in form, and, as before mentioned, are supported by a pile foundation. The hollow iron columns are painted within with a waterproofing compound, and then filled with cement to exclude moisture and lessen the possible weakening of the structure by internal corrosion.

While this work has been progressing on the west side, the new east side or Second avenue elevated road has been under construction. The work of erection was begun in the early part of the current year, and for a large part of the time 6,000 workmen have been employed upon it. The chief difficulties encountered were in the construction of the piers.

For a distance of four miles a perfect network of gas, water, and sewer pipes was encountered, making a special plan necessary for each foundation. The most troublesome pier of all was that at 108th street, where the center of the pier was directly over a large sewer which received two large inlets within the area of the foundation, and the problem was further complicated by the presence of a 30 in. gas main and two croton water pipes. Though twenty piles were enough to carry the piers under ordinary conditions, it was necessary at this point to drive 82 piles