THE WORKS OF THE ILLINOIS STEEL COMPANY, U.S.A.

THE Illinois Steel Company, owning and operating five separate plants, is one of the largest steel manufacturing companies in the United States, and is one of the most progressive in keeping up its equipment with modern and improved processes and machinery. The company has an authorised capital of £10,000,000, of which £3,730,000 has been issued. The report of the company for the year 1897 showed that the various works had produced during that year an aggregate of nearly 1,200,000 tons of pig iron and spiegeleisen, and 1,000,000 tons of finished product. It shipped its products to every part of the United States, to the bordering countries of Canada and Mexico, and also to Europe, Africa, Australia, South America, Siberia, Japan, China, and Korea. The following is a summary of the balance-sheet for that year :—

Assets :	£
Plants	3,984,200
Other investments	1,403,800
Materials on hand, accounts, &c.	1,755,000
Total	7,143,000
Liabilities :	£
Stock and bonds	6,387,200
Bills and accounts	723,100
Reserve funds	28,500
Total	7,138,800
Balance :	£
Surplus	4,200

The president of the company is Mr. John W. Gates; the vice-presidents are Mr. Charles H. Foote and Mr. W. Palmer; the secretary is Mr. William A. Green. Since this article was written, the company has effected a consolidation of several interests under the name of the Federal Steel Company. This great combination includes steel manufacturing, iron mining and railway, and other enterprises. Particulars of these allied interests were given in THE ENGINEER, of October 21st, 1898.

The Illinois Steel Company was formed in May, 1889, by the consolidation of the North Chicago Rolling Mill Company, the Union Steel Company, and the Joliet Steel Company. This consolidation brought under the control of the new company five separate plants, as follows :—(1) The works at North Chicago, established in 1857; (2) the works at Milwaukee, established in 1868; (3) the works at South Chicago, established in 1879. All these had been owned by the North Chicago Rolling Mill Company; (4) the works of the Union Steel Company, at Chicago, established in 1863; (5) the works of the Joliet Steel Company, at Joliet, established in 1870. These several works occupy about 700 acres of land, and comprise seventeen blast furnaces, four Bessemer steel plants, a large open-hearth steel plant, two modern rail mills, billet mills, plate mills, a slabbing mill, a twin rod mill, bolt and spike mills, and mills for fish-plates, joists, shapes, and merchant bars. There is also a plant for the manufacture of steel bridges and structural work, and another plant manufacturing cement from furnace slag. The works have seventeen miles of narrow-gauge railway, operated by thirty-two locomotives.

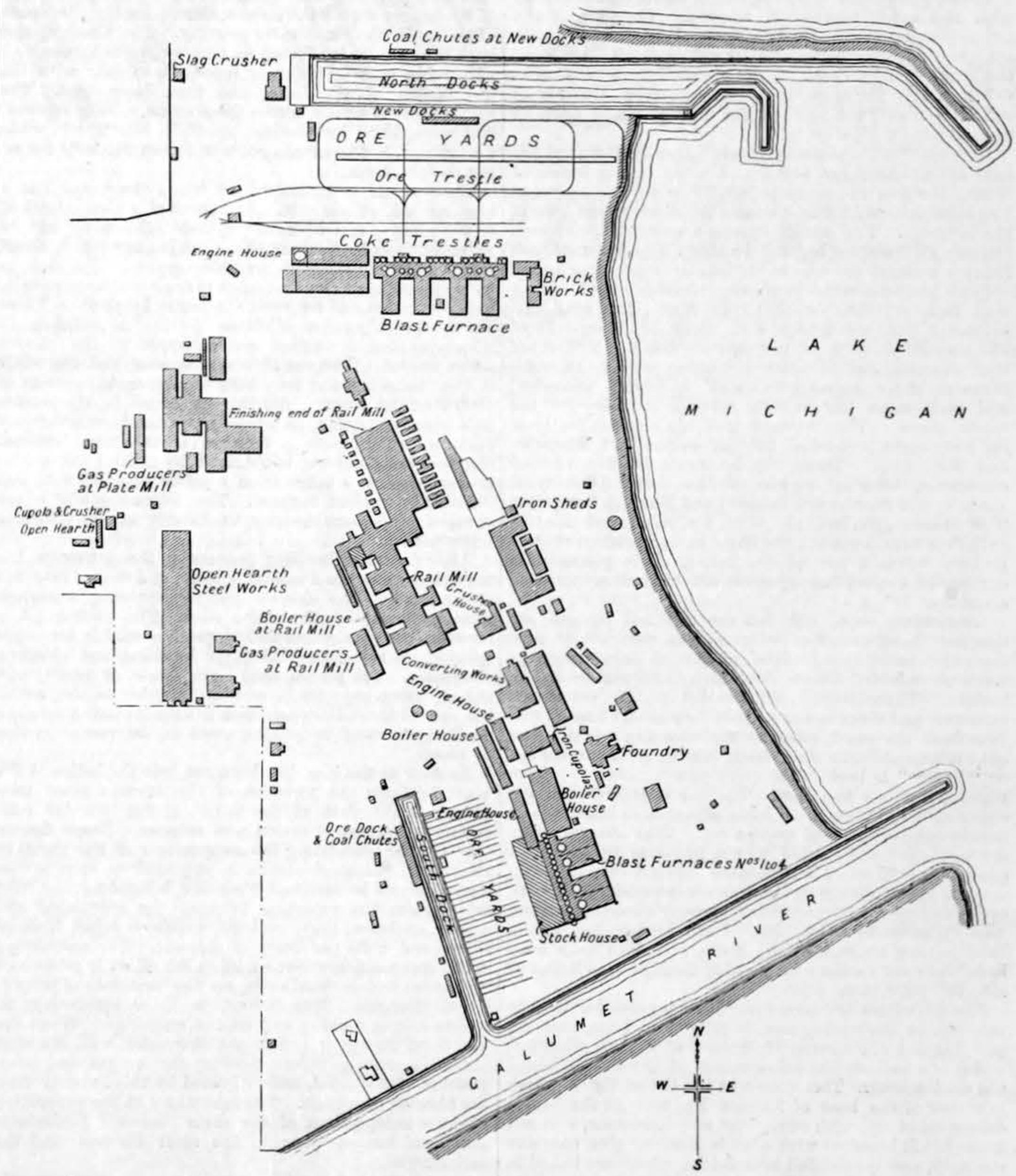
The company also owns coal mines, coke ovens, iron ore properties, and limestone quarries in different parts of the country. It also owns a controlling interest in the Chicago, Lake Shore, and Eastern Railway, which has extensive yards and effects connection with a number of the railways centreing at Chicago, thus affording means of direct communication by rail with all the different plants. This railway has in all 124 miles of main line and sidings, and operates about 370 miles. Its equipment includes fifty-seven locomotives and 3127 cars, a large number of which are employed in bringing coal, coke, limestone, &c., to the steel works. In the transportation system controlled by the company an interesting feature is the carriage by water of raw materials and products between the works at Milwaukee and South Chicago, a distance of about 90 miles. As both plants are on the shore of Lake Michigan, it was decided to get the benefit of the low rates for water carriage, and a contract was made with the Wisconsin and Michigan Ferry Company, by which the loaded railway cars are transported on large transfer boats fitted with rails and hauled by tug boats.

All the works are conveniently situated for obtaining raw material. The port of Two Harbours, on Lake Superior, from which the ores of the Mesabi iron range are shipped, is 1020 miles distant from Chicago by water. The Vermillion range is 690 miles distant by rail, while from the port of Escanaba, on Lake Michigan—490 miles by water—are shipped the ores from the Gogebic, Menominee, and Marquette ranges, which are 300 to 400 miles distant by rail. Thus ores of various grades can readily be delivered during the winter, if desired, when the season of navigation is closed. Coal for fuel and for making gas is hauled by rail from the coal mines of Illinois and Indiana, while oil is obtained from the Indiana oil fields. Coke is brought by rail from the Connellsville district of Pennsylvania, and the Pocahontas district of West Virginia, a distance of 500 to 625 miles. Limestone is brought by rail from the company's quarries at Loganport, Bloomington, and Bedford, about 175 miles distant.

Having now briefly described the property and plants of the company, its business and its resources, we shall proceed to describe more in detail the largest plant, that at South Chicago, usually designated as the "South Works."

These works, as already noted, were established in 1879 by the North Chicago Rolling Mill Company, which already had iron and steel works on the north side of Chicago and in Milwaukee. Four blast furnaces were blown in during 1880, and a Bessemer steel mill and rail-rolling mill were added in 1882. In 1889 the consolidation took place, and the Illinois Steel Company was formed, and since then the plant has been greatly enlarged and improved.

The works are situated on the western shore of Lake Michigan, near its southern extremity, and at the mouth of the Calumet River, about 12 miles south from the centre of the city of Chicago. They cover an area of about 260 acres, and have about 36 miles of railway of 4ft. 8½in. gauge, and 6½ miles of 3ft. gauge. The standard gauge lines are operated by the Chicago, Lake Shore, and Eastern Railway. The site has a frontage of 5200ft. on the lake, and 2500ft. on the river, with a dock on each side for the accommodation of shipping. The North Dock, opening from the lake, is 2900ft. long and 200ft. wide, and is protected against heavy seas by a narrow entrance. The South Dock, opening from the Calumet River, is 1000ft. long and 96ft. wide. On one side of the North Dock the company's manufactured products are loaded on the ships, while on the other side are the ore yards for blast furnaces Nos. 5 to 8, having a storage capacity of 700,000 tons. The South Dock is bordered by ore yards having a storage capacity of 400,000 tons, which stock is used for furnaces Nos. 1 to 4. Three large or four small vessels can be unloaded at once, while another is taking in coal, and still another is unloading timber. The docks have a depth of water sufficient for vessels of 18ft. draught. Not only can ore be delivered by four ships at once, but four other ships can at the same time be loaded with finished product in the shape of rails, billets, rods, wire, tin-plate bars, structural shapes, barrel hoops, nuts and bolts, pig iron, cement, &c.



"THE ENGINEER" Fig. 1 Plan of the South Works of the Illinois Steel Company, U.S.A. SWAIN ENG.

FIG. 1—PLAN OF THE ILLINOIS STEEL COMPANY'S SOUTH WORKS, U.S.A.

During the eight months' season of navigation of 1897, there were 1,629,865 tons of ore received at these docks. As the cargoes are lighter during the winter months, and as several of the older and smaller vessels are still in service, the average cargo is about 3000 tons. The large modern steamers often bring 4000 to 5000 tons, and one vessel in 1897 brought a cargo of 5575 tons. There is at present a tendency to increase the cargoes, and when the lake harbours and the shallower parts of the channels between the lakes are deepened to provide for the intended draught of 21ft., it is expected that cargoes of 6000 tons will be carried. There is, of course, great economy in bringing very large cargoes per vessel, and this is one reason of the steady increase in size of the ore-carrying vessels on the great lakes.

At the North Dock the ore is handled by sixteen cantilever hoisting and conveying machines of the Brown type, handling scoop-shaped buckets of one ton capacity. At the South Dock, there is a row of fifty-three swinging booms, by which buckets are raised from the hold of the ship and dumped into iron push cars running on trestles over the ore yards. At this latter dock a gang of forty-two men has unloaded 1600 tons in the morning and 1750 tons in the afternoon. This makes 3350 tons in eleven hours, or 7·25 tons per man per hour. The following are examples of records of quick work :—

	North Dock.	North Dock.	South Dock.	South Dock.
Cargo, tons	4000	2639	3350	2750
Men, including signal boys	158	81	42	95
Hoists	12	9	—	7
Time, hours	8½	6¼	11	6½
Tons per hour	471	422	304·6	435
Tons per man per hour	3	5·2	7·25	4·6

The hoisting booms at the South Dock are of inverted V shape, with the legs pivoted on the floor of the dock, while the apex carries a sheave. The hauling rope is led over the sheave to a gallows frame, whose legs are in front of the boom, while the end of the boom projects beyond the cap of the frame. The ore buckets are cylindrical, 30in. in diameter and 24in. high, holding 850 lb. of ore. The bail is attached below the centre of gravity, and in hoisting the bucket is locked to the bail. The loaded bucket in the hold of the vessel is attached to a pulley suspended from the overhanging end of the boom, and a signal is given to the engineman on the dock. As the bucket is hoisted the boom is simultaneously raised to a vertical position, and the bucket swings in between the legs of the boom, where it is caught by two men standing on a platform 20ft. above the ground. One of them releases the latch, and the bucket automatically dumps its load into a car holding about two tons. The bucket is then swung out and lowered, the boom swinging down at the same time, and another loaded bucket is attached. When the car is filled men push it along on the elevated tracks to any desired part of the yard, and then dump its load sideways to the ground below. In operation the equipment for each boom, or for each hatchway, consists of four buckets, two cars, or wagons, seven men shovelling in the hold, two men to dump the buckets, and four men to push and dump the car. If the ore is to be shipped away by rail it can be dumped from the bucket through a chute in the platform to a railway car standing underneath.

About 2,000,000 tons of ore are received annually at the two docks. It is unloaded here not only for the South Works, but also for the Joliet Works, and the Union Works, the ore for these latter two works being delivered directly from the vessels into the railway cars on the dock, as above noted.

The work at the ore docks goes on night and day, the work of unloading commencing as soon as a vessel arrives. It takes about six to twelve hours to unload a

vessel, the ore being taken out at the rate of about 40 tons per hatch per hour, or an aggregate of 200 to 530 tons per hour. Some of the steamers are of ordinary construction, resembling ocean cargo steamers, but usually having the engines well aft. There are also "whaleback" steamers, with rows of hatches across the deck, and having the engine at the extreme stern. Many of the steamers tow barges as long as themselves, these being either steel hulls of ordinary construction or whaleback barges.

Fig. 1 is a general plan of the works. There are eight blast furnaces, arranged in groups of four each. They have a combined capacity of 960,000 tons of iron per year, with a minimum fuel consumption of 1500 lb. of coke per ton of iron, and the furnace yield of ores from 55 to 62 per cent. Furnaces Nos. 1 to 4 were built in 1880-81, and are 75ft. high, with bosh diameters of 17½ft. to 19½ft. For each furnace there are four Whitwell-Foote hot-blast brick stoves, 21ft. diameter and 67ft. high, the flues from all of which lead to a single stack or chimney. The waste gas from the furnaces which is not used in the stoves serves as fuel for forty horizontal tubular boilers, 6ft. diameter and 20ft. long, supplying steam at 100 lb. pressure for the blowing engines, and also for the engines in the Bessemer department.

There are ten blowing engines, two to each furnace, with two extra engines in reserve. They are of the Cuyahoga Engine Company's vertical type, with steam cylinders 36in. by 54in., and air cylinders 84in. by 54in., the latter being on top. Some of them have the Corliss valve gear. They are to be compounded, two steam cylinders taking the place of the present single cylinder to each engine.

Furnace No. 1 ordinarily produces spiegel iron at the rate of 7000 tons per month. A stock house, 368ft. by 100ft., shelters the daily supply of coke, and hoists in two brick towers 100ft. high raise the stock to the tops of the furnaces. The casting-houses are of brick, and each furnace has a casting bed 62ft. by 150ft. The output of each furnace is about 300 tons of pig iron in twenty-four hours.

Blast furnaces Nos. 5 to 8 are shown in Fig. 2. They were built in 1890, and are 85ft. high, with bosh diameters of 19ft. 6in. to 20ft. 9in. Each has a capacity of 375 tons of pig iron in twenty-four hours. There are four Massick and Crooke hot-blast stoves to each furnace, these being 74ft. high and 22ft. diameter, and each stove has its own stack or chimney for the waste gases. The furnace gas also serves as fuel for forty-eight horizontal tubular boilers, 6ft. diameter and 20ft. long. These supply steam for ten vertical condensing blowing engines of the Porter-Allen type, made by the Southwark Foundry and Machine Company. The steam cylinders are 40in. by 60in., and the air cylinders 84in. by 60in., the latter having positive-motion gridiron valves in the cylinder heads. It is proposed to compound some of the engines in order to secure increased economy.

Limestone, coke, and the ore received by rail are dumped in stock piles from railway cars of 30 tons capacity, there being about 6500ft. of standard-gauge track on trestles about 12ft. high, approached by an incline. These trestles are parallel to the line of the furnaces, and there is but a short distance for transportation from the stock piles to the charging hoists. The coke is dumped into bins, from which the charging car or "buggy" is loaded, the coke passing over a screen which takes out the dust. The ore is loaded into the charging cars by hand, or by a steam excavator, whose bucket holds a full load for one car. The charging cars are assembled and hauled to the furnaces by a narrow-gauge locomotive. Each furnace has a double platform vertical hoist tower of steel frame construction, fitted with cages, and operated by a Crane Company's hoisting engine, with cylinders 12in. by 12in. Each furnace has also a brick casting house, 63ft. by 164ft., furnished with sand beds and sand runners for pouring the iron into ladles or into the pig-casting beds.

The dust from the furnaces, which is carried over into the flues by the waste gases, is prevented from entering and clogging the stoves by means of a dust chamber, which is a balloon-like enlargement of the flue, in which the dust collects. This is seen at the left of Fig. 3, which is a view of the base of furnace No. 5. As the dust is composed of ore, with some coke and limestone, it is not wasted. It is mixed with a little lime to give cohesive strength, and is moulded into bricks which are baked in a chamber heated by exhaust steam and waste gases from a boiler. These bricks are then again charged into the furnaces, thus avoiding a considerable loss by waste.

The iron is ordinarily run from the furnaces into 12-ton ladles, which are hauled on cars to the Bessemer or open-hearth steel plants. The Sunday iron is cast into pigs, which are used at the steel plants or shipped away. The slag is run from the furnaces into slag cars of the Weimer pattern, which are emptied into long beds, the slag forming layers 2in. to 3in. thick. When a sufficient quantity has accumulated, it is excavated and loaded into railway cars of 30 tons capacity by a steam excavator, which can load ten cars per hour. This broken slag is used for railway ballast, road metal and concrete. It has also been used for the manufacture of building brick. There is also at the works a special plant for making mineral wool or slag wool, by spraying a jet of molten slag with steam jets. This material is extensively used for the insulation of heat and sound, and in covering steam pipes, filling floor spaces, &c.

The Bessemer steel plant was put in operation in 1882, and has now a capacity of 2200 to 2600 tons of ingots in 24 hours. In 1890 the form of the converters was changed, a concentric nose being adopted in place of the old hood-shaped top with excentric nose. The three new converters are 14 tons capacity instead of 10 tons. There are four blowing engines in the Bessemer mill. Two of these are vertical engines, similar to those at the blast furnaces, but delivering air at 20 lb. to 25 lb. pressure. They will probably be converted into compound condensing engines. The other two are horizontal engines of an old-fashioned type.

The general arrangement of the converters, hot metal delivery track, casting pit, and cranes, is in accordance with the design of Mr. R. Forsyth, and arrangements are being made for removing the converters weekly, or whenever desired, as originally contemplated in Mr. Forsyth's plans. The converters have Mr. A. Holley's system of removable shells, the shells and bottoms being handled rapidly by hydraulic lifts under the converters. Increased speed in changing the bottoms is now obtained by the use of a special form of car or truck. Each converter has a shell independent of its trunnion ring, and when the lining is thin or out of shape the shell can be released and withdrawn, a new one being at once pushed in and secured in position. This enables the mill to maintain a large and regular rate of production. The molten iron is brought from the blast furnaces in 12-ton ladles, as already noted, and is charged into two horizontal cylindrical mixers, Figs. 4 and 5, each of which holds 150 tons of iron. By thus mixing the iron from different casts from the various furnaces an iron of great uniformity in chemical composition and in temperature can be obtained for the converters. The ladles are raised to the charging floor by a hydraulic lift, which revolves through an angle of 90 degrees during the ascent, thus bringing the spout of the ladle into position for pouring. The tilting up and back of the ladle is effected by power applied through an adjustable socket, which is thrown into gear with the mechanism of the ladle, and then disengaged. The empty ladle is hauled across the floor on a cable railway, and is let down by another hydraulic lift, which, while descending, is turned into position to run the ladle out on the surface track.

