

freight rates, the measure of success is production of transportation at least cost. When the mill cannot bid low enough to get the contract it must shut down. The railroad shops must keep going, thus the monthly or annual comparative statements seem to lose the biting sting of the selling price. Accurate and detailed cost-keeping is necessary to prevent the home manufacture of articles at a cost extravagant in comparison to the price for which the article can be bought outside. Piece-work payment has long since been universally adopted by the commercial industries, and affords a veritable panacea for keeping cost-accounts and increasing output. The boundary line of net economy cannot be hazy except at the direct sacrifice of net profit. A mechanical man leaving railroad employ and entering a factory must first surmount this obstacle. His new employers demand designs having lowest shop cost. They reject arrangements which would have been considered satisfactory in his previous situation. Railroad establishments need to regard themselves as having a real profit and loss account. In the weaving industry the "harness" (the arrangement of little eyelets which raises and lowers the threads of the warp of a loom) is set up at an outside shop. One concern does this work for all the competing mills. Having specialized in this line, their operatives can turn out these accessories cheaper than the mills could make their own.

In the discussion, which was largely of a general nature following the lead of the papers, Mr. Eugene Chamberlain, chairman of the freight car equipment pool of the New York Central Lines, in a humorous way demolished seriatim the points by which the author of the paper had attempted to show that railroading was not carried on under business principles. He thought that in railroading as in other lines of work a man must make it clear that he could "deliver the goods" and that there were not wanting many examples of men who had demonstrated their capacity to do so, citing specifically the president of the American Locomotive Company. He said that railroading has ceased to be individual effort but is team work and the successful man is he who organizes the team so as to work to the best advantage. The tenor of Mr. Chamberlain's remarks was that it is easy to sit in a carriage and criticize the gait of the man who walks.

Mr. M. B. Wild, statistician of the Baltimore & Ohio, gave in a written discussion a cold analysis of the paper, which he characterized as very sweeping in its charges, founded upon a misunderstanding or ignorance of actual conditions and grossly exaggerating in its specific illustrations. He also took occasion to express his abhorrence of "graft" in every form and his contempt for those who indulged in "commissions," quoting from Pope with the alteration of a single word—

"Graft is a monster of so frightful mien  
As, to be hated, needs but to be seen;  
Yet seen too oft, familiar with her face,  
We first endure, then pity, then embrace."

And in this connection expressed the view that there is altogether too much "embracing" between railway men and supply men.

Mr. W. G. Besler lowered the author of the paper gently by his opening statement that impressions are not necessarily facts and that the statements made were as applicable to a cotton mill or a blast furnace as to a railroad. For his own part he had never been afraid of having so many smart men around him that he would lose his job. He then read at length a paper on "Experience versus Technical Training," recently presented to the St. Louis Railway Club.

Mr. G. R. Henderson related two or three instances in which the efficiency of the service had been marred and economy negated by the indiscriminate blue-penciling of requisitions, and another member detailed how a refrigerator car worth \$80 a day had been held up for four days because some hinges worth twenty-five cents apiece had been cut from a requisition.

President Vreeland announced that negotiations were under way to secure permanent quarters for the club in the new engineering building and believed the matter would be arranged before the end of another year.

It was announced that at the February meeting Mr. C. L. Chester will present an illustrated lecture on "Panama and Its Canal."

#### BEGINNING OF ERIE'S TERMINAL IMPROVEMENTS.

For the past eight years, pending the appropriation of sufficient funds to carry on the work of terminal improvement, the executive and engineering officers of the Erie Railroad have been evolving plans of great magnitude to improve the means of entrance to the eastern terminal of the road at Jersey City, N. J., and to better the terminal facilities. These plans, in a broad way, include the building of four additional tracks, to be devoted exclusively to passenger trains, the erection of a new station building and very probably the electrification of the suburban lines entering the terminal. While the plans have not matured to a point where they may be definitely outlined, the first great engineering feature has been started: That of providing a four-track passageway through the solid rock of Bergen Hill, a populated ridge or extension of the Palisades about 90 feet high and over 4,000 feet wide, which, paralleling the Hudson about three-quarters of a mile from the bank, constitutes a mountainous difficulty to railroads entering New York from the west.

