

a sense the machine is complete, and may be driven quite satisfactorily with the small crank and gear supplied with it. But in the author's opinion, it is far preferable to discard the large gear altogether. Get a grooved wooden pulley (a V-groove is the best) 1½ inches in diameter, with a center hole a shade smaller than the pinion or small gear on the armature shaft, and drive the pulley right onto the pinion. Driven with a ¼-inch round leather belt from a hand wheel or sewing machine flywheel, a speed of 2,400 revolutions per minute can easily be attained, at which speed the machine will be found very efficient and useful.

The following table gives windings for various approximate voltages at 2,400 revolutions, although nothing very definite can be given, as much depends upon the make and condition of the machine. The voltage varies directly as the speed.

Wire No.	Volts.	Amperes.	Volts.	Amperes.
31	100	0.4	50	0.8
28	50	0.8	25	1.6
25	25	1.6	125	3.2
24	20	2.0	10	4.0
23	16	2.5	8	5.0
22	12	3.25	6	6.5
20	8	5.0	4	10.0
19	6	6.5	3	13.0
17	4	10.0	2	20.0
14	2	20.0	1	40.0

#### THE SOLUTION OF NEW YORK'S TRANSPORTATION PROBLEM.

Less than a decade ago the SCIENTIFIC AMERICAN was urging upon the authorities of New York city the immediate construction of the first Rapid Transit Subway, pointing out that the objections to underground travel were mainly founded on prejudice. We pointed to the fact that the increase in the traffic on the surface and elevated railroads, which even then was beginning to be very marked, was but the beginning of a tide which would rise with increasing rapidity, and unless speedy measures were taken to meet the contingency, would, before many years had passed, entirely swamp the existing means of transportation. After many disappointments and protracted delays the Subway was authorized and built. Its completely successful operation, and the fact that its trains were speedily filled to their maximum capacity, proved the truth of our contention that it was only by going underneath the surface, that New York could hope to grapple successfully with the tremendous problem of providing adequate rapid transit. It has frequently been remarked, perhaps not altogether without some truth, that while New York city is apt to be somewhat late in adopting new improvements, when she once has done so, she develops them with a zeal and on a scale of magnitude, for which no parallel can be found. Certainly this has been the case in the matter of providing means for underground travel. The first rapid transit subway with its four-track road, its eight-car express trains, and its high running speed both in local and express service, ranks easily as the finest complete system of city underground railways to be found anywhere in the world; and to the 21 miles which are now in operation in this city, there will be added within four or five years' time an additional mileage of rapid transit tunnels, which will bring the total to over 100 miles.

The enterprise of the city itself is being ably seconded by the efforts of the great railway corporations. The New York Central Company is about to place its freight tracks which parallel the western water front of Manhattan, entirely below ground, and the company is also proposing to build a connecting tunnel from this new subway to connect with its existing main lines, running to the Grand Central terminal. The Pennsylvania Railroad Company has already completed its two tubes below the Hudson River, and is rapidly excavating its way across Manhattan Island, at a depth of 50 to 60 feet below street level, to a junction with the four tunnel tubes which are being driven below the East River to connect with the Long Island Railroad system.

Another enterprise whose magnitude is little understood is that of the Hudson Companies, whose project includes the construction of no less than four tunnels below the Hudson River, two crossing at Morton Street and two at Cortlandt Street, and a connecting tunnel running parallel with the Jersey shore and underneath all the big terminal stations of the roads which run into Jersey City. Moreover, the two tunnels which cross at Morton Street are being rapidly extended below Manhattan Island, one branch running from Sixth Avenue below Ninth Street to Astor Place, and the other extending below Sixth Avenue to Thirty-third Street, where there will be a terminal station. In addition to the four East River tunnels of the Pennsylvania Railroad Company, the Belmont interests are building what is known as the old Steinway tunnel, which passes below the East River and extends under Forty-second Street to the Grand Central Station. Finally, there is the Rapid Transit tunnel from the Battery to Joralemon Street, Brooklyn,

which will connect the subway lines of Manhattan and Brooklyn.