Each mixer is supported on four rollers, and has a circular rack on one side. By means of a rack attached to the plunger of a hydraulic cylinder, the mixer can be revolved so as to discharge its contents through a spout into a ladle standing on weighing scales. The ladle is then run on to an elevated track in front of the converters, and is emptied and returned to position by power. There are three iron cupolas adjoining the mixing building, in which pig iron is melted and delivered to the mixers when desired. Two are 10ft. in diameter and the other is 11ft. diameter, and they have an aggregate capacity of 5500 tons per week. Should the metal in the mixers cool from long delay, its temperature can be raised by oil burners, which spray a flame over the iron. Spiegel iron for re-carburising is obtained by melting the pig in four cupolas, or is taken from a mixer supplied with hot metal from a blast furnace. The latter method is the cheaper, and gives greater uniformity in the chemical composition.

After the re-carburising process in the converter the steel is poured into a receiving ladle, and thence into the casting ladle, the double pouring ensuring a perfect mixture and uniformity in the steel. The casting pit is circular, and has about 250 degrees available for ingot casting, the remainder being for handling and cleaning the ladles. The pit can hold three heats, or twenty-one ingots, which capacity is ample. Another casting pit in the rear of the ladle-repair shop is used for soft Bessemer steel ingots used in making some of the poorer grades of plates.

As soon as the iron has been run into the ladles at the blast furnaces the foreman of the furnace plant telephones to the clerk at the mixer, giving him the estimated percentage of silicon and sulphur. These figures are used for calculating the composition of the metal in the mixer, which calculation is repeated as soon as the true analysis is received from the laboratory. Under this system the variation between the calculated and actual analyses may be kept within 0·1 per cent. of silicon and 0·05 per cent. of sulphur. The calculation of the composition of the metal in the mixer is performed by a chart and decimal scale, on the principle of proportional triangles. This is found to be as satisfactory as a slide rule in rapidity and ease of working. When the iron from the mixer enters the Bessemer mill, the steel blower is given a ticket showing the weight and composition of the metal, and is guided by this in controlling the blowing operation. The laboratory at the converting works is independent of the main chemical laboratory, and furnishes analyses to the steel blowers and the metallurgist.

One or two test ingots—according to the requirements of the specifications—are taken from each heat, and these are 2¼in. square and 6in. long. One is for chemical analysis and the other for physical test. The test piece is ⅜in. square and 20in. long, and when cold must be bent to a right angle by blows from a hammer. One piece, about 1in. square and 3in. long, is sent to the chemical laboratory, where drillings are taken and the chemical analysis made for that heat.

The iron is poured into open moulds standing on cast iron stools forming ingots, which are 16in. square and weigh from 4500 lb. to 5000 lb. The moulds are stripped from the ingots as soon as the latter have solidified sufficiently to bear handling, and the stripping crane then places them on iron cars on a narrow-gauge track. A locomotive hauls them to the mould yard, where they are left to cool. The ingots while still white hot are taken to the rail mill, being kept in a vertical position all the time.

In the original plant each mould or ingot was handled separately by 5-ton Holley hydraulic cranes, but these gave way to three Wellman steam and hydraulic jib cranes, lifting two moulds or ingots. The latter are in turn to be replaced by 15-ton cranes having three sets of tongs, so that the number of lifts per heat, for the same weight of product, will be six instead of eighteen. The improved facilities for handling will effect an increase in the output, and avoid the method sometimes practised of casting into moulds mounted on cars or trucks.

The capacity of the converting work is about 625,000 tons of steel ingots per year, the output being about 2550 tons of ingots per twenty-four hours. During the month of December, 1897, the output was 54,176 tons in 49½ turns of twelve hours. For the year 1897 it was 520,245 tons of ingots in 536 turns.

(To be continued.)

THAMES AND SEVERN CANAL.

IN our issue of May 8th, 1896, we gave a plan and section of the Thames and Severn Canal, with some photographs taken in various places along the line of the canal, showing its neglected and decayed condition. We are now glad to be able to state that the work of restoration commenced in the early part of 1896 by the Thames and Severn Canal Trust is completed, and it only remains for the canal to fill with water for traffic to re-commence throughout.

The Thames and Severn Canal commences by a junction with the Stroudwater Navigation at Wallbridge, Stroud, and passing Brimscombe and Chalford, rises 241ft. to the summit level at Daneway by twenty-eight locks. The first 4¼ miles of the canal from Wallbridge to Bell Lock, Chalford, have never been closed for traffic, but from above Chalford to Inglesham, the junction with the Thames, there has been no through traffic for some years, and this portion has been the scene of the restoration works.

The summit level of the canal extends from Daneway to Siddington, a distance of 8 miles 8½ chains, and from Siddington there is a short branch to Cirencester, 1 mile 2 furlongs 5 chains long, and on the same level, making a total distance of 9 miles 3 furlongs 3½ chains. This summit level, passing as it does through very bad ground, has always been in the past history of the canal its weakest point, on account of the constant leakages which occur, and it is doubtful whether there is any portion of canal in England more troublesome to keep water-tight than this has been. In Mr. Robert Whitworth's report of December 22nd, 1782, he states the following:—"Unfortunately the level leads over some bad rocky ground, which cannot be avoided for several miles together, that is worse than I have ever seen any canal cut through for such a continued length, yet there cannot be the least doubt but that by time and money it may be made moderately water-tight."

Unlike the summit levels of most other canals, that of the Thames and Severn is not provided with reservoirs for storing water, but is solely dependent for its supply on the pumping engine at Thames Head, and a feeder from the river Churn entering the canal at Cirencester. This feeder can only be used free of charge on Sundays, owing to the prior rights of the millers on the Churn.

The pumping engine at Thames Head, situated 4½ miles from the end of the summit at Daneway, was erected in 1852, and was constructed by Messrs. Thomas and Co., of Charlestown Foundry, Cornwall. It is a beam engine, and pumps from a well 63ft. deep, delivering 3,000,000 gallons in twenty-four hours.

Every effort will be made to maintain the water in the summit level at a height of 3½ft. above the lock sills, and not to allow it to fall below 3ft.—that is, to use only for locking purposes the 6in. between 3ft. and 3½ft. Twenty-five chains from Daneway Bridge commences Sapperton Tunnel, by which the canal is led through the Cotswold Hills. This tunnel is 3808 yards long, of which 1436 yards are in rock, being the upper beds of the inferior oolite, and 2372 in brick arching. The width in the narrowest place is 11ft. 8in., and there is no towing path. Twenty-four shafts were sunk for use during its construction, the deepest of which is 234ft. from the bottom of the canal to the ground level of the hill above. From Siddington summit lock the canal descends by eleven locks a distance of 4¾ miles to Latton, where there is a junction with the North Wilts branch of the Wilts and Berks Canal from Swindon, giving communication thus eastwards from Swindon, to the Thames at Abingdon, and westwards from Swindon to the Kennet and Avon Canal at Semington.

From Latton to the junction of the canal with the Thames at Inglesham is a further distance of 8¾ miles, with a descent of five locks, the total fall from Siddington to the Thames being 130ft. 6in.

There are altogether on the canal fifty-seven bridges and forty-four locks. The dimensions of the locks are, between Wallbridge and Brimscombe, 68ft. by 16ft.; between Brimscombe and Chalford Chapel Lock, 70ft. by 12ft. 9in.; from this lock to Daneway, 75ft. by 12ft. 9in.; and between Siddington and South Cerney Bottom Lock, 75ft. by 13ft.; and from here to Inglesham, 97ft. by 13ft., with the exception of Latton Lock, which is 75ft. by 13ft.

The work of restoring the canal has been carried out under the direction of Mr. G. W. Keeling, M.I.C.E., Mr. E. J. Cullis, A.M.I.C.E., having been the executive engineer.

Since August 5th, 1898, Mr. W. J. Snape has had sole charge of the canal and works as manager and engineer. Mr. Snape holds the same appointments for the Stroudwater Navigation, and the joint office of both Navigations is at Wallbridge, Stroud.

The following are the principal places on the canal, with their distances from Stroud:—

Stroud to—	Miles.
Brimscombe	2½
St. Mary's	3½
Chalford Wharf	4
Valley Lock	4¾
Bakers Mill Wharf	5⅝
Puck Mill	5⅞
Whitehall	6¼
Daneway Wharf	7⅛
Daneway end of Sapperton Tunnel	7½
Coates " "	9⅝
Thames Head Wharf	11⅜
Thames Head Pumping Station	11⅝
Siddington top lock, junction with Cirencester branch, 1⅜ miles	15¼
Siddington bottom lock	15½
South Cerney top lock	16¾
Wilmoreway	18⅜
Cerney Wick	19½
Latton, junction with North Wilts Canal	20¼
Latton Wharf, Cricklade	21
Eisey	22
Marston	23½
Castle Eaton Bridge	24
Kempsford	25½
Dudgrove	28
Inglesham, junction with river Thames	28¾
Lechlade Wharf on river Thames	29½
River Severn to Thames	37⅝

The through tolls fixed for all classes of goods passing over the canal are, from Stroud to Cirencester, 6d. per ton; and from Stroud to Inglesham, 1s. 2½d. per ton.

The restoration of the navigation of the river Thames from the junction with the Thames and Severn Canal at Inglesham to Oxford, a distance of 33 miles, is now on the point of completion by the Thames Conservancy.

THE BARRY DOCKS.

(*Concluded from page* 584).

THERE still remains something more to be said about the interesting excursion to Barry Dock. Reference to the plan, Fig. 1, will show that along the west side of Lady Windsor deep sea lock there is a graving dock, whilst at the north-east corner of Dock No. 1 other graving docks are shown; the former belong to the Barry Railway Company, the latter to the Barry Graving Dock and Engineering Company. The Barry Railway Company's graving dock is known as the Barry Commercial Graving Dock; it has the following dimensions:—The outer side bay, 346ft. in length; the inner, 327ft.; the length from the outer to the middle caisson is 366ft., and from the middle caisson to the end wall 363ft.; this is being extended to 483ft., which will give a total length of 869ft. The width at entrance is 60ft., at the top of dock 113½ft., at the bottom 100ft. The depth of water on the sill at high water ordinary spring tides is 26ft. 6in., and at high water ordinary neap tides 18ft. 3in. 937 vessels have used this graving dock. It can accommodate four vessels at once. The pumping machinery consists of seven centrifugal main pumps with a combined capacity of 260,000 gallons per minute and two small drain pumps capable of pumping together 12,000 gallons a minute, and the water can be pumped either into the dock or into the sea.

The Barry Graving Dock and Engineering Company's dock at the north-east of Dock No. 1 is a double dock with an entrance 60ft. wide, furnished with a wrought iron box caisson; a similar caisson divides it at the middle; the outer side bay is 314ft. long, the inner 318ft., the length between the caissons and between the middle caisson and the end wall is in both cases 355ft.; the total width of the floor is 100ft., and at the coping 113½ft. The depth of water on the sill is at high water ordinary spring tides 24ft. 6in., and at high water ordinary neap tides 16ft. 3in. Four ships can be accommodated at the same time in this graving dock, and up to May 2183 vessels had used it. If necessary the middle caisson can be removed, but this is rarely needed. The inner portion of this dock was also being extended to give a length of 405ft., or a total length of 778ft. This company is moreover constructing a new single dock, which is shown alongside of the double dock on the plan, Fig. 1. We give two illustrations—Figs. 40 and 41—which will give some idea of the operations connected with this work. The marl is 65ft. below the coping level at parts, and, as will be seen from Fig. 40, very heavy timbering is required in trenching for the side walls; this is owing to the fact that the site is that of an old timber pond cut. Fig. 41 indicates very clearly the system of construction followed. The walls are of masonry with foundations of cement concrete, with large stones embedded; the floor is of cement concrete, on a foundation of lime concrete with stones embedded, and where necessary stone filling is used in the way shown. The dimensions of this graving dock are—width of entrance 65ft., of floor 66ft., at coping 81ft., total length 623ft. Depth of water on sill at high water ordinary spring tides 27ft. 6in., at high water ordinary neap tides 19ft. 3in.

A pleasant and interesting feature of the visit to Barry was the trip round the docks in electric launches, passing round the old dock, then through the unfinished junction out into the new dock, thus enjoying the distinction of being passengers in the first craft to enter Dock No. 2. The appearance of the new dock from the launches was very fine, and not only could the excellent workmanship be investigated, but we were enabled to realise the extensive area of this great sheet of water. This trip was followed by an excellent luncheon given by the Barry Railway Company, and then by the visit to Barry Island and Whitmore Bay already referred to; at 3.40 the departure took place, and at 4 our kind hosts took leave of us at Cardiff and handed us over to the tender mercies of the Great Western Railway Company.

We may fittingly add to our remarks on the new works at Barry Dock the names of those who have been mainly concerned in bringing the works to a successful termination. The consulting engineer is Sir John Wolfe Barry; his resident, Mr. R. C. H. Davison, to whom we are indebted for illustrations, and most of our information on the subject. The Barry Company's engineer is Mr. James Bell, who, with the assistance of Captain Dawes, its dock master, directed the dredging for the Lady Windsor Lock, which necessitated the removal of 84,000 cubic yards, mostly of rocky marl, that had to be cut to 18ft. below low-level of ordinary spring tides. Then the contractors for the various works were as follows:—Sir John Jackson, the Barry Commercial Graving Dock and the locks and jetties of the deep sea lock; Messrs. Robert Stephenson and Co., the lock and dock gates; Sir W. G. Armstrong, Mitchell, and Co., the gate machinery, the hydraulic cranes, and capstans; Messrs. Brown, Lenox, and Co., the fender chains, buoys, and other chains; Messrs. Price and Wills, the island railway, and the dock railways and buildings; Messrs. E. C. and J. Keay and Messrs. John Lysaght supplied the trestle and girder work, the last-mentioned firm also furnished the pontoons; Messrs. Tannett Walker, and Co., the winding engines and sluice machinery of the lock, and the coal tips and hydraulic engines of the new dock. The late Mr. T. A. Walker was the contractor for the graving dock of the Barry Graving Dock and Engineering Company, and for the main dock and railways.

It may be noticed that all the machinery of the dock is worked by hydraulic pressure at 750 lb. per square inch, there are three installations, all shown on plan Fig. 1, but all the mains are connected and circuited. In all there are eight pairs of compound horizontal surface-condensing engines with steam cylinders 16in. and 28in. diameter by 24in. stroke, supplied with 80 lb. steam from twenty-three Lancashire boilers 28ft. long by 7ft. diameter. The pressure pumps are on the differential ram principle, the diameters being 4⅞in. and 6⅞in., the water storage is provided by twelve accumulators with rams 22in. internal diameter, loaded to maintain the pressure. There are seven miles each of 7in. hydraulic pressure mains, of 8in. hydraulic return mains, and of 5in. fresh-water mains. There are also for manipulating ships and wagons, discharging cargo, &c., forty-one movable hydraulic pedestal cranes, five fixed hydraulic cranes—one of them 50 tons. One steam floating crane, five steam travelling cranes, three hand travelling cranes, one hand fixed crane, 120 hydraulic capstans—four of 10 and twenty-seven of 5 tons; 252 bollards, 171 mooring rings, forty-five buoys, and various accessories. The docks, tips, sidings, entrances, works, workshops, and stations are all illuminated by electricity; the plant is housed near the north hydraulic engine house, from which the steam is supplied, and consists of eight engines of 970 indicated horse-power, driving six Crompton dynamos, two Patterson and Cooper's dynamos, three Brush and two Crompton alternators. There are 159 arc lamps, 2593 incandescent lights, fifteen transformers for lowering 2000-volt current to 110 volts, and a total length of thirty-five miles of electric mains. Messrs. J. Stone and Company's system of electric lighting is used in the passenger coaches. The Barry Railway is well-connected in every direction with other railways, and itself owns over thirty miles of railway, and forty-eight dock sidings, and ninety-three locomotives, ninety-six passenger carriages, twenty-four passenger vans, and 1186 goods and other wagons that are always being added to as required. There are engine sheds, fitting and workshops, where all repairs to locomotives and other machinery are done, whilst in the vicinity of Barry Dock Station new offices are being erected; the building is three storeys high, and covers an area of 2050 yards.

TABLE A.

	Gross tonnage.	Length, ft.	Beam, ft.	Draught, ft.	Time coaling.	Total load, tons.	Tons coaled per hour.	Tons in Bunkers.
S.S. Racine	1578	250	35·3	18	4½	2081	462	—
S.S. Haberton... ...	1443	247	35·3	15·6	4¼	1947	458	—
S.S. Ocean	1442	247	35·3	15·6	4⅓	1934	416	60
S.S. Activity	1091	225	31·8	16.2	4	1327	332	58
S.S. Harlring	1838	268·2	37·7	17	5¼	2467	460	70
S.S. Nordboen... ...	2404	310	44	20·4	26½	4055	154	460

The trade at Barry Dock has shown a continual increase ever since the opening in July, 1889; in the following year the total imports amounted to 63,675 tons, the exports to 3,201,597 tons; the number of vessels was 1753, with a registered tonnage of 1,692,223, of which 1321 with a tonnage of 1,310,039 were steamers, and 432 with a tonnage of 382,184 were sailing vessels. In 1897 the total imports were 248,349 tons; exports, 5,859,255 tons; the number of steamers 2489, tonnage 2,844,862; sailing vessels 317, tonnage 322,449; total number of vessels 2856, with a registered tonnage of 3,167,311. Since the opening to end of 1897 the numbers are:—Total vessels, 18,687; tonnage, 19,594,964; total imports, 1,226,487; exports, 37,783,590 tons; exports and imports together, 39,010,077 tons. The imports include pitwood, timber, rails, silver sand, iron and iron ores, building materials, and general merchandise; the exports, principally coal and coke, a few rails, a small quantity of iron and iron ore, and a few thousand tons of general merchandise. This year the coal strike will have considerably interfered with the working of the dock, and the actual output will consequently be diminished; to what extent is a factor that will be regarded with interest by many people.

It is interesting to state that the population of the district is now about 30,000, although in 1884 it was not above 100. There are 5206 houses on the spot, and the number of men employed is 1708; moreover, there is an excellent service of trains, so that those preferring to live elsewhere find every facility offered them for their conveyance backwards and forwards.