The Erie's present two-track tunnel through Bergen Hill will be used exclusively for freight service when the new tracks are in operation, and the four new tracks will be used exclusively for passenger business. At present the freight business is seriously hampered, as during the rush hours in the morning both tracks are operated in the same direction, allowing no westbound movement of any kind for two hours. In the evening it is not possible to operate in the same manner, as the schedule requires a number of eastbound passenger movements. The capacity of the tunnel is increased, however, for westbound movement in the evening by the combination of two trains, both locomotives being coupled at the head of the train, and at points where divergent routes occur the trains are separated with slight delay.

The new four-track line is incorporated as the Penhorn Creek Railroad. The filed location begins at Jersey avenue, Jersey City, and extends through Bergen Hill to a connection with the present main line of the Erie Railroad east of the Hackensack river. The passenger business originates on six lines, and at points from four to six miles from the terminal at Jersey City. These lines are merged into three groups, the New York Susquehanna & Western Railroad and the Northern Railroad of New Jersey, forming one group; the main line of the Erie Railroad and the New Jersey & New York Railroad forming another, and the Greenwood Lake division and the Newark branch a third. The six tracks required by these groups are merged into four west of Bergen Hill, and by an arrangement of flying junctions all grade crossings are avoided. It is the intention to use the new four track solely for passenger business, operating three tracks eastbound and one westbound during the morning rush hours, and three westbound and one eastbound to accommodate the homeward rush in the evening. The system of connections at the west end of the open cut will permit three trains to leave the terminal at the same time, running abreast through the cut, and to diverge to the various lines with absolutely no interference for a distance of nearly six miles, and the reverse movement may be made in the morning. This will give the Erie suburban line facilities unsurpassed by any other road, and provide for great growth of suburban business without overtaxing its capacity. The New York Susquehanna & Western trains, which now go into the Pennsylvania terminal, will, by the new arrangement, be given access to the Erie terminal through the cut.

The four new passenger tracks will pass diagonally through the hill in the general direction, and 67 feet south of the old tunnel, as a straight open cut broken by four sections of four-track tunnel: Under Hoboken and Central avenues and intervening Erie Railroad property, 580 feet; under Summit avenue, 255 feet; under the intersection of



St. Pauls avenue and Bevan street, 285 feet; under Hudson County boulevard, 190 feet. The open cut sections will be of the following lengths: Open cut from eastern portal, 1,300 feet; between first and second tunnel, 670 feet, and other open cuts, 190 feet, 700 feet and 275 feet, respectively, the total length through the hill being 4,400 feet. The open cuts will be 60 feet wide at the base and 100 feet wide at the top. This makes the cut two feet wider than the Marble Hill cutoff on the New York Central, which it resembles in design, and therefore the largest piece of work of this character in the country.

In determining the grade through Bergen Hill, the engineers endeavored to establish a line that would reduce the rock excavation through the hill to the minimum without being out of harmony with the feasible location of the new connections to be built west of the hill, or with the company's terminal plans. The Erie crosses railroads at both portals of its present tunnel. On the west of Bergen Hill the line of the Erie passes under the Delaware Lackawanna & Western in front of the entrance of the Lackawanna tunnel, and at the eastern portal passes over the New Jersey

The contract for the open cut and tunnel work through Bergen Hill was let to the Millard Construction Company, of Philadelphia, and involves the removal of 500,000 cubic yards of rock and 113,000 cubic yards of earth.

