THE VIADUCT AT FORT DODGE, IOWA.*

By BRUNO SCHROEDER.

FORT DODGE, Iowa, will soon be able to boast of a noteworthy engineering structure in the shape of a bridge which is to cross the Des Moines River Valley. The viaduct is an extension of the Chicago Great Western Railroad. Its length is 2,582 feet. Its maximum height is 134 feet. The dimensions of the structure are slightly smaller than the Boone Bridge.

The first 1,155 feet of the viaduct are built of heavy steel uprights or posts, of which the highest is 104 feet from the ground. On these uprights, steel girders rest, the longest of which measures 75 feet and weighs about 18 tons. The smaller girders rest on the towers, and are 38 feet long. For the purpose of handling these large masses of steel, two derricks are used. The larger derrick drops the steel members in place; its lifting capacity is 25 tons, and its reach is 64 feet. The smaller derrick is used to carry pieces of less weight, as well as the necessary supplies. The lifting capacity of the smaller derrick is but 15 tons.

The girder construction extends as far as the Minneapolis and St. Louis Railroad. Since it is necessary to span these tracks, the girder system is changed to truss spans. Two of these spans cover the distance in question, each being 220 feet long. Beyond the river are two more spans of the same length. In the building of these truss spans wooden false work was erected up to the bottom of the bridge. After a section of the span was built, the falsework was removed and used under the next span. One of our illustrations shows a section of the woodwork and a section of the bridge built upon it, likewise the derrick in the act of taking one of the wooden uprights from under the span completed, and placing it in position for the next span. On reaching the river, piles were used in addition to the wooden frames. These piles were driven in the river bed, to make up the extra height and to provide a foundation that would not

the amount of capital invested, the technical excellence of machinery employed, the permanent fireproof buildings, and the modernized methods of handling materials and product. One of them said:

"Of all this, we have at home not the faintest conception. We read in a consular report that there are in this country 286 brown-coal briquette factories with 691 presses; that they work up annually 44,211,000 tons of lignite; and that the 21 coal-dust-briquette factories of the Dortmund Syndicate alone turn out 2,100,000 tons of 'industry briquettes' per annum, but such figures leave no definite impression. We haven't got beyond the stage where a more or less experimental machine press under a wooden shed is considered a briquette factory."

Meanwhile, each American mail continues to bring inquiries from owners of lignite, peat, and coal properties in many States and Territories, all asking for further details concerning German processes, the cost, capacity and productiveness of machinery, thermal values and market price of the various kinds of briquetted fuel, and other information which it is difficult to condense into ordinary correspondence. With a view of answering more fully these inquiries—which at present relate more especially to the utilization of lignite and peat deposits—the present supplementary report is submitted.

I.—THE LIGNITE-BRIQUETTE MANUFACTURE.

It has been repeatedly stated that the outward cleanliness of Berlin and other German cities is principally due to the general consumption of brown-coal briquettes for household and steam fuel; further, that they are made from ordinary German lignite without the use of tar or other artificial binder; that they are compact to store, clean to handle, easy to kindle, burn with a clear, strong flame, are cheaper than good bituminous coal, and are made practically smokeless. Lignite varies in its value and adaptability for briquetting purposes according to its geologic age, hard-

proportion is about 45 per cent of water, so that German lignite contains rather too much, while Austrian contains much too little, though this latter difficulty has lately been partially overcome by steaming. The important question to be now decided is how American lignite will fulfill these requirements.

During the past six weeks, samples of lignite from near Bismarck, N. Dak., and from Troy, Ala., have been received at this consulate, turned over to the syndicate mentioned in a previous report,* and molded experimentally into briquettes with entire success. The Dakota lignite is old and hard, contains 38 per cent of water, but crushes and pulverizes easily and forms without binder briquettes of firm structure, which burn readily, are practically smokeless, and leave only 4 per cent of ash, while the best German brown-coal briquettes yield from 9 to 12 per cent of inorganic residue. The percentage of water contained is rather low, but by adapting the heating-drying process to that proportion of moisture, this obstacle, such as it is, can be easily met, and the reduced task of evaporation will be an economy in the general process.

The Alabama lignite, on the other hand, is an ideal material, and from the one sample submitted is conceded here to be even superior to the standard brown coals of Germany. It contains the correct percentage of moisture, crushes easily, and molds readily into firm, shining, black briquettes, so clean that, as one of the experts at Magdeburg said, "They might be used for paper weights."

The importance of these simple demonstrations will be inferred from the fact that, according to a recent State geological report, there are 55,000 square miles of lignite beds in the Dakotas and Montana, all near the surface of the ground, and ranging in thickness from 20 to 80 feet. The extent of the lignite deposits in the Gulf States is perhaps less exactly known, but they certainly cover a large area. There is also lignite in Missouri, Iowa, and several other Western States and Territories, and it is from all these hitherto practically neglected deposits that an inexhaustible future supply of smokeless domestic fuel will be derived. It will, therefore, be of interest to state concisely what constitutes a first-class, up-to-date lignite-briquette factory in Germany, where the industry has reached, after many years' experience, its highest development. A typical example is the factory at Lauchhammer, about 80 miles south of Berlin, on the direct line to Dresden. This establishment, which is of the latest and most approved construction, has eight presses, with the necessary pulverizing, heating, and drying plant, run by electric motors with current generated by steam evaporated with wood from the mines, the whole under handsome, substantial buildings of brick, stone, and iron; and cost, with tracks, switches, and full equipment for handling raw material and loading the briquettes into cars, \$371,000, of which \$178,500 was paid for machinery. Each press weighs 32 metric tons and stamps out 100 to 120 briquettes per minute, or 70 tons in a double-turn day's work of twenty hours. The heating and drying apparatus for each press weighs 18 tons. The power required for each press and dryer is 125 horse power, and both the dryer and jaws of the press between which the briquettes are squeezed at enormous pressure are heated by exhaust steam from the Corliss engine in the power house, the whole supply for the eight machines being equivalent to about 150 horse power.