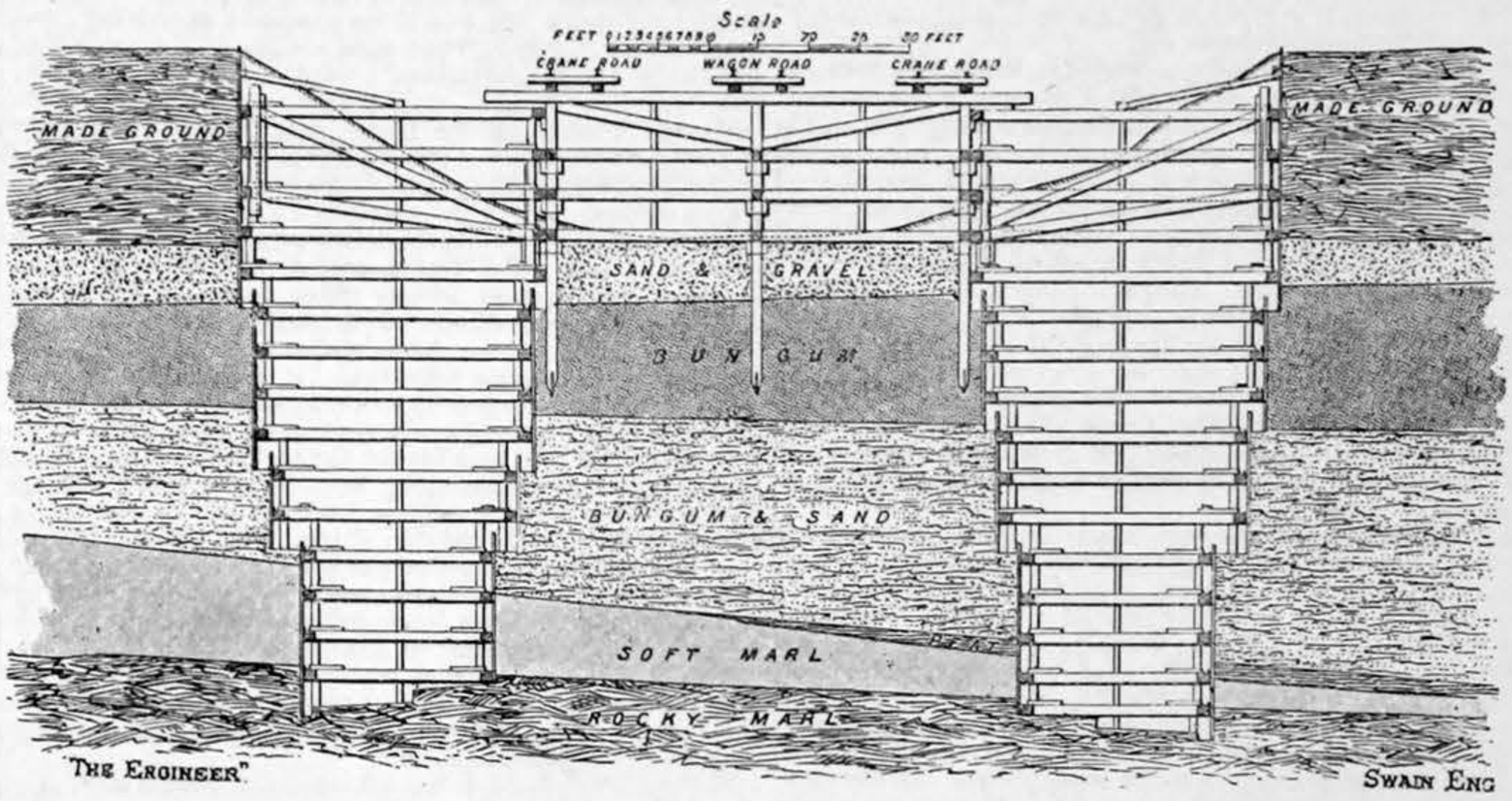


Fig. 40—TIMBERING FOR NEW DOCK EXCAVATION

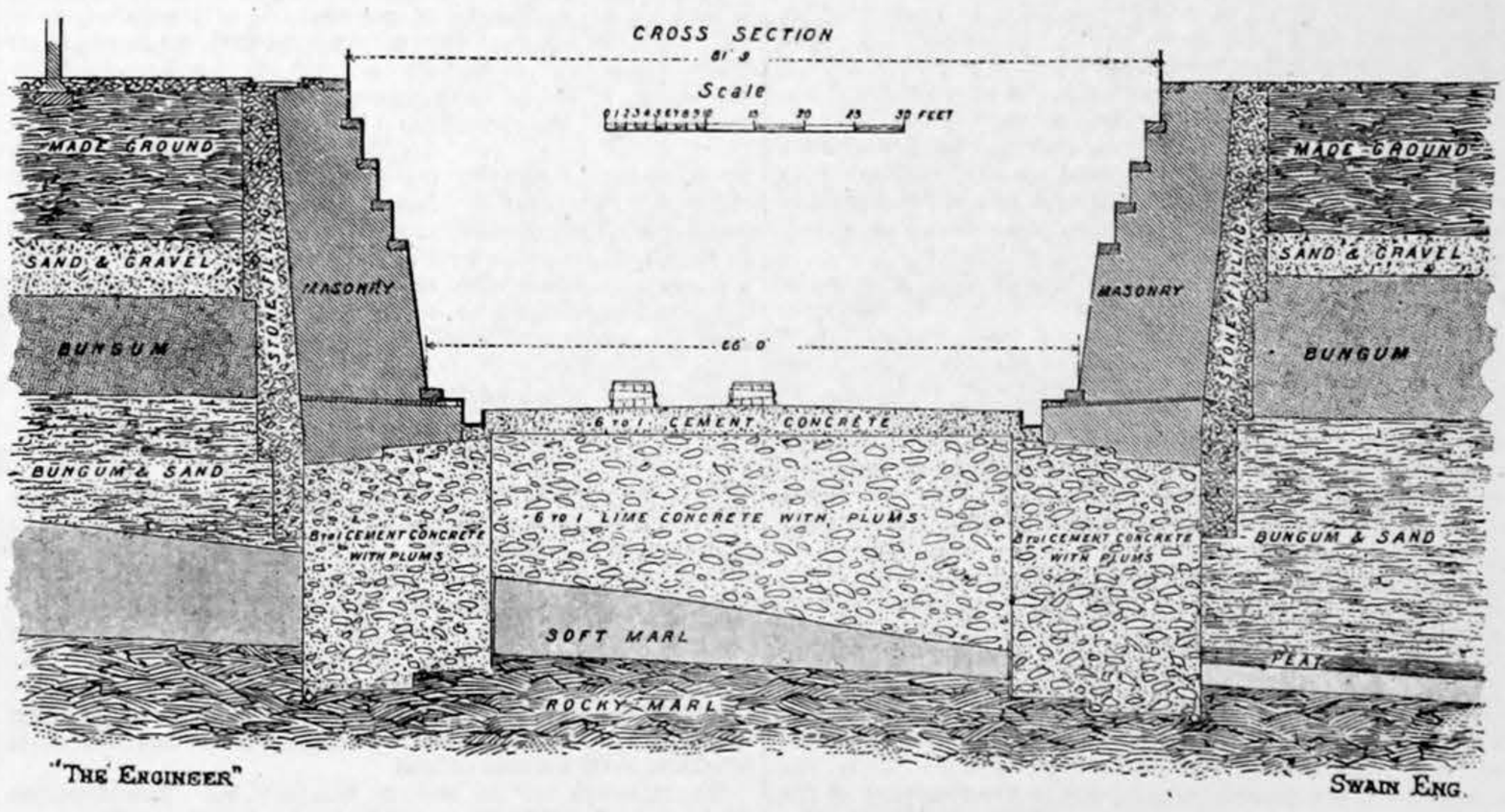


Fig. 41—CONSTRUCTION OF NEW SINGLE DOCK

A word or two may now be said about the coal tipping. The possible capacity of a tip is far greater than the actual tipping done by it, inasmuch as very many delays occur, and consequently about 300,000 to 350,000 tons may be taken as a fair estimate for the annual output of a tip, although judging from the performance during short periods of time, and calculating from that the annual output, a number ten times as great may be stated but would not be correct. The actual amount tipped in 1897 was 5,854,920 tons from 23 tips, or an average of 254,562 tons per tip.

Trimming in the vessel, changing vessels, waiting orders and cargoes, slack seasons, breakdowns, &c., are sources of delay, but we give in Table A, borrowed from Mr. Davison's paper, some examples of the despatch of vessels.

All except the last were self-trimmers, and in that case no less than 12½ hours were spent in shifting tips and getting in the bunker coal, although three tips were used. In the first two cases one, and in the second two, tips were used.

KING'S COLLEGE, LONDON.—The David Salomons Scholarship for 1899 has been awarded by the Institution of Electrical Engineers to T. R. Renfree, student in the Siemens Engineering Laboratory of King's College.

MOTOR CARS IN PARIS.

The section devoted to mechanically-propelled vehicles in the Salon du Cycle et de l'Automobile, which was opened in the Galérie des Machines in Paris last week, was much larger than might have been expected in view of the fact that makers had shown all their latest types of motor cars at the Tuileries Exhibition in June. Since then a good deal of progress has certainly been made in the designing of mechanical vehicles, and the new systems of propelling mechanism exhibited at the Salon were decidedly interesting. In speaking of new systems, however, we do not mean to infer that any notable departure has been made from the various types of spirit engines already adapted to road vehicles. In most cases the new motors were designed on principles which had been tried in the early days of the motor car industry, and for some reason or another abandoned, and the others were simply copies of existing motors, modified in certain details to constitute "improvements." The most striking thing about the show was the desire of even the makers of the highest standing to find something better than their present types of engines. None of the firms are apparently entirely satisfied with their mechanisms, and there is a keen anxiety to hit upon new propelling devices that shall be far in advance of the motors now in use.

The Société des Automobiles Mors, for instance, exhibited vehicles fitted with two new types of engines. The system they usually employ is a motor with four cylinders coupled in pairs at an angle of about 90 deg. They build cars in the form of a dogcart, and the machinery is placed behind the rear axle. A lighter type of four-seated car was shown with a horizontal two-cylinder engine placed transversely in the fore part of the car, the two cylinders being as nearly as possible in the same axis. They are flanged for air cooling, and are also fitted with water jackets. This was the type first designed by M. Mors for the propulsion of road vehicles, and he apparently finds that for the lighter cars it gives better results than the four-cylinder engine. To a heavier type of car M. Mors had fitted a two-cylinder vertical motor of 8-horse power, which was also placed in front. The design and arrangement are very similar to that of the Daimler engine.

Another departure has been made by MM. Panhard et Levassor, who are beginning to cater for the needs of buyers who cannot afford to pay fancy prices for the highly-finished carriages turned out at the Avenue d'Ivry works. The little car they showed for carrying two persons was fitted with a 3-horse power single-cylinder horizontal motor. The cylinder is flanged, and also has a water jacket. As the motor is in the rear the tranmission gear is, of course, not the same as in the ordinary Panhard cars, but is more direct, and operates with less complicated gearing on to the countershaft. In the cars exhibited by the Société des Automobiles Peugeot there was no change beyond the substitution of electric ignition for the incandescent tube on two of the cars. M. Peugeot has been carrying out experiments for some time past in this direction, and has met with such success that he has decided upon adopting this method of firing for the future. Now that M. Peugeot is about to abandon the platinum tube there are only one or two firms at the most who continue to use it.

The well-known carriage builders, Belvallette Frères, showed for the first time a beautifully-finished carriage propelled by mechanism on the Bergmann system. The motor is a horizontal single-cylinder engine of 5-horse power. The piston operates a shaft carrying three pulleys for the various speeds, and each pulley has a loose leather belt connecting with the countershaft. A lever terminating in a jockey pulley comes down on one or other of the belts, and gives the desired tension for the running of the vehicle. The lever is operated from the seat and moves transversely over the range of three belts, and the pressure may be increased or diminished as required. The gas mixture is fired by magnetic-electric ignition, and it would be interesting to know whether the sparking is sufficient to ensure the regular running of the motor. As the carriage shown was the first one constructed, and had only recently been completed, the experiments have, no doubt, not been sufficiently conclusive to prove the efficiency of this system. The driving gear has been simplified as much as possible, and it is claimed that the carriage may be started from the driver's seat, though it is to be remarked that in no other vehicle for which similar claims have been made has the starting gear acted at all satisfactorily.

The light car shown by M. Th. Klaus is only new in the sense that it was exhibited for the first time. It has been worked upon for some years past, and has apparently now reached its definite form. It has two horizontal motors, one on each side of the car. The cylinders are cooled by air flanges and a water jacket, as is the case with most of the small motors recently introduced, but despite these precautions we have found that the motors get very hot after running a short time. The controlling of the inlet valves by means of a spindle on the steering lever working against a segment piece is very ingenious. The motor is stopped by merely raising the lever. To start the engine, a lever terminating in a ratchet working on a pinion is operated from the seat, but evidently this is found impracticable, for on the vehicle exhibited the lever had been suppressed.

Another new exhibit was that of the Compagnie des Automobiles Henriod, who have lately brought out a carriage in which the propelling mechanism is designed by M. C. E. Henriod. As in the case of the latest type of Mors motor, the two cylinders are placed transversely in the fore part of the carriage, and the pistons work on one shaft, carrying the fly-wheel, and terminating in three pinions which gear into bevel wheels on the countershaft for the various speeds and for reversing. The cylinders are flanged and have no water jacket, the idea being, apparently, that the draught set up by the fly-wheel will be sufficient to keep the engine cool. We have found, however, in practical running that there is a decided liability of the engine to get hot.

An interesting vehicle was that exhibited by the Société des Moteurs Gobron et Brillie, in which it is sought to secure a perfect balance and suppress the vibration by exploding the gas mixture between two pistons. There are two vertical cylinders, and consequently four pistons, the lower pair acting directly on the shaft, and the upper two by means of rods and bevel gearing. The motor, which developes 6-horse power, ran for seven consecutive hours on each day of the show, and the noise and vibration were certainly much less than we have noticed in any other mechanical vehicle. MM. Faugère, Ochin et Dangleterre, of Corbeil, are one of the newest firms to engage in the motor car industry, and they exhibited a couple of vehicles fitted with two-cylinder horizontal motors of 6-horse power. The crank shaft carries two fly-wheels, between which is the belt for the transmission. The whole of the mechanism is enclosed in a gear case, which may be easily removed by loosening three or four bolts. The engine is started from the seat by a lever, for which system the firm claims to have a patent. M. L. Fisson has abandoned the Benz motor he formerly employed for a two-cylinder vertical engine of his own design. The motor is placed in the fore part of the car and the power is transmitted by spur wheel gearing, which is entirely enclosed. The exhaust is conveyed into an unusually large "silencer" for suppressing the noise and odour.

The only steam carriage exhibited was the "motocar" constructed by Count Dalla-Décimas and several other gentlemen interested in the mechanical vehicle movement, but unfortunately their efforts do not appear to have been crowned with entire success. The generator at the rear of the car is ingenious. It is composed of a series of concentric tubes with spirals between them, to ensure the superheating of the steam by a longer circulation in the hot tubes. The heating surface is said to be 3½ square metres. There is a row of petroleum burners underneath a few inches from the ground, and it is difficult to believe that they would remain alight in wet and muddy weather, while even the draught behind the car would be liable to blow them out. The waste heat is utilised for raising the temperature of the water before entering the tubes. The engine will develope 8-horse power at 120 revolutions. It has three cylinders at 120 deg., and weighs about 56 kilos. The engine is under the driver's seat, and the power is transmitted to the countershaft by spur wheel gearing. It is possible that something may be done with this mechanism for motor cars, but as at present arranged it appears to be utterly impracticable. The electric carriage builders, Mildé et Cie., had a novelty in the shape of a fore-carriage for light vehicles. It is a circular frame supported on the axle of a single steering wheel fitted with a pneumatic tire. The frame carries 105 kilos. of accumulators, and a small motor, which is geared on to the driving axle by spur wheels. It is claimed that the car will run 70 kiloms. on the level without re-charging. The arrangement is rather cumbrous for a light car, but it certainly appears to open up a new application of electricity for the propulsion of cars. In the lighter types of carriages there was little to be seen beyond the application of systems of spirit engines which have long been on the market. By far the great majority of them had De Dion motors adapted to light vehicles of every possible shape. M. D. Farman, however, exhibited a new tandem car propelled by a two-cylinder horizontal motor, in which the transmission was effected by two belts and two chains, each giving a different speed. The motor is of 4-horse power on the brake. The cylinders are flanged, and are also cooled with water. Instead of circulating the water through cooling tubes the tank, itself serves this purpose by being made tubular, so that there is a very large surface exposed to the air.

If the show has not presented anything that is strikingly new it has at all events indicated that makers are still striving to produce a more satisfactory mechanism than anything that is yet available for road vehicles. All that can be said at the moment is that some of the systems of motor cars are giving very good results, and are so far practicable that the industry has for two years past been making rapid headway on the other side of the Channel; but before these cars can come into general use the existing systems must not only be improved, but there must be a sufficient variety of good mechanisms to prevent the trade being monopolised by a few firms, as is the case at present. From what could be seen at the show, it appears as if makers have little hope of improving the existing motors to any great extent, and certainly it is extremely difficult to devise anything new. Manufacturers, indeed, scarcely seem yet to have made up their minds what direction to take in choosing a definite type of engine. Those who make vertical motors are trying the horizontal types, and those who have hitherto given their attention to the horizontal engines are experimenting with the vertical, while some are endeavouring to make a selection among all sorts of systems. It is true that since the various motor car concerns were formed into companies there is plenty of money for carrying out this purely experimental work, and probably, therefore, the progress in the near future will be more rapid than it has been in the past. The chief difficulty lies in finding some suitable propelling mechanism for the lighter types of carriages, for which there will necessarily always be a very heavy demand. Among the considerable number of light vehicles exhibited at the show propelled by the De Dion motor, there were a few carriages fitted with new engines upon the same principle, and it remains to be seen whether any of these will solve the problem of small vehicle propulsion.

RAILWAYS IN INDO-CHINA.

The loan of eight millions sterling proposed by the Governor-General of Indo-China, and introduced into the Chamber of Deputies with the full support of the French Government, is to be devoted entirely to the construction of a network of railways, without which M. Doumer believes that it will be impossible to turn the rich natural resources of Tonkin and Cochin-China to satisfactory account. The amount asked for is intended to carry out a part of the entire railway scheme, and permit of work being immediately started upon the construction of 1660 kiloms. out of a total length of 4000 kiloms. of line.

The railways will be built in five sections. The most important is the 400 kiloms. of line which will put Haiphong into communication with Hanoi and Lao-Kai on the Chinese frontier. This railway will be eventually extended to Yunnan-Sen by virtue of a concession accorded by China to the French Government, and it will probably be carried out by a company, whose interest on capital will be guaranteed by the Colony. The French attach the greatest value to this enterprise, as not only will the colonial section open up the vast region watered by the unnavigable Red River, but the Chinese extension will put Tonkin into communication with what is deemed one of the richest mineral territories of the Celestial Empire. Yunnan has already been thoroughly explored by French mineralogists and other experts, who express the opinion that the proposed railway will be a very profitable undertaking. The section from Hanoi to Vigne will have a length of 320 kiloms. It will pass through a rich and populous country, and will greatly facilitate the exportation of the natural products. The third section from Kwang-tri to Hue and Tuoron, a distance of 195 kiloms., is regarded more as a strategical line, since it will put the capital of Annam into direct communication with the only accessible port in that country. Nevertheless, between Hue and Kwang-tri the railway will pass through rich cultivated plains that will provide it with plenty of traffic. The fourth section will have a length of 650 kiloms., and will connect Saigon with Kahn-Hoa, while a branch line will go off to the high plateau of Lang-Bian, which is at present almost inaccessible. The climate on the plateau is particularly suited to European settlers, and it is expected that this district will become one of the most prosperous regions in Cochin-China. The fifth section, having a length of 95 kiloms, will be an extension of the existing line between Saigon and Mitho to Cantho, on the south-west, where a large traffic is likely to be done in the transport of rice and other produce. All these sections will be eventually connected up with new railways, and two branch lines will go off to the uplands of Attopeu and the river Mekong, where it is intended to establish a sanatorium for the Government officials.

All these enterprises will provide a considerable amount of work to the French makers of rails and railway material; but as they are very busy just now on account of the home companies, who are spending a great deal of money on the renewal of their plant, in view of the Exhibition of 1900, it is by no means improbable that a good many of the Indo-Chinese contracts will have to go abroad, if it is intended to complete the lines within a reasonable time.

THE JAPANESE DESTROYER, IKADSUCHI.

A preliminary high-speed trial was made on Thursday, the 15th inst., of the torpedo boat destroyer Ikadsuchi, the latest addition to the Imperial Japanese Navy. This is the first of six precisely similar vessels under construction by Messrs. Yarrow and Co., Limited, at their yard at Poplar. These boats are interesting, in that they are larger than anything hitherto attempted in this direction by Messrs. Yarrow, and that their contract speed is 31 knots. The Ikadsuchi is 220ft. long and 20ft. 6in. beam, and has a draught when loaded for trial of 8ft. 6in. aft. Her trial load is 35 tons. On the occasion of this run she had all this on board, and, in addition, she carried seventy-eight persons. The trial was witnessed on behalf of the Japanese Government by Admiral Matsunaga, Captains Kondo and Kurobe, of the Construction Department, and Commander Ishida, who will eventually have charge of the destroyer when she is taken over by the Japanese Government and his staff. The engines are triple-expansion and have four cylinders, the two low-pressure cylinders being at each end of the combination, following the Yarrow, Slick, and Tweedie design, and they are so well balanced that the vibration, considering the power produced, is remarkably small. The sizes of the cylinders are:—High-pressure, 20½in.; intermediate, 31½in.; and two low-pressure cylinders of 34in. There are two sets of engines driving twin three-bladed propellers, and the estimated horse-power for the contract speed is about 6000, though the engines are said to be quite capable of working up to 7000-horse power if necessary. The stroke is 18in., and the number of revolutions about 400 per minute.