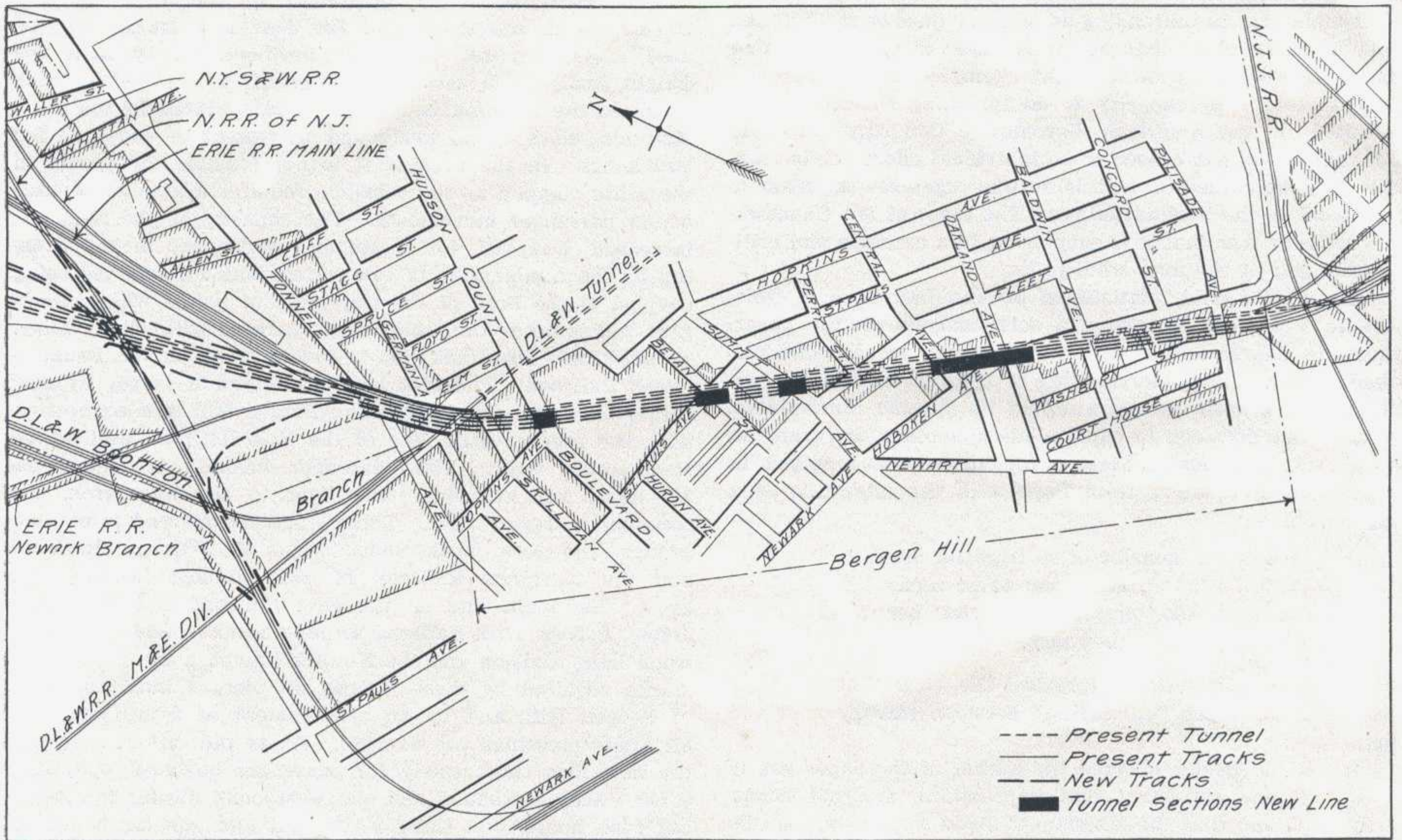
Excavation for the several sections through Bergen Hill, counting from the east, is as follows:

Section.	Character.	Earth, Cu. Yd.	Rock, Cu. Yd.
1	Open cut	31,740	121,000
2	Tunnel	.....	34,100
3	Open Cut	14,900	113,200
4	Tunnel	.....	12,850
5	Open Cut	2,800	42,200
6	Tunnel	.....	17,100
7	Open Cut	37,950	115,600
8	Tunnel	.....	15,000
9	Open Cut	26,500	27,500
Total.....		113,890	498,550

Estimates for the concrete lining required for the four tunnel sections are:

Section.	Concrete Lining.	Portal Facings.
2	5,574 cubic yards	860 cubic yards
4	2,258 "	1,175 "
6	2,740 "	1,135 "
8	1,826 "	975 "
Total.....12,398 "		4,145 "

The work involves the removal of buildings from portions



Erie's Terminal Improvements—Plan Showing Location of Tunnels and Tracks at Approaches.

