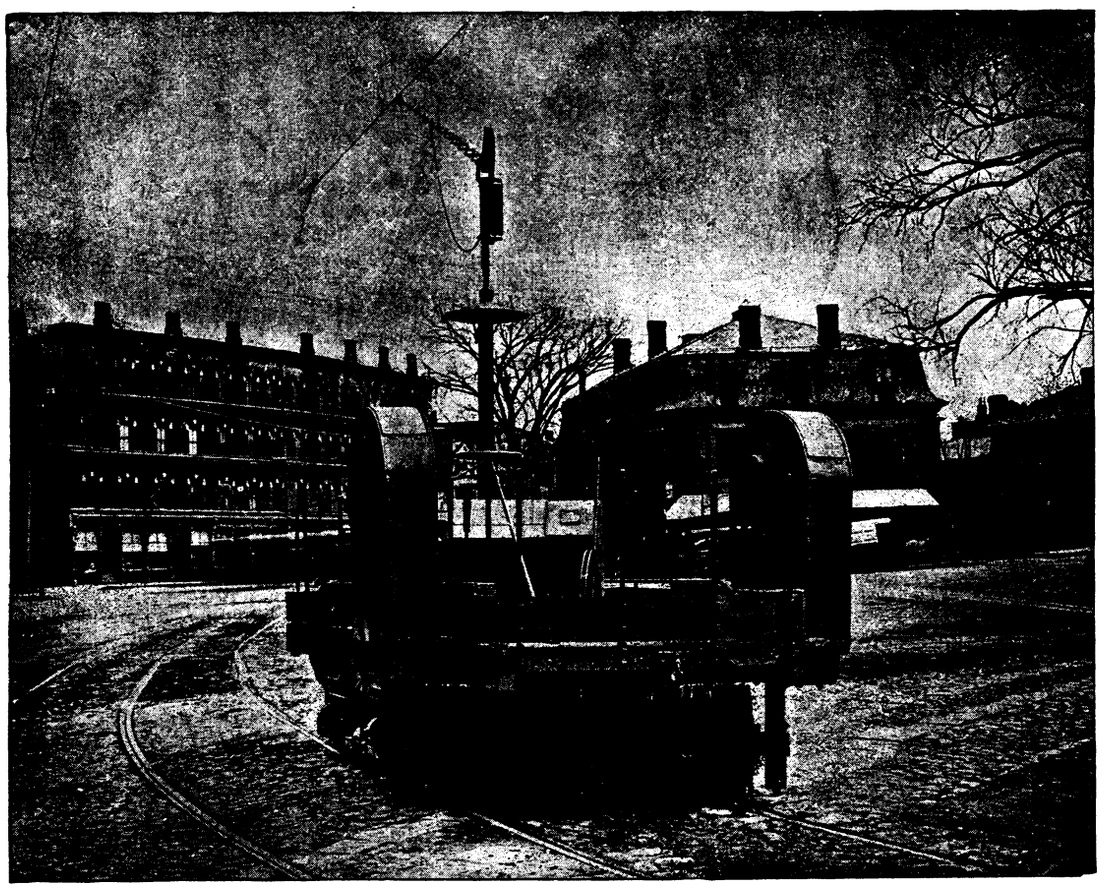
SNOW-BROOM FOR USE ON ELECTRIC RAILWAYS.

ANTICIPATING the usual New England winter, the Thomson-Houston Company designed a snow-broom (shown in the accompanying cut) for use on the Cambridge division of the West End Street Railway. The truck, which is of the Brill type, and has a five-foot wheel-base, is equipped with a thirty-horse-power motor geared to drive the truck at a speed of twelve miles per hour. The snow-broom is thirty inches in diameter, and set at an angle of forty-five degrees. It is driven by a stationary motor of twenty horse-power, at a speed of one hundred revolutions per minute. But two men are required to operate the broom, the brakes and controlling mechanism being placed in such a position as to render it an easy matter. The broom was used for the first time during the snow-storm of March 31, and performed admirably; and it was also tested by placing bricks and boards in front of it, and the way these were brushed aside to a distance of four or five feet from the track leaves no doubt of the ability of this appliance to cope successfully with heavy storms. The company has also built a much larger machine, with thirty-six-inch wheels, and fitted with two brooms and a scraper, which will be able to deal with the severest storms.