There are four boilers, two for the port, and two for the starboard engines. These boilers are of the ordinary Yarrow water-tube type, and are capable, if pressed, of doing well over 1500-horse power each; each boiler has its own funnel. There are two stokeholds, the boilers being placed so that two can be fed from one hold, through the three furnace doors with which each is provided. The forced draught is worked by means of a horizontal fan, 6ft. in diameter, the spindle of which descends to the level of the stoking floor, where it is connected to a small horizontal engine; there is therefore one fan to two boilers. The boilers are constructed for a working pressure of 250 lb. on the square inch.

The electric equipment, for which Messrs. Siemens Brothers are responsible, consists of forty-two fixed 16-candle power lamps, three navigation lights, three signal lights, and a 20in. projector of 20,000-candle power, provided with an automatic lamp, Mangin mirror, and dispersing lens. The dynamo, which gives 100 ampères at 80 volts, is of the Admiralty pattern, and is coupled to a Bellis tandem compound enclosed engine, running at 500 revolutions per minute. The armament consists of a 12-pounder quick-firing gun, mounted aft, and a broadside of five 6-pounder quick-firers. There will, in addition, be two 18-in. torpedo tubes. These will be placed aft, and will be capable of swivelling. There will be storage room for six torpedoes. The coal-carrying capacity of these boats is 90 tons, which is capable of taking them at economical speed for a distance of over 3,000 nautical miles. The coal is carried in bunkers situated at the sides of the vessels. The officers' quarters, which are much more roomy than in the generality of destroyers, are in these particular boats placed immediately aft of the engine room, from which, they are separated by a bulkhead.

On the occasion of the trial, an early start was made from Poplar, and the vessel was taken down to the Maplin measured mile, and put to full speed. She more than fulfilled her contract, for she attained a speed of well over 31 knots, with a steam pressure of only 185 lb. on the square inch, a vacuum of 25in., and just over 400 revolutions per minute of the engines. The official trials are shortly to take place.

THE DERWENT AND ASHOP WATER SUPPLY SCHEMES.

A smart parliamentary struggle over the rivers Derwent and Ashop is likely to take place soon. Leicester, Sheffield, and Derby are each contending for entire control of the head waters of these rivers, with the primary object of supplementing their existing water supplies. Without for a moment suggesting which of these towns, if any, should be permitted to take the whole or part of this water, we propose to give some idea of the nature of the water supply; to describe the schemes as at present suggested; and to set out what are the claims which each town puts forward to being a participator in the water.

All three schemes aim at impounding the head waters of both the Derwent and the Ashop, either by means of reservoirs on these rivers themselves, or else by a reservoir just below their junction. We hear that a number of attempts have been made by the three towns to come to some general understanding between themselves, but these have fallen through, apparently because each one wishes to play the leading part.

The rivers Derwent and Ashop both rise in the Peak country, the former just on the borders of Derbyshire and Yorkshire. They come together at a place called Ashopton, Fig. 5, a pastoral village of the true Derbyshire type, with its famous inn, a relic of the old coaching days. It is charming country, and is the watershed of the Derwent. It comprises 23,000 acres, which contain as a total but 100 inhabitants, and it is only very slightly cultivated. At the source of the

DERWENT AND ASHOP GATHERING GROUNDS

Fig. 1—"SLIPPERY STONES" NEAR SOURCE OF DERWENT

Fig. 2—THE DERWENT AT RONKSLEY MEADOWS

Fig. 3—THE DERWENT NEAR OUZELDEN CLOUGH

Fig. 4—THE ASHOP NEAR HAGGLEE FARM

Fig 5—THE CONFLUENCE OF DERWENT AND ASHOP

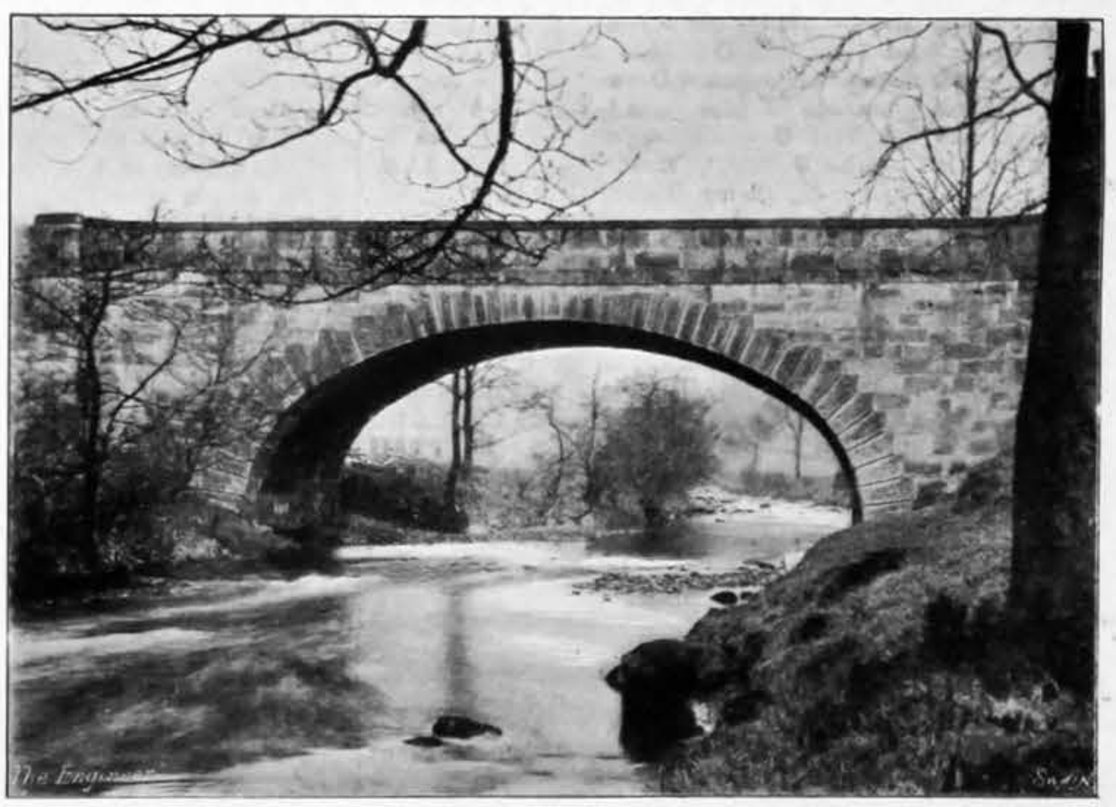


Fig. 6—THE DERWENT NEAR ASHOPTON

Derwent, near Slippery Stones, Fig. 1, as a local authority says, one finds himself "absolutely alone with earth and sky, save for the bleating of the startled sheep or the crowing of the grouse he disturbs as he walks along." An ideal spot for obtaining pure water; indeed, the water is said to possess an extremely high degree of organic purity, and according to a report made by Sir Edward Frankland, it is remarkably soft, being almost entirely free from salts of lime and magnesia, and for dietetic purposes one of the best in the kingdom. Of the rainfall, strangely enough, there does not appear to be any direct evidence forthcoming. The valleys of the Derwent and the Ashop, it is stated, have never been gauged. The fall in adjoining valleys, however, has been taken for a lengthy period, and the results there obtained point to the fact that somewhere about 40in. of rain may be expected in ordinary dry seasons in the valleys now under consideration. On this basis it is calculated that 30,000,000 gallons may be expected to be realised as a daily average.

Of the three schemes, that of Leicester is the most daring, if for no other reason, certainly on account of the distance to which the water is to be taken, some 66 miles. Sheffield is very much nearer, only 10 to 12 miles off, and it is extraordinary that this town should not have gone to this source before. The Leicester and Derby schemes are similar in design.

Taking them in detail, the Leicester scheme is the outcome of a large amount of thought, and has only been adopted after careful search and investigation in other directions. First of all, Loughborough was suggested as a possible source, this town having acquired more water than it is likely to require for its own uses for many years to come. This project was discarded because it was found that, supposing in the future Leicester had to further increase its supply and carried out such another scheme as the present Derwent project, it would still have to pay Loughborough for fifty years, whether it used the water or not. It had also been in turn suggested that water should be obtained from Bardon Hill, Twyford and Mere, Eye Valley, and Rutland. Each scheme, however, had to be given up. Then it was attempted to obtain a supply from Birmingham, but not only would this have been accompanied by a large expenditure of money in Parliament, but the cost of the mains would have been more than the cost of the Derwent project. Eventually, therefore, it was decided to adopt this. It provides a total of five reservoirs, though at present it is only proposed to form one. The five reservoirs are as follows:—

(1) *The Ronksley Reservoir.*—This is situated about five miles up the Derwent from Ashopton. It will have a masonry dam, and contain 921 million gallons. Fig. 2.

(2) *The Ouzelden Reservoir*, the masonry dam of which will be built across the Derwent, some 3½ miles north of Ashopton, and the water in it at its highest point will reach the base of the Ronksley Dam, the reservoir being some 1½ miles long. It will contain 2530 million gallons of water. This is the first of the reservoirs which it is proposed to construct, and from it 12,000,000 gallons daily will be drawn. Of this, at present, Leicester proposes to take 5,000,000, giving Derby and Derbyshire 7,000,000 gallons. From this reservoir it is suggested to lead an aqueduct to conduct the water southwards, and compensation gauges and storm overflows are arranged for. Fig. 3.

(3) *The Blackden Reservoir.*—This is on the Ashop, some 4½ miles above Ashopton. Here, again, the building of a masonry dam is proposed, and the suggested capacity of the reservoir, which will be a mile long, is 467 million gallons.

(4) *The Hagglee Reservoir.*—This completes the storage reservoirs so far as water supply is concerned, as No. 5 is only intended for compensation purposes. Here, again, there is to be a masonry dam, supplied with overflows and compensation gauges. It is to be placed near Hagglee Farm, some 2½ miles north-west of Ashopton, Fig. 4, and the reservoir is to contain 2161 million gallons, so that the total suggested storage, when the whole scheme is carried out, is as follows:—

Derwent	Ronksley Reservoir	921	million gallons.
	Ouzelden ,,	2530	,, ,,
Ashop	Blackden ,,	437	,, ,,
	Hagglee ,,	2101	,, ,,
Total		6079	

From the Hagglee Reservoir the Leicester scheme proposes to take a tunnel 1200 yards in length to join the aqueduct coming from the Ouzelden Reservoir, rather more than a mile from its commencement.

(5) *The Bamford Reservoir.*—This will be the last to be constructed, and will only be used for a compensation reservoir. It will be constructed with an earthen dam, and will contain 2502 million gallons of water. At Bamford also there are to be fifteen filter beds, which are to be constructed in three groups of five filter beds each.

From this point the water will be led through alternating cast iron pipes, concrete conduits, and tunnels, to service reservoirs at Ambergate, 637ft. above Ordnance Datum, which will eventually hold 30,000,000 gallons, but at first only 5,000,000 gallons. From here supplies could be taken to Derby, or any other town which might require them, and water could be led by gravitation to service reservoirs in the neighbourhood of Leicester. It is an important scheme, and if only the first part of it be carried out the estimated cost is £1,520,000. One cannot but admire the pluck and enterprise exhibited by Mr. Everard, the engineer to the Corporation of Leicester, in working out and bringing forward such a scheme—a scheme which has for its object the impounding the whole of the upper waters of the Derwent and Ashop, together with all their tributaries.

The Derby scheme is practically as elaborate as that of Leicester, and it provides for no less than eight reservoirs. The series begins with the Ronksley reservoir, with a dam across the Derwent half a mile north of Ronksley Farm, and extending about a mile and a-quarter up the river from that point. Next is the Howden Reservoir, also on the Derwent, but extending up the tributary river West End as well; a third reservoir on the Derwent would be situate about the confluence of the Derwent and the Abbey Brook. Derby's No. 4 reservoir, to be called the Woodlands Reservoir, would drain the Ashop and the Alport; No. 5, the Ashopton Reservoir, situated near Ashopton Bridge, would take the remainder of the Ashop waters just before that stream enters the Derwent; No. 6, to be called the Bamford Reservoir, would continue the line of reservoirs on the Derwent from Ashopton Bridge to Bamford Mills. The two other reservoirs would be the Edale Reservoir, on the river Noe, with a dam near Barber Booth; and the Burbage Reservoir, draining the Burbage Brook, and situated a quarter of a mile above and below Burbage Bridge. The pipe lines, conduits, &c., from the various reservoirs would in the Derby scheme converge into a huge service tank at Crich, below Ambergate; and there would be additional service tanks at Bargate, near Belper, and at Little Eaton, just outside Derby.

The Sheffield scheme is considerably less pretentious than either of the foregoing. It proposes the construction of three large reservoirs on the Derwent, one near Slippery Stones, to be called the Howden Reservoir; one immediately below this, to be called the Derwent Reservoir, and extending as far down stream as Ouzelden Bridge; and a third, to be called the Bamford Reservoir, skirting the foot of Win Hill, from the junction of the Ashop and Derwent down to below Yorkshire Bridge. Further, the Sheffield Bill proposes to put a weir across the Ashop above Alport Bridge, and from above the weir to convey the waters there collected through an aqueduct or tunnel into the Ouzelden Brook, which falls into the Derwent above the proposed Derwent Reservoir. By these means, and by means of pipe lines from the reservoirs to the city, the Sheffield Corporation will be enabled to secure the waters of the Derwent, West End, Alport, Lady Clough, Cranberry Clough, Abbey Brook, Ouzelden Brook, Lady Bower Brook, and their tributaries.

As will have been seen, each town in succession proposes to acquire rights over the whole of the watershed, and it is interesting to note the avowed intentions of each one. Leicester proposes to supply Derby and Derbyshire in addition to itself and neighbouring towns; it even in the first instance proposes to give to Derby and Derbyshire more than half the total amount of water to be obtained, and suggests a joint Water Board. Derby says nothing about Leicester, which is not to be wondered at considering the distance between these two towns, every yard of which is going further away from the source. Derby only professes to act on its own behalf and on that of Derbyshire, inserting clauses to give itself power to share responsibilities with the Derby County Council, and other Derbyshire authorities, and also to empower it to sell water in bulk. Sheffield mentions neither Derby nor Leicester, but it is proposed to share the water with Rotherham and Doncaster—both of them further away from the source of supply than itself—and provides for a joint Committee representing the three Corporations to settle the terms upon which Rotherham and Doncaster are to be supplied.

And now as to the claims which the various towns can have upon this water. How comes it that Sheffield, in Yorkshire, and Leicester, in Leicestershire, can have any claim upon the water of a river which rises in a different county, and which in the case of Leicestershire does not flow through one inch of its soil? The answer to questions such as these has already been given in the case of the water supply of Manchester, Liverpool, and Birmingham. If a large community can prove its needs and formulate a workable scheme, it will be allowed to carry it through, in a more or less modified form, according to the opposition it has met with.

Sheffield has for some years now been looking far into the distance with respect to its water supply. Already this town has the use of the waters of the Rivelin, Loxley, Ewdon, and Little Don Valleys, but it is not fully persuaded that its water supply is ensured sufficiently far ahead, and hence its present attitude. The waters of the Derwent form Sheffield's last resource before going to, say, the Lake district for water. It is difficult to understand why it has not acquired the Derwent supply before. Six years ago it was recommended to do so, and there is every reason to believe that it would have been allowed to make use of the Dore and Chinley tunnel, which would have been exactly at the right level for the pipes. Whether or not it will now be able to prove that it is in such want as to warrant permission being given to it to go into an adjoining county for further supply remains, of course, to be proved; but, in addition, the town is prepared to contend that it has *primâ facie* rights; that the boundary between Derbyshire and Yorkshire follows for a great distance the ridge which parts the watersheds of the Derwent and the Don; that there are gathering grounds in Yorkshire dipping towards the Derwent; that five of the six feeders on the left bank of the Upper Derwent are wholly in Yorkshire, and that for some distance from the point where the Abbey Brook joins the Derwent this latter is the county boundary right up to its source. So much then for the claims of Sheffield. Derby evidently does not recognise the claims of anyone but itself and the county which bears its name. From their point of view this is very natural. The whole length of the Derwent is in Derbyshire, although it forms part of the boundary with Yorkshire. Not only this, but Derby is actually on the Derwent, and therefore claims the exclusive right of dealing with the upper waters and regulating the amount of water flowing in the river. This point, we may be sure, will be most carefully attended to whichever of the towns may in whole or in part obtain water from the Upper Derwent, for Derby depends largely in its commerce on water power derived from the river.

The claim of Leicester to the Derwent is that it is the nearest source from which it can obtain a sufficient amount of water for its present and future needs, and it will doubtless urge that these needs are, even at the present time, very pressing, and that it has exploited a large number of other sources without success. Leicester further claims the water almost as a right, since it is in the watershed of the Trent, contending that its claim is just, as the Derwent flows into the Trent, and that, at any rate, Sheffield can have no participation in this source of supply, as the town is in the watershed of the Ouse. Leicester, however, does recognise that Derby has a good claim to the water, as is shown by the provision it makes in its Bill.

"IMPROVEMENTS" IN PRESERVATIVE PAINTS.

THE subject of preservative paints for exposed ironwork is so important to all constructional engineers that a brief sketch of some recent investigations and improvements in the direction of preparing a more efficient material than those at present found on the markets may perhaps be welcomed by our readers.

Oxide of iron colours, which are among the most highly favoured pigments for linseed oil paints, are usually manufactured by igniting at a high temperature in a muffle furnace some raw mineral or by-product, such as yellow ochre or crude sulphate of iron. Furnacing for a short time or at a comparatively mild heat yields a dark-brown oxide; if the operation is prolonged or the fire urged, the colour gradually changes to a light brown, then to a red, afterwards to a reddish purple, and finally to a dark purple. Evidently, therefore, the product becomes more expensive as its shade alters from brown to purple, even though each and every such material may be almost equally composed of pure ferric oxide, varying solely in its physical characteristics. Experiments have lately been instituted by Baucke with the view of deciding whether there is any practical advantage to be gained in using the more costly—*i.e.*, purple—grades of oxide as the basis of a purely preservative paint; for it is clear that the colour, *qua* colour, is a matter of quite secondary importance. Bearing in mind that much engineers' paint is employed for railway work, such as bridges and roofs, where the substance is constantly exposed to the peculiarly corrosive influence of the acid exhaust from coal and coke fires, Baucke has specially studied the behaviour of iron oxide towards dilute inorganic acids. He finds that the pigment undoubtedly becomes more resistant the longer it is furnaced or the more severely it is ignited, and that chemically a purple oxide is more valuable than a brown one. Making proper allowance for the increasing cost, he considers a distinctly red oxide the best of all, and suggests that such a material shall be chosen for most industrial purposes. As the colour changes during the process of manufacture, so also the specific gravity of the oxide rises, always assuming that the ochre, &c., is reasonably free from heavy impurities. Again considering expense, he shows that a density of 4·2 is the most suitable; and he proves that this figure may be utilised as a means of gauging the commercial value of the pigment.

An English patent—No. 28,484, 1897—has recently been taken out by H. Loesner, who is well known to all readers of German industrial chemistry as a painstaking investigator of the relative protective capacity of different varieties of paint and varnish. His process consists in grinding some colour into linseed oil in the presence of a certain proportion of hydraulic cement, or cement diluted with sand. Precautions are taken to prevent the cement from absorbing water before the paint is applied to the ironwork; so that when the film is finally exposed the new ingredient is slowly caused to set by means of the moisture present in the surrounding atmosphere; at length producing a thin layer of hardened cement, or cement-mortar embodied in a paint of conventional composition, in which the former provides the waterproofing qualities, and the latter the colour and general appearance of ordinary paint. The patentee claims that the introduction of cement in this fashion does not militate against the proper spreading of the material, and that the product is satisfactory in every respect, being absolutely damp-proof and permanent.

