THE NEW JERSEY TUNNELS AND SUBWAYS.

If the original company which undertook in the year 1874 the task of driving a tunnel from Jersey City to Manhattan beneath the Hudson River, and failed, could see the comprehensive system of subways and tunnels which is now being constructed by the Hudson companies, they would at least have the satisfaction of realizing that they had inaugurated one of the most important systems of underground railways in the world. When, in the year 1902, Mr. W. G. McAdoo resolved to take hold of the uncompleted tunnel and push it through to the Manhattan side, public interest in the scheme was altogether dead; but realizing how great was the advantage that would be conferred by a direct rail connection, and foreseeing how vast would be the growth in popularity of a means of transit that would be so much more comprehensive and expeditious than the ferry system, he not only succeeded in pushing through the original scheme, but he and his associates have extended it on the ambitious scale shown in the accompanying engraving. Briefly stated, the object of the subways and tunnels is to place the great terminal stations of the railroads, in Jersey City, in direct railroad communication with the various business centers on Manhattan Island, so that a passenger on arriving at any one of these terminals, can take a train which, in a few minutes' time, will land him without change of cars, either in the neighborhood of lower Broadway and Fulton or Cortlandt Streets or at any point on Sixth Avenue from Ninth to Thirty-third Street, or on Ninth Street from Sixth Avenue to Fourth Avenue. These tunnels will also afford rapid transportation for trolley-car passengers and for the thousands who walk to the ferries on the Jersey side from their homes.

