

capital and energy into the field will curtail production and tend to make scientific investigators wait for the cheaper product, which is not likely to be forthcoming.

"It is understood that the agreement between the Government and the other parties to the undertaking is that the first seven grams produced shall go to the other parties. At the present rate of production of 170 milligrams a year, it would appear that several years must elapse before the cheap radium will be available for distribution."

MUST STEAM-TRACTION GO?

EARLY PREDICTIONS of the disappearance of the steam-locomotive seem to have been rather premature; so much so, in fact, that some have jumped to the conclusion that electric traction will never supplant steam. But the extent to which it has done so is already great; and the rapidity of the change has been nothing less than "sensational"—to use a word employed by the editors of *The Engineering Magazine* (New York, April) in introducing an article on the subject by Reginald Gordon. Mr. Gordon, in a careful analysis, shows just what ground the electric locomotive has occupied, and why; and he shows how further progress is a matter of finance rather than of engineering. Every railway in the United States could begin to abolish its steam-locomotives to-morrow, and to substitute electricity, if some one would agree to foot the bill. Yet this would be undoubtedly a foolish course, for electric traction is not always economical, nor good for every one of our railroads. Writes Mr. Gordon:

"There are two general classes of electric service in use on railroads that have formerly been operated by steam. For local trains running short distances and making frequent stops, the common practise is to run trains made up of electric-motor and trailer-cars, as on the New York Subway and elevated roads and the Hudson and Manhattan Tubes, as well as the elevated lines of Chicago and Boston. In trains of this kind the motors of every motor-car are controlled by one motorman at the head of the train, and the number of motor-and trailer-cars is increased or diminished to suit the requirements of the traffic. This is known as the 'multiple-unit' system and provides great flexibility and efficiency of train operation. It is in use on more than 200 miles of the Long Island Railroad and on 60 miles of the New York Central, comprising parts of the Hudson and Harlem divisions, as well as the Camden-Atlantic City line of the Pennsylvania for local service. Where heavy trains must be hauled for considerable distances and at regular express speeds, electric locomotives are used, singly, or as double units to secure sufficient tractive power.

"At the present time the replacement of steam-locomotives by electric has been accomplished on the following lines: At New York City, on the Hudson and Harlem divisions of the New York Central to Harmon and White Plains, respectively, a total of 60 miles; on the New York, New Haven & Hartford, as far as Stamford, Conn., 33½ miles; and on the Pennsylvania from its New York City station, 9 miles to a point near Newark, N. J., in addition to a three-mile run to its Long Island yards. The Boston & Maine operates the Hoosac Tunnel, and the Michigan Central and Grand Trunk railways, the Detroit and St. Clair tunnels, respectively, by electric locomotives to the exclusion of steam. The Great Northern Railway has been using electric locomotives through its well-known tunnel in the Cascade Mountains for nearly four years; and the Butte, Ana-

conda & Pacific, a line somewhat more than 30 miles in length, entirely replaced its steam-locomotives with electric for all trains, most of which consist of heavily loaded ore-cars.

"The New York, New Haven & Hartford has equipped its great Harlem River freight-yards with electric-switching locomotives exclusively, and on the 40 miles of its line between Stamford and New Haven, Conn., operates 70 per cent. of its traffic electrically with the Edison Company's power, as mentioned. That part of the Chicago, Milwaukee & St. Paul between Harlowton, Mont., and Avery, Idaho, 400 miles in length, will soon be equipped for operation by electric locomotives. The line crosses the Rockies as well as the Belt and Bitter Root mountain ranges, and there are maximum grades on the four subdivisions of the line of 2 per cent., 1.7, 1.0, and 4 per cent.

"By the end of the year 1914 there will be employed on a portion of the Norfolk & Western Railway electric locomotives for hauling coal-trains. This line is about 30 miles in length and has grades of more than 100 feet per mile. Trains of 3,200 tons have been hauled over this division by three Mallet



THE ELECTRIC LOCOMOTIVE USED IN SWITZERLAND.

All the Swiss Government railroads are to use electricity. Many of them are already equipped, using the unrivaled power-supply of Alpine waterfalls. This is the 2,500 horse-power Lötschberg Railway locomotive. Its motors operate with an alternating current supplied from overhead conductors at 15,000 volts.

steam-locomotives, which will be supplanted by the electric locomotives.

"The Government of Switzerland decided last year to operate all its railways by electricity. Many of the lines already use electric locomotives and motor-cars."

Will the electric locomotive drive out steam-traction eventually? Passengers are pleased everywhere with their introduction. They do away with smoke and cinders, cut down noise to a minimum, move more smoothly and speed up more rapidly, with consequent saving of time. Nevertheless, Mr. Gordon thinks that the chance of their universal use is very remote. The fact is that electrification costs money and pays only under special conditions. He says:

"In those cases where the electrified portion is comparatively short, such as the Pennsylvania and Long Island roads at New York City, the Michigan Central tunnel at Detroit, the Grand Trunk, or the Hoosac tunnels—in other words, in an essentially terminal or tunnel installation—the investment for electrical operation, tho large, is justified by the incidental advantages derived, such as the elimination of the smoke and gases, the more rapid acceleration and greater smoothness of running as compared with steam-locomotives. On very long lines, such as are proposed by the Chicago, Milwaukee & St. Paul, amounting to 440 miles, the capital outlay assumes large proportions."

Further extensions are merely a matter of money:

"To-day it is no longer a question whether electricity can be used for main-line trains or not—it is whether the necessary money can be raised to undertake electrification. Under present conditions, it does not look as if the steam-locomotive would be displaced by the electric just yet. Let any one who doubts this statement consider the outlay necessary for electrifying every steam-road in the United States. How much would it cost? Is it conceivable that such a sum of money could be raised?"