

ments he has been making. The gun squad accompanies the bicycle infantry illustrated in the accompanying photograph, in marches through northern Illinois; and to test the ability of the vehicles cross-country, trips are frequently taken through cultivated fields and underbrush, the idea being to test the efficacy of the carriages as a substitute for horses in artillery service. The single-motor carriage depicted is the first motor which was tested by Major Davidson and was utilized in the attempted run between Chicago and Washington. It might be said that the same obstacle which resulted in the failure of Mr. Alexander Winton's attempted trip from the Pacific to the Atlantic coast, caused the failure of Major Davidson's attempt—the sandy condition of the highways.

THE RAPID TRANSIT SUBWAY, NEW YORK.

The construction of the great twenty-one mile system of underground railway known as the New York Rapid Transit Subway would be a notable feat of engineering, even if it were being built under what might be called normal conditions of traffic, such as may be found in the outlying and less thickly populated suburbs; but as a matter of fact, the difficulties of the work have been enormously increased by the condition that practically the whole of the tunnel lies immediately beneath the double tracks of the busiest street surface trolley lines in the city. These tracks being of the underground-trolley type are extremely heavy in construction, while most of the cars which traverse them are of the largest and heaviest type, and run under an unusually close headway, it being no uncommon thing for three or four cars to be on one block at the same time. Moreover, the subway lies, as we have said, for the greater part of its length beneath some of the principal arteries of vehicular traffic in the city, and it was laid down as one of the strict conditions imposed upon the contractors, that there must be no interference whatever with the operation of the electric tracks, and the least possible obstruction to ordinary street traffic. The problem of carrying the electric tracks while the solid ground beneath them was being cut away was no ordinary one, and considerable ingenuity has been shown in working it out. On the front page of this issue will be found a cross section taken on Fourth Avenue, showing the means adopted for supporting the trolley tracks and also the great number of gas, water and electric mains, while the earth and rock were being excavated, the steel framing built in place, and the concrete covering and the back filling and surface filling put in.

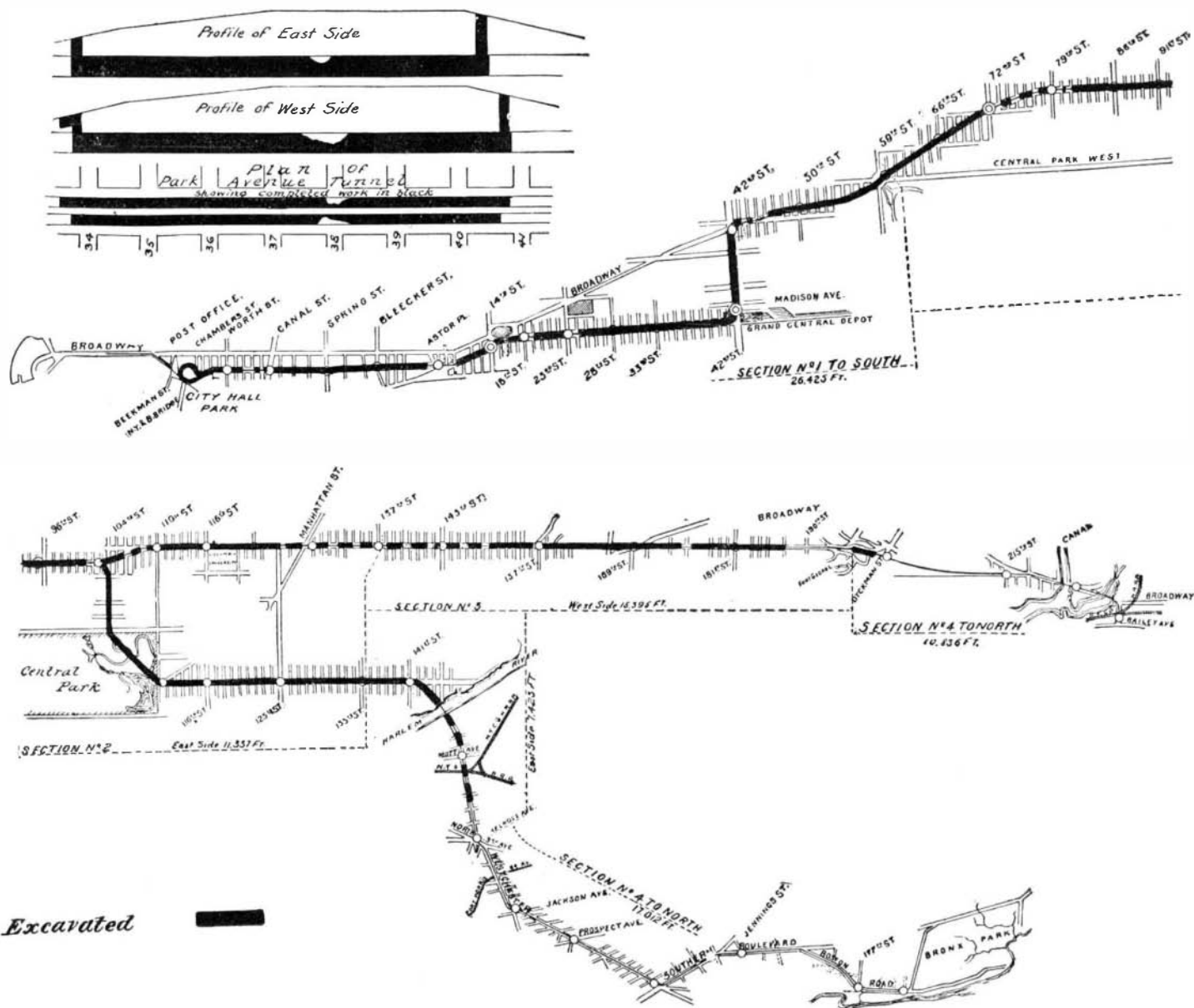
The method of carrying the electric tracks was as follows: At the level of the street surface two pairs of 24-inch I-beams, 2 feet in depth and about 35 feet in length, were placed parallel with the tracks, one pair on each side thereof. At each end of the I-beams 12 x 12 posts were sunk to a firm foundation, and for the length of track covered by the I-beams the soil beneath the yokes carrying the tracks was dug out, and 12 x 12 timbers placed underneath them crosswise to the track. Heavy bolts were then passed up from the ends of the transverse timbers to the top flanges of the I-beams and drawn up snugly by nuts, the load of this stretch of track with the cars upon it being thus transferred to the I-beams. Similarly, 12 x 12 support-

