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.

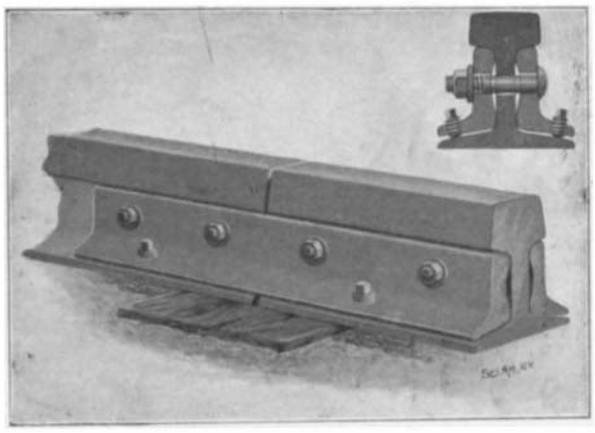
The contractors for the new bridge were required to remove the main spans and the river piers down to low water; to remove the old bridge viaduct down to the springing of the arches; to remove the old gas and water mains; to erect an entirely new main bridge; new cylinder foundations, new steel girder 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.

Automobile News.

American capitalists are reported to have taken the initial steps toward establishing a system of public automobiles in the city of Manila.

Ten automobiles have been delivered to run between San José and Alviso, Los Gatos and Saratoga, giving a rural passenger service. Another automobile line is contemplated in the oil districts near Bakersfield, Cal., thus connecting the Southern Pacific and Santa Fé Railroad systems.

A party of six persons started from Paris in a 30 horse power Panhard car for Pekin by way of Berlin, Moscow and Siberia. It will be interesting to see how far the automobile will proceed before it is permanently disabled. Such trips have been tried repeatedly, and have always ended in failure.

As between automobiles and horse-drawn vehicles the braking facilities of the former are usually far superior to those of the latter. The average American-built motor vehicle of whatever type may be brought to a standstill from a 20-mile-an-hour rate of speed in less space than can a team being driven at a moderate trot—say, seven miles an hour.

The Austrian military authorities have a motor under construction at the motor factory at Vesselsdorf, in Moravia, which is to be used by the Austrian army for the purpose of reconnaissance, and also for racing. The car is being fitted with three separate motors, which will work independently of each other. The maximum speed is stated to be 120 kilometers, or 74 miles, per hour, and an entirely new system of transmission is to be used.

The battle between the French builders of electric vehicles still goes merrily on. Last summer's record of 289 kilometers on one charge was recently surpassed by a vehicle designed by M. Kreiger, which covered 307 kilometers before its batteries were exhausted. The difficulty about increasing the traveling radius of electric vehicles seems to be that the weight to be carried also increases with each added kilometer.

Eastern and Western automobilists are at loggerheads over the formation of a national body. It appears that a New York organization with the resounding title "The Automobile Club of America" desires to retain the supremacy it has acquired by virtue of its wealth and by being first in the field in this country, while the representative clubs of other large cities desire recognition on the basis of membership figures. This would enable a combination of representatives from the smaller clubs to take the management of affairs from the New Yorkers. A call sent out by the Chicago club has been either not received or ignored by the A. C. of A. In the meantime an organization which everybody seems to have forgotten—the American Motor League—formed on October 29, 1895, has stepped into the breach, and will hold a meeting in the near future to which the warring factions will be invited.

The last Alcohol Exposition was such a great success that it has been decided to hold a new one in May. It will be held as usual under the auspices of M. Dupuy, Minister of Agriculture. Like the preceding exposition it will consist of apparatus utilizing alcohol for the production of motive power, light and heat, also of various types of carbureted alcohols. The exposition will be preceded by a series of competitive tests, and those upon alcohol motors and automobiles will be of especial interest. The automobiles will no doubt be tested as before by taking them through a run in the vicinity of Paris. According to the programme, three sections are provided; first, the fixed motors, portable motors and carbureters; second, automobiles and boats; third, lighting and heating devices. The Automobile Club is taking an active part in the event, and there is no doubt that it will show an increased improvement in the alcohol motors since last November.