The whole of the extensive and exceedingly costly work which we have outlined above is being built entirely below the street and river surface; and to this must be added the vast network of street railways which was formerly operated by the Manhattan Street Railway Company, and the equally extensive lines of the old Manhattan Elevated Railway Company, all of which—elevated, surface, and subway—are now amalgamated and operated by a single corporation known as the Interborough Company.

It will readily be understood that the planning and construction of so many underground railways, crossing and recrossing the island and each other, has necessitated careful consideration of the depths at which they must be built in order to avoid interference. As a matter of fact, when the work which is at present under way or proposed has been completed, there will be presented, in at least one part of Manhattan Island, the curious condition of five separate railway systems running, one above the other, at five different levels. The particular spot referred to is the intersection of Sixth Avenue and Thirty-second Street, where, in addition to the three superimposed underground roads, there will be two distinct railway systems above ground; first the trolley street railway, and above that the elevated railway. The arrangement of the tracks and stations, and their relation to the adjoining buildings, is shown in the sectional view on the front page of this issue.

We doubt if it would be possible to find in any city in the world a center of transportation which will compare in importance with that which is herewith represented. Far down below the street surface, at a depth of 55 feet, will be the tunnels which lead from the new terminal station of the Pennsylvania Railroad, across Manhattan Island and below the East River to Long Island. These tracks will be used both for the local service and for such of the main line express trains as will be run through to the extensive yards of the company on Long Island. The local trains will be operated on the multiple-unit system, with motor cars and trailers alternating, while the express trains will be hauled by powerful electric locomotives of the general type shown in our engraving. Immediately above the roof of this tunnel, and separated therefrom by the depth of its steel floor, will ultimately be built a three-track subway, the two outer tracks to be used for local trains and the center track for express service. Above this, again, will be the two tracks of the Sixth Avenue branch of the Hudson Companies' system, and at this point will be located their terminal station. At the street surface are the two tracks of the street railway; and above them are shown the elevated railway and its Thirty-third Street station. Above the elevated tracks is yet another means of travel in the shape of the footway bridge, connecting the two platforms. Finally, as if to render this epitome of modern transportation complete, we have, on the left hand, or westerly side of the station, one of the modern, electrically-driven escalators. In this connection it is interesting to note that not only the escalator, but the five railway systems, are operated electrically.

Fully to appreciate the significance of this junction, we must remember that from this point it is possible to take a car which, directly or by its connections, will not only take one to any point in Greater New York, or Jersey City and its suburbs, but to any city of the whole United States, and that this, moreover, can be accomplished very largely without having to make any change in the open.

#### The Discovery of Nubian Manuscripts.

While examining some sheets of parchment bought at Cairo for Coptic manuscripts, Carl Schmidt made a discovery of much importance to philology and history. The repetition of the word "Uru," which among modern Nubians means king, convinced the German savant, who is an authority on Coptic and the early Christian archaeology of Upper Egypt, that the text was Nubian, a language which, although still spoken, is no longer written. The manuscripts date from the eighth century A. D., and are translations of Christian works in which frequent references to St. Paul are made. One manuscript is a collection of extracts from the New Testament, and the other a hymn of the cross. The Greek original of the hymn is not known. When the documents are deciphered philological science will be enriched by the knowledge of the language spoken by the people of Nubia before the invasion of Semitic tribes, and the mysterious inscriptions on many of the Egyptian monuments may be read.

The Horseless Age says the United Kingdom remains the best customer for American motor cars, its purchases growing practically in the same proportion as the total exports. The most remarkable development has taken place in the Mexican, West Indian, and South American markets, and it will probably not be long before American manufacturers will control these markets, as they now control that of Canada.

