THE NEW REDHEUGH BRIDGE AT NEWCASTLE-ON-TYNE.

The accompanying illustrations, for which we are indebted to the engineers of the bridge, Messrs. Sandemann & Moncrieff, show an important work of bridge reconstruction, which embodies several new features that give it a special interest outside of that which attaches to the magnitude and importance of the bridge itself. The river Tyne, which flows between Newcastle and the adjacent town of Gateshead, passes through a deep depression, that serves effectually to separate the two cities as far as pedestrian and vehicular traffic is concerned. The celebrated high-level bridge, built by Stephenson, was the only convenient communication between the two towns until the erection in 1871 of the old Redheugh Bridge, which has recently been removed to make way for the more modern structure. The old bridge was one of those curious compound structures, which serve as landmarks in the history of the development of bridge designing, and shows how this important branch of engineering was gradually feeling its way from crude, complicated and indeterminate forms of fifty years ago up to the few highly scientific and simple systems, to one or the other of which all modern bridges belong. The old bridge consisted of four spans with a masonry viaduct approach on each side. The lengths of the spans were, commencing from the Newcastle side, as follows: A shore span 168 feet in length, two river spans 252 feet in length, and a shore span on the Gateshead side of 167 feet. The total length of the approaches was 348 feet, and of the whole bridge 1,187 feet. From high water to the under side of the bridge was 86 feet 7½ inches. The old bridge had a total width of 41 feet, and was made up of a 20-foot roadway and two 7-foot sidepaths for pedestrians. The superstructure was a continuous lattice girder which possessed the extraordinary feature that the continuous upper chords, which were circular in section, were used as gas mains and the trough-shaped lower chords were utilized as water mains. These conduits belong to the Newcastle and Gateshead gas and water companies, both of which corporations are large shareholders in the Redheugh Bridge Company. Our photographs show clearly the circular gas main which formed the upper chord of the old bridge. Associated with the trusses was a set of suspension chains, two for each truss, which were carried by latticed towers above the piers, and extended down to a connection with the bottom chords at about the middle third of the length of the spans.

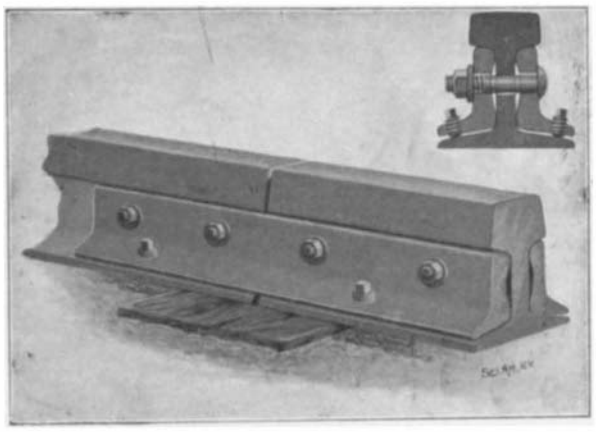
The contractors for the new bridge were required to remove the main spans and the river piers down to low water; to remove the old bridge viaduct down to the springing of the arches; to remove the old gas and water mains; to erect an entirely new main bridge; new cylinder foundations, new steel girder approach spans, and to set in place new steel gas and water mains; all this, moreover, was to be done without any interference with the roadway, which was to be kept open until such time as it became absolutely necessary to close it.

The new bridge is carried on three river piers, and the new superstructure consists of two shore spans of 168 feet and two river spans of 252 feet between centers of end pins. The total width of the new floor of the bridge is 53 feet, including a 20-foot roadway, two 7-foot sidewalks, and a lateral extension of the floor beams on each side for carrying the gas and water mains. In preparing the foundations for the new bridge, in the case of each pier four 8-foot steel cylinders were sunk by the pneumatic process to depths ranging from 50 feet upward. These cylinders were located on the outside of the old foundations, at a distance from center to center, transversely to the axis of the bridge, of 55 feet, and were carried up to a height of 6 feet above high-water level. The interior of the cylinders was filled with concrete. Upon these cylinders were erected the four inclined legs of the new bridge pier. These were built up of standard steel shapes, and were strongly trussed both in the direction of and transversely to the axis of the bridge, Each column foots upon a cast-iron bedplate, and the columns average about 80 feet in length. The main trusses are 252 feet in length and 35 feet 4 inches in depth. The upper chords are spaced 23 feet apart between centers. They are 1 foot 10 inches in depth by 2 feet 6 inches in width. The lower chords measure about 2x2 feet in section. The general details of the truss are shown clearly in the accompanying illustrations. It is built up of standard, rolled-steel shapes, the compression members being latticed and the tension members consisting of rolled-steel bars.