Thus equipped, the plant at Lauchhammer turns out from 500 to 600 tons of briquettes per day, which sell on cars at the factory for from 7 to 9 marks (\$1.66 to \$2.14), according to season and market, with an average of 8 marks (\$1.90) per 1,000 kilogrammes, or metric ton of 2,204 pounds. Profits depend on the usual varying conditions, location, management, demands, etc., but it is common to read in the Berlin papers official notices announcing dividends of brown-coal-briquette companies ranging from 15 to 20 per cent of their capital. So enormously has the industry been developed in recent years that there is now an overproduction, and it is said that 100,000 carloads (1,000,000 tons) of briquettes will be carried over to the fuel supply of next summer and autumn.

II.—THE UTILIZATION OF PEAT.

Peat as a material for fuel ranks next in natural order below lignite, in that it is of similar but much more recent geologic origin, contains more water, is but slightly carbonized, and has a correspondingly lower thermal value than brown coal. The task of converting peat into serviceable fuel consists in cleaning the material of roots and rubbish, reducing the water to a small percentage, and so condensing the peat in volume that its thermal value shall be raised to practical efficiency. This is done by various methods, some of which are in this country as yet partially covered by patents, but they may all be grouped under three heads, according to the form which the ultimate product is to assume, viz: (1) Compressed peat, with or without admixture of coal dust or other inflammable matter; (2) peat coke; and (3) briquettes made by compression, with or without heat, of the material prepared by the first of these processes.

Compressed peat.

A pioneer in the invention of machinery and processes for making compressed peat in northern Europe appears to have been Mr. C. Schlickeysen, of Rixdorf, near Berlin, whose installation and present methods have been mentioned in a previous report of this series.† His first two machines were of vertical construction, and were built in 1859 for a steam peat-compressing plant at Zintenhof, near Riga, in Russia, where they worked successfully for many years, turning out daily about 80,000 pieces of wet compressed peat, which, after drying, were used as smokeless fuel in a large cloth factory at that place. During the ensuing forty years, he has built peat-compressing plants in Holland, Hungary, Switzerland, and at various places in Germany, constantly improving his equipment and processes with a view of perfecting the product, cheapening its cost, and substituting more and more automatic machinery for manual labor, until the

THE FIRST SECTION OF THE WOODWORK, THE FIRST SECTION OF THE BRIDGE BUILT UPON IT, AND THE DERRICK IN THE ACT OF TAKING ONE OF THE WOODEN UPRIGHTS FROM UNDER THE SPAN COMPLETED AND OF PLACING IT IN POSITION FOR THE NEXT SPAN.

wash away. Fortunately at this point the river was shallow, so that the work was not difficult. Beyond the river girders are again used, the width of the girders here being 10 feet from center to center. The uprights have a slant of 4 inches to the foot. There is room for only one track.

In laying the foundation, bolts were placed in each pier extending down several feet. It was, therefore, necessary to place these bolts after the foundation was laid. Upon these bolts the posts by which the girders are held rest. The distance between posts varies from 38 to 220 feet. Although the piers and bolts were made by one company and the steel work by another, still there was not a variation of a quarter of an inch. A more striking example of the precision of modern engineering could hardly be desired.

The weight of the bridge is estimated at 3,300 tons. From twelve to sixteen men were employed in assembling the steel work. The entire number of men employed in constructing the bridge was about fifty.

LIGNITE, PEAT, AND COAL-DUST FUEL.

SINCE the publication of the last report of this series (Advance Sheets No. 1527, December 23, 1902) on the methods of manufacturing fuel briquettes from coal dust, lignite, and peat in Germany, two experienced engineers—one from New York, the other from Minnesota—have come to this country to make careful scientific studies of the subject for the purpose of assisting to transplant the industry, or such of it as may be adaptable to American conditions, to the United States. Both these experts have declared themselves astonished by the proportions of the fuel-briquette manufacture in Germany, the size and number of factories engaged,

ness, and the percentage of water contained. A lignite with less than 30 per cent of water is very difficult to work by the usual processes, and it is for this reason that Austria-Hungary, which has an abundance of very old and hard brown coal that contains from 26 to 28 per cent of moisture, has practically no supply of briquettes from that source. German lignite, on the other hand, is of much more recent formation; it contains from 46 to 52 per cent of water, and is usually so soft that it can be cut with a spade. Many lignite beds in this country are filled with logs and pieces of wood, so well preserved in the matrix of partially carbonized material that they burn readily and form a cheap and abundant fuel for steam and other heating at the briquette factories. The part played by the water contained in lignite forms the key to the whole economic briquetting process. The crude brown coal is brought from the mine, crushed and pulverized, and then run through a large revolving tubular cylinder, heated by exhaust steam from the driving engine, and hung on an inclined plane so that the powdered material runs downward through the tubes by gravity, and is carried into the machine press that stamps it into briquettes. During this passage through the cylinder, it is dried and heated until there remains the right proportion of moisture, combined with the proper temperature to develop the latent bitumen in the lignite and make the powdered mass plastic and easy to mold under heavy pressure between heated iron jaws into a hard, clean briquette, with a glistening surface and sufficient firmness of structure to stand weather, transportation, and other contingencies. To do this perfectly and economically, the natural lignite should contain, as it comes from the mine, approximately enough water so that heating to the proper temperature for pressing will evaporate out just sufficient water to leave it at the proper degree of moisture. The ideal

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† Advance Sheets No. 1486 (October 11, 1902).