ing timbers were placed from the I-beams to the adjoining sidewalks on either side, one end being bolted to the I-beams and the other resting upon the sidewalk flagging. The material was then excavated by pick and shovel, dumped into buckets of an overhead cableway, loaded into carts and taken to some convenient dumping ground. The timbers extending from the I-beams to the sidewalks served to hold in place and carry during the progress of excavation the numerous water, gas and electric mains, which lie immediately below the surface of the street. These were slung from the beams by stout chains, which held them securely in their proper level and alignment during the work of excavating. As the excavation was carried down, additional and longer 12 x 12 posts were put in place until subgrade was reached. The foundation blocks and concrete floor were laid and the steel columns and the I-beams of the roof erected, the side walls and the intervening arches of concrete built in place, and the back filling rammed in, completing the work. As the filling was brought up to grade, the chains supporting the gas and water mains were unslung and the 12 x 12 timbers removed, the surface of the street being finally restored to its original condition. The steel framing is spaced about 5 feet apart longitudinally and answers in some sense to

have been repaved and put in first-class condition. From the south side of Astor Place to Ninth Street no excavation has been done, there being some dispute with the owners of the buildings underneath which the tunnel at this point will have to pass. From Ninth Street the excavation is complete, the steel work is in and most of the concreting completed to Fourteenth Street, where more than half of the excavation for the large Fourteenth Street station has been done and the balance of the work is being pushed forward with great dispatch. From Fourteenth Street to Seventeenth Street the solid rock has been excavated for three out of the four tracks, the steel has been put in, and the street restored to its original condition. Most of the excavation has been done for the Eighteenth Street station, and for the block immediately to the north of it. From Nineteenth Street to Twenty-third Street the work is nearly finished, as is the excavation for the Twenty-third Street station, which is about ready for the insertion of the steel framework. From Twenty-third Street to Thirty-third Street there is a practically unbroken stretch of completed Subway. The excavation is still going on for the Thirty-third Street station, and at the portal of the two-track tunnels which extend from Thirty-third Street

to Forty-second Street. On both the east and west side branches of the tunnel on this stretch excavation is completed, and about half of the concrete lining has been put in place.

