THE DOUBLE-DECK SURFACE AND TUNNEL STATION OF THE HUDSON COMPANIES IN JERSEY CITY.

New York city is, at the present time, the greatest center for engineering works of magnitude in the world. In proof of this, it is sufficient to state that the work in the way of terminal railway stations, bridges, tunnels, and water supply now under construction in or near this city represents a total outlay of over $600,000,000, or about three times as much as the estimated cost of completing the Panama Canal. One of the largest of these public works is the elaborate system of tunnels and terminals, which is being built by the Hudson Companies to provide better transit facilities between Jersey City and Manhattan Island—a work, the cost of which, when fully completed, will probably be over $50,000,000.

This system of rapid transit (for such it is) has grown out of the abortive attempts, made some thirty years ago, to drive a tunnel from Jersey City to Manhattan, between Hoboken and the foot of Morton Street. Meritorious as was the original scheme in plan and purpose, it failed for mechanical and financial reasons. Considering that subaqueous tunneling was then in its infancy, and that modern methods of driving were unknown, it is surprising that the original company should have accomplished what it did; but lack of mechanical appliances, coupled with the treacherous character of the river silt through which the tunnels were being driven, to say nothing of the difficulty of securing the necessary capital, led to the abandonment of the work. Thanks to the far-sightedness and energy of Mr. McAdoo, president of the Hudson Companies, the work of completing the abandoned tunnels was taken up a few years ago, the necessary capital subscribed, and the work of driving the tunnels through to Manhattan commenced. Under the care of Charles M. Jacobs, chief engineer, who brought to the work a large experience and the very latest methods of driving with the Greathead shield, the tunnel soon began to make rapid progress toward the Manhattan shore.

Before the work had been long in progress, it was realized that, if the scheme for providing rapid transit between the two cities was to be adequately carried through, it would be necessary to provide additional tunnels at a crossing located in the latitude of the "downtown" financial district; and accordingly, the company laid out a route extending from the Pennsylvania Railroad Company's terminal station in Jersey City to Cortlandt and Fulton Streets in Manhattan. At the same time, the scheme was developed to its logical conclusion, by planning to build tunnel lines parallel with the Jersey foreshore, extending from the Hoboken terminal of the upper pair of tunnels to a connection with the Jersey City terminal of the Cortlandt Street tunnels. Also, with a view to placing Jersey City in direct touch with the uptown shopping district, it was planned to continue the Morton Street tunnels, easterly below Manhattan to Sixth Avenue and northerly below Sixth Avenue to Thirty-third Street, and build a branch line from Sixth Avenue to Astor Place. The plans also called for a huge terminal station and building, extending on Church Street from Cortlandt to Fulton Street, the tunnel to contain five parallel tracks, and the terminal office building to be twenty stories in height on a block 180 feet wide by 420 feet long.

This ambitious undertaking has been pushed along during the past two or three years with untiring energy, and with a remarkable absence of the delays which would seem to be so inseparable from large engineering works of this character. At the present writing the two upper tunnels are completed, and the Hoboken terminal station is nearly so. Also the extension of the tunnels below Manhattan Island has been fully completed to Sixth Avenue, and is nearly completed to Eighteenth Street. The work of excavation is well under way from Eighteenth to Thirty-third Street. As matters now stand, there is every indication that trains will be in operation from the Hoboken terminal to Eighteenth Street and Sixth Avenue before the winter sets in. The Cortlandt Street tunnels have been driven 82 per cent of the distance below the Hudson River, and the big terminal building is now up to the eighth floor. It is expected that this building will be completed by May 1, 1908, and that the tunnels connecting with it will be ready for service in the autumn of the same year.