The same chemist has also elaborated a quick method of testing paints to determine their moisture-resisting power. This is known as a "steam test," and, being simple to carry out, may conveniently be described here. Pieces of sheet iron are thoroughly freed from rust on one side by friction with emery cloth, then coated with a thin film of paint, and set aside to dry for four days. A second coat is next applied, and also allowed to harden for the same period of time. A vessel containing water is made to boil vigorously, narrow strips of wood are laid across it, and over them are placed the pieces of iron, painted side downwards, in such a manner that the films are completely surrounded by the rising steam. The water-bath is so arranged that the level of the liquid can be maintained at a uniform position, which is, throughout the whole test, always 50 mm. below the metal plates. After about fifteen hours' boiling the paint is dried at 100 deg. Cent., removed from the iron by the aid of aniline and a brush, and the surface of the metal is carefully examined for spots of rust. If the iron be not corroded the paint may be considered fairly weatherproof; for the author calculates that one hour of his steam test is equivalent to two or three months' exposure to wind and rain. Twelve hours may be taken as the minimum period of resistance for a good paint; scarcely any kind of composition will withstand the steam longer, except the patent material described in the last paragraph.

A series of comparative trials with different varieties of oil paint applied to wood, tin, galvanised, and plain sheet iron has been carried out by G. R. Henderson, in America. The test pieces were given two coats and exposed for a year out of doors in a south light. Tin and galvanised iron lasted best when protected with a first coat of white lead and a second coat of zinc white. Sheet iron appeared to prefer a mixture of two-thirds white lead and one-third zinc white in each coat. Poplar and white deal behaved satisfactorily with either pigment alone or both together; "yellow" was more difficult to paint, but lead for the priming coat was indicated.

LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

BRITISH AND AMERICAN MACHINE TOOLS.

SIR,—Mr. Hugh Campbell, in his letter on "British and American Machine Tools," which appeared in your issue of the 9th inst., makes several incorrect statements regarding "the one firm in this country who has a line of key-seating machines." As representing the firm referred to, I must apologise for having to touch upon personal matters; but Mr. Campbell has given your readers only one side of the question, and I should therefore like to put the real facts before them. These are as follows:—Mr. Campbell ordered a large size keyseater from my firm on the 18th December, 1896, and was distinctly assured at that time that delivery could not be effected in less than from five to six months—*i.e.*, 18th June, 1897, as the latter limit—owing to our being exceptionally busy at the time, and because the machine would need special alterations to suit Mr. Campbell's requirements. When quoting, and also on receipt of order, we drew Mr. Campbell's attention to the fact that cutter bars were essential to the machine, and that those to suit his machine, being special, would take almost as long to make as the machine itself. In spite of these admonitions, Mr. Campbell did not order these cutter bars until 21st June, 1897, or six months after we received the order for the machine itself, and then, forsooth, cancelled the orders for machine and cutter bars less than a month after, on July 19th. There was no question of cancelling the order because of delay in delivery, until we had to inform Mr. Campbell that our men were out on the forty-eight hour question. Then, although we assured him that there was only ten days' work required to complete the machine, when we got our men back again, he pleaded continued delay—*i.e.*, one month in excess of our estimated time—and cancelled the order.

Mr. Campbell's firm was not amongst those who came into line and fought the forty-eight hour and machine questions, and had not backbone enough to fight for the very existence of the engineering trade in this country. It gives me much pleasure, therefore, to here record that this order was the only one we had cancelled by an English firm owing to that dispute.

Turning to Mr. Campbell's letter generally, if he had been as well informed on the subject of British as he appears to be on that of American machine tools, he certainly would not have put pen to half the statements he has made, as they will not bear the test of the most superficial examination. For instance, Mr. Campbell states that "boring and turning mills were not built in England until a couple of years ago, and then only in small sizes by Messrs. Richards and Co., of Manchester." It will no doubt surprise Mr. Campbell to learn that my firm has been building boring and turning mills steadily since May, 1889, in sizes ranging from 2ft. 6in. to 20ft. in diameter, but—alas for the British enterprise!—75 per cent. of these were for the Continent. The question of delivery is one that could easily be met in ordinary times; but the whole British machine tool trade is at the present time so abnormally busy that quick deliveries are an impossibility, hence the American opportunity. That many orders pass us on this account—and this account only—for these very machines, we have had ample proof lately, but the output of a works is limited, even when the plant has practically been doubled in the last three years.

Again, referring to capstan and turret lathes, Mr. Campbell says, "What firm or firms in this country, except Alfred Herbert, Limited, of Coventry, can show us such a line of these tools for both bar and casting work as the Americans?" Has Mr. Campbell ever heard of Alfred Muir and Co., of Manchester, who have been building the American type of capstan lathe for years, and does Mr. Campbell realise that my firm build their own types in nineteen different sizes on five different models? No doubt it will surprise Mr. Campbell to learn that we have taken orders for over sixty capstan lathes this year, and could, without doubt, have taken orders for half as many again had we not had at least six months' work on the books throughout the year. Surely these figures point to the fact that one British type of capstan lathe at the least holds its own. I might also in this connection remind Mr. Campbell that my firm were the original patentees of the chasing lathe, the screwing die box of which is so important a feature of the capstan lathe, however made. As to the claims Mr. Campbell makes for American drill presses, we are perfectly willing to dispose of two, a 25in. and a 32in., to him; they are built by an American firm of good repute, but will not hold their own, even when pitted against smaller sizes of drilling machines made by ourselves, in such essential points as accuracy, stability, or capability of production.

I must apologise for trespassing at so great length on your valuable space, but I hope your readers will have gathered from my remarks that Mr. Campbell and those who seem, at the present time, to take a delight in belittling the enterprise and ingenuity of the British machine tool makers, appear to those who have some knowledge of what has been done, and is being done, in both England and America, to be simply retailing some of the glib, though often erroneous, statements made by the ubiquitous American representatives who have recently inundated this country. As a case in point, let me relate an experience of my own: An American was enlarging to me on the advantage of making a certain thing in a certain way, and when I pointed out to him what an utter fallacy he was supporting, he backed out with the words "Well, at any rate, it gives us something to talk about."

THEODORE COVENTRY.
(Smith and Coventry, Limited.)
Salford, Manchester, December 19th.

SIR,—I have read with interest the leading article in your issue of the 2nd inst., and Mr. Campbell's letter in your current number. His letter very ably supports your view, and goes further, but, in my opinion, not too far by any means. I have during the last ten years taken a deep and close interest in this most important industry, and in 1893 I read a paper on the subject before one of the London engineering societies, and at the present time am writing a series of articles in one of your contemporaries; and it is the competitive side of the question that seems to me so important—I mean American enterprise and English indifference. I am not interested in any way whatever with any American firm, but it is sheer folly to imagine that if things go on as at present we shall retain our position. At first they came with hand tools, and few firms here can beat them in that line; then light tools, such as sensitive drills, turret lathes, light milling machines, and so on, and now they have commenced to supply heavy tools in earnest. If anyone thinks this is not so because he does not see many heavy machines in stock, he may learn that it

has now become a practice to cable for heavy tools, and, what is more, get very prompt delivery—certainly quicker than they can be got in England in most cases.

Our tool shops are busy, I know, but the Navy boom will not last for ever; and, as you very ably pointed out in your leader, the cycle boom is on the wane. As an Englishman, I should be glad to see only English tools used here, but I venture to think he is a greater patriot who encourages his countrymen to maintain their superiority than to shout out that their products are the best when really they are inferior. I do not hesitate to say that we can make as good a tool as any country, but I doubt if we are doing so at the present moment; but whether we are or not, we are at any rate giving our American friends the opportunity to flood our market largely on account of our want of enterprise. How many English firms have show-rooms in London? How many exhibit in any way outside their own shops? If American firms can sell the first-class tools they are offering at a profit after paying a high wage rate and costly freight, then I submit we ought to do the same and go one better, but we must be prepared to spend money and burn a good many patterns.

London, December, 14th. E. C. AMOS, M.I.M.E.

SIR,—With reference to Mr. Hugh Campbell's wholesale onslaught on British machine tool makers in your last issue, we wish to correct a rather damaging statement of his, that no firm in this country can offer a good planing machine, cutting at 20ft. and reversing at 80ft. per minute. We are making a speciality of planing machines, and these speeds on a noiseless running machine are our ordinary practice. Our standard machines also embody advantages which, we have good reason to believe, are not on even the best and most expensive American planers, viz., an additional slow-cutting speed of 12ft. per minute for extra hard material, and having correspondingly increased driving power, automatic lifting motion to the cutting tools during the return stroke, the total avoidance of torsional strain on main gearing shafts, and consequent spring. We might mention many other points of interest in planers to show that, as regards up-to-date improvements, we are by no means content to take a back seat. It is evident that Mr. Campbell is not acquainted with the younger firms in the tool trade. We instance one machine only of those mentioned by him as it most directly affects ourselves.

CLIFTON AND WADDELL,
Machine Tool Makers.

Johnstone, Scotland, December 13th.

SIR,—What "A Fitter" says about a horizontal lathe in Woolwich Arsenal 25 years ago is quite true. It is, however, within my knowledge that this kind of machine, which was then, and is now, very rare in engineering workshops in this country, was already at the time he names one of the tools most frequently met with in similar works in the United States.

Is the slowness with which they are coming into use here due to our innate conservatism? Tools of this class are exceedingly useful, especially for dealing with irregular work, which is very awkward to bolt on to a vertical face plate, and which necessitates troublesome counterbalancing.

Then also many articles can be most conveniently faced in a horizontal lathe, instead of being planed in a planing machine, thus avoiding the loss of time involved in the running back of the planing machine table.

As regards the general question of American *v.* English machine tools, my experience and observation, gained in both countries, lead to the conclusion that in the smaller class of machine tools the Americans have generally led the way, and that there has been a great improvement of recent years in their heavier tools.

36, Paradise-street, Birmingham, W. H. THORNBERY.
December 17th.

SIR,—Allow me to draw attention to a remark in your most interesting article, in the issue of November 25th, on the Linotype works, which, although perhaps literally correct, is still misleading.

Speaking of the bright cold steel bars, you say the American can be procured at £13 per ton, whereas the bars which were supplied by Sheffield firms, and supposed to be similar, but really very inferior, cost £23 to £24 per ton.

Now, as a matter of fact, we are regularly getting from a Leeds firm odd shafts of bright cold rolled steel, 3ft. to 22ft. long, of the highest quality and finish, cut to dead lengths and square centred, at a cost per ton for 1in. diameter, £15; for 2in. diameter, £13 10s.; for 3in. diameter, £13 10s. less 2½ per cent. delivered free.

Manchester, December 19th. G. M. H.

THE PATENT-OFFICE LIBRARY.

SIR,—Those whose business takes them to the Patent-office Library are considerably indebted to both your journal, and to your contemporary *Engineering*, for much of the improvement that has been introduced there in late years, rendering it more serviceable for the purpose for which it is primarily intended, namely, that of a reference department of the Patent-office. I was pleased, therefore, to read the leading article thereon in your issue of the 25th November, as the question of the future disposition of this unique and valuable collection, and the plans relating, as intended to be carried out in the new premises, ought to be made known in good time before occupation, so that due consideration may be given to suggestions offering for the much needed amendment in the system.

The essential points to be kept in view are ably put by your correspondent Mr. Thomas Pinch, with the principal of which I agree. All the arrangements should aim to make this strictly a reference library, whereby the reader may find for himself the matter he is in want of, with no aid from a librarian. Granted those in charge are ever most ready to supply information when applied to, the very fact of having to requisition the assistance of others, who know nothing of the matter relating to the search, is in many cases more of a hindrance than help. An example of this necessity for the discoverer to search for himself may be given by referring to the new system curtailing the use of periodicals introduced since occupation of the temporary premises. Thus, say information be required relating to the use and advantage of some particular pump, or any machine in general use, details of the working of which might be found in any one of the number of periodicals devoted to engineering and mechanical subjects. Now, current numbers of periodicals must be asked for as required, so that, to satisfy a search in the above-mentioned instance, each journal file would have to be sent for separately, entailing much loss of time, or, as would more probably be the case, abandonment of the search. This inconvenience may be further exemplified by pointing out that unless one regularly follows the week's literature, it must be considered lost, unless one is prepared to wait, in the same way, for each file as sent for. The cramped accommodation under which current periodicals may be perused induces me to think that many must forego the privilege.

The deprivation of half the library now stored in the incommodious "Stock Room" must also be a serious loss in time, if not otherwise, to a great many, and consequently is no doubt an indirect loss to the Patent-office itself. A building with the requisite accommodation might well have been afforded, considering the large yearly revenue surplus coming from those who, either personally or by representative, resort there.

As regards the catalogue, it occurs to me that the "subject matter" is more important in this Library than the "authors," yet, as I understand, this half of the catalogue is not to be issued for another twelve months.

Touching the system of subject matter reference. I venture to suggest that it might be useful if the "Class Index" to the Abridgment of Specifications had the Press reference of any work or works in the Library wherein matter might be found bearing upon the subject.

December 14th. HENRY BROCKELBANK.

SIR,—In your interesting leader of the 25th ult. there are one or two points which I think may lead to misapprehension on the part of your readers as to the arrangement, scope, and value of the Patent-office Library.

Speaking as one who has used this library for many years in preference to any other, for consulting technical and general scientific works, I can only say that the arrangement serves my own purpose better than any other. All the works relating to each subject are placed together, and the reader can refer to them without filling in any form of application, &c. Above all, the courtesy and knowledge of Mr. Hulme and his staff are always available to an extent which I have not found to be the case at any other library.

It must be remembered that the Library is intended primarily for the inventor; and, secondly, for the technical and scientific searcher, and it is, of course, impossible to provide a perfect library in such cramped temporary premises; but it appears to me that we are furnished with as thoroughly "scientific an arrangement of the volumes" as could be supplied. The works which are ranged on the shelves are those most required, and any others can be obtained for the asking, while as to newly published works, the Patent-office Library seems to me to be generally first in the field. Of course questions of finance constantly clip the librarian's wings, but the flights which he is enabled to take invariably bring down the best quarry.

For technical and scientific journals, both British and foreign, the Patent-office Library undoubtedly occupies the premier position among our public libraries.

As to the cataloguing, I do not know what system of authors' catalogue, other than that adopted, could have been used. The numbers given after each entry are merely "accession" numbers, and, of course, the Dewey or any other system for press-marking them would be useless for temporary premises. Although I may say that in the catalogue—available for reference at the Library—additional marks indicating the position of the works on the shelves are added.

Finally, there exists for reference a MS. list of the periodicals, and I invariably find that all the reference catalogues at the Library are kept absolutely up to date.

The importance of the subject dealing with our public libraries, and with the cataloguing of their contents, cannot be over-estimated, and I trust that the publicity which you have given to the matter may result in an increase of the grant to this valuable library.

57, Chancery-lane, W.C., GEORGE T. HOLLOWAY.
December 13th.

THE INSTITUTION OF CIVIL ENGINEERS' ENTRANCE EXAMINATION.

SIR,—The thanks of the profession, especially those of members of the Institution, are due to you for your able article upon this subject in your last issue.

I have followed with great interest the correspondence you have published, and as it was my letter in your issue of November 4th that gave rise to the discussion, I shall esteem it a favour if you will allow me to supplement it with one or two further remarks.

My friend, whose papers induced me to write in the first instance, duly passed the examination, as he well deserved to pass, if the time he had devoted to reading and cramming was not to be afterwards looked back upon as utterly thrown away. It is just this cramming of superfluous mathematics, in order to come up to the level of these papers, that is the bone of contention, and much will be gained if the Council will adopt the suggestion you make to supervise and render practical the papers submitted by the examiners. A certain amount of theory is not only essential, but indispensable; when, however, it comes to such questions as have recently been criticised, the examination for an engineer approaches absurdity. The large majority of candidates pass because they have read up for it, but as you point out, few would pass without special preparation, not even members of the Council itself.

Sir, the policy of the Institution in initiating entrance examinations is right without question; the papers set, however, are undoubtedly wrong, and it is in the latter that amendments are needed. One other word. You published in your issue of November 11th a letter signed "M. Inst. C.E." which might have almost been supposed to cover a semi-official pronouncement by the Council. The increase in candidates, and the large percentage who pass the examinations, in no way "form a complete answer" to the objections that are raised against the papers; they tend, in fact, to emphasise the importance both to the Institution and to the candidates of putting the papers upon a basis of actual engineering value rather than, as at present, of high mathematical proficiency abnormally attained.

December 18th. ASSOC. M. INST. C.E.

AUTOMATIC GAS METERS AND COOKERS.

SIR,—As a side issue to the engineering world, the rapid devevelopment of the penny-in-the-slot system which has astonished the millions, demands something more than a passing notice. Perhaps one of the most surprising adaptations is that for gas distribution. The enormous success of this system is possibly due mainly to the reasonable desire of the public for knowing what they are buying, the cash payment, and also to the immense popularity of the pennyworth.

To such a state of perfection have automatic gas meters been brought, it is impossible to foresee to what extent they will be ultimately extended. It is probable in the near future that different rooms, workshops, offices, &c., of the same institution will control the consumption of what is required for lighting and heating purposes by automatic interception meters, rather than allow an indefinite quantity of gas to be used without regard to cost, as in many cases existing at present. Such waste not only affects the cost of production of materials, but also the health of the workers, which is of the first importance. It may be found advantageous where rooms are let as apartments in houses or hotels to allow each tenant to be responsible for their own amount of gas, in preference to the unsatisfactory fixed charges so generally made. For internal arrangements in workshops, slot meters might be employed by a mutual arrangement with the head of the department and the employés. Of course, in such a case the meter would be the property of those directly concerned. The meters being fixed in a passage or landing, can easily be available for examination and collection from time to time. In cases of illness the ready check afforded upon the consumption of a bedroom stove is a satisfactory element. Applications for automatic meters are so numerous that few gas undertakings can afford to be independent of the assistance afforded by them. It is not so much the financial side of the matter as revenue earners that has to be considered as the popularising of gas in every home, office, or workshop. It has recently been pointed out that for city and town offices a gas fire is perhaps as useful a system of heating as can well be used, no attention being required from the time the stove is lit in the morning to when it is turned off at night, thus saving not only time in this, but avoiding annoyance of too large or too small a fire and other attendant inconveniences. For bedrooms gas fires are becoming increasingly popular. Where properly fixed, and connected by a flue direct into the chimney, this method of heating is peculiarly suitable. The temperature of a room can be maintained most evenly night and day, which in several cases of illness is of immense importance, while the necessity for making the fire up, and thereby disturbing a patient, is dispensed with. There is, moreover, the additional important consideration that the fire is always available. To those affected with asthmatical, bronchial, or kindred complaints, this cannot afford to be disregarded, especially considering the liability of a sudden attack, which often occurs in the middle of the night, when some hours must frequently necessarily elapse before a coal fire can be got ready. If this notice were from a medical point of view instead of from an engineering one, much might be said in respect upon this subject. The omission of reference to the convenience obtainable in cases of illness would, however, render any notice of gas fires incomplete.

Many gas undertakings are now recognising the importance of giving every facility for supplying gas fires, are fixing them free of cost, and only making a nominal annual charge for the stove. The undertaking of which I have the honour to be the engineer is doing this with good results. In consequence of what has become to be known as the "fixed free" stove business, the numerous stove and meter makers have been inundated with orders, the delays occasioned in consequence being vexing alike to the consumer and the gas officials. The method of calculating the desirability of adopting this penny-in-the-slot system is easily calculable. My experience is that for an ordinary automatic meter for lighting purposes only, the annual gas consumption therefrom equals 10,000 cubic feet, and where a small cooker is supplied this consumption is doubled. This quantity of gas at the profit on cost of manufacture per thousand will furnish the income available as interest on the small original outlay, depreciation, and the extra cost of collection. From 20 to 35 cubic feet of gas for a penny is the general charge. An ordinary flat-flame burner consuming 5ft. per hour will thus last from four to seven hours, or where an incandescent burner is used, consuming from 3 to 4 cubic feet per hour, the time the pennyworth will last is proportionately longer. Generally speaking, gas undertakings supply fittings, burners, meter, and stove, free of cost, so that the consumer's maximum liability is only one penny. My experience is that the addition of a small cooking stove is as great a convenience comparatively in small class property as in large, where gas cooking stoves are considered well nigh indispensable.

Such a development in one of the branches of the great engineering profession is truly astounding.

Corporation Gasworks, Huddersfield, EDWARD A. HARMAN.
December 19th.