THE THOMSON-HOUSTON SNOW-SWEEPER.

THE EXTENSION OF THE METRIC SYSTEM.

THE question whether the employment of the metric system is growing or not, was recently discussed in a note presented to the Académie des Sciences by M. de Malarce. An abstract of this appears in "Publications of the American Statistical Association," New Series, No. 4.

M. de Malarce begins by stating that in 1887 the states where the decimal metric system was obligatory comprised a population of 302,000,000 inhabitants, — an increase of 53,000,000 since 1877; the states where the metric system was authorized by law as optional (England, certain British colonies, Canada, the United States) comprised 96,900,000 inhabitants, — an increase of 19,000,000 since 1877; and the states where the metric system was legally admitted in principle, or partially applied, as in the customs (Russia, Turkey, British India), comprised a population of 395,000,000, — an increase of 54,000,000 since 1877.

The metric system is thus legally recognized throughout the civilized world by 794,000,000 people, — an increase of 126,000,000 since 1877. These 794,000,000 represent 60.6 per cent of the population of the civilized world; that is to say, of countries which have a census or an official enumeration of the population. These latter contain 1,311,000,000. China, Japan, and Mexico have different systems, decimal but not metric. They represent a population of 474,000,000. The other civilized nations not comprised in the figures given above have neither the decimal nor the metric system. They represent but a slight fraction of the civilized world, — less than 43,000,000.

If we pass to the examination of monetary systems, it will be noticed that the five states that formed the monetary union of 1865 — France and her colonies, Belgium, Italy, Switzerland, and Greece — comprise a population of 111,000,000. Four states — Austro-Hungary (since 1870), Monaco (1879), Finland (1878), Russia (1887) — coined certain pieces in conformity with the French system, which are receivable, according to a decision of the French Government, at her public banks, and in consequence are legal tender in France. These states represent a population of 144,000,000.

Four states in Europe, — Roumania (1867), Spain (1868), Servia (1873), and Bulgaria (1877), — one state in Africa, — Kongo (1877), — one state in Asia, — Persia, — and nine states in America, — the Argentine Republic, Bolivia, Chili, Columbia, Hayti, Nicaragua, Peru, Uruguay, and Venezuela, — have also coined money according to the French system; and these represent a population of 56,000,000. The total population, therefore, of the states which have coined money similar to the French system, comprise 311,-

000,000 as against 162,000,000 in 1877. These 311,000,000 equal 23.7 per cent of the population of the civilized world.

Besides these states which tend to the French monetary system, and to an international circulation, there are certain notable exceptions; as, for example, England, Canada, Germany, the Netherlands, Scandinavian Union, Turkey, Morocco, Portugal, China, Siam, Japan, the United States, and Brazil.

EXCAVATIONS FACILITATED BY FREEZING.

ABOUT seven years ago Mr. Herman Pœtsch of Aschersleben, Germany, conceived the idea that excavations through difficult ground could be facilitated by freezing it by means of cold brine circulated through pipes inserted down to rock or impervious

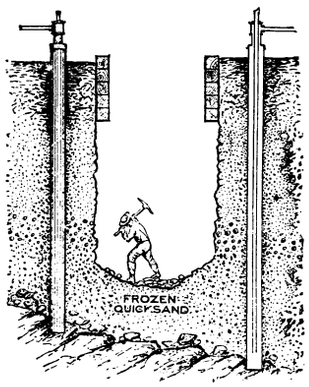


FIG. 1.

material; these ground-pipes being perfectly closed at the lower end, and containing a smaller pipe open at the lower end, down which the brine is pumped, rising in the outer pipe, and returning to an ice-machine to be cooled again.

After some experiments made with a small apparatus, which were so far satisfactory as to make it evident that the process was a success, he undertook the completion of a shaft partially sunk at the Archibald Mine, near Schweidlengen, Germany, which resulting successfully has induced its application in many coal-fields

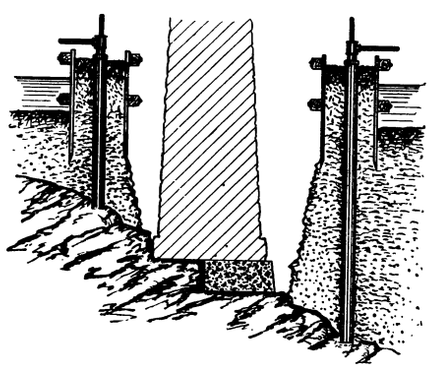


FIG. 2.

throughout Germany, France, and the Netherlands. There was much need, in Germany especially, of some way of getting to the beds of lignite and coal, of which there are many covered with beds of quicksand that are almost impassable. This process has added materially to the area of available coal-fields. The greatest depth yet reached in this way through water-bearing strata is 250 feet, although there is no limit to the depth capable of being reached; and there has been no failure to accomplish the work undertaken.