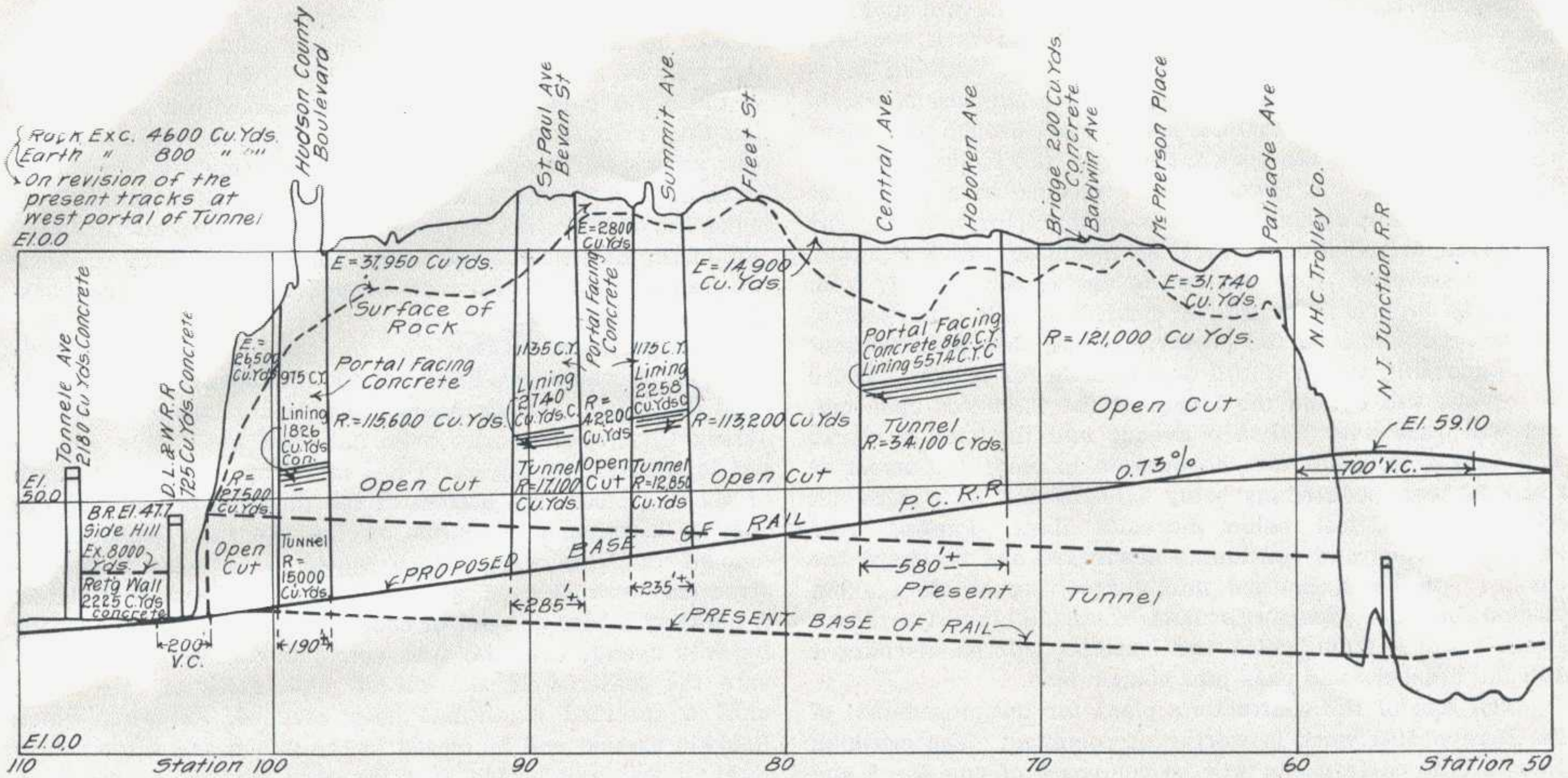
Junction or West Shore road. It was decided to excavate at the western portal to provide room for the four new tracks on the same level with the present tracks, and the Lackawanna will replace its present bridge over the Erie right of way with a lattice girder structure having a longer span. At the eastern portal the New Jersey Junction or West Shore road had to be avoided either by under or overhead crossing. It was finally decided to build a four-track viaduct up to and over the New Jersey Junction Railroad, and to enter the hill about 40 feet above the present base of the rail in the old tunnel. This would avoid the difficulty of a tunnel under the New Jersey Junction Railroad, and would accomplish a great saving in the matter of rock excavation in the open cuts. The grade of the open cut and tunnels through Bergen Hill as a result of this elevation of the tracks at the eastern portal will be .73 per cent.