There is a gap of about one block opposite Vanderbilt Avenue on Forty-second Street, most of it solid rock work, upon which no work of excavation has been done; but from just west of Vanderbilt Avenue to Broadway the stretch of line through Forty-second Street is about three-quarters excavated, and a large amount of the steel work is in place and concreted up. There is another gap at Forty-second Street and Broadway, where work is being delayed by a dispute with the property owners, and but little work has been done as yet at



PLAN SHOWING IN BLACK LINES COMPLETED EXCAVATIONS ON NEW YORK SUBWAY.

the framing ribs of a modern steamship. The concreting between the side posts and between the I-beams of the roof is built in arched form to enable it better to resist the crushing pressure to which it is subjected.

The accompanying plan showing the progress of the work to date will be of considerable interest. On those portions of the road covered by heavy black lines, the work of excavation has been completed, while the intervening gaps represent the work that has been only partially excavated. Commencing at the loop under City Hall Park, we find that the excavation has been entirely completed, and, indeed, very little remains to be taken out, if we except the large station at the Brooklyn Bridge, as far north as Pearl Street. From Pearl Street to just below Canal Street but little work has been done. It was anticipated that on account of this ground having originally been a swamp, there would be considerable trouble with water, for which reason this particular stretch of line was left until the last. The contractors, however, are not experiencing any abnormal difficulty, and it is likely that the intervening gap of a few blocks will be completed by the fall of next year. From Canal Street to Astor Place the Subway has been entirely excavated, practically the whole of the steel work and concreting is done, and before many months the surface of Elm Street will

Long Acre Square. From Forty-fifth Street to Seventy-second Street there is the longest stretch of completed line on the whole system. With a few exceptions this work is not only excavated, but the steel is in and concreted up and the street surface is largely restored. From Seventy-second Street to Eighty-first Street the work is somewhat backward. In places the ground is scarcely broken and there is here much work yet to be done. From Eighty-first Street to 100th Street, excavation is completed and much steel in place. There is considerable work to be done for two blocks south of 104th Street, where the four-track road divides into its western and eastern branches. From 104th Street to 110th Street on the west branch, the excavation is completed in stretches, while there are one or two blocks on which much work remains to be done. From 110th Street to Manhattan Valley excavation is practically completed, while about three quarters of the elevated structure across the Valley has been erected, and only awaits the delivery of the 160-foot steel arch over Manhattan Street to enable this fine viaduct to be completed. At present the structure is painted red, but ultimately, when it has been given its coating of olive green, it will present a thoroughly attractive appearance. The design of the bridge is more open and less cumbersome than the adjoining Riverside viaduct,