M. R. Mathot, a Belgian engineer, has invented a device which is applied to explosion motors and serves to register their performance in the same manner as the indicator of a steam engine. It communicates with the explosion chamber by a small pipe and has a registering device somewhat similar to that of an indicator, except that the record is made upon a band of paper which rolls out continuously. The cylinder contains a small piston which works back and forth under the action of the varying pressures of the motor. The cylinder is connected to the tracing device which presses the pencil against a drum driven by clockwork. As the temperature is high on account of the heat of the explosive gases, the cylinder is surrounded by a water jacket in which a rubber tube assures the circulation. In this way a series of interesting diagrams are obtained which are of great utility in studying the performance of the motor. The cycle of the motor is clearly indicated, especially the periods of compression and explosion. Variations in the carburetion and in the ignition are also registered. This instrument will no doubt be of great service in the study and designing of explosion motors.

Engineering Notes.

An oil well on the ground which is rented from the Crown in Russia, for 5 kopeks a pood, by the Baku Naphtha Company started gushing at the rate of a million poods daily. Work was stopped, owing to the fear of a conflagration.

While drilling for oil in the Colorado desert in Southern California, the drilling tools, which reached a depth of 500 feet, were suddenly thrown out and the well began to spout hot water and steam. Volcanic substances were showered about the surrounding country, says the Railway and Engineering Review, and the men lost no time in escaping from the derrick. Some distance from the point where the well was drilled is a region where signs of volcanic conditions underneath frequently appear, and it was thought that the well was drilled down to this stratum.

There is at present a great boom in the manufacture of metal cars. Besides the new plant of Charles T. Schoen for the manufacture of car wheels of pressed steel, there are several others under way, notably those of the Structural Steel Car Company at Canton, Ohio, and the National Rolled Steel Car Company, which will locate near Pittsburg. The head of the Structural Company is Elwood C. Jackson, formerly of the firm of Jackson & Sharp, of Wilmington, Del. The Rolled Steel Company will engage in the manufacture of trucks principally.

Experiments to determine the liability of liquids and compressed acetylene to explode were tried recently at Berlin. Several cylinders loaded with 4 kilos of liquid acetylene were placed in position, with a valve at the top. The gas which collected at the upper part of the cylinders was under a pressure of 725 pounds per square inch. A cartridge containing one kilo of picric acid was then applied and exploded by electricity, with the result of blowing off the top of the cylinder, but the acetylene was not detonated, and the cylinder emptied itself on the gaseous acetylene. Another cylinder was charged with 3½ kilos of liquid and a 200-gramme cartridge placed in the bottom; when the electric current passed through into it the liquid acetylene exploded, destroying the cylinder. A cylinder of liquid acetylene was fired at with a rifle without explosion resulting, neither was a cylinder of acetylene disturbed by the explosion of a quantity of picric acid close to it. The experiments proved that acetylene is undisturbed by sympathetic discharges, but that the liquid will explode always if a detonator is in contact with it.

Mr. Arnold Foster, English financial Secretary of the Navy, lately objected in a speech against the great variation of types and of dimensions in the machinery of vessels of war and machinery of the government generally, saying in effect that it was dangerous and obstructive to the service. Mr. Foster says there is one set of tests for the navy, another for the army, a third for the Board of Trade, a fourth for one of the great railway companies, a fifth for another railway, and war vessels go to sea with lots of tubes for condensers and boilers, all having different standards of gages. He impugns the value of the English destroyers, and says not one of them is fit to guard a battleship at night in a storm. Their ability to do this will be the standard in future, not to test how fast they can race over a measured mile. The destroyers of the future should be built of standard types, so that if anything goes wrong with one of them, interchangeable parts can be supplied at once. This is very well for a suggestion, but has the Honorable Secretary taken into consideration the time required to put it into execution?

Mr. Patrick Dagnall, a retired Royal Engineer sergeant of the British army, has devised a new cartridge contrivance for the magazine rifle, which is intended to supersede the present bandoliers, which contain several disadvantages militating against their efficiency. The apparatus is only a few ounces heavier than the existent bandolier and consists of a thin circular box, 8 inches in diameter by ¾ inch deep. One disk has loops at the back for fastening it to a strap round the man's waist. A second disk, to which short tubes for receiving the cartridges are attached, revolves freely on a central pivot attached to the first disk, the rim of which forms a complete cover and protection for the cartridges, which can only be taken out at one point, where an opening is left for that purpose. Cartridges cannot possibly fall out by accident, yet when wanted they drop as quickly into a man's hand as he can possibly transfer them to the magazine of his rifle. In a trial with the bandolier a soldier loaded his rifle from the Dagnall contrivance and discharged 20 shots in two minutes, whereas in the same time he only succeeded in firing 16 rounds by loading the rifle magazine from the bandolier, thus showing a decided advantage in rapidity of firing. The containers are devised so that they can be worn either on the left or right side. With one on each side a soldier can carry just as many rounds as in two leather bandoliers, and the incumbrance is by no means so great.