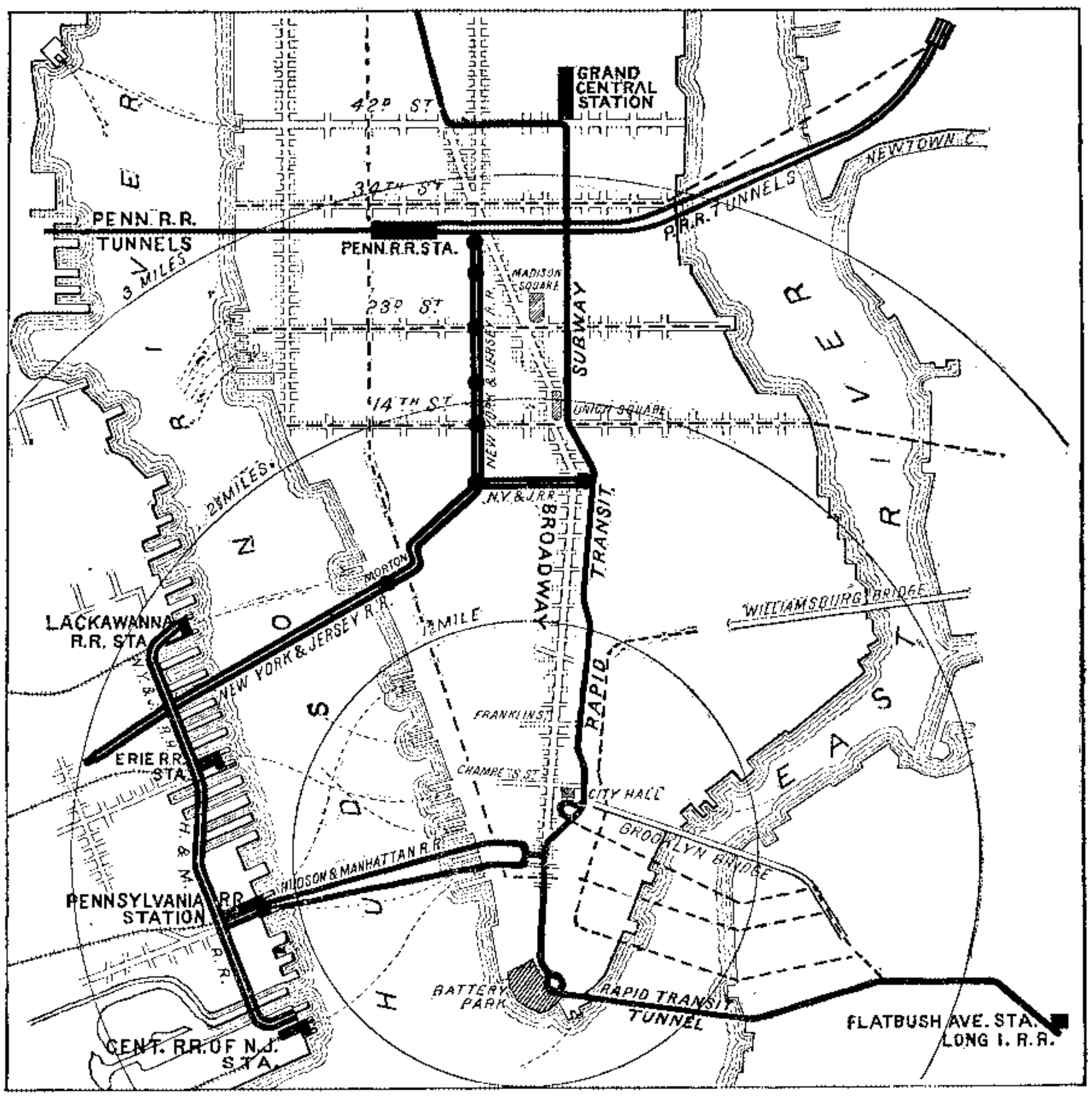
The Jersey City terminals will be connected by a double-track system, consisting of two 15-foot tubes placed side by side, with a single track in each, which will extend from the Delaware, Lackawanna & Western Railroad, along the shore line to the terminal of the Central Railroad of New Jersey. At the D., L. & W. terminal the tracks will be near the surface, with the rails at a level of about 15 feet below street grade. From that point they will descend to 30 feet below street grade at the Erie terminal. At the Pennsylvania terminal they will be 70 feet below street grade; and from that point they will ascend to an elevation of 15 feet below grade at the terminal of the Central Railroad of New Jersey. At the point where this shore subway passes under the foot of Fifteenth Street, in Jersey City, it will be intersected by twin tunnels which will extend from Thirteenth and Fourteenth Streets and Provost Street to the subway, whence they will pass below the Hudson River to a station at Morton Street, in Manhattan. Thence they will be continued up Morton Street to Greenwich and Christopher Streets, where there will be a station, and thence up Christopher Street to a station at the junction of Ninth Street and Sixth Avenue. Here the system will branch into two separate pairs of tunnels, one of which will be carried below Ninth Street to Fourth Avenue to a connection with the existing Fourth Avenue Rapid Transit Subway. The other branch will continue north below Sixth Avenue, with stations at Fourteenth, Eighteenth, Twenty-third, Twenty-eighth, and Thirty-third Streets. The surface of the rail in these tunnels below Manhattan Island will be at an average depth of 33 feet below street grade. At Thirty-third Street the system will be in touch with the Pennsylvania Railroad tunnel across Manhattan Island, so that this portion of the road, or what is known as the Uptown Tunnel, will tap two important systems of underground travel, namely, the Rapid Transit Subway on Manhattan Island, and the Pennsylvania Railroad tunnels connecting with the whole of the Long Island Railroad system. The portion of the new tunnel above described, including the Jersey subway, as far as the Erie Railroad station, is being built by the New York and Jersey Railroad Company. The rest of the system, including the subway from the Erie terminal southward to the terminal of the Central Railroad of New Jersey, and the twin tunnels extending from the Pennsylvania Railroad terminal to Manhattan Island, with a loop on Church Street, is being built by the Hudson and Manhattan Railroad Company; and the contract for the construction of the whole of the work has been undertaken by what is known as the Hudson Companies. The downtown tunnel will consist, like the rest of the system, of two separate tubes with a single track in each. It will extend from the Pennsylvania Railroad terminal to Cortlandt Street, which it will follow as far as Church Street, below which it will pass in a loop, to return below Fulton Street and under the Hudson River to the Pennsylvania Railroad terminal.