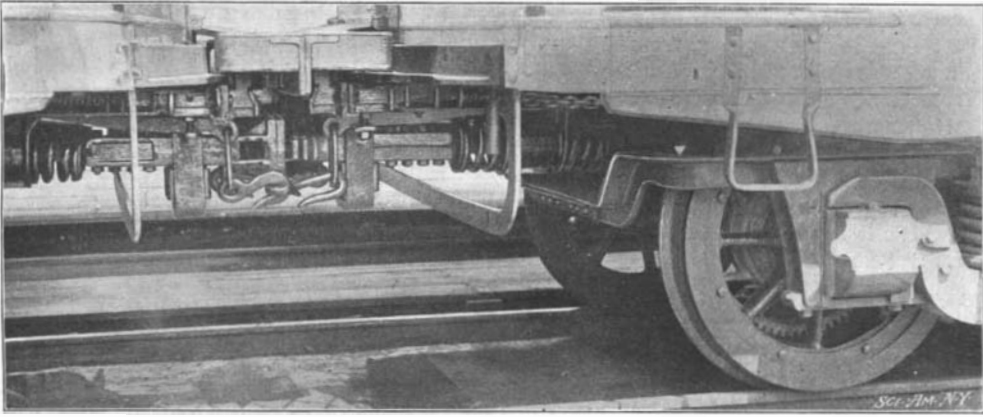
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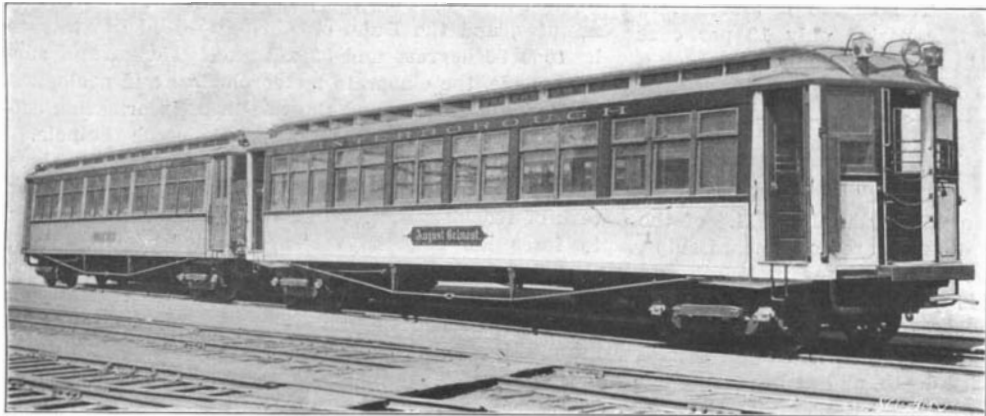
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