of the right of way, and for several years the Erie has been buying residence and other property on top of the hill, and the buildings have been and are being removed as the work demands it. A time limit of 22 months has been set for the completion of the excavation work and the excavation is therefore being started simultaneously at various points. The removal of the top layer of earth will be accomplished by means of scrapers and steam shovels, and rock drilling will begin at the ends of the open cuts, so that points may be reached where tunneling can be started at the earliest moment. The early completion of the longest tunnel, that under Hoboken and Central avenues and intervening property, is particularly desired, for the reason that these thoroughfares cannot well be crossed by a contractor's transportation line because of the existence of an elevated structure on one and an electric surface line on the other, and the



probable refusal of the city authorities in any event to permit interruption to traffic on these streets. While most of the rock taken out east of this tunnel will be carried eastward to be stored and used for fill and ballast east of Bergen Hill, a portion of it must be taken westward, and it is

Newark branch to the north side and will proceed thence west parallel to the Newark branch, descending to pass under the New York Susquehanna & Western bridge, proceeding thence to the northwest and along the present embankment of the Lackawanna "cripple yard" tracks, a dis-

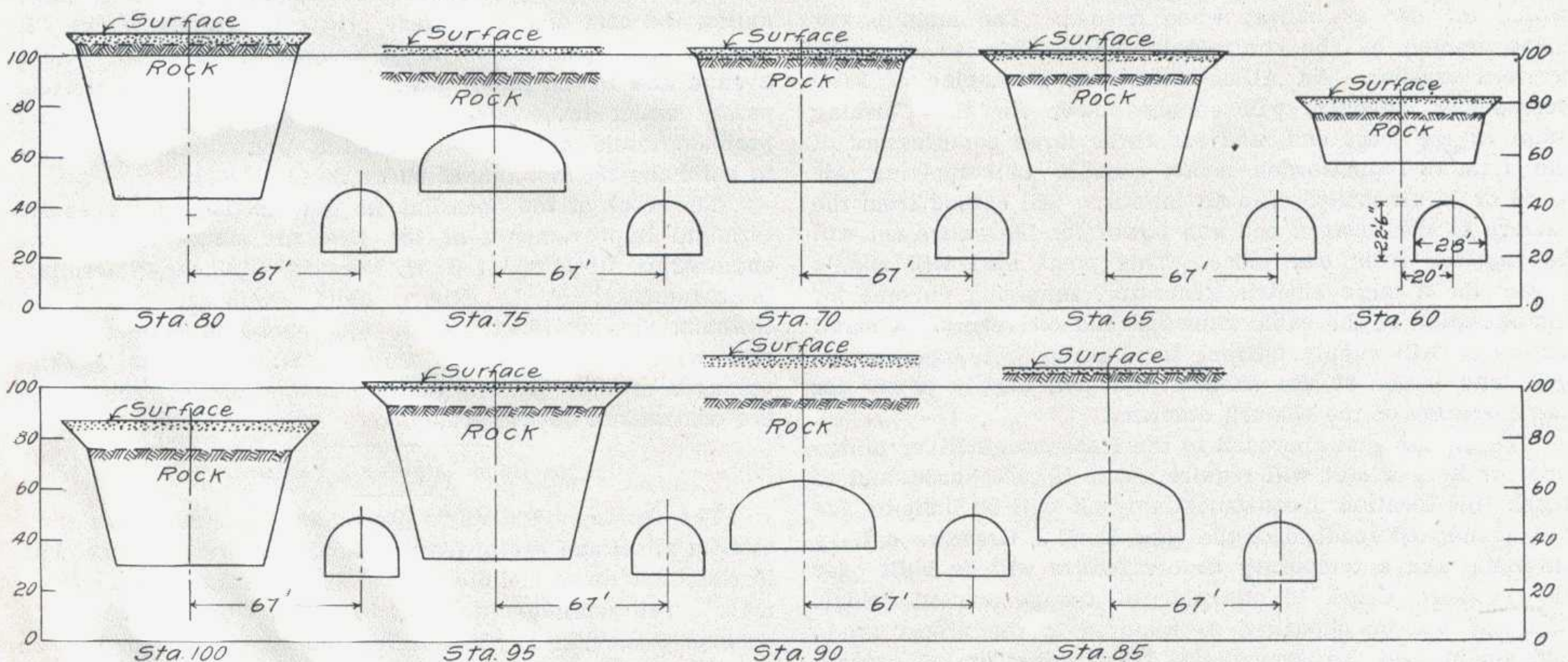


Erie's Terminal Improvements—Profile of Bergen Hill and Tunnels.

planned to complete the tunnel in time to make it a channel through which such rock may be taken. In the case of the Hudson County boulevard, the necessity of carrying excavated material over or under it is immediate; and in order to avoid interruption to traffic on this thoroughfare and the expense of building and maintaining a crossing at grade or above the boulevard, it was decided to build a

tance of about 1½ miles, in the vicinity of which the earth excavation is to be deposited for use in the construction of the new embankments essential to the Erie's track plan west of Bergen Hill.

As a large portion of the new railroad line is projected upon land now unoccupied, the construction of embankments will be started as soon as the material is available. Later



Erie's Terminal Improvements—Cross-sections through Bergen Hill.

temporary tunnel for the contractors' transportation line. The latter will run along the south side of the open cut from Central avenue to the western portal, thence crossing above the Delaware Lackawanna & Western tracks in a northwestward direction and crossing Tonnele avenue at grade. The transportation line will then cross overhead the present

the present Bergen roundhouse and its appurtenances will be removed and a narrow-gauge construction track will be built to the north from a connection with the construction track first built, at a point where it crosses the Newark branch. This northern branch will bring material for the construction of the embankment for the eastbound and the