In the earliest stages of the development of this enterprise, it was proposed to utilize these tunnels for running the steam railroad cars of the railroads terminating in New Jersey directly into New York; but as the present companies realized the full magnitude and importance of the enterprise, they very wisely determined to equip the system with the most up-to-date rolling stock and plant, designed especially for its use, and to follow in general the high class of construction which has been used in the Manhattan Rapid Transit subways. The rolling stock, therefore, will be entirely new. The cars will be large and brilliantly lighted; they will be constructed of steel and rendered absolutely fireproof. The protected third rail will be installed, and there will be a complete system of signals of the automatic and semi-automatic type placed throughout the whole line. In the subway on the Jersey City side and under Manhattan, where the service will be local in character, the trains will be run probably at about the same speed as those on the Manhattan Subway. In the tunnels below the Hudson River, however, where there are no stops, the trains will be run at express speed. This means that a passenger alighting, say at the Erie or D., L. & W. or, indeed, any of the terminals, can be in Manhattan in four or five minutes' time, and at Thirty-third Street, Fourth Avenue and Ninth Street, or at Fulton and Broadway, within from five to twelve minutes from the time he takes the tunnel train.

The present condition of the work is that, on the uptown tunnels, the north tunnel is completed from the shaft on the Jersey side to the shaft on the New York side, and the south tunnel is completed from the Jersey side to within 50 feet of the New York shaft. Work is also progressing on the approaches in New York. Of the downtown tunnels, the working shaft on the New Jersey side has been sunk, and the work of driving the two tunnels will shortly be under way, both tunnels being driven simultaneously. It is intended to use the shield method of construction with iron segmental tunnel lining for the whole of the system, not merely for that portion that lies beneath the Hudson River, but also for the subway beneath Jersey City and Manhattan. It is expected that the whole work will be opened to the public in from two to three years' time.

As showing the great activity in the work of connecting Manhattan Island with the mainland by tunnels, we have included on our map the tunnels of the Rapid Transit Subway and of the Pennsylvania Railroad that are now either under construction or have been authorized for construction by the Rapid Transit Commission. The most northerly of these are the Pennsylvania Railroad tunnels, which extend in the neighborhood of Thirty-third Street from New Jersey below the Hudson River, Manhattan Island and the East River to a station in Long Island City. These tunnels will not only give the Pennsylvania Railroad system a large terminal station in the heart of Manhattan Island, but they will place the network of railroads on Long Island in direct railway communication with Manhattan. The two Pennsylvania Railroad tunnels leading into Long Island will be below Thirty-second and Thirty-third Streets, and those which will extend to Jersey City will lie below Thirty-second Street. The other tunnel that is now under construction, is that of the Rapid Transit Road, which extends from the Battery below the East River to the foot of Joralemon Street.

The opening of the Rapid Transit tunnel and its remarkable success had the immediate effect of awakening a keen competition among capitalists to secure franchises for the construction of further subways and tunnels, both in Manhattan and Brooklyn. With commendable foresight, Mr. Rice, the present acting chief engineer of the Rapid Transit Commission, had prepared extensive surveys for future roads, and recently the Rapid Transit Commission and the Board of Estimate and Apportionment have authorized the construction of no less than nineteen different subways. Included in and forming part of these various routes are five tunnels beneath the East River. The first of these extends parallel with the Pennsylvania tunnels across the East River and connects with the crosstown subway below Thirty-fourth Street. Another tunnel has been authorized from Brooklyn to Fourteenth Street. This last has been laid out with a view to its probable use by the Brooklyn Rapid Transit. It will connect through the Subway below Fourteenth Street, with a loop system running from Fourteenth Street through University Place and Wooster Street to Canal Street and thence returning over the Manhattan Bridge to Brooklyn. This loop will provide a route by which the Brooklyn surface cars can pass over to Manhattan Island and return. The same Fourteenth Street Subway will form part of a loop for the Brooklyn Rapid Transit elevated cars which will run down Fourteenth Street to Greenwich, down Greenwich to Liberty, and through Liberty Street and Maiden Lane to return to Brooklyn by a tunnel under the East River from Maiden Lane to Pineapple Street. For the accommodation of the Belmont interests, should they be disposed to bid upon it, a subway and tunnel have been laid out from the loop below City Hall Park, through Beekman Street and under the East River to Cranberry Street, Brooklyn. Another tunnel, which will probably form part of the system of subways which the



By this system a passenger, landing at any of the Jersey City railroad terminals, will be able to take a train direct to central points between Forty-second Street and the Battery. The five projected tunnels beneath the East River are shown in dotted lines.