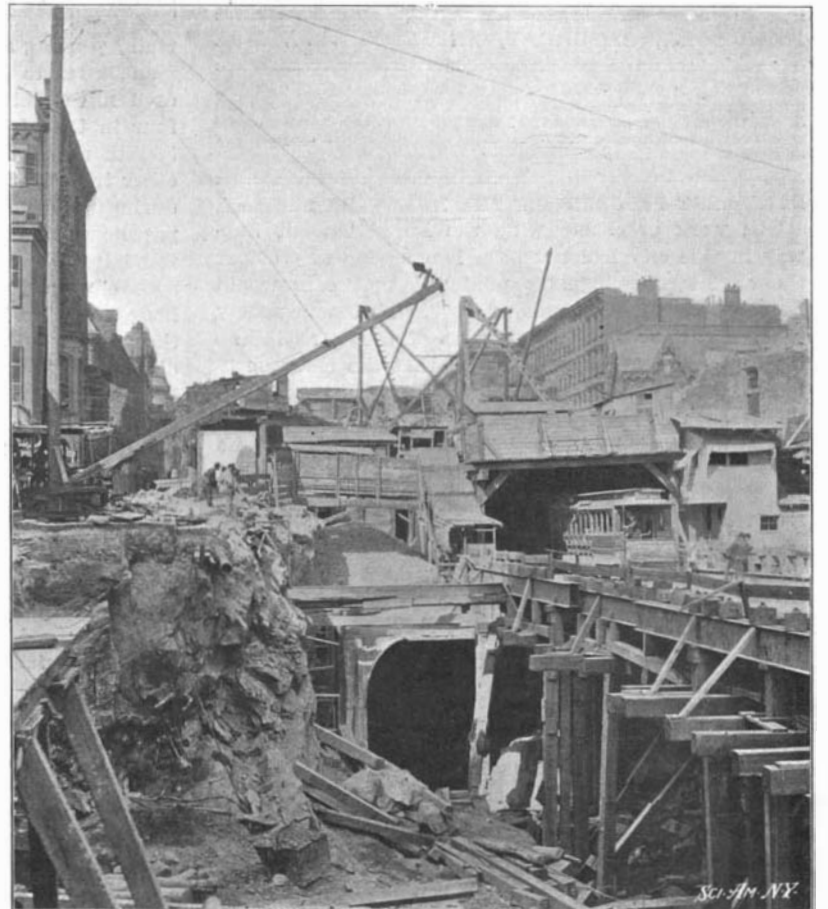
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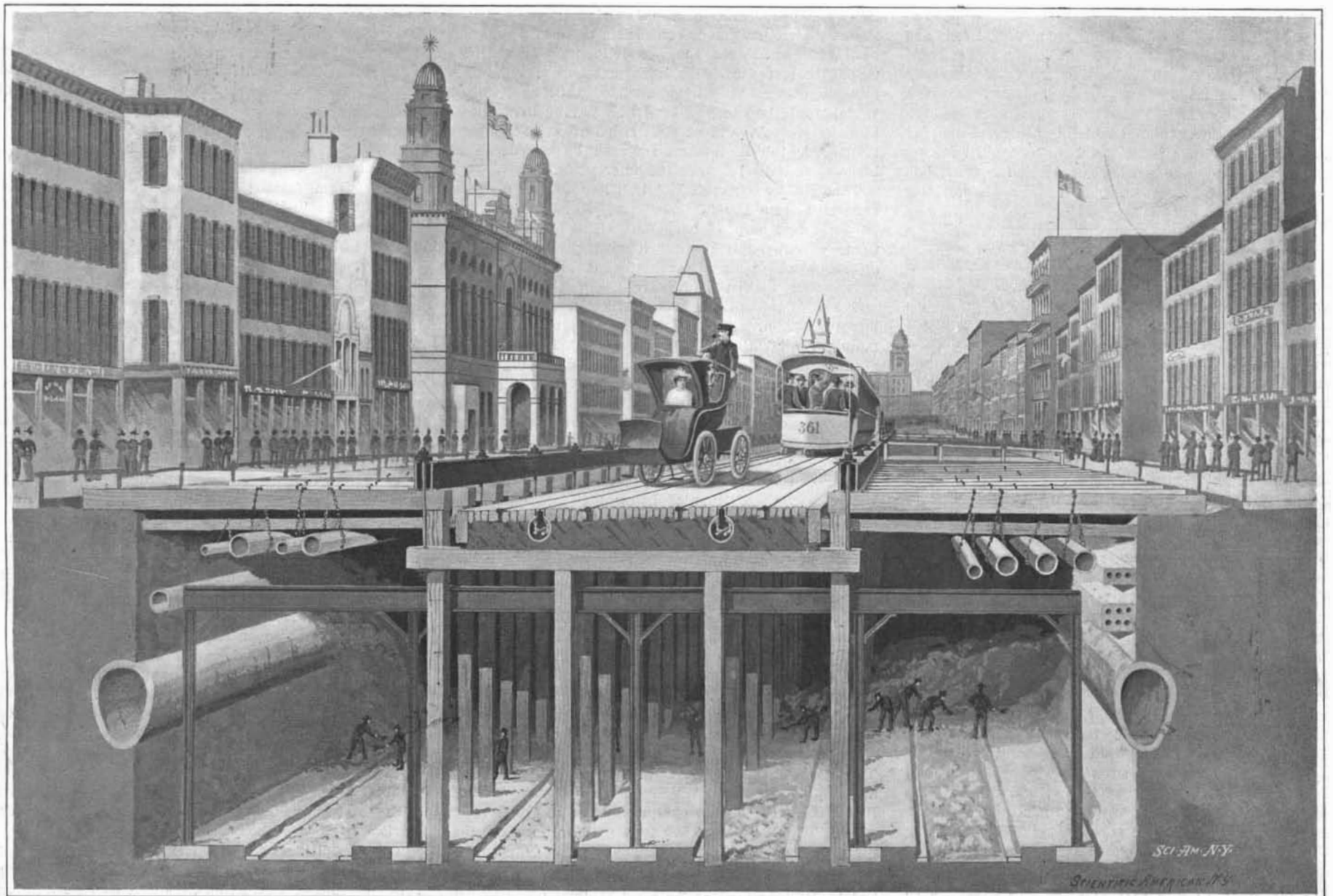
Platforms and Couplings of Cars.