From an engineering standpoint, one of the most attractive features of the Hudson Companies system is the large underground station, which has been excavated below the present terminal of the Pennsylvania Railroad Company in Jersey City. This station, which is 150 feet in width, and with its approaches nearly 1,000 feet in length, has been cut out of the solid rock at a depth of 85 feet below street level, and, as will be seen from our front-page engraving, lies immediately below the large Pennsylvania Railroad Company's train shed. The walls and roof are finished throughout with a heavy lining of concrete. The station provides for four, and in some places five, parallel tracks, two for through trains, and two for local trains. Access is had either directly from street level by a subway below the floor of the upper station, or from the station floor itself, by means of six passenger elevators. Two elevators lead directly to the street, and four elevators of exceptional size, each being capable of holding over a carload of passengers, lead directly from the platforms of the tunnel station to the platforms of the Pennsylvania station overhead.

Joint traffic arrangements have been made between the Hudson Companies and the Pennsylvania Railroad Company, according to which, as soon as the new Pennsylvania terminal station on Thirty-third Street is completed, the present terminal in Jersey City will be handed over for operation to the Hudson Companies. All long-distance travel on the Pennsylvania lines destined for upper New York will be carried directly through that company's tunnel to Thirty-third Street; while the long-distance travel on the Pennsylvania destined for lower New York will transfer at Harrison for the Hudson Companies' lines, and will enter New York by the Cortlandt Street tunnel route. Eventually, the Hudson Companies will be in a position to carry passengers to Newark and vicinity, either by ferry, and by surface lines over the present tracks of the Pennsylvania Railroad, or direct by tunnel beneath the Hudson River, said tunnel tracks emerging by an incline near Harrison.

An excellent feature in the operation of this system is the fact that a new type of car of absolutely uninflammable construction will be used exclusively. The cars, which were designed expressly for this service, will be entirely free from wood, and even the cushions of the seats will be of fireproof material. It is estimated that 250 cars will serve to maintain a constant succession of trains through the tunnels on a headway of one and a half minutes. During the rush hours there will be eight cars to the train. Operation will be by the multiple-unit system, and every car will be equipped with motors. Advantage was taken of the fact that the cars were to be built entirely of steel, to provide them with a wide margin of strength over cars of the ordinary construction. They are designed on the bridge or girder principle, which has been preserved in spite of the fact that in addition to the usual end doors, center doors are provided on every car.

These middle or side entrances are operated by compressed air; the impulse for operating which will be given by the motorman at each end of the car. At the proper moment, he will move a lever, which will close or open not only the doors on the end platforms, but also the double doors on the sides of the cars. The force of this impulse, however, will be controlled, so that there never will be any possibility of a person being caught between the doors. In other words, the force which closes the doors will be just sufficient to do so; and should a passenger be about to enter the car at that moment, it will be possible for him to stay the progress of the closing door with the hand.

These center doors are on both sides of the cars, and have been thus installed for the purpose of solving some of the rapid transit problems which always exist in any large terminal station in New York. For instance, the trains of the Hudson Tunnel system will run between platforms in the new terminal station building at Church and Cortlandt Streets; there will be five tracks running between six platforms. Alternate platforms will be used for the purpose of loading and unloading the cars. Passengers will pass out of a train just arrived on to an unloading platform, the side doors of the cars permitting them to discharge their passengers in a comparatively few seconds' time. The doors on that side of the cars will then be closed, and the doors on the opposite side will be opened to admit passengers from the loading platform, who desire to embark. Thus the incoming and outgoing passengers cannot collide, and there can be no congestion.

The cars are large and comfortable, and capable of seating over fifty persons each. There are no cross seats, as at present exist in the elevated and subway trains, because the side doors of the cars take up the space at present occupied by the cross seats; but for the convenience of those who may be compelled to stand on the three-minute run under the river, there is a series of posts extending from the floor to the roof of the car, to which one may conveniently cling or lean. The floors of the cars have been laid with cement which may be readily washed, thus giving it the highest sanitary efficiency. In the cement floors will be imbedded quantities of carborundum, which is a very hard abrasive material, impossible of wear under the feet of the passengers, and which makes it impossible for a passenger to slip.

A new method of cutting steel is said to have been patented by a Belgian engineer. The process consists in first heating the metal by means of an oxy-hydrogen flame and then cutting it by a small stream of oxygen gas, which unites with the steel and forms a fusible oxide, which flows freely from the cut. It is said that the cut is fully as smooth as that made by the saw, and is only 1-100 inch wide.