#### Engineering Notes.

The commission of engineering experts which was appointed by the municipality of Turin to investigate the project for a new international railroad passing through Mont Blanc, and thus providing communication between the Rhone and Dora Baltea valleys, has now issued its report. The commission selects Aosta, at an elevation of 1,600 feet above sea level, as the starting point of the railroad, which, after climbing 1,700 feet, should pass through a tunnel under Mont Blanc at a height of 3,100 feet and emerge upon the village of Les Houches in the Chamounix Valley and Pre St. Didier. By this route the distance between Turin and Chamounix would be reduced to 116 miles, and from the former city to Geneva 166 miles. It is suggested that as the railroad and tunnel would extend through three different countries, the cost of construction should be borne by the respective governments, while furthermore the municipalities of Turin, Geneva, and Chamounix, which have the most to gain from the enterprise, should also participate in the outlay.

Owing to the great crush that always prevails at certain of the great railroad stations in London in the early morning to procure workmen's tickets, automatic machines for the issuing of the same have been installed, thereby avoiding the long queues at the booking offices, and expediting the delivery of the tickets. In Great Britain this class of ticket, which enables the workmen to travel at purely nominal fares over considerable distances—in one case 28 miles can be traveled for four cents—is issued up to about 7:30 every morning, and accordingly there is a vast section of the public which avails itself of these facilities. The automatic machines have proved highly efficient, and expedite the delivery of the tickets to a considerable degree, since no time is lost in tending change, the passengers being required to insert the correct amount into the machine. At Farringdon Street the machine installed issued 2,500 two-cent tickets per day, and proved so reliable in operation, no serious delays occurring through the mechanism breaking down, that the system has since been considerably extended, and now machines for the issuing of three and four-cent tickets are being widely adopted. A further boon possible with these automatic machines is the issuing after 4 o'clock in the afternoon of tickets dated for the following day, thereby relieving the pressure upon the device in the morning, when a considerable rush sets in during the later hours in which the machine is in operation.

The Applied Science Reference Room of the Pratt Institute Free Library (Ryerson Street near DeKalb Avenue, Brooklyn) exists for the purpose of aiding those engaged in any trade or industry. Hundreds of questions arise every day, in the factories and shops of a city, which could be answered from some printed page. It is the intention of the Applied Science Reference Room to supply as many of these printed pages as possible. Sometimes they are in books, very often in periodicals or transactions, and again may be found only in a trade catalogue. In the room set aside for this work in the Free Library of Pratt Institute are taken nearly a hundred trade and scientific papers, giving the latest news of the industrial world. There are besides over fifty of the labor union papers, of which a file is preserved. The most important of the periodicals are bound, and these bound files contain much material that can be found nowhere else. The publications of the United States Patent Office are kept here also, and are used daily. The collection of books here includes up-to-date publications in various industries, such as electrical engineering in all its branches, plumbing, manufacture of textiles, industrial chemistry, gas engines, the making of cement, and so forth. The books in this room are not allowed to go out, so that anyone coming is sure to find the book he wishes to refer to, if it is a part of this collection. The library has, however, a good collection of books in these subjects for circulation, often duplicates of the books in the Applied Science Reference Room. The room is in charge of Mr. Edwin M. Jenks, whose work is to help those who are looking up any question that lies within the province of this room. A large collection of trade catalogues furnishes the very latest information in many lines, and is being enlarged constantly. The library will get any trade catalogue in print, at the request of any user of the library. One new feature of the room is a collection of mounted cuts of machines and mechanical devices. These may be used in the room or taken away to work with, if desired. A man looking up a new form of chuck, for example, will find a score of cuts showing different chucks, and among these may well find some that will be of service to him. Men studying in the evening schools, those preparing for civil service or other examinations, lawyers, and men of various interests will find this department of use. It is open every day except Sunday, from 12:30 P. M. to 9:30 P. M., and can be used between 9 A. M. and 12:30 P. M. through the library office. Come in when you have a question, or want to see a trade paper.