westbound New York Susquehanna & Western approaches to the bridge over the Erie freight tracks, and also for the four parallel tracks constituting the main stem of the flying junction plan.

The Millard Construction Company is now at work with scrapers east and west of Hudson County boulevard, is building the temporary tunnel under the boulevard and has taken steps towards the installation of two rock crushing plants and other necessary facilities, to cost between \$200,000 and \$250,000. The smaller crushing plant will be established in front of the eastern portal, and through this plant will be handled all the rock taken from the 1,300-foot cut at the eastern end. A tower will be erected at a point just west of Palisade avenue, near the eastern portal, to support two 65-ton balanced cable-ways, by means of which the rock will be conveyed from the cut to the crusher plant, from which the broken stone will be carried by belt conveyors to two storage points on the property of the Erie Railroad east of Bergen Hill, where it will be available for ballast. These cable-ways will extend the length of the 1,300-foot open cut, and will pass over Palisade avenue and the trolley tracks at a height sufficient for the buckets to clear the street at about 16 feet, pedestrians being safe-guarded by a wire net over the street just below the cable lines. Passing over Palisade avenue and continuing downward and eastward the buckets will be discharged into a receiving or storage bin erected on the company's land south of the Thirteenth street viaduct, from which the material will be discharged into the crushers and pass into hopper bins.

The size of the contractor's plant for the prosecution of the Bergen Hill work is worthy of comment. The crushing plant at the eastern end will be composed of one No. 9 and two No. 6 crushers, provided by the Power & Mining Machinery Company, and the plant at the western end will comprise one No. 10 and four No. 6 crushers. In addition to the longitudinal cable-ways mentioned, other cable-ways will be erected across the western sections of the cut to convey the rock to the narrow-gauge cars of the transportation line, which will convey it to the western crusher plant to be located west of Hudson County boulevard. From this plant the broken stone will be carried by means of belt conveyors to a nearby property owned by the Erie, and there stored for use as ballast when needed. The main power plant erected by the contractors will be located near the western crusher. An Atlas boiler and an engine of 2,000 horsepower capacity, will supply power for the crushing plant at the west end, and for three large compressors of the Laidlaw-Dunn-Gordon make, capable of supplying air to 60 or 70 air drills. The air pipe line will extend from the eastern to the western end and power for the entire cut will be supplied from one place. This plant also will supply power for a large electric generator, supplying current for the operation of the cable-ways and belt conveyors. A small generator will supply current for lighting. A separate engine and boiler at the eastern end will supply power for the operation of the eastern crushers.