HIGH-SPEED AIR PUMPS.

SIR,—Having had considerable experience with high-speed air pumps, more especially when in charge of one of H.M. torpedo gunboats, the following results obtained from a small Edwards air pump running in a launch under my supervision have been of interest to me, and may also interest others. The pump was working under unfavourable conditions, viz., with an outboard condenser, with which, as many of your readers will know, it is often difficult to obtain good results with the ordinary air pump; the action of the latter, generally speaking, being irregular, and the vacuum at its best not being particularly good. At 420 revolutions per minute the vacuum was 29in., at 450 revolutions 28⅝in., and at 500 revolutions 28¼in. The reduction in vacuum at the higher speeds evidently was not due to any fault in the pump, but due to the temperature, as at each of the speeds the highest vacuum permissible with the existing temperature of feed was obtained. The action of the pump was all that could be desired, and the discharge perfectly regular. The gauges were correct, and the highest vacuum obtained was 29·5in.

FREDK. CHAS. HASTE, late R.N.

148, Bedford-road, Clapham, December 20th.

SIR,—Being very much interested in the above, and desirous of gaining further knowledge, it was a disappointment when I found Mr. Bremner's disposal of Lupton's pump in so summary a fashion. Whilst admitting that the vertical pump is slightly the more effective, there are many cases in which the horizontal pump is best and cheapest. Mr. Bremner's comparison of the two pumps implies that Edwards' jet condenser pump, at 200 revolutions per minute, must be a much higher-speeded pump than Lupton's pump at 90 revolutions per minute; but in all probability Lupton's pump will run at double, or even treble, the speed of Edwards' pump in actual feet travelled by the bucket, and I very much doubt if any other pump would give better results with the same temperature of injection water used. It would be instructive to know what is the length of stroke, number of revolutions, temperature of water, and vacuum obtained from the respective pumps. W. R.

Crossbills *cid* Keighley, December 21st.

LIVE STEAM FEED-WATER HEATERS.

SIR,—In reply to your note to my letter of November 29th, will you allow me to say that the explanation I gave of increased transmission due to flow will apply to water at any temperature in contact with a surface hotter than itself, and that even in the case of water already uniformly heated to boiling point the rate of evaporation will depend on the rate of convection of water to the surface. The experiments quoted in your article of November 25th fully bear out this view. That increased evaporation due to flow is not recognised in the revered text-books would, indeed, be heresy to imagine. My contention was that the explanation of this from the known effect of flowing water in setting up cross streams which impinge on the surface, seems to have received little or no attention in the recent literature of the subject. In fact, it would seem to be not generally understood that the condition laid down in the article quoted of "a violent impingement of the water on the surface" can be fulfilled by producing a high velocity of flow over the surface.

Liverpool, December 6th. T. E. STANTON.

SCREW PROPELLERS.

SIR,—Referring to the article under the above heading in your issue of the 9th inst., I would submit that the reason for the net result of the screw propeller being equal to that of the paddle-wheel lies in the fact that although designed and constructed on widely varying principles, the proportions of diameter, pitch, area, &c., of each, for obtaining a maximum efficiency, are derived from one basis of calculation, viz., the displacement and immersed section of the hull, in relation to the speed required. Both have a similar ratio of slip. The type of engine for driving varies in construction, but the net efficiency in each case is about equal.

Leeds, December 13th. F. HATTERSLEY PICKARD.

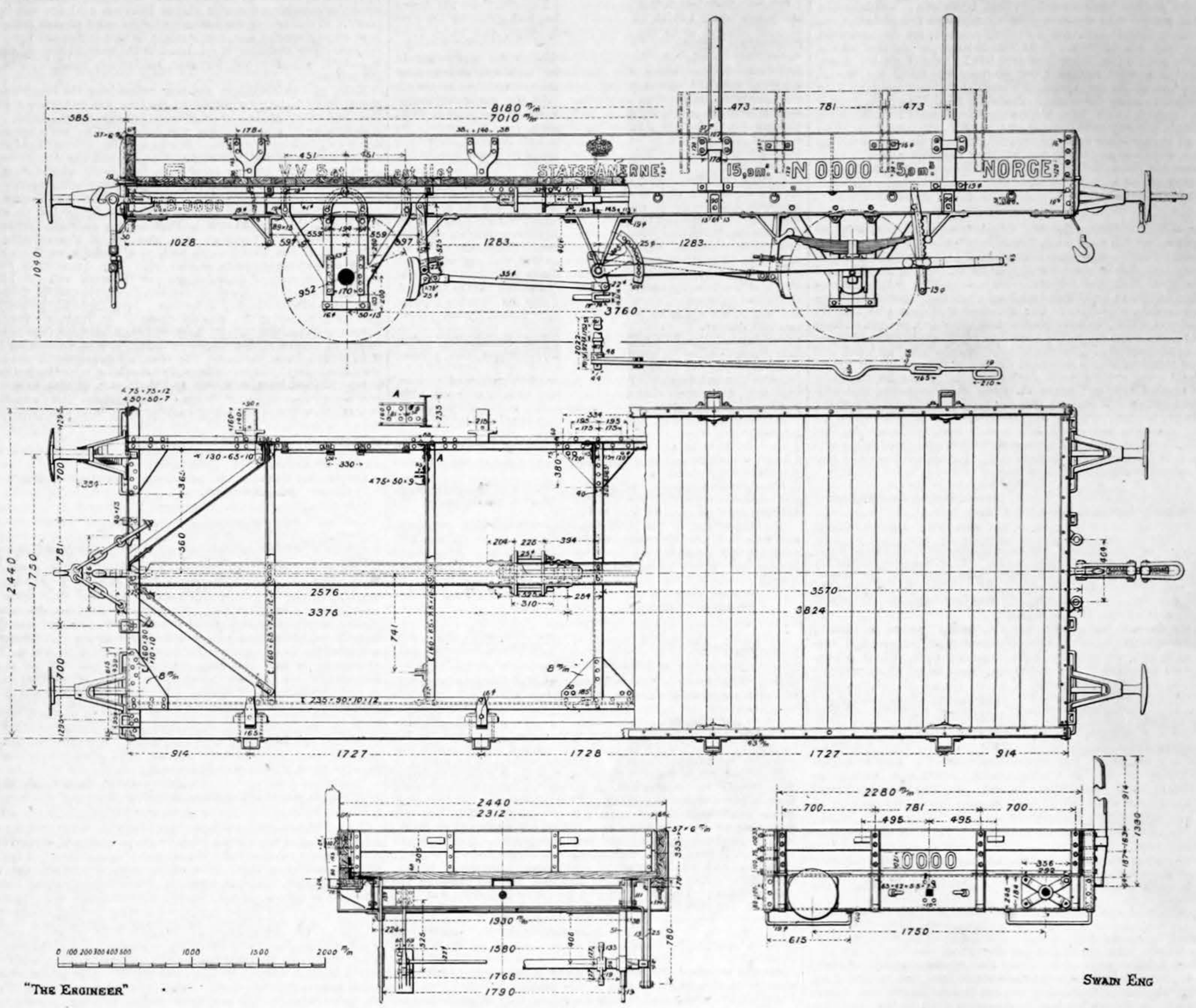
THE STRENGTH OF MORTAR.

SIR,—The literature of cement is very large. We can find full particulars of its strength in a dozen books, pamphlets, and papers, but I fail to get any definite information about lime mortar. Now for every ton of cement used there are at least five tons of lime. We build very high houses and tall chimneys, and rely more or less on the mortar for their stability. Where can I find any recent and useful data on the subject? SIMPLEX.

London, December 20th.

THE Royal Commission on Metropolitan Water Supply have decided to appoint an Assistant Commissioner to render them aid in their inquiry with respect to the estimated costs of the Welsh and Thames schemes which have been laid before them. It is likely that the appointment will be offered to Colonel Rathborne, late R.E.

CONTRACT OPEN—NORWEGIAN TIMBER TRUCK



CONTRACTS OPEN.

NORWEGIAN STATE RAILWAYS.

TENDERS are invited for the supply and delivery in Norway of sixty broad-gauge goods trucks, namely, forty timber trucks, ten ballast trucks, and ten closed goods trucks, in general accordance with regulations dated 6th July, 1896. The accompanying illustration is of the timber truck, or *stake-vogne*. Rolled beams, corner irons, and plates to be of the best Siemens-Martin steel; couplings, buffers, bearings, bolts, nails, &c., to be of Norwegian or Swedish manufacture. A receipt will be given for the proper delivery of tenders. For tenders which are delivered without receipt, no responsibility will be accepted. Tenders offered by telegraph, and telegrams which modify tenders previously sent in, must contain the mark prescribed below, written immediately after the address. Tenders or telegrams affecting the same, which are not marked in the manner prescribed, or not sent in before the expiry of the time allowed, will be put aside. The right is reserved wholly or partly to accept any tender or to reject all. Tenders in sealed envelopes, marked "Godsvogne," should be addressed to Jernhanestyrelsens Expeditionskontor, Christiania, where they should be received by Wednesday, January 4th, 1899.

It may be well to note here that foreign firms are placed at a great disadvantage as regards these Norwegian tenders, as, when a foreign firm offers, it must undertake to do the work from 10 to 15 per cent. lower than any Norwegian firm which may happen to be competing; otherwise preference will be given to native manufacture. This applies, however, only to tenders for goods which native manufacturers are capable of competing for.

THE CORK ELECTRIC TRAMWAYS AND LIGHTING INSTALLATION.

WE have been furnished with details of the electric installation at Cork, which has recently been erected by the Cork Electric Tramways and Lighting Company, Limited. This company has certainly set itself a vast feat to perform, and it will be interesting to watch the result. In a pamphlet circulated among possible consumers we read "that lamps used in sitting-rooms, halls, passages, and kitchens, which usually require lighting between dusk and 10 or 11 p.m. throughout the year, can be supplied at the average rate of 2¾d. per unit," and that "for basements and other dark corners requiring artificial light regularly throughout the whole day, electricity is obtainable in Cork at the extremely low rate of 1½d. per unit," and that "it has now become extravagant not to at once replace the older forms of light in such situations by electric lamps, as the saving in the cost of the light will be sufficient to pay for the entire cost of the change in less than a year." Further than this, a table is given contrasting the difference in cost between using electricity and gas at 3s. 4d. per 1000 cubic feet, the price charged in Cork. From this table it appears that, according to the company, there is a saving all along the line from 8-candle power lights in shop windows, where the lamps are only alight for two hours per day, and the saving is 7d. per lamp per annum, to where the same sized lamp is burning continuously all the year through, where the saving over gas is £4 7s. 6d., and this saving, after renewal of lamps is taken into account. The charges will be made by the Brighton maximum system—the first two hours being charged at 5d. per unit, and the remainder at 1d. per unit.

The figures speak for themselves. Naturally there must be something more than appears on the surface. The company, in addition to lighting, intends to run the tramways electrically, and also to supply power at 4d. for the first two hours and 1d. afterwards. The station is situated in Albert-street, and is built of brick, piles being used for the foundations. The chimney stack is of steel.

The plant consists of three Babcock and Wilcox boilers, each 2531 square feet heating surface, capable of evaporating 8000 lb. of water per hour, and working at 150 lb. These supply steam to three McIntosh and Seymour side-crank tandem compound condensing engines, running at 135 revolutions per minute, with steam heater between the cylinders. These engines are coupled direct to six-pole 200-kilowatt compound generators, giving 500 volts. The engines are condensing, the water being obtained from the river Lee some 220ft. away. The condensers are of the Wheeler Admiralty type, capable of dealing with 12,000 lb. of steam per hour, and there is the usual accompaniment of feed heater, feed pumps, hotwell, filters, &c. There is a battery of accumulators consisting of 256 feeder cells, having a capacity of 770 ampère hours at 110 ampères discharge.

The tram equipment will consist of eighteen top-seat cars, capable of seating forty-four passengers, made by the Brush Electrical Engineering Company, each fitted with two motors with series parallel controllers. The gauge is extremely narrow, only 2ft. 11½in., and the motors have had to be specially designed. The switchboard is provided with the necessary apparatus for lighting and traction work.

The cables, of which over 20 miles have been laid, are made by Messrs. Callenders, and are jute covered, lead sheathed, and tape armoured. Generally they are laid in the ground, but in a portion of their course they have to traverse the river, and here they are laid in a trench excavated in the bed of the river, vulcanised bitumen wire armoured cable being used at this point. The distribution is by the three-wire system, current being supplied for lighting at 230 volts, and for power at 460 volts.

The trams are to be worked on the overhead trolley system, a double track being laid in the principal streets. The tramway crosses the river twice, first over Parnell Bridge—a steel swing bridge—and also over Patrick's Bridge, which is of stone. Special arrangements are made for the trolley wires where they come on the swing bridge. The rails, which in the city are laid on concrete and outside the boundaries on creosoted sleepers, are 83 lb. per yard. The rails are bonded and cross-bonded on the Chicago principle. Centre poles with double bracket arms are used in the principal streets for carrying the trolley wires, and side posts with single arms on the rest of the line.

Enclosed type arc lamps, run five in series, are used for lighting the principal streets, and are placed on alternate trolley wire poles. There will eventually be about 100 lamps.

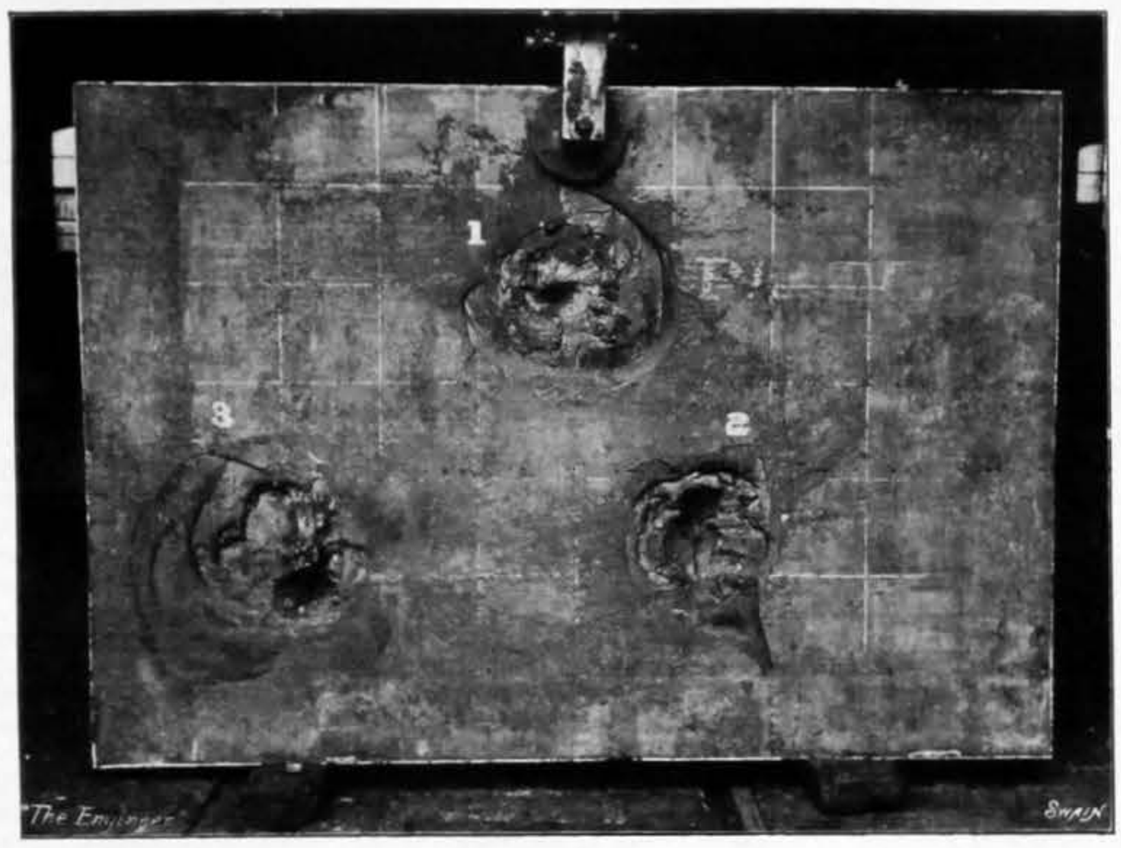
The British Thomson Houston Company, Limited, were the contractors for the work as a whole, and have themselves supplied complete the electrical equipments for the power station.

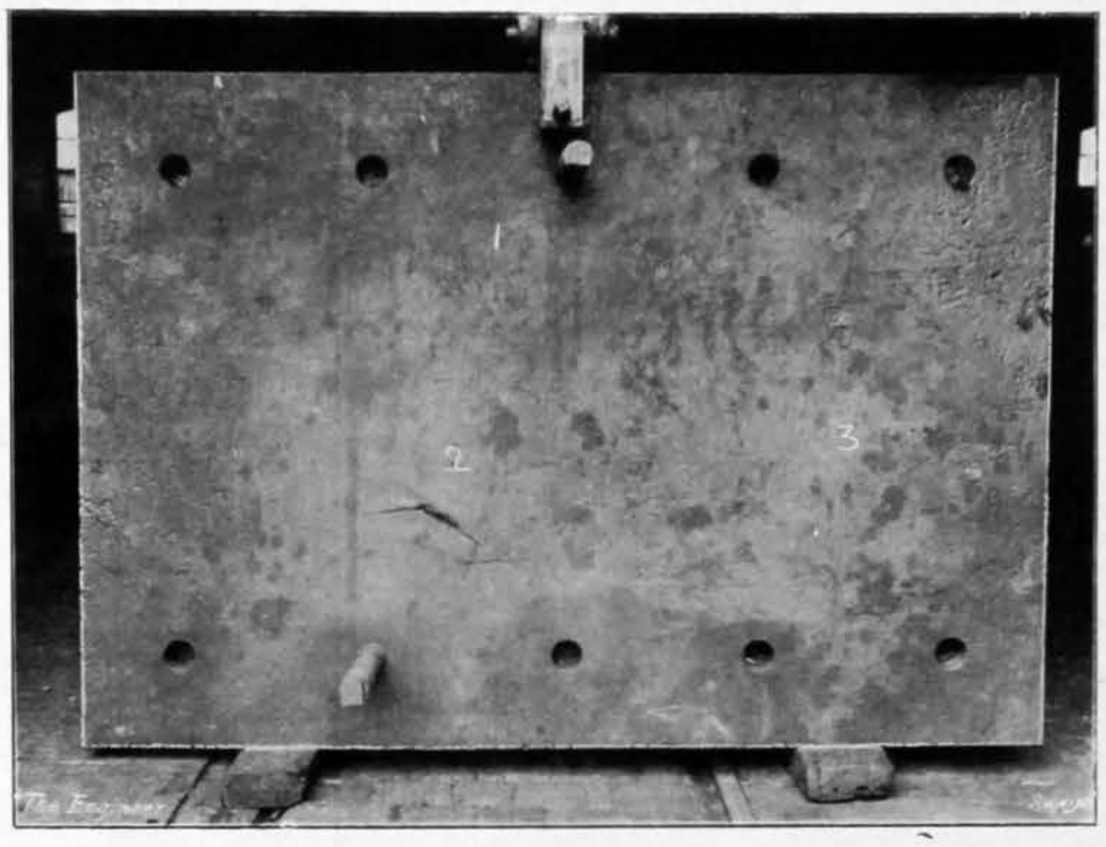
Already nearly the equivalent of 14,447 8-candle power lamps is applied for, and 113-horse power for motor work.

The company will undertake the wiring of premises if this be desired, and certainly it appears to be a most enterprising concern.

