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

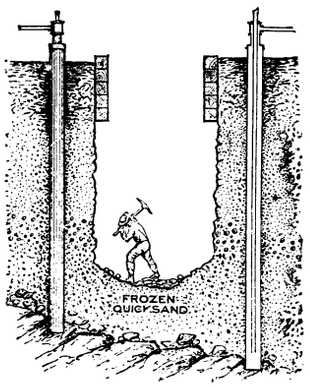

FIG. 1.

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

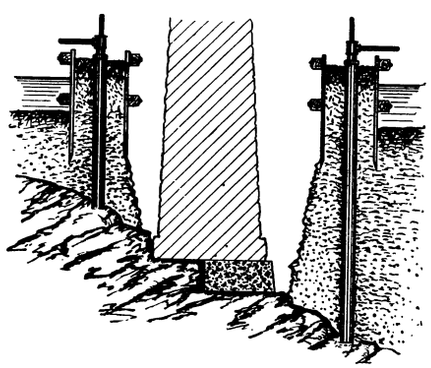

FIG. 2.

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

that they have not undergone the pressure to which the coal-beds were subjected, although, as in the case of the coal, the wood of which they were formed grew on the spot now occupied by the beds or seams. The other theory is, that the wood was washed down by the rivers from mountainous forest regions, and deposited in quiet bays of the river, where it finally decomposed, and formed the lignite of to-day.

The following are various analyses of lignite in its manufactured form, after having been dried and pressed by machinery, but without the addition of any foreign matter. Indeed, such is never added, nor is it necessary, the lignite containing within itself all the properties necessary for making it into a cleanly, cheap, and efficient combustible. The similarity of these lignite briquettes to wood as regards their heating effects, and the ashes left, will be noticed in the analyses.

Analyses of Lignite Briquettes.[1]

Date.	Mine.	Moisture.	Ash.	Number of Grams Necessary to Melt One Gram of Lead.	Centigrade Heat Units per Gram.
March 16, 1887.....	Fishbach	18.66	4.9	18.1	4235
" 21, 1887. ...	Rottgen	17.6	6.2	16.9	3954.6
" 21, 1887....	Bruhl	13.6	5.4	18.6	4352.4
" 21, 1887.....	Rodder Gruble	14.6	5.4	17.9	4186

Owing to the great thickness of the bed, the working expenses are very low; and, when worked in the open, the raw material can be delivered at the works for seven pence per ton. No explosives are necessary, and as a rule the lignite is loaded direct at the working faces into the wagons of a wire-rope railway, which convey it to the mill.

In some cases, as at Honem, near Cologne, the workings are all under ground, owing to the great thickness of the layer of gravel which covers the lignite. The method pursued in these cases for working the lignite is precisely similar to the "pillar and stall" system adopted in collieries. Great chambers are cut in the lignite, and supporting pillars are left. The proportion which can be extracted by this means is about two-thirds of the mass. The surface of the ground above the workings sinks and cracks, and has to be made good, even at considerable cost; so that, whenever possible, the open system should be adopted.

The lignite rests in some cases upon a bed of pure bluish-white clay, as at Kalscheuren, and in others upon a bed of white sand. In either case the material is utilized. The clay makes beautiful white ornamental bricks and piping, while the sand finds a ready sale for a multitude of purposes. At Herzengorath the lignite rests upon this bed of sand, the sand itself being occasionally hard, and in thin beds of friable sandstone. At this mine the concession is surrounded by the collieries of the Aix-la-Chapelle basin; but as the uses for the two kinds of fuel, coal and lignite, are so different, the competition is not dreaded, the more especially as the coal cannot be burned in the stoves as at present used for burning wood; and it is as a substitute for wood, which is largely used as fuel on the Continent, that briquettes of lignite find especial favor.

The great difficulty which stood in the way of the utilization of the raw lignite consisted in the necessity for rapidly and economically driving off the excess of water it contained, and in doing this in such a manner that the quantity left could be easily controlled and regulated. Absolute dryness is by no means necessary, nor is it aimed at, and for the following reason. The lignite, like the wood of which it is composed, contains a certain amount of resinous matter; and the secret of the compressing of lignite into briquettes, and of their cohesion in that form, is this very resin which is contained in it. The pressure to which the lignite is subjected in order to form it into briquettes is enormous, and at the moment of compression it develops very considerable heat; so much so, that the hand can barely support the temperature of a newly formed briquette. Supposing for a moment that absolutely dry lignite were fed into the press, as indeed was first done: the result would be that the heat developed would be so intense as to carbonize the resin, and the briquette would have no consistency or solidity, but would crumble to pieces.

In order to obviate this, numerous series of experiments have proved that the lignite, as it enters the press, must contain eighteen per cent of water, and that this amount of water is sufficient to so modify the heat as to prevent the carbonization of the natural resin, allowing the resin to attain to a sticky state only. This, combined with the force of the blow, forms a solid briquette with a polished surface, which does not soil the hands, and which is not easily broken. A constant stream of cold water is kept in circulation around the press, so as to cool it as much as possible. The briquettes, as they leave the machine, are steaming; and the blow given to the succeeding briquette is utilized to impel those which have preceded it, straight into the railway-wagons, along channels formed of wood, but having at the bottom two iron rails to diminish the friction. By this means hand-labor is avoided for the transport, and the lignite is not touched from the time it enters the mill in the raw state until it enters the railway-wagon and is sent off to the consumer.

The briquette industry is increasing from year to year, the existing works are putting up additional presses to increase their output in accordance with their increased orders, while one or two new companies have recently started, and are in a fair way to success.

[1] The analyses were made by a qualified chemist of Cologne.

THE CHINCH-BUG IN ILLINOIS.

THE economic entomology of Illinois has been distinguished, during the last four years, by the longest period of continuous chinch-bug devastation known in the history of that insect; but, as evidences of the disappearance of this outbreak began to accumulate last fall, it is perhaps not too soon to write its history.

Mr. S. A. Forbes, the State entomologist, states that its beginnings were apparent in 1885, when noticeable injuries to corn were reported from ten counties of southern Illinois; in 1886, thirty counties of that region were seriously damaged, Washington County (about the centre of destruction) being perhaps worst infested; in 1887 the loss was severe in thirty-eight counties of the southern district, and very noticeable in thirty-seven others of northern and western Illinois; while in 1888 small grain and corn were heavily infested throughout all the southern counties, favorable weather alone enabling the crops to withstand the injury better than the year preceding. The attack was now considerably diminished in the centre of the affected area; but farther to the east, in Clay, Richland, and Crawford Counties, it was much heavier in the beginning of the season than the preceding year, its force decreasing, however, with the disappearance of the first generation. On the extreme southern borders of the State, on the other hand, it continued with undiminished severity, the damage done in 1888 being greater than that in 1887, — greater in Pope and Pulaski Counties than ever before since their settlement. There was thus apparent a wave-like propagation outward from the centre above mentioned, the crest of the wave of increase requiring two years to pass from Washington County to the Ohio River. A similar gradual increase northward was demonstrated by a comparison of the numbers of chinch-bugs in the early spring of 1887 with those of the summer and fall, in the counties of Montgomery, Christian, and Shelby.

The recent wide-spread appearance of three destructive contagious diseases of the chinch-bug, and a consequent diminution of its numbers, make it seem at last unlikely that any extraordinary loss will follow this year in the territory which has been so long infested.

From the observations and studies reported, it appears that severe drought in the middle and latter part of the summer may diminish the number of the chinch-bug by lessening the food-supply