Special interest attaches to the erection of the bridge. The new structure was built with its axis parallel to the axis of the old bridge, one truss of the old structure being within and the other on the outside of the new truss. The new floor was built above the level of the old floor, and the overhead wind bracing at the panel points of the new bridge was arranged to clear the top chords, or gas mains, of the old bridge. The new structure was built entirely by overhang from the piers, the two river piers being constructed by this method until they met in the center, and the two shore piers being tied back to the river trusses, and built out by overhang until they reached the shore abutments. The work was carried out under the supervision of the resident engineer, George Huntley, from the plans of Messrs. Sandemann & Moncrieff, the designers. It was constructed by Sir William Arrol & Company, the contractors of the great Forth Bridge.

IMPROVED RAILJOINT.

We present an illustration of an improved rail joint, for which a patent has been granted to A. M. Wilson, of Cherokee, Ia. The object of the invention is to provide a simple and inexpensive device that can be applied to any angle-bar joint of the standard type for the purpose of giving it extreme stiffness and rendering the joint permanently secure. The improvement consists essentially of the provision of four set-screws, which are adjusted in four threaded holes in the base-flanges of the angle bars. The two set-screws in each angle bar are placed approximately half-way between the abutting ends of the rails and the outer ends of the angle-bars, as shown in the accompanying drawing. The angle-bars may be, and in most cases will be, of the standard fish-plate type, clamped one on each side of the rails and held in position by four or six screw-bolts, as the case may be. After the angle-bars have been adjusted in the ordinary manner, the four set-screws are screwed down with a wrench or other suitable tool until they bear upon the base of the rail. The further tightening of the set-screws gives the angle-bar a rocking or clamping movement, such as would result from the driving in of a wedge between the rail-base and the flanges of the angle-bars. This movement will tend to crowd the angle-bars more firmly in under the head of the rails, thereby greatly increasing support at the most critical point in a rail joint. The importance of this result is seen when it is borne in mind that, with the slightest loosening of the screw-bolt nuts, the



IMPROVED RAILJOINT.

joint becomes loose and the rail ends are deflected under passing wheels. Another important feature in this improvement is the fact that when the set-screws are screwed down there is a resulting tensional stress put upon the screw-bolts, and this stress is greatest at the lower edge of the nuts. The resulting pressure will act upon the nuts with a locking effect which will prevent them from working loose and will tend to hold the rail joint in permanent adjustment.

The Domestic Manufacture of Portland Cement.

The development of the rock and Portland cement industries in the United States during the past decade forms one of the most interesting chapters of the building trade and manufacturing industry. It was not until about ten years ago that any decided effort was made in this country along this line, the greater portion of the cement used being imported from England, Germany and other European countries. The total manufacture of Portland cement in this country for the year 1891 was 454,813 barrels, which was equal to but 13.2 per cent of the product used in this country in that year, the exportation for the same year amounting to 2,988,313 barrels. During the next five years the importation of Portland cement varied but little from that of the afore-mentioned year, and at the same time the manufacture of the product at home had a rapid growth, the domestic production for 1896 being 1,543,023 barrels, or 37.4 per cent of the product used in this country in that year. Coming down to 1897, we find a domestic production of Portland cement of 2,677,775 barrels, while the importation of the same product for that year was 2,090,924 barrels, the domestic production being equal to 56.8 per cent of the consumption in the country and exhibiting a gain of over a million barrels over the previous year. In 1898 we manufactured 3,692,284 barrels of the product and imported 2,013,818 barrels. Taking up the figures of the industry for 1899, we find a gain of over a million tons in domestic production over the previous year, and 1890 shows a similar gain over 1899. To-day the domestic production of Portland cement equals more than 80 per cent of the entire consumption of the product in this country, and within a few years the importation of the product into this country from Europe will have gone the way of many other European products formerly used in this country, but now supplanted with similar products of domestic manufacture.