Coffee Substitute Culture in California.

A syndicate of Stockton capitalists has purchased a 500-acre tract of very rich land on Robert's Island, one of the numerous fertile river islands west of Stockton, and expects soon to commence the cultivation of "coffee."

They are going to put this large tract into "blackeye beans," which are used extensively in the manufacture of the cheaper grades of coffee. The bean takes a nice brown color, has a good flavor, and cannot be detected from the genuine coffee bean—the imported article—except by an experienced expert; and even such a person would find it difficult to detect the counterfeit in a ground mixture of the real article.

The blackeye bean owing to the demand for it in the manufacture of coffee sells readily for five cents per pound; much cheaper than real coffee can be purchased for. The blackeye bean is not at all injurious, as has been determined by repeated experimenting and chemical tests; but, on the contrary, it makes a very nutritious drink when mixed with real coffee, as is always the case, and the flavor is delicious. In fact, about the only thing against the blackeye bean is, that it is *not* coffee, and no enthusiastic coffee drinker would knowingly drink any substitute. This is the first attempt to cultivate the blackeye bean in California.

Prize for Lucerne Cultivator.

Consul-General J. G. Lay, of Cape Town, transmits the following information concerning a competition for a lucerne cultivator in South Africa, which should interest American agricultural implement manufacturers:

The endeavor to obtain the best cultivator for lucerne sown broadcast has led the Cradock Agricultural Society, of Cape Colony, to arrange a competition in 1908, at which a prize of $500 is offered for the successful implement. Practically no lucerne is sown by drills in Cape Colony, but thousands of acres are sown broadcast, and the acreage is increasing so rapidly that the cultivator awarded the prize will undoubtedly have a large sale. A "drag" implement, similar to that used for drilled crops, will not do for broadcast lucerne, owing to the damage done the crop in cultivation.

The trial is for a "general purpose" implement to be used on lucerne from one year old and upward, to produce a fine tilth of not less than three inches in depth (with the object of conserving moisture), to destroy grass and weeds, and which must leave the surface of the ground as even as it found it, and *in good condition* for irrigation. The judges will inspect the lucerne three weeks after and also six weeks after the trial to see the effects. Entries must be made *not* later than noon on January 1, 1908, and the implements must be on the grounds appointed for the trial by February 1. The selling price of the implement at Cape ports must not exceed $145.

Some suggestions as to the style of cultivator suited to the work have been given by the secretary of the agricultural society and embrace the following points:

The machine should run on wheels, which will admit of its traveling from place to place, and have a roller or drum revolved at a rapid speed by gearing from the main or traveling wheels, fitted with long spring arms or teeth, the roller being suspended and capable of being lowered or raised by the usual lever or quadrant, so that the teeth can be raised out of harm's way when traveling, and lowered for either very shallow or deeper cultivation. The chief difficulty will be in arranging so that the machine will not dig out lucerne as well as weeds. The principle will be best made clear to foundry and machine shopmen by stating that it would be the power wood-molding plane adapted to cultivation, where the traveling pace of the team would represent the "feed" of the molding plane, and the drum and teeth would represent the blade holder and the revolving blade. By adjusting the proportion of the speeds of the traveling wheels and the drum unquestionably any fineness of tilth can be produced in either dry or irrigated land. It must have teeth with spring or give in them both forward and backward, and also spring or give sidewise, or across the machine, sufficient to admit of a tooth slipping off a large lucerne root. Straight spikes seem to be best, of spring steel, an arrow at the point, say one-half or three-fourths inch in diameter, for just such a distance as they will enter the ground, and hooked or bent only at the extreme end sufficiently to make them enter the ground without having more weight in the machine than is necessary for strength. A spring tooth of flat section, with a half turn in the middle, seems likely to give the required spring in both directions, provided the tooth is fairly long. The principles involved are embraced somewhat in an English hay-tedding machine.

Further details concerning the cultivator, with the conditions of entry and trial, as well as the name and address of the secretary of the agricultural society, are on file in the Bureau of Manufactures for the information of those interested.