Fig. 1 shows a shaft being dug and partially timbered up. In practice it is usual to place pipes about 8 inches in diameter, and about 3½ feet apart, in a circle around the space to be excavated. It is of great importance that the pipes be perfectly closed, and that they extend not only to the rock, but far enough into it to allow any surface fissures to be frozen, thus preventing as far as possible percolation through the ledge.

Fig. 2 shows the process applied to an excavation for a bridge-pier, the frozen wall surrounding the excavated space being in effect a coffer-dam. By its application in this way, the last difficulty is removed in the way of bridging the great rivers having deep alluvial beds, where the depth to rock is so great as to preclude pneumatic foundations; i.e., greater than one hundred feet below the water surface.

It has been applied once to tunnelling. In digging under a hill occupied by residences in Stockholm, it was feared that the movements of the ground would cause the buildings to settle and crack. The inner end of the tunnel was formed into a freezing-chamber, and cold air at a temperature of −67° F. was circulated through it, which effectually hardened the sand to a depth of five feet from the surface, making a material resembling sandstone rock. The freezing was continued ten or twelve hours, and then excavation and walling-up proceeded with for the same length of time. About one foot per day was made in this manner. It is often desired to make excavations in this way adjacent to or under buildings where there is danger of undermining the foundations.

The owners of the American patents, The Pœtsch-Sooysmith Freezing Company of New York, have made several improvements in its application to tunnels especially. The first application of the freezing process in this country was in digging a shaft for the Chapin Mining Company at Iron Mountain, Michigan, where a rectangular shaft 15½ feet by 16½ feet in the clear, and 95 feet deep to the ledge, was sunk through quicksand and bowlders. Twenty-six 8-inch pipes closed at the lower end were sunk to the ledge in a circle 29 feet in diameter; and a Linde machine, having a refrigerating capacity of fifty tons of ice per day, cooled the brine. This work was very successful, the ledge being reached in seventy days after the ice-machine was started. A shaft at Wyoming, Penn., is now being constructed in the same way.

THE LIGNITE INDUSTRY IN GERMANY.

AMONG the number of new industries which are making their way in the world, the manufacture of briquettes from the brown coal or lignite deposits in Germany is one which has of late made considerable strides. This process is well described in *Engineering* of March 22. Up to within the last ten or fifteen years, these tertiary deposits of lignite, or half-formed coal, were not utilized in commerce, and were only worked in a small way by the local peasants for consumption in their cottages. Even this small trade almost died out with the introduction of cheap coal, due to the extension of the railway system, as, owing to the fifty per cent of moisture which the lignite contained, it was impossible for it to stand transport or to compete with coal.

The beds of lignite in Saxony, and on both banks of the Rhine near Cologne, are from ten to twenty yards thick; and, as they are only covered by from five to ten yards of gravel, they are easily worked in the open as quarries, the gravel being removed and used for filling up as the working of the lignite advances. The lignite is of a dark-chocolate color, and, as its consistency is about that of cheese, it can be easily and cheaply worked by means of the pick and shovel.

Near the surface it contains slightly more moisture; but, taking an average of the whole thickness, it amounts to about fifty per cent. The decomposition of the wood is not in all places perfect; and stumps, roots, branches, and trunks of trees are sometimes met with. When these occur too frequently, the lignite is not so well adapted for making briquettes, as, owing to the wood being of a still fibrous nature, it cannot be so readily reduced to powder, which is absolutely necessary for its manufacture into fuel, though of course these remains of trees can be burnt as ordinary wood, and are indeed so utilized. As a rule, however, the mass of the bed is friable, and can easily be crushed in the hand.

With regard to the formation of these deposits, there are in Germany two theories. The one is that these masses of lignite were formed in precisely the same manner as the coal-seams, but