MAP SHOWING THE NEW JERSEY TUNNELS AND SUBWAY; ALSO THE EAST RIVER TUNNELS RECENTLY AUTHORIZED BY THE RAPID TRANSIT COMMISSION.

New York City Railroad Company is anxious to build, will extend from Montague Street, Brooklyn, under the East River, to Old Slip, New York, to connect with a subway under William Street. It is probable that all of these tunnels and the connecting subways beneath the avenues and streets of Manhattan will be in a condition for bids by the spring of 1906, and although only a part of them may be undertaken at once, it is probable that before another decade has passed, everyone of the lines indicated on our map will be in active operation.

Engineering Notes.

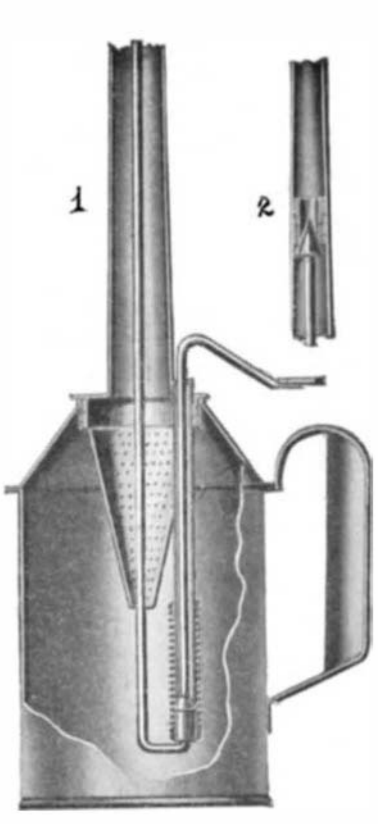
About 1890, some railroads commenced to build small spans and plate girders of steel, and, for eyebars, steel was almost exclusively used. At that time most of the rolling mills, which had formerly manufactured wrought iron, were equipped with steel furnaces, but continued for some time to make both kinds of material, until they found it more profitable to confine themselves to the manufacture of structural steel only, and discontinued the manufacture of wrought iron. In 1894, it was practically impossible to obtain wrought iron shapes, and from that time forward steel entirely superseded wrought iron as the modern structural material. The year 1894, therefore, may be considered as the commencement of the present epoch—the steel age.

There are different methods of executing laboratory instruction in engineering schools, and these range from the complete written-instructions method, which might be carried out by any intelligent man, to the pure research method, in which a problem is assigned and no assistance given for solution except facilities of laboratory and library. Equipment for such laboratory instruction is also quite various in kind and excellence, but on the average represents large outlays of money for installation and maintenance. It is difficult to see how all the schools with variety of apparatus and method of using the same can accomplish the same ends, and it may be that much of our apparatus is useless, as charged by some English critics. From the discussion, however, it does seem that the aim of the instruction, or the object to be attained by the student, may justify both method and apparatus, and that old, worn or small pieces will suffice when the aim is to teach the commercial tests, in which case also the complete printed report form is satisfactory. When, however, it is the aim of the instruction to make useful engineers, in the highest sense, by sending out bold and clear-thinking men, well equipped with the fundamental principles and their application, then the modified research method in some form is absolutely necessary. In this case the great range of problems and variety of the scientific foundation material make the most complete laboratory none too good nor need any part of it lie idle for want of usefulness.