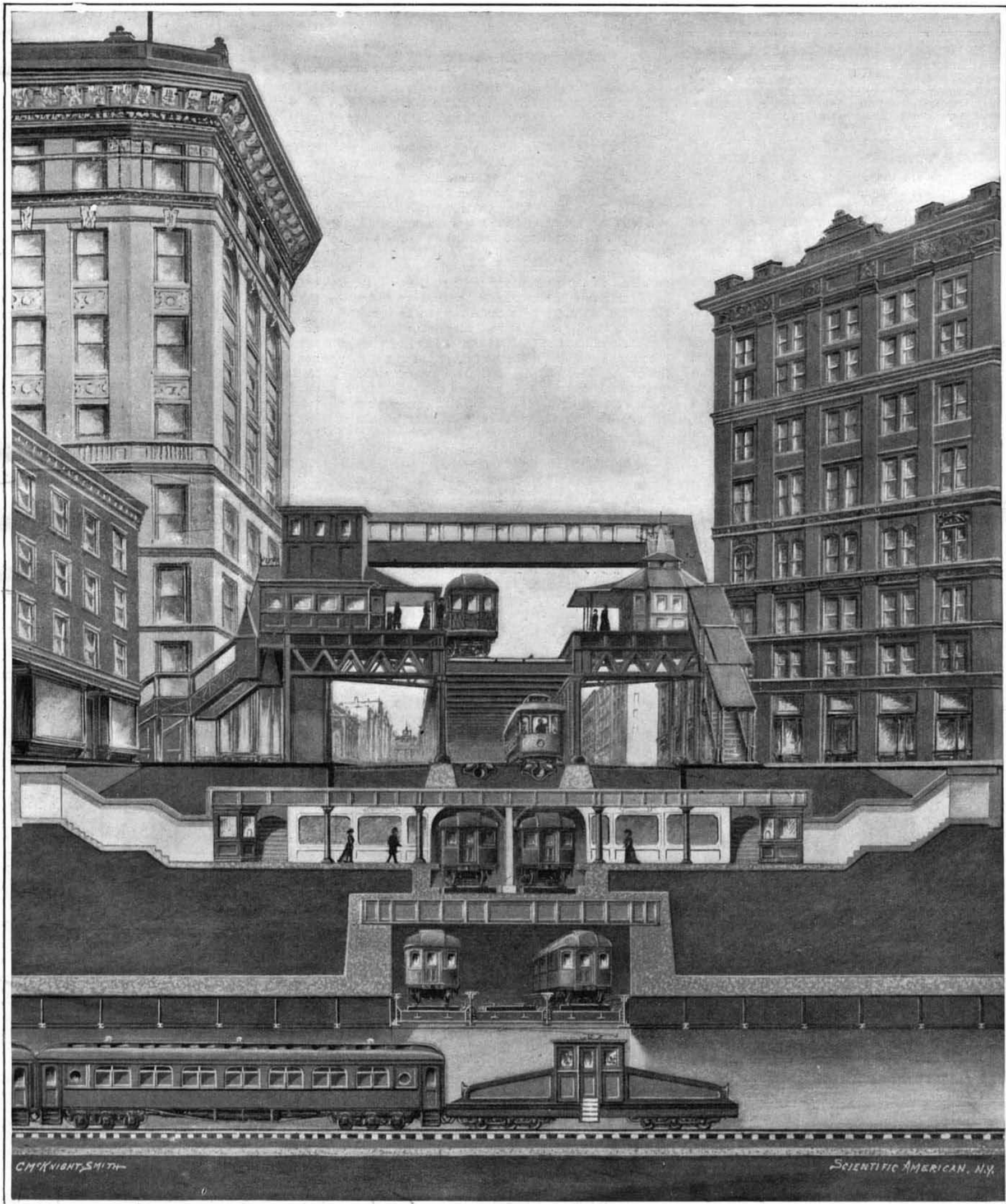
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Sectional View Looking North at the Junction of Sixth Avenue and 32d Street, Showing Five Superimposed Railway Systems—The Pennsylvania, Rapid Transit Subway, Hudson Companies, Street Surface, and Elevated Railways.

HOW NEW YORK CITY IS SOLVING ITS TRANSPORTATION PROBLEM.—[See page 486.]