The wonderful development experienced by the building trades during the past year or two has been largely instrumental in stimulating the development of the domestic Portland cement industry. It has not been so long ago since New York, Pennsylvania and Ohio produced all the Portland cement manufactured in this country; and while these States are still the centers of this important industry, there are now at least fifteen States engaged in the industry. Pennsylvania leads in the industry, producing more than one-half of the some 8,000,000 barrels which now make up our annual domestic production; while New Jersey, New York and Ohio are prominent factors in the industry, their places in the annual production being in the order of their mention above. For a long time our importation of the product was chiefly from England, Germany finally supplanting the English product, and the German product having more recently been supplanted by the domestic product.

This indispensable building product takes its name from the fact of its close resemblance to the oolitic limestone formation on Portland Island in the English Channel, the industry having been instituted on the banks of the Thames and Medway, where an admixture of chalk and clay dredged from the river beds formed the basis of the product. While the industry as evolved in this country is based upon the same lines as originally used in England, the mixture of materials now used has been worked out by a long series of experiments. At the great Portland cement establishments in Lehigh County, Pennsylvania, blue-gray crystalline limestone and a dark gray siliceous variety are ground and mixed in the desired proportions. This mixture is then molded into a brick form and burned to the condition of slag. It is then ground to a powder in the form of cement. A natural cement rock in the form of impure limestone of the Upper Silurian formation is present near Buffalo, N. Y., and the Rosendale cement is made from water limestones of the Lower Helderberg group in Ulster County, N. Y.

In all sections where the industry is carried on, limestone in one form or other forms the basis of the product. The limestone deposits in the Lehigh Valley in Pennsylvania, now the leading center of the industry in this country, are similar to the argillaceous limestone deposits in Belgium. The Belgium product is made by the direct burning of a limestone of approximately the composition of a correct cement. The Lehigh Valley limestones contain a slight excess of clay over the amount required; and to obviate this a small amount of pure limestone is ground with the rock in order to produce the correct mixture. When pure limestone and clay are employed in cement manufacture they must be ground very fine, hence the cost of production is much greater than when the natural cement rock is used; and attempts at manufacturing Portland cement in this country from pure limestone and clay have not been attended with success. Blast furnace slag has lately come into use as a material in the manufacture of cement. The molten slag is granulated in running water, dried, ground and mixed with limestone and slaked lime, and the clinker produced is ground in the same manner as the regular Portland cement clinker. While marl now enters largely into the manufacture of Portland cement, the production from this material is equal to less than one-fifth the production from limestones.

There is a close relationship between the original Roman cement and modern Portland cement. The former product was manufactured from an admixture of volcanic ash or sand and mile. The English Roman cement is made by calcining septarian nodules dredged from Chichester Harbor, off the coast of Hampshire, and from the Whitby shale beds of the Lias formations in Yorkshire. These latter departures of the cement industry have a close parallel in the Portland cement made from marl formations in this country. The presence of 15 per cent or more magnesia in some of the Portland cements now produced forms a serious objection to them, the imitations coming chiefly from Belgium. Owing to the abundance of the natural materials in this country, there is no necessity for resorting to the manufacture of imitative cement.

The development of this industry in this country has necessitated the evolution of much in the way of improved machinery. For a long time vertical continuous and intermittent kilns were chiefly employed in the Portland cement industry. Four or five years ago the rotary furnace was perfected, and was at once adopted by leading Portland cement manufacturers. To-day nearly three-fourths of the product manufactured in this country is burned in this improved type of furnace. There has also been marked improvement in grinding machinery, screens, and in machinery for handling the raw material as it comes from the quarries.

W. G. I.