Cars Submitted for Trial on the Rapid Transit Subway.



Station Excavation and Portal of Tunnel at 33d Street.



Typical Cross-Section of Subway on Fourth Avenue. Showing Method of Supporting Trolley Tracks and Gas and Water Mains During Construction.

THE RAPID TRANSIT SUBWAY, NEW YORK.—[See page 202.]

Correspondence.

Gravitation as a Cause of Volcanic Action.

To the Editor of the SCIENTIFIC AMERICAN:

Your correspondent in the issue of August 9, writing on "Gravitation as a Cause of Volcanic Action," evidently doubts that certain planetary positions cause electrical disturbances in the earth, and that volcanic and seismic action may be caused by electrical or magnetic influences. But let us consider carefully the evidence in favor of these propositions.

We know that magnetic earth currents (which interfere with telegraphing), brilliant auroras, severe thunderstorms, violent storms of many kinds, and also earthquakes and volcanic activity accompany sun spots. All these are electrical disturbances, and the eruption of Mount Vesuvius and numerous seismic shocks which occurred at the time of the last large sun spots—about September 15, 1898—were no doubt electrically caused by them.

The moon's equatorial passage has certainly no gravitational influence, and yet it must be something more than mere coincidence that severe volcanic and seismic disturbances have accompanied this planetary position every time during the past four months, with but one exception: None were reported for June 27; but the abnormally severe storms on and about that date proved the electrical effect. The moon's last equatorial passage, on August 21, caused terrific earthquakes in Mindanao, Philippine Islands, and a violent eruption of Mont Pelée on that date, more shocks at Los Alamos, Cal., on August 20, 21 and 22, earthquakes for two hours in Austria and violent tremors near St. Petersburg on the 22d, and an eruption of Mount Allomonte, Italy, beginning the same day. All these were two to four days after full moon and half-way between apogee and perigee.

Within twenty-four hours of the direct opposition of Saturn on July 17, there were terrific tremors on St. Vincent Island, cloudbursts in Illinois, a tornado in Ontario, and a typhoon at Hongkong—all electrical disturbances.

The recent severe earthquakes at Los Alamos, Cal., began a few hours after the very close conjunction of Mars and Neptune on July 27, and were most severe on that night and on the 31st, when Mercury was again in perihelion, and the day before perigee.

Mercury is found to have more influence in causing seismic and volcanic action than almost any other planet—probably because of its eccentric orbit, nearness to the sun, and frequent periods. About fifteen hours before the superior conjunction of Mercury on August 11 at 4 A. M., there was a severe earthquake and tidal wave at Juneau, Alaska, and there were frequent shocks at Los Alamos from 4 P. M., August 9, to 12 P. M. on the 12th, the most severe one occurring at 2:40 P. M. on the 10th. Mercury's equinox of August 27 probably caused the eruption of Mont Pelée on the afternoon before.

All the other earthquakes and volcanic eruptions reported in the newspapers during July and August, with but two exceptions, came just as expected according to this astronomic theory. Among these were the violent eruption of Mont Pelée on the evening of July 9—described and illustrated in the SCIENTIFIC AMERICAN of August 16—and also those on the 10th and morning of the 11th, the moon crossing the equator on July 10.

As to the electrical disturbances that accompany volcanic eruptions being "caused by the heat from the volcano"—as your correspondent maintains—that is, of course, partly true; and this electrical energy might also "touch off" other volcanoes; for I have certainly not altogether mistaken effect for cause, and these remarkable and constantly-recurring coincidences furnish a good proof that seismic and volcanic action may be electrically caused and that certain planetary positions, such as close conjunctions and oppositions, equinoxes, perihelions and perigees, cause electrical disturbances in the earth and also, probably, throughout the solar system.

Similar effects would probably result when several planets come directly into line with each other or with the sun, although not in line with the earth, and also if most or nearly all of the twenty other satellites should cross their primaries' equators at nearly the same time. Planetary positions of this kind must have occurred on May 20 and August 14.

The best way, it would seem, to prove and perfect this astronomic theory of volcanic action would be to compare the times of greater and less activity in some perpetually active volcano, like Stromboli, in the Mediterranean, or Sangay or Cotopaxi, in Ecuador, with the prevailing planetary positions. Here is a suggestion for the "international convention of scientists for the study of seismological problems," which—according to an Associated Press dispatch—Emperor William of Germany is endeavoring to bring about for next spring.

Just how certain planetary positions cause electrical disturbances in the solar system or disturb the electrical equilibrium is a subject for theorizing and in-

vestigation; but however difficult it may be to understand does not disprove the idea in the face of the evidence. There are many things we cannot explain the whys and wherefores of, such as the X-rays, wireless telegraphy, telepathy, clairvoyance, etc., but that should not prevent us from believing in and making use of these principles of nature. The scientific investigator must seek simply the truth, without bias or prejudice, no matter if reasons are not apparent.

The most probable dates in the coming two months for seismic and volcanic disturbances to begin or to reach a maximum are September 1, 3, 11, 17, 22, 23, 30; October 1, 10, 15, 16, 19, 23, 27 and 30.

Livermore, Cal.

ELMER G. STILL.

New Automobile Records.