Electrical Notes.

The General Electric Company has recently received an order from Tokio, Japan, involving $750,000. It is for the erection of a trolley system in that city.

The city of Carlsbad, Bohemia, is about to have street cars. This is probably the only city of its size in the world without modern methods of transportation.

The American Electrochemical Society is just being formed, and over two hundred names have been enrolled. The first meeting for the purpose of organization and for the reading of appropriate papers will be held in Philadelphia early in the coming spring.

The power house of the branch of the Pennsylvania Railroad running from Burlington to Mt. Holly, N. J., burned a short time ago, and the company announces that it will not be rebuilt and that the line will hereafter be operated by steam locomotives instead of by motors.

The operation of main line railways from Switzerland has been occupying considerable attention. The abundance of water power, scarcity of coal and the considerable grades make the project feasible commercially. Preliminary studies will probably be carried out very soon.

It is stated that the London, Brighton and South Coast Railroad, one of the leading trunk roads in the South of England, is seriously contemplating the substitution of steam traction by electricity throughout the whole of its system. The company has recently engaged the services of Major Cardew and Mr. Philip Dawson as consulting electrical engineers. These two engineers are the leading experts in electric traction in England. The reason for this development is probably due to the fact that another company has been formed for constructing an electric railroad on the "tube" principle between London and the fashionable southern seaside resort Brighton. As the London, Brighton and South Coast Railroad is the only line at present serving this important center, the construction of a tube railroad would offer a serious menace to their interests.

The City and South London Railway, the pioneer electric tube in the English metropolis, has opened to the public its extension to Islington. A service of two and a half minutes will be run during the busy morning and evening traffic, and a four minutes' service during the less busy hours of the day. The complete journey from Clapham Common, the terminus on the south side of the river, to the Islington terminus in the north will take just twenty-seven minutes. The new trains are to be composed of four coaches, instead of three, as at present. By this plan there will be an increase of 33 per cent in the carrying capacity. There is to be a subway communication at the Elephant and Castle with the Baker Street and Waterloo Railway, and a foot-passenger subway right into the London, Brighton and South Coast Railroad Company's trunk station at London Bridge from the City and South London Railway station. There will also be subway communication between the Great Northern Trunk Line and City line, both at Moorgate Street and Old Street, in the City.

The Marconi system of wireless telegraphy has been established between Newhaven on the south English coast and Dieppe on the French coast. A regular service of mail boats is maintained between these two ports on either side of the English Channel, about 60 miles apart. The installation will be utilized to signal the departure of the boats, with instructions as to the amount of luggage, number of passengers carried, and other useful information, and it will no longer be necessary for friends of passengers to wait for hours at either end when fog or other causes have delayed the boat. By the existing cable, messages have to be sent via London and Calais, and sometimes have taken three hours in transmission. Both time and expense will thus be saved by the Marconi installation. Lloyds have also decided to adopt the use of Marconi's system at all their stations, and a contract has been entered into between Lloyd's and the Marconi company for ten stations to be fitted immediately for a term of fourteen years. Lloyd's will also take over Marconi's existing stations, and a rental will be paid by them for every station fitted.

The Current Supplement.

The current SUPPLEMENT, No. 1,364, has for the subject of its front page engravings the recent Paterson fire. "The Early Inhabitants of the Danish West Indies" is a most timely article, and is elaborately illustrated with seventeen engravings. "Charleston and Its Exposition" describes this exhibition, which is now open. "Naval Development During the Next Decade" is by Rear-Admiral George W. Melville. "Aerial Navigation Problems" is a letter by Carl E. Myers, the aeronautical engineer. "The Paris Alcohol Motor Exposition" describes some new and interesting motors. "Recent Science," by Prince Kropotkin, is concluded in this number.