SOCIETY OF ENGINEERS.—This Society, which has been established since 1854, held its annual dinner at the Hotel Cecil on Wednesday, December 14th. Mr. W. Worby Beaumont, the President, was in the chair, and the company included Sir Benjamin Baker, Sir John Durston, General Sir Oriel Tanner, Mr. W. H. Preece, Mr. W. H. M. Christie, Astronomer Royal; Mr. Alexander Siemens, Mr. J. W. Swan, President of the Institute of Electrical Engineers; the Hon. C. S. Rolls, Mr. John Aird, M.P., and various past presidents and vice-presidents of the Institution. The occasion was taken advantage of to present an address on vellum and a tea and coffee service to Mr. G. A. Pryce Cuxson, who for the past ten years has filled with zeal and ability the office of secretary. The President, in responding to the toast of "The Society of Engineers," proposed by Mr. A. J. Walter, observed that there were in this country at the present moment more than a million of people who were employed as the result of the great inventions of Stephenson. The Society of Engineers had now been established for forty-five years, and it could not be denied that its successive members had played no unimportant part in the progress of the world. Mr. W. H. Preece, who proposed "Engineering Enterprise," drew attention to the remarkable growth in knowledge, comfort, and pleasure which had resulted from the development of engineering science in the present century. Sir Benjamin Baker replied, and several other toasts were honoured, including that of "The Guests."

MESSRS. BROWN'S 9IN. KRUPP PLATE





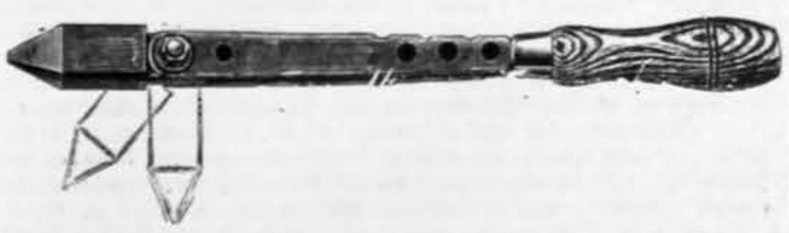
COMPLETION OF BROWN'S KRUPP ARMOUR TESTS.

THE introduction of the Krupp process into armour manufacture entailed the tests of plates of three special thickness from all our makers, namely, 6in., 9in., and 12in. approximately. As a matter of fact, the weight of the plate was specified, and not its exact thickness, and this weight per square foot was such that in the case of the heavier plates it necessitated a thickness rather below 9in. and 12in. Thus, as we reported on the occasion of the trial of Vickers', and also Brown's, 12in. plates so called, that the actual thickness was 11$\frac{11}{16}$in., or 11·69in., so Cammell's was 11·66in., which in such a case means the same thing. We now give plates from the official photographs of Brown's 9in. Krupp plate so called, which is actually 8·8in. thick, the area being 10ft. by 7ft., and the weight 11·225 tons. It is a very fine result, but the chief reason for giving it is that we have not given any sample of this thickness. The attack was made on October 27th last with a 9·2in. gun, delivering three Holtzer shot, each weighing 380 lb., on the plate with striking velocities of 1891, 1882, and 1880 foot-seconds, which implies a perforation of 20·3in. of wrought iron, bearing a relation to the thickness of the plate of 2·30. This large factor was completely defeated, as may be seen in the photographs of the face and back of the plate herewith. A few hair cracks may be seen, especially running from No. 2, which appears to have told most, although not the most severe blow, for the bulge at the back is the highest, viz., 2$\frac{5}{8}$in., and it began to yield in a crack, while the others appear to be sound and free from any sign of yielding. Probably this shot was the best of the three. It may be observed that the calibre of the shot, 9·2, bears an unusually large ratio to the thickness of the plate, and the trial is a very severe one. The striking energy of the first blow was 9423 foot-tons, and consequently the energy per ton of plate was 841·4 foot-tons. Messrs. Brown are to be congratulated on having thus most successfully met the whole of the tests, the 12in., as reported by us, having taken place on July 21st last, and the 6in. the previous year.

NEW "FOOTPRINT" TOOLS.

THE class of tools made by Mr. Thos. R. Ellin, of Sheffield, are well known. They differ from the tools of the ordinary type in being made throughout of thin steel pressed into such shapes as to give the strength in the direction desired. Two new specimens are before us, one of a pair of wire-nippers,

especially intended for cutting off the ends of cycle-wheel spokes, and the other of a soldering bit. They are both illustrated by cuts, which are practically self-explanatory. It will be noticed that the handles of the cutter are of U-shaped cross section, and that the cutting levers are made of pieces of thin steel bent double. The ingenious arrangement by which great cutting power is gained will be at once understood. The working pins are of a



special cast steel. A spring opens the handles, and a leather strap is provided for keeping them closed when desired.

The soldering bit has several points of interest. The shank is again of U-section steel for the exposed part, but the tang which passes right through the handle is bent circular. A number of holes are pierced, as shown, through the shank at its upper end, so that very little heat is actually conducted to the handle. The bit proper is secured by one or two bolts; one is, as a rule, sufficient, and can be bent as shown into various positions; different shaped bits can be fixed for various jobs. It is a convenient, light and handy tool. It is satisfactory to note that both these tools, which we have no doubt will recommend themselves to our readers, are of English manufacture.

ARMOURED PIPES.

A USEFUL armouring for submarine telegraph and telephone cables has been found in a modification of the well-known locked coil wire rope manufactured by Messrs. Felten and Guilleaume, of Mülheim-on-the-Rhine. By making the rope hollow instead of solid, and adapting it as shown in Fig. 1, which illustrates a four-core telephone cable with air spaces formed by paper partitions, and surrounded by gutta-percha and a lead cover to prevent the penetration of water, and locked coil armouring for protection against mechanical injury. In the same manner the locked coil sheathing is used as an armouring for lead pipes suitable for mining purposes, &c.; but in this case it is not only a protection against external pressure, but also renders the pipe more able to resist internal pressure, so that such pipes are especially adapted for the conveyance of water under high pressure, compressed air, &c.

Fig. 1

Fig. 2 is a section of the armoured pipe showing the construction. The lead pipe, which is smooth externally and internally, is first served with impregnated hemp, forming a bed for the locked coil armouring, which is finally served with a double cover of asphalted hemp. The latter is not necessary, but is useful in protecting the locked armouring against destructive elements in water and earth.

Fig. 2

Armoured lead pipes are made by Messrs. Felten and Guilleaume from $\frac{1}{4}$in. up to 3in. bore, and in any length capable of being transported. Therefore the many joints necessary in ordinary forged and cast iron pipes, which are often the cause of leakage, are entirely dispensed with. The comparatively few joints which should be necessary in long lengths are made by means of the couplings illustrated in Fig. 3. It will be seen at a glance how tightly each half of the joint can be attached to the ends of the pipes, and how easily suitable branch-off pipes and cut-off cocks can be inserted where necessary. The flexibility of the pipes also allows of their being used on undulating ground and in curves where, when forged and cast iron pipes are used, many angle pieces are indispensable, without counting the danger of bursting of pipes and flanges. Also alterations in the installation are much more easily effected with these lead pipes, as they will readily coil on a reel, whereas the ordinary pipes, consisting of short lengths, must be taken to pieces for transport, and re-jointed afterwards.

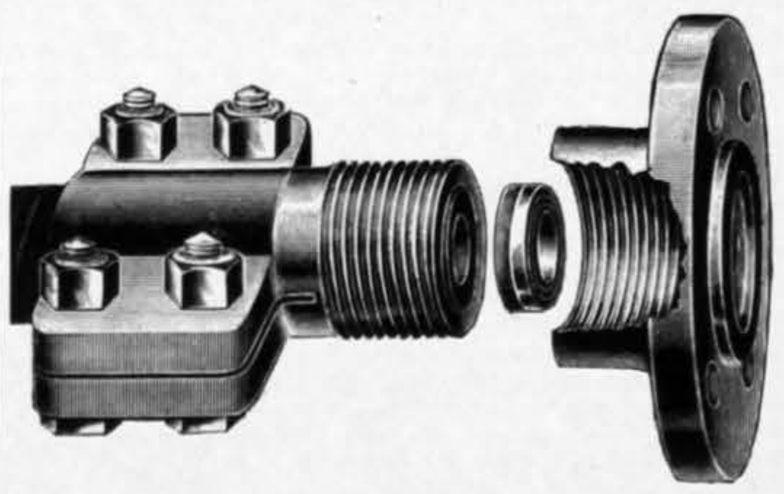


Fig. 3

Armoured lead pipes are already in use for conveying drinking water through rivers, lakes, and seas to ships, lighthouses, islands, &c. For instance, the part of Amsterdam on the other side of the Y is now supplied with water for drinking and industrial purposes by means of three armoured pipes. They have a bore of 2in., a lead cover of $\frac{5}{16}$in. thickness, and a total diameter over the armouring and asphalted hemp covering of 3$\frac{1}{8}$in. Each pipe as used at Amsterdam is made in a length of 500 yards without joints, and weighs about 10 tons. They were laid 12·4 yards below the Amsterdam water-mark in the bed of the river, a special trench having been dredged out for the purpose. For the laying two lighters towed by a steam launch were employed, fitted with trestles to carry the three reels holding the pipes. As the lighters proceeded, the three pipes uncoiled from the reels simultaneously, and dropped in the deep water of the Y, the whole operation lasting but thirty-five minutes. After laying, the pipes were submitted to a pressure test, which proved them to be absolutely water-tight. In the works the pipes had already been successfully submitted to very severe tests. Messrs. W. F. Dennis and Co., Billiter-street, are the agents in this country for Messrs. Felten and Guilleaume.

THE GAS-LIT BUOYS OF THE CLYDE.

CONSIDERABLE progress has been made of late years in respect to the illumination of buoys, rendering them of much greater utility for night navigation. The Clyde Lighthouses Trustees, who were the first to set the example of employing gas jet buoys—now about nineteen years ago—have for some time past been introducing an innovation in the buoying and lighting of the Clyde and its estuary in fixing occulting or flashing lights on many of the buoys formerly fitted with fixed lights. The buoys at the Gantock Rocks off Dunoon, at Skelmorlie, and at Rosneath points, and many of the buoys on the north side of the river between Greenock and Port Glasgow, have been changed from fixed to flashing lights, and the Trustees have just arranged for the same change being made at Strone Point, where, in place of the present black buoy, they are substituting a new buoy provided with the occulting arrangement, the cost of which will be about £390. The oil gas supply on the Pintsch system, which the Trustees manufacture at their own works at Port Glasgow, and supply to all their buoys and light ships periodically, will in this case be sufficient to last for 180 days and nights—*i.e.*, for six months continuously. Concerning the method of obtaining the occult or flashing effect of these lights, it is not, as is sometimes supposed, by means of clockwork or a perforated revolving screen. The revolving shutter arrangement has been found to be too apt to get out of gear to be satisfactory, and the contrivance in use is the "occulting box," a conical-shaped box about a foot in diameter at the base. The gas, which is at high pressure in the tank attached to the buoys, is reduced to ordinary house pressure by a reducing valve in the lantern. Inside the occulting box is a goatskin diaphragm or drum, which rises and falls with the pressure exerted by the gas. This diaphragm in turn operates upon little iron spindles, which alternately open and close the gas inlets at the required intervals of one, two, or three seconds, as the case may be. The iron casing of the lantern is so constructed that the heaviest sea fails to extinguish the light, this only being possible when the lantern has been entirely submerged for several minutes. The flashes of light from the numerous buoys are varied, so that the mariner may identify the buoy and know exactly his position. In all there are about forty lights, fixed and flashing, to be kept in order between Port Glasgow—where the jurisdiction of the Lighthouses Trust begins—and Garroch Head. At the gas-making works at Port Glasgow the plant in use is capable of producing 4000 cubic feet per day. After being made and purified the gas is allowed to go into the gasholder, from which it is pumped at great pressure into two large tanks. This pressure is the essential feature of the system, as the oil gas can be subjected to a much greater pressure than ordinary coal gas,

a *sine quâ non* where the space in the tanks and buoys is so limited. From these tanks the gas is pumped at a pressure of about 170 lb. per square inch on board the storage chambers of the steamer Torch, a specially-equipped vessel, built in 1882 by Messrs. Robert Duncan and Co., Port Glasgow, which visits the different buoys and beacons in turn, according to the holding capacity of the tanks attached, and re-charges them with the illuminant. The gas is put into the buoys under a compression equal to about six atmospheres, or 90 lb. per square inch, and the buoys are necessarily of strong construction, with their joints very perfectly made. The lantern is fixed several feet above the buoy, and is connected with the gasholder by a small pipe, the flow of gas through which is controlled by an automatic regulator, whereby the emission is kept uniform and constant.

DOCKYARD NOTES.

IT appears that the Blake is at last to be put to rights. It must be very nearly two years ago now that reports got about as to the state of her boilers, which were getting worn out, having done more than their share of work. The ship was, however, still employed, though the condition of the boilers made it unwise to use her as the swift cruiser she properly is. There is nothing new in this economy of boilers; our Admiralty are averse to changing them, so long as the necessary precautions only mean a loss of three or four knots. There are a great many ships in service with some of their boilers in the condition "you've got to be gentle with them." There would seem to be some rough-and-ready rule that boilers should last a certain number of years without much, if any, regard as to what has been got out of them in the period. There are, of course, surveys and reports, but when economies are to be effected it is usually at the expense of the boilers. In the French and Russian navies boilers are replaced, perhaps, twice where in ours it would only be done once. There used to be a joke about certain ships that were ordered not to fire their guns except in case of battle, because there was some uncertainty as to how much gun would be left after firing. That joke has lost all, or nearly all, its fitness now-a-days, but there is room for one about ships ordered not to steam full speed, unless capture by the enemy should be otherwise certain. "Victory or steam for full speed" might be the cry. Seriously, however, if the Navy League, instead of busying themselves about the armaments of ships that are never likely to go into action, were to devote a little time to the boiler question, there would be at least less energy wasted.

THE principal sufferers by the mania for making boilers last as long as possible are the makers of the engines. Foreigners desirous of having warships constructed for them are apt to take pretty careful note of the actual performances of ships, without being in a position to know that such and such a boiler or boilers were not made the most of for fear of possible consequences. When a 17-knot ship is known to have struggled along at about 13·5 knots, she soon gets a service reputation of "groggy engines," and the foreigner hears of it sooner or later. The measured mile trip he is not captured by; on what he can get hold of about actual performances he pins his faith. It may, of course, be put forward that the Admiralty know the whole truth, and that they do not build warships for advertising purposes. But the fact remains as one of the many little side incidents whereby the Admiralty help to make things harder for private firms, who, to begin with, they have probably ground down to the last penny. This is all a side issue to the main one. Things are much better than they were, but there is still a good deal of unpleasant unwritten history on the subject of our warships' boilers. They are not renewed when they ought to be if the maximum of efficiency is to be secured.

THE *Daily Graphic* in its naval notes falls out with some recent remarks in this column about the use of electricity on shipboard in the American Navy. The matter is scarcely one that admits of argument. In a nutshell the fact is that it is a great deal easier to work guns by machinery than by hand. An American Board, struck by the beauty of electrical arrangements, suggested their adoption. But the seamen who had to do the fighting, recognising that the experience of Santiago was not a sample of the full stress of battle, put forward more practical views. Every sailor who has studied the matter believes that in the heat of action nothing but hand-power will be of much use, and that making electricity the sole or even the chief agent is a mistake, because the issues on the result are so tremendous that all avoidable risks should be avoided where they can be. Nothing short of a hotly-contested fight will change this opinion, and so, though electricity may become a valuable adjunct, it is never likely to become of prime importance. Hydraulic machinery is open to more or less the same criticisms, but in our service, at any rate, we do not now-a-days rely upon it too much; all the 12in. guns can be worked by hand if need be, everything for turning being ready rigged in the armoured space directly under the barbettes, and the stations allotted. The man who can invent improvements in hand gear has a brighter future than he who relies upon any other motive power. The advantages of being able to do things by hand are being daily more recognised. During the recent war scare, while the Channel Fleet lay alongside the New Mole at Gibraltar the evolution of "shifting billet" by hand was frequently practised. It is, perhaps, only in our Navy that men drag 15,000-ton battleships about; but it is an eventuality that may have to be faced in war time—faced fairly frequently as likely or not; and a good deal of credit is due to Admiral Stephenson for having ordered the performance. There is no question as to whether electrical or any other arrangements will work in peace practice; the question is will they work in a thunderstorm and an earthquake, which two combined would sample pretty fairly a hotly-contested modern fleet action. If there is any doubt upon this head, it is insane to rely upon any motive power for which hand power can be substituted.

THE Yarrow-built Austrian torpedo boats Boa and Cobra met our Channel Fleet at Gibraltar on their way out, and appear to have excited a good deal of admiration on account of their appearance of strength. "More ship and less tin box full of machinery," as one officer put it. The general opinion was that they are eminently practical boats, capable of standing a great deal of knocking about without deterioration, a thing quite as vital as high speed. These boats are of 135 tons displacement—not, therefore, of excessive size as topedo boats go now-a-days.

THE Turks are thinking of sending the Messudujeh, built at Blackwall, and the Assar-i-Tewfik, built at La Seyne, old ironclads, to one of the Italian shipbuilding firms to be modernised. It is a question, however, whether, after the twenty odd years that they have been in Turkish hands, it will be possible to do much with them unless they are treated like the Irishman's gun. Some of the Turkish ships are supposed not to have been in dock for twenty years, or to have worked their engines for nearly as long a period. If it is really true that the ships are going to Genoa, one of the supposed objects of the Kaiser in his recent visit to Turkey—to get the Turkish fleet re-made in Germany—has missed fire. Enough attention was not paid, perhaps, to the problem how a Turkish ironclad was to get through the Bay of Biscay.

WORKS ON THE GREAT WESTERN RAILWAY.

THE year 1898 will remain a memorable one in the annals of the Great Western, for it has witnessed, in the South Wales coal strike, a previously unexampled dislocation of traffic on this line, when the ninety or so coal trains that in ordinary times passed daily through Swindon fell to an uncertain three or four. The Great Western, however, has a staying power which helps it speedily to recover from even so heavy a stroke as this, and during the great strike, while the weekly traffic returns were continually sinking, the great work of relaying the main line from Paddington to Penzance, undertaken before these troubles arose, was carried on with redoubled energy. This famous route to the West has, indeed, been largely remodelled since Brunel completed it, and nearly all the gloomy, cavernous wooden stations of that early railway era have now disappeared, to give place to the now favourite "umbrella" roofed type.

Starting down the line from Paddington this autumn, we notice, first, works in progress at the West London Junction; works which look, at first sight, like the commencement of the new railway to start from this point, and to run thence to Ickenham, Rinslip, and Gerrard's Cross—forming a short route to High Wycombe—a scheme for which the company obtained powers two years ago. The manifest signs of activity here have, however, nothing to do with that project, of which the first sod is not yet cut. The explanation of all these gangs of navvies, and these long lines of tip wagons, being that the company has decided to construct an extensive series of goods and mineral sidings at this, which will, in railway politics, be no doubt an important strategic point in the near future, having regard to the relations now developing between the Great Western and the Great Central, for the interchange of traffic on their systems; and not forgetting the fact that the Great Western is also negotiating with the London and North-Western for what is practically intended to be a joint plan of operations in constructing the Buckinghamshire Railway just mentioned to High Wycombe.

The Great Western has been until quite lately a railway whose resources have been undeveloped. It was not without reason that it was known among the last generation of railway men as "the sleepy giant;" but in these latter days things are very different. For instance, years ago the suburban traffic of the line was a quite negligible quantity, but with the spreading of London westward it has largely developed; although, even so, the Great Western has undoubtedly less traffic of this kind than any other of the great railways of England.

Not the least important feature of the Buckinghamshire Railway—which is also to run through a part of Middlesex—will be that it will open up an entirely new suburban district, as well as affording a shorter route to Oxford than that, *viâ* Didcot, now available. Signs of the times worth noting in this connection are the extension of Ealing Broadway Station to double its previous length, now in progress, and the provision of a new wayside station on the main line midway between Slough and Taplow. The full four miles distance between those two stations is a long interval for a district scarcely outside the twenty miles radius from London. This autumn, however, a beginning has been made with a station to be called "Burnham Beeches," which will at once accommodate and develop the summer excursion traffic to that lovely open woodland space, purchased for the delight of the public by the Corporation of the City of London some years ago, and will serve the village of Burnham and its surrounding hamlets, hitherto sadly lacking in railway facilities. The new station will be open in the spring, and will consist of a central island platform, placed between the up and down main line and the up and down relief. It will resemble the present Taplow Station in most respects.