Alexander Winton, seated in his famous "Bullet," broke all records on September 16 at the first annual meet of the Cleveland Automobile Club. The "Bullet" was started in the 10-mile open race against H. S. Harkness, of New York, who rode the Mercedes with which he won the majority of the prizes at the Brighton Beach races. After the first mile, which was made in the comparatively slow time of one minute and twenty seconds, the "Bullet" increased her speed. The time for the ten miles was ten minutes fifty seconds. The last five miles was made in five minutes and nineteen and one-quarter seconds. Twice during this 10-mile race Winton covered a mile in one minute two and three-quarters seconds. In the pursuit races run on the same occasion Winton established the record of one minute two and one-half seconds in the second mile.

Rollin White at the same meet drove his steam machine five miles in six minutes and forty-three seconds, which is a new record for that type of vehicle.

The world's records for speed have been beaten at the Deauville races, which were held on the 26th of August. Deauville is one of the principal French watering places, and the annual races which are held here are always of great interest. As at Nice, the track is a cement avenue bordering the sea. The race consisted of a kilometer dash (0.6 mile) and over 600 yards of track were allowed before the start in order to get up to speed. A great crowd of chauffeurs was assembled at Deauville, and most of the leading makes were entered. M. Serpollet had constructed two new racers which resembled the one he used at Nice, except that the new machines are pointed at both ends, being somewhat boat-shaped. There are places for two persons in the middle, but the latter are nearly concealed within the body. The race was held under favorable conditions as to weather, and a rather strong wind was blowing behind the chauffeurs, which may have had some effect on the speed. It was a Mors car which broke all previous speed records, and made the kilometer in 26 2-5 seconds, which is a speed of 78.6 miles an hour. This machine, which was piloted by Gabriel, belonged to the automobile class (maximum weight 2,200 pounds). Chaudard came just behind Gabriel, lacking only 1-5 second, thus making the kilometer in 26 1-5 seconds. He was mounted on a Panhard & Levassor racing car of the Paris-Vienna type, weighing 2,175 pounds. One of the Serpollet racers came next in 27 1-5 seconds. A Mors car followed in 28 seconds. It was piloted by Levegh and weighed 2,195 pounds. Rigal, on a Buchet motorcycle, made 28 4-5 seconds, as also a Panhard car of the automobile class. The German machines, of which there were two of the Mercedes type entered, also made a good record, 32 and 32 4-5 seconds. The lightweight class (up to 1,430 pounds) was headed by the Decauville, which made 30 1-5 seconds. It weighed 1,430 pounds, and was piloted by Théry. A Serpollet car mounted by Rutishauser made 31 1-5; its weight was 1,408 pounds, and it had a 12 horse power motor. The world's record of speed is now beaten by 1 4-5 seconds. It was held by Jarrott, who made 28 1-5 seconds at Welbeck on the 22d of August, thus beating Vanderbilt's record of 29 2-5 seconds on the Achères route.

The Current Supplement.

The current SUPPLEMENT, No. 1395, opens with a fully illustrated article on the manufacture of fresh-water pearl buttons. Mr. Edward P. Thompson writes on the inherent nature of coherers; and Prof. Henri Moissan tells of his new method of manipulating liquefied gases in sealed tubes. Electricity has not been neglected, for the SUPPLEMENT contains a fully illustrated article on "Some Uses of Electrical Pumping Machinery," and a description of the electrically-operated Belgian-Ougree blast furnaces and steel works. A resumé of the year's work in astronomy by Poincaré will be found of interest. The second installment of a review of the "Existing Methods of Cultivating Anaerobic Bacteria" is published. Among the minor articles may be mentioned those on "Italian Bell Towers," "A Simple Form of Fuel Calorimeter," "Calcium Carbide from Non-Electric Furnaces," "Foucault's Pendulum" and "Treasures of Savages."

The Alligator Extinct in the South.

The alligator is said to be practically extinct in the South. To Dame Fashion may be attributed his passing away. The demand for shoes, satchels and pocket-books of alligator skin has been such within the last ten years that we will probably soon be compelled to visit our museums and zoos to hunt up the creature, which has unjustly earned an evil reputation as the terror of Southern swamps. Mr. J. Knight Perkins, of Kalamazoo, thoroughly searched the southern portions of the country for 14-foot alligators. In all New Orleans he could find but one alligator 10 feet long. He discovered that even little alligators from 4 to 8 inches long had disappeared from the market.