At a recent meeting of the Belgian Electrical Society, J. Carlier reviews the different apparatus which have been designed for taking the speed of locomotives. The "kinemometers" of Richard and Jacquemier are not easily applied to locomotives, on account of the fragility of the different parts of their mechanism. But for experimental cars they have a better chance of succeeding, as the latter are less subject to heavy shocks. M. Hayne has devised a registering speed indicator for locomotives which is of strong build. It has a revolving disk, which turns proportionally with the time by a clockwork movement. It works by friction against a roller, which is mounted on a shaft carrying a screw-thread. The screw works in a nut, which is drawn in the opposite direction by the movement of the car wheels. Thus the roller moves over the disk at a distance from the center which is proportional to the speed. The Hausschelter register is used to indicate upon a dial, in front of the engineer, the speed of the locomotive in miles per hour. Besides, it registers on a band of paper, which rolls out proportionally with the time, the speed, the duration of the run, and of the stops. When the speed exceeds the proper limit, a bell is rung. Dr. Hasler, of Berne, has devised an instrument which may be an improvement on the above. It is a totalizing speed counter, indicating the speed at intervals of time which are three times nearer together than the above instrument. It registers the speed of the train, the total time of the locomotive, the length of the distance passed over, and is also to be adapted for recording the air-brake pressure. The speed of the train is represented by an irregular curve, which utilizes nearly the whole width of the paper band, and the point works every three seconds. In the Pennati tachymeter, the pencil-holder is raised along a vertical rod by means of a half-nut running upon a screw. At intervals of twenty seconds an electro-magnet works the pencil lever, so as to separate the nut from the screw. The speed is taken by a wheel running upon the rail, and its shaft operates the gearing of the apparatus. Electric tachymeters have been made, but these have not been applied with much success upon locomotives, excepting the Scholkmann system, which has been used on the Prussian state locomotives.

A NOVEL OIL CAN.

Pictured in the accompanying engraving is an oil can of novel construction recently invented by Messrs. Frank W. Clow and Joseph Brooks, of Livingston, Mont. The oil can is of the type used in oiling locomotives and large machinery, in which a long spout is provided to permit of reaching parts which would be inaccessible if the ordinary oil can were used. One of the principal objections to oil cans with long spouts is that in reaching distant bearings or oil cups, a large amount of oil is usually spilled out before the nozzle can be inserted to the desired spot, because, owing to the length of the spout, the can must be tipped up to pass between the various parts of the machine. The present invention seeks to overcome this objection by providing a valve which normally closes the spout, so that the can may be entered into the machinery without spilling a drop of oil, and then when the proper bearing is reached, a thumb piece is depressed, opening this valve and permitting the oil to flow out. In our illustration the spout of the can is broken away, and also a portion of the body of the can, in order to bring out the details. A portion of the upper end of the spout, with the nozzle screwed on, is represented in Fig. 2, and shows the valve that closes the end of the spout. The valve stem passes down through the spout to the bottom of the can, where it is bent upward again to pass through an air-inlet tube to the outside of the can. Here the valve stem terminates in a thumb piece. The bottom of the air-inlet tube is closed by a second valve formed on the same valve stem. A coil spring on the tube is connected to this valve and serves normally to hold it and the flow valve closed. When the thumb piece is depressed, both valves are open and air enters the can through the tube to replace the oil which passes out of the spout. An inverted conical strainer is set into the mouth of the can to exclude all foreign matter from the spout. This strainer is attached to the cap which carries the spout and also the inlet tube, so that the entire mechanism may be removed by unscrewing this cap, and this leaves a large opening through which oil may be poured in without danger of spilling. The construction is such that the oil will not collect in and clog up the spout; but if the valve becomes clogged in any way it may be readily cleaned on unscrewing the nozzle from the spout.



A NOVEL OIL CAN.

Official Meteorological Summary, New York, N. Y., July, 1905.

Atmospheric pressure: Highest, 30.17; lowest, 29.58; mean, 29.97. Temperature: Highest, 96; date, 18th; lowest, 61, date, 27th; mean of warmest day, 86, date, 18th; coolest day, 66, date, 23d; mean of maximum for the month, 82.6; mean of minimum, 68.3; absolute mean, 75.4; normal, 73.9; excess compared with mean of 35 years, + 1.5. Warmest mean temperature for July, 78, in 1901. Coldest mean, 70, in 1884. Absolute maximum and minimum for this month for 35 years, 99 and 50. Average daily deficiency since January 1, — 0.4. Precipitation, 6.01; greatest in 24 hours, 2.74, date, 10th and 11th; average of this month for 35 years, 4.51. Excess, + 1.50; deficiency since January 1, — 1.71. Greatest precipitation, 9.63, in 1889; least, 1.26, in 1893. Wind: Prevailing direction, south; total movement, 7,358 miles; average hourly velocity, 9.9 miles; maximum velocity, 46 miles per hour. Thunderstorms 8th, 9th, 10th, 11th, 13th, 19th, 20th, 30th, 31st. Clear days, 5; partly cloudy, 17; cloudy, 9.

The celebrated grape vine in the conservatory at Hampton Court, England, planted in 1769, had in 1830 a stem 13 inches in girth and a principal branch 114 feet in length, the whole vine occupying more than 160 square yards; and in one year it produced 2,200 bunches of fruit weighing on an average a pound—in all, about a ton of fruit.

Correspondence.

New Nomenclature.

To the Editor of the Scientific American:

Permit me to suggest two names for new "articles" in daily use.

1. Kinetograph: A photograph or series of photographs for use in kinetoscopes or like machines.

2. Aerogram: A message sent by wireless telegraphy.

C. G. Dickson.

Washington, D. C., August 3, 1905.

The Danger of Lightning in Armored Concrete Constructions.

It is a well-known fact that any constructions made entirely of iron are practically immune against the effects of lightning, as the amount of electricity accumulated in the case of a lightning stroke is allowed to distribute itself over the large surface of the roof, and to flow off to the earth at many places with greatly reduced intensity. As pointed out in a recent article in Beton und Eisen, conditions are quite similar in connection with buildings made entirely of armored concrete, as the discharging current will find the roofing iron and distribution rods of an armored concrete roof, struck by lightning, a good conductor of electricity, so as to flow off to the more substantial girder iron with which the roofing iron is connected by wire meshes. Now, as experience has shown lightning not to be discharged to the earth in a concentrated jet from the place of striking, but to have a tendency to distribute itself to all sides if possible, the electricity will be diffused throughout the roof traversed by a network of iron rods. The electricity being greatly reduced in intensity, will have an excellent opportunity of flowing off to the ground through the round irons inserted in armored concrete columns, thus being communicated to the foundation of the current column, which in turn transmits it to the ground. This shows that neither artificial lightning arresters nor their parts will be required in connection with any construction consisting entirely of armored concrete.

Tests with Haulage System to Economize Air.

At the Fürstlich von Plesschen Colliery, in lower Silesia, electricity has been used extensively underground, but with the idea of avoiding firedamp explosions it has been found necessary to use air motors in all such places that were in the return air-way, or such places that were not directly reached by fresh air. The installation at the Fürstensteiner mines is very extensive, and owing to the use of coal cutters these latter mines have been provided throughout with air mains, and to connect with this system was convenient, whereas it would be necessary to use lengthy cables should the introduction of electricity be contemplated. The material that is derived from the seam or measures having a thickness of 23 feet must be hoisted on the incline and for this purpose it is necessary to use a motor of some kind. The system which has here been introduced is the endless-rope system so that whatever motor is used it can run continuously. A duplex air hoist of the ordinary type with slide valves, is installed but it is impossible to use a cut-off so as to expand the air to any great extent on account of the formation of ice in the exhaust. The motors, therefore, do not work economically and use a great deal of air. To overcome this, as has been tried in other districts, the use of reheating was not deemed advisable on account of the danger from explosions.—Translation of article in Gluckauf, Mines and Minerals.

The Current Supplement.

The current Supplement, No. 1545, is commenced with an interesting article on "The Kazarguene Bridge." This Russian bridge is the longest reinforced concrete bridge in the world. "The Steam Turbine As Applied to Electrical Engineering" is by the Hon. Charles A. Parsons, and Messrs. Stoney and Martin. "The Winning Automobiles in the Sixth International Cup Race for the Bennett Trophy" describes the Italian cars. The usual scientific, electrical, and engineering notes will be found in their accustomed places.

John Carbutt.

John Carbutt died July 28 at his home in Philadelphia, aged seventy-three years. Mr. Carbutt went to that city from Sheffield, England, in 1853. He was a chemist, and made scientific photography his life study. The Photographers' Association of America chose him as its first president. He made several inventions, chief of which was the orthochromatic plate. In 1879 he perfected the Carbutt dry plate.

Probably the first iron railroad bridge was built on the Philadelphia and Reading Railroad at Manayunk by Richard B. Osborne, Chief Engineer, in 1845. It was a double-track through bridge, of 34 feet clear span, of the Howe truss type, with cast-iron chord and web braces, the bottom chord and vertical web members being of wrought iron. This bridge was followed by several others of the same type.