Reading Station, whose rebuilding was mentioned in a previous article in THE ENGINEER, is now practically completed. Further on down the route to the west, the old Chippenham timbered station is at last doomed, and the work of rebuilding has been commenced with the goods yard. After Chippenham comes the great Box Tunnel. New sidings are to be built on the up side of it at Corsham. Both the Box and Middle-hill tunnels have been the scenes of a great deal of work in these two years past. Box has been lined for a great part of its length with brickwork, and Middle-hill entirely so. The bricks used are blue Staffordshire, which seem now to have become universally favoured for railway works. The five miles of line from Box into Bath, perhaps the most architecturally impressive of all these works, have seen some changes of late. Nearing Bath the line runs through more or less shallow cuttings provided by Brunel with very handsome retaining walls from 10ft. to 12ft. in height, built of the soft oolite of the district, known as "Bath stone." These walls have always formed a dignified and impressive feature on approaching Bath. Their profile exhibits a graceful curve, and the stone of which they are built gives an impression of massive solidity, which recent alterations here have found to be quite unwarranted, the stone being quite thin, and the foundations merely shallow footings. At certain places these walls have been replaced with retaining walls of blue brick—not so graceful, but much stronger. In other places the stone has decayed, and has been patched with bricks, variously red and blue.

The new Bath Station has been found a great convenience. Little is to be said about the line further west, works completed a few years ago having brought it up to date as far as Teignmouth. Between Exeter and Teignmouth, however, the wooden viaduct, nearly a quarter of a mile long, crossing the unfathomable mud of Cockwood Creek, has been altered. It was built of timber originally, because it was found practically impossible to get any foundations in for stone piers, and the same cause has determined the alterations completed this year. Instead of rebuilding in stone, truckloads of limestone were brought from the company's quarries near Totnes, and dumped into the mud and water of the creek on either side of the viaduct until an embankment was formed, thus strengthening the old wooden structure.

SMOKE ABATEMENT.

THERE is in Sheffield a Smoke Abatement League, which includes several of its most enterprising citizens, both amongst the professional and manufacturing class. The League was originated through a resolute determination to check the excessive production of smoke in the industrial quarters of the city. A number of prosecutions have been instituted, all against the owners of workshops and factories, the campaign having been aimed at these exclusively, and no attempt made to deal with offenders of the household. The leading spirits of the League have proceeded on the assumption that the smoke nuisance is mainly attributable to two causes—the lack of sufficient boiler power and to careless stoking. The efforts of the smoke reformers have undoubtedly resulted in a cleaner and a clearer atmosphere throughout a city which was greatly in need of vigilant attention, but the fight for pure air has now come to a pass which is somewhat peculiar. Some time ago the Sheffield magistrate had a decision of his against a local firm reversed at Quarter Sessions. The other day, when several cases were brought before him, the magistrate, while expressing the hope, with regard to one of these prosecutions, that there would be no complaint in the future, proceeded to say that in his opinion the result of the appeal in which his decision was reversed took away the power of the Court to deal with these cases. It was contended by the solicitor for the League that because the magistrate's decision was reversed in one case, under a particular set of circumstances, he should not feel justified in refusing an order in another case. To this his Worship replied that he did feel justified, because the latest case resembled the other. The similarity was admitted, whereupon the magistrate declared, "Then they will all go. I cannot go on making orders for appeal." This action of the local Court has naturally discouraged the local gentlemen who are endeavouring to secure cleanlier conditions of living, and it is felt that the cause of reform has been set back by his Worship's action. It is believed, however, that the position he has taken up is not tenable, and that he will have to take the cases that come before him upon their merits. The Smoke Abatement League, which the Medical Officer for the city extols as "a most useful society," will have the support of the public in their demand for the carrying out of the law, even although in a particular instance the decision of the local Court may have been set aside at Quarter Sessions. It has been proved in actual experience that a great deal more smoke is made than is essential for the carrying on of local industries, and, that being so, the law must be put in force so long as those who make the smoke are indifferent to its overproduction.

THE LOCOMOTIVES ACT, 1898.

THE Locomotives Act, 1898, comes into operation on January 1st next. It applies to the whole of England, and will effect some radical changes in the law relating to the licensing and use of traction engines, steam road rollers, and other locomotives in the public streets. In anticipation of the Act coming into force, suggestions have been submitted to the Local Government Board by the officials of the several County Councils of districts adjoining London with reference to the new bye-laws which will have to be made, and the forms of licences and other forms which will have to be used in consequence of the passing of the Act, and it is anticipated that model bye-laws and forms will be issued by the Local Government Board on the subject. The Act provides that the existing bye-laws shall remain in operation until August 2nd, 1899, unless previously repealed or suspended by bye-laws made under the new Act. In this connection it may be mentioned that the London County Council is empowered under Section 1 to grant permission for vehicles drawn or propelled by a locomotive on a highway to carry weights in excess of those stated in Section 4 of the Locomotives Act, 1861; and under Section 3 the County Council is authorised to give consent to more than the three vehicles allowed by the new Act being drawn by a locomotive. It is thought probable that applications under those sections may have to be dealt with in London immediately the Act comes into force, and under Section 14 the County Council can act through its surveyor or other authorised officer. As a result of this the London County Council has just decided to permit the Highways Committee to act on its behalf in relation to all matters under the new Act pending the issue of a further order on the subject, and has also authorised Sir Alexander Binnie, the chief engineer, to deal with all applications made to the Council under Sections 1 and 3, already referred to.

THE SIMPLON TUNNEL.—The Zurich correspondent of the *Times* states that the Italian War-office has sent a military commission, composed of three generals, a colonel and two majors, to study the question of the defence and fortification of the Simplon Tunnel at Domo d'Ossola, the Italian end of the works at present in the course of construction.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Fleet engineers: James H. Gilbert, to the Howe, for Haulbowline Dockyard; Benjamin J. Barnes, to the Resolution; Edward Norrington, to the Victory, for Reserve; Samuel J. Robins, to the Tamar, for Hong Kong Yard; George Elbrow, to the Monarch, for Cape Yard; W. Coleman to the Victory, for the Vengeance; T. J. Haddy, to the Magnificent; J. D. Nicholson, to the President, for service at Woolwich Arsenal; C. Lane, to the Majestic; J. M. C. Bennett, to the Thunderer, for new royal yacht. Staff engineer: William F. Pamphiett, to the Pembroke, for the Astraea. Chief engineers: Thomas R. Reynolds, to the Victory, for the Barham; James T. Willoughby, to the Wildfire, for the Salmon; Charles A. Moore, to the Pembroke, for the Astraea; W. W. H. Rawlingson, to the Hibernia, additional, for Malta Dockyard; F. H. Dart, to the Pembroke, for the Blenheim; R. W. Green, to the President, for service at the works of Messrs. Whitehead and Co.; R. St. J. Raper, to the Victory, for the Scout. Engineers: W. H. Wood, to the Victory, for Portsmouth Dockyard; Alfred Burner, to the Victory, for Portsmouth Drawing-office; Robert B. Dixon, to the President, additional, for service; Alfred Whitmarsh, to the Vivid, for the Orwell; W. A. Dathan, to the Victory, for the Dove. Assistant engineers: George H. Durston, to the Pembroke, for the Grasshopper; A. E. Cock, to the Victory, for the Andromeda; G. Moore, to the Alexandra. Probationary assistant engineers: Frederick C. Fisher and George H. White, to the Magnificent.

RAILWAY MATTERS.

IN consequence of the great pressure of work in all the locomotive engineers' shops throughout this country, and the utter impossibility of obtaining deliveries within a reasonable period, the Midland Railway Company has been compelled to place an order for twenty goods engines and tenders, which are urgently needed, with Philadelphia and New York firms. At the present time the Midland have two hundred engines on order with English firms.

A COLLISION occurred on the Great Eastern Railway on Monday afternoon between Ilford and Manor-park. A local goods train was shunting, when a truck left the metals. A through goods train proceeding to London almost immediately afterwards came into collision with it, and the engine and several trucks were thrown across the metals. Fortunately no one was injured, but the up and down main lines and the up local line were blocked, the permanent way being considerably damaged.

CONSIDERABLE excitement has been caused in Atherstone owing to the receipt of information that the London and North-Western Company, in order to avoid the reduction of speed to four miles an hour, is intending to construct an entirely new railway direct from Nuneaton to Tamworth, to be called "the fast lines." It will be shorter, and have better gradients than the present railway, and will run some distance away from Atherstone. The present railway will then be known as the "slow lines," and as the number of trains will be greatly reduced, there will be no necessity for a bridge for some years to come.

AN interesting memento of the early days of the railway in this country was sold at a well-known London auction-room on Monday. This was Stephenson's plan of the railway from London to Birmingham, scale 4in. to the mile. The survey was commenced in 1830 and finished in 1832, and the actual work of the railway started on June 1st, 1834. The copies of this plan, deposited when powers were applied for, were burnt in the great fire at the House of Commons Private Bills Office in 1834. This plan was for a long time the property of the late Mr. George King, M.I.C.E., and was sold for twenty-six guineas.

TWO weeks ago it was announced that the London County Council had appointed Mr. Young, manager of the Glasgow tramways, to the management of the Metropolitan tramway system, at a salary of £1500 a year. But Mr. Young, after a short visit to London, declined the post, and Mr. Baker, of Nottingham, was next appointed at an annual salary of £1000. It appears, however, that the Council is again meeting with disappointment, as the Nottingham Corporation have declined to release Mr. Baker under six months, when his engagement terminates. In the meantime a special sub-committee of five members of the Council has been appointed to carry on the management of the undertaking.

THE railway traffic of this country is the most heavily taxed in the world of any on a large scale, says *Sell's Commercial Intelligence*. The average ton-mile rate paid to the railway companies in Great Britain is not less than 1½d., while in a large number of cases, where goods are placed in the higher classes, it rises to 2d. or 3d. per ton-mile. This would not be a matter for serious concern were it not that our industrial rivals and competitors have considerably cheaper transportation costs, but when we reflect that the average ton-mile rate in this country is fully a hundred per cent. higher than the average of the United States, and probably 60 per cent. higher than the average of Belgium and Germany, the matter becomes much more a cause for anxiety. Our contemporary makes a strong appeal to traders, colliery proprietors, and owners of wagons, to assist in bringing about this much-needed reform by adopting double-bogey trucks, and by insisting upon the railway companies granting considerable rebates for loads of this kind. The change cannot take place in a day, but a beginning cannot be made too soon.

THE projected Leek and Manifold Valley Light Railway will prove a great factor in the development of a portion of West Derbyshire and East Staffordshire. It will commence at Hulme End, near the village of Hartington, and proceed through the valleys of the rivers Manifold and Hamps to Waterhouses. The route is one of great natural beauty; among the points of interest are Thor's Cave at Wetton, the singular disappearance of the Hamps and Manifold rivers underground, and their reappearance united at the village of Ilam; the Ecton Mines, and the ruins of Throwley Hall. The line will, in short, give access to some of the finest of the scenic glories of Derbyshire, including Dove Dale and Beresford Dale. It will probably be one of the first light railways in the kingdom established on the narrow-gauge principle under the Light Railways Act of 1896, and will possess great commercial value and utility. At Waterhouses there will be a junction with a railway of the ordinary gauge about to be constructed and worked by the North Staffordshire Railway, which will join the Chuvaet Valley line near Leek, the capital of the Staffordshire moorlands.

TWO schemes are again put forward for the construction of a light railway in the Land's End district. They are promoted by practically the same people as produced the schemes which were disapproved by the Light Railway Commissioners in August last, but have undergone considerable modification in the sense suggested by the Commissioners. One of the two is still described as the Land's End, St. Just, and Great Western Junction Light Railway, but the name of the third is altered from the Penzance, Newlyn, and St. Just Light Railway to the Penzance, Newlyn, and West Cornwall Light Railway. Both propose to connect with the Great Western main line, the "Newlyn" line at Marazion, and the "Land's End" line at Ponsandane, which is between Marazion and Penzance. The idea of continuing the line along the promenade at Penzance has been abandoned, and extensions are proposed to meet the wants of parts of the district which in the opinion of the Commissioners were neglected under the former schemes. Over a considerable part of the route the lines follow the same course, and it is believed that either of them would be much more satisfactory than the old plans. The cost is estimated at from £140,000 to £150,000

IT is now an open secret that, as the result of the recent visit of Mr. F. J. S. Hopwood, Assistant Secretary of the Board of Trade, to the United States, the Board is seriously contemplating the promotion of an Act of Parliament, similar to the law lately passed in America, to make the use of automatic couplers compulsory on the railways of the United Kingdom, says *Transport*. The possibility of such legislation is a very serious matter for our railway companies, involving as it may, in the estimate of one general manager, an expenditure of no less than £7,000,000 of money in re-fitting the existing rolling stock, besides having a most important bearing upon the safety both of employés and passengers, and *Transport* has recently interviewed half a dozen of the most responsible of our railwaymen—four of them general managers and the other two directors—with the object of ascertaining their views on the situation. One of those interviewed—an ex-manager, now a director—expressed himself in favour, notwithstanding the cost to the companies, of legislative action by the Board of Trade on the lines above indicated, but the other five pronounced against such legislation in more or less strong terms. As the result of its inquiries, our contemporary has no doubt that a Bill to empower the Board of Trade to enforce the adoption of automatic couplings on our lines, within a stated period, would meet with strenuous opposition from the railway companies; but, on the other hand, the railway authorities display every disposition to support the Board in pursuing its investigations into the subject, and, if a proposal is made by the Board to hold a public inquiry into the relative merits of the coupling systems of England and America, it will, *Transport* thinks, meet with hearty support on all hands.

NOTES AND MEMORANDA.

THE United States Ordnance Department has recently adopted maganese steel exclusively for gun carriage shields in place of nickel steel.

IT was stated at the offices of the East London Waterworks Company, on Monday, that the constant service of water had now been put into force throughout the whole district supplied by the company.

AT the meeting of the London County Council held this week the Parliamentary Committee was authorised to seek powers in the next session of Pailiament to enable electrical traction to be used on all or any of its tramways.

THE coal consumed in making scrap iron car axles at the Southern Pacific Railroad shops, as stated by Mr. D. Uren, before the Master Blacksmiths' Association, is 0·46 of a pound—bituminous—per pound of iron heated. The scrap is heated in four piles of 600lb. each. These are roughed down the full length under the steam hammer, after which one-half of the axle is heated and finished, and then the other half is treated likewise, three heats being required. The work is claimed to be improved enough by the heating to justify it.

THE treatment of steel in the shop is important, and steel has been condemned because of mistakes in handling it in the machines. In one case, says the *American Engineer*, a failure resulted from too high a speed in the lathe, which on examination was found to be over 20ft. per minute for the finishing cut, when the best practice with extra heavy lathes on the same material is 19ft. per minute for the roughing cut, and from 14ft. to 16ft. on the finishing cut. Often the best economy is found not in using the maximum speed, but in sacrificing speed in order to maintain a heavy cut which heats the tool less. It seems in many cases to be good practice to work hard and slow. The desired end is to remove the maximum amount of metal in a given time, and this may be better done on a strong, stiff machine by a heavy cut and rapid feed and low-cutting speed than by light fast cutting.

IN giving evidence before Lord Llandaff's Commission on the London Water Supply, Mr. C. Hawksley, M.Inst.C.E., handed in a table which showed that the population of Greater London was estimated to grow from 5,656,909 in 1891, to 13,043,712 in 1941. The population of Greater London now actually supplied was 5,703,404. In considering future requirements he had taken 55 gallons per head as a safe basis. The table gave as the average daily supply in 1897, 202,102,544 gallons. Of that quantity there came from the river Thames 112,178,641 gallons, from the Lea 55,292,863 gallons, from springs and wells 34,488,016 gallons, from ponds at Hampstead and Highgate 143,024 gallons. The real object of the table was to give the estimated quantity of water required in 1901, and every ten years up to 1841. Lord Llandaff said that to meet the requirements Lord Balfour's Commission reckoned upon 52½ million gallons per day from the Lea, 40 million gallons a day from wells in the Lea Valley, and 27½ million gallons from wells in the Kent district, making a total of 120 million gallons a day.

LARGE quantities of electrical machinery are now being made at Pittsburgh for buyers in this country, according to the *Consular Journal*. The chief producer is the Westinghouse Electric Company, who have in hand contracts to supply the Hull Tramway Company with apparatus for ninety-two electric railway motors, to equip forty-five cars, and one track sweeper. Besides this, the company named have also to supply the Hali ax Tramway Corporation twelve motors, to equip six cars; for the Bradford Tramway Company forty-eight motors, to equip twenty-four cars; for the city of Norwich eighty motors, to equip forty electric cars, and four electric generators, to be installed in the power-house of the Norwich Tramway Corporation, to generate the electric current for the operation of these cars; for the city of Coventry twenty motors, to equip ten cars, and two power generators; and for Plymouth ten motors and two power generators are being manufactured for the operation of the local tramways. This makes a total of 262 electric railway motors and eight generators now under construction for England.

THE London County Council invites designs for a dust cart for use in connection with the collection and disposal of house refuse. It is required that the cart shall be so constructed and furnished with such a covering as to prevent the escape of any refuse from the cart and also to prevent any nuisance arising from any offensive refuse which may be carried in the cart. The designs will be judged by Captain Sir Douglas Galton, K.C.B., F.R.S., the chairman of the Council of the Sanitary Institute. A premium of £25 will be paid to the competitor whose design is adjudged to be the best, unless Sir Douglas Galton shall determine that no design sent in is sufficiently good to merit such premium, in which case the Council reserves the right to withhold payment of the premium. Full details and any drawings, or other particulars necessary for a complete explanation of the design, should be sent in a sealed cover addressed to the Clerk, London County Council, Spring-gardens, S.W., and endorsed on the left-hand corner of the cover, "Dust Cart and Cover," and should be delivered not later than 10 o'clock on Tuesday, the 28th day of February, 1899.

IN a paper recently read before the Engineers' Society of Western Pennsylvania, the author Dr. R. Moldenke, gave some particulars relating to the melting point of cast iron from observations he had made. A set of fifty-seven pig and cast irons, with but few exceptions, had no abnormally large variations from ordinary standards, but the range of silicons from ·14 up to 3·29 per cent., with their corresponding variations in combined and graphitic carbons, were admirably adapted to bring out the influence of the former to lower the melting point. The two extremes only are given herewith; a white iron which melted at 1990 deg. Fah. having 4·20 per cent. combined carbon, and a grey one going at 2280 deg. Fah., or 290 deg. higher, contained only ·13, the balance of the 3·56 per cent. total carbon being graphite. To properly determine the influence of phosphorus, manganese, and sulphur on the melting point, it would be well to take an iron which remains perfectly white at all casting temperatures, and add to it different proportions of these elements while it is in a melted state, casting each resulting mixture at once. In this way all the carbon remaining combined, a good comparison would be obtainable.

AN instructive paper was read at the late meeting of the American Society of Mechanical Engineers by Mr. C. H. Benjamin, on "The Bursting of Small Cast Iron Fly-wheels." The author arrives at the following conclusions:—(1) Fly-wheels with solid rims, of the proportions usual among engine builders, and having the usual number of arms, have a sufficient factor of safety at a rim speed of 100ft. per second, if the iron is of good quality and there are no serious cooling strains. In such wheels the bending due to centrifugal force is slight, and may safely be disregarded; (2) Rim joints midway between the arms are a serious defect, and reduce the factor of safety very materially. Such joints are as serious mistakes in design as would be a joint in the middle of a girder under a heavy load; (3) Joints made in the ordinary manner with internal flanges and bolts are probably the worst that could be devised for this purpose. Under the most favourable circumstances they have only about one-fourth the strength of the solid rim, and are particularly weak against bending. In several joints of this character on large fly-wheels, calculation has shown a strength less than one-fifth that of the rim. Several important American engine builders are said to have changed the design of their wheels lately by bringing the rim joints opposite the ends of the arms.

MISCELLANEA.

THE Assistant Director of Government Dockyards, Mr. Marshall, has recently visited Pembroke Dockyard, and inspected her Majesty's new yacht, which is now being built there, and upon which a very large number of artificers are at present engaged, preparing her for the launch, which will take place in about four months' time.

A CONTRACT for 15,000 electrