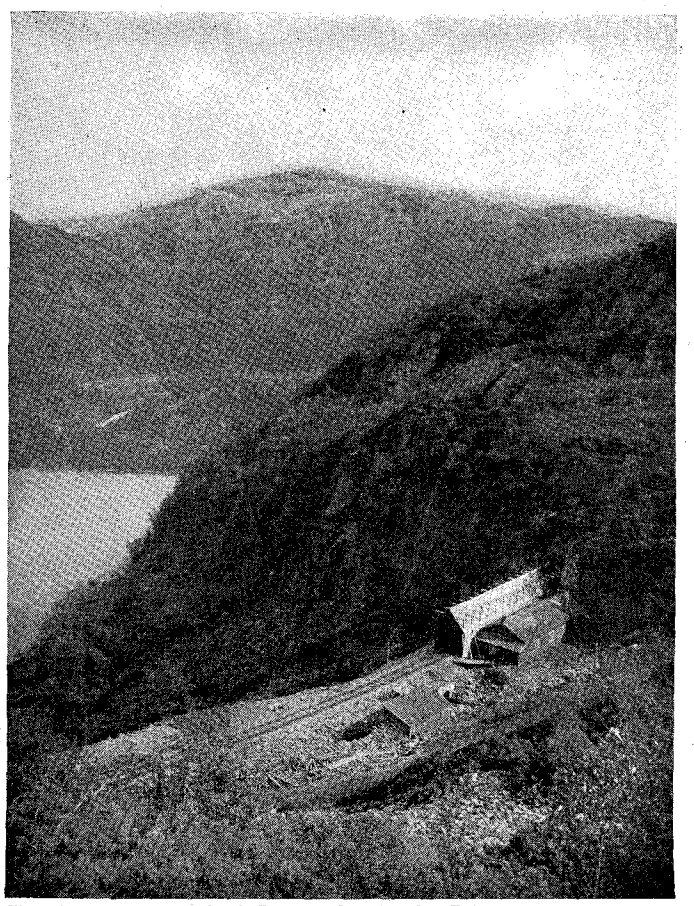
moment it is impossible to predict whether the public or railway management will profit most by the invention.

"Like many other investigators who have contributed something of value to his fellows, Mr. von Kramer made his discovery while conducting experiments for an entirely different purpose. The idea had occurred to him that as there were electric currents and forces passing through all parts of the earth he would like to get in contact with them by some means. It was while he was engaged on this purely speculative kind of research that he found that sound could be transmitted through walls and other solid masses without interruption. By placing 'a frame,' that is, a coil of copper wire, outside a building, and a wire inside, electromagnetic contact is made between the coil and the wire, by means of which sound is conveyed from one to the other. He next found that if one set of wires, *e.g.*, the frame, were moved about from place to place the movement did not interrupt the sound. From this point forward rapid progress was made in adapting the invention to useful ends. A small frame was fixt to a motor-car and a wire laid along the ground, with the result that it was possible to speak from the motor-car and to receive messages in it while traveling at full speed. Encouraged by these satisfactory tests, arrangements were made for a more elaborate trial on a railway. This took place last July on the London, Brighton & South Coast Railway, and was completely satisfactory. The directors of the Stratford-on-Avon and Midland Junction Railway courteously agreed to give Mr. von Kramer full facilities for laying down the system permanently on their line. The first section is now in working order."



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VIEW ON THE NEW NORSE RAILWAY

Showing one of the tunnel entrances. There are no less than 184 tunnels on the line, one of them over three miles long, the longest work of its kind in Northern Europe. There are 24 miles of tunnels in 300 miles of road.

The system, we are told, is simple. Two frames of copper wire are fixt to a railway carriage and completely encircle it. A copper wire is laid parallel to the rails either above or below the surface of the ground, and sound emitted in the telephone box in the carriage is conveyed through the speaking-coil to the ground wire by electromagnetic induction and then transmitted to a receiver at any given point. In the same way if a message is spoken into the transmitter of the railophone call-office it is conveyed along the ground wire, picked up by the frame on the train, and conveyed to the receiver in the railway carriage. To quote further:

"But perhaps the most valuable application of this system of telephony will be for the purpose of automatic warning. Suppose, for example, that the working rule of a line was that no express train should come within a mile of another train, whether it were standing or traveling on the same metals. An engine-driver might be quite ignorant of the fact that his course was being obstructed till he had dashed round the fatal curve. The railophone is capable of setting a gong ringing automatically on either or both engines at any given distance. The driver may thus be warned while he is still a mile away from another train. An onlooker at Stratford recently who tried to guess the purpose of the railway carriage to which the wires had been attached, hazarded the guess that it might be a traveling signal-box. With the genius for hitting on a terse phrase for which the man in the street is proverbially famous, he had accurately described one important part of the wonderful invention."

A NOTEWORTHY NORSE RAILWAY

ONE OF THE most interesting railways completed in Europe within recent years has just been opened across the Scandinavian peninsula, to provide direct communication between Bergen and Christiania. In constructing the line great natural difficulties were successfully overcome, necessitating preparatory labors extending over a number of years during which a variety of alternative schemes were discust. The line, we are told by C. Van Langendonck in an article contributed to *The Engineering Magazine* (New York, May), was first projected in 1870, and was estimated to be about 300 miles in length; five years later, the Norwegian Parliament voted a grant for the construction of a railway from Bergen to Vossevangen, at the foot of the mountain range, a distance of about 67.5 miles. The work was commenced forthwith and was opened for traffic in 1883, forming the westerly section of the scheme. We read further:

"The extension of the line eastward was not abandoned, but the main difficulty was to find an easy passage through the mountains of the Dovrefjeld range. The district in question is the most mountainous in Norway, with short, narrow valleys, from which the mountains rise abruptly, if not perpendicularly, to great heights. The fjords penetrate far into the country, and nearly all the valleys forming the natural outlines for the railway scheme are traversed by large streams. Another point of great importance was the amount of rainfall and the snow, the latter having proved a serious trouble. At one time eleven alternatives for construction of the line were under consideration. . . . . .

"The direction chosen across the mountain necessitated the construction of not less than twelve tunnels, with an aggregate length of 11¼ miles, or about 25 per cent. of the total length. . . . The Gravehals tunnel has a total length of 17,420 feet, and is the longest work of its kind in Northern Europe. . . . .

"Altogether, there are no less than 184 tunnels on the line, representing a total length of about 24 miles. The line crosses 14 bridges. The constructional work entailed the excavation of nearly 36,000,000 cubic feet of earth and 28,000,000 cubic feet of rock on the high mountain section, while the consumption of dynamite ran to 1,800,000 pounds. There are 55 stations between the two terminal points. Of the 14 bridges, three are in masonry, one having a span of 150 feet and another being 566 feet in length with eight 70-foot spans. Owing to the exposed nature of the line in the upper section above the timber line, extensive fencing as a defense against drifting snow was necessary beside the track, these screens being almost continuous for 60 miles between Mjolfjeld and Gjeilo. The line passes through a wilder stretch of country than any other European railway. The winter lasts nine months and sometimes longer, the snowfall is heavy, and the rainstorms terrific with a tremendous downpour. The line cost about $15,600,000 to build, and the difficulties of construction are only equaled by those experienced in keeping it open for traffic. . . . The line, however, has reduced the time of transit between Bergen and Christiania from 54 to 14 hours."