To fill the east approach to the Hackensack River bridge west of Bergen Hill will require about 157,000 yards, and to reach this location a construction track will be built on the old, abandoned roadbed of the New York & Greenwood Lake Railroad, and a temporary timber trestle will be built over the Penhorn Creek to one side of the permanent bridge. Material will be deposited as required to the proper grade and height, and the construction track raised during process of filling. During the construction of the Hackensack bridge the old embankment on the west side of the river will serve for the construction track while the bridge is being erected. The western approach will be filled after the bridge is completed. One of the incidental features of the contractors' work is that of providing the city with a new street between the Hudson County boulevard and Bevan street, along the

north side of the open cut. This will be done by removing about 12,500 cubic yards of earth north from the cut to a distance of 100 feet, to form an embankment for the street. Another feature of the work arises from the necessity of removing a section of the side-hill at the western portal north of the entrance to the Lackawanna's tunnel, in order to give room for the new tracks which pass under the Lackawanna in front of the latter's tunnel entrance. This probably will be accomplished by setting up on the high ground on the south side of the tracks a derrick with a long boom, and thus bring material across the tracks in buckets to the contractor's narrow-gauge cars. As this material is chiefly earth it will be used with the other earth mentioned to make the fill for the proposed Newark branch on that portion of the line between the New York Susquehanna & Western viaduct and the Boonton branch of the Delaware Lackawanna & Western.

The plans for bridges over the open cut are in brief as follows: A water pipe bridge of 100 feet span will be erected west of Hudson County boulevard to carry two mains of the Jersey City water works over the open cut. This will be put in place when the earth has been removed to the depth of six feet below the bottom of the pipes, thus reducing the cost of erection by eliminating the use of a considerable amount of false work which would be necessary if construction were delayed until the open cut were completed. A highway bridge of steel or concrete will be erected to carry Baldwin avenue over the open cut. The contractor will excavate the material in the cut on both sides of this street until a specified depth has been reached, following which Baldwin avenue will be closed to the public and a temporary right of way and bridge over the open cut will be provided. The material in Baldwin avenue will then be removed and the bridge erected. At Palisade avenue a plate girder bridge of 80-foot span will be built over the cut. The street will be temporarily diverted to the westward over a temporary bridge. A plan also has been devised to carry the trolley tracks on a steel bridge crossing diagonally over the open cut at a point directly under the proposed Palisade avenue bridge. One plan for accomplishing this is to erect this bridge and divert the traffic over it before any excavation is made for the open cut east of Palisade avenue, thus eliminating the cost of a temporary bridge for trolley tracks. It was at first planned to build bridges to carry St. Paul's avenue and Bevan street over the open cut, but as the cut passes under these streets at their intersection a difficult problem would have resulted, and it was thought advisable to build the 285-foot tunnel under these streets.

The work of the open cut, as well as the comprehensive terminal improvements of the Erie are under the general engineering direction of G. H. Burgess, engineer of terminal improvements; F. L. Stuart, chief engineer; and J. M. Graham, vice-president. A. L. Moorehead is resident engineer with office at Jersey City. J. H. Louchheim, general manager of the Millard Construction Company, represents the contractors on the ground.

#### A Good Timetable Feature.

The Southern Railway's passenger department has instituted a novel and useful feature published in connection with its timetable or schedules. It is in the form of an "index map." The passenger desiring to look up the schedule, say, between Asheville, N. C., and Morristown, Tenn., can look on the index map and find that the number of the line between these points is 10. Then looking for this number in the timetable, he finds the schedule with much more readiness than is possible without this adjunct; and so it is between any two points on the system. The map, of course, has no reference to the operating divisions. The plan is an extremely useful and convenient one, even to persons accustomed to traveling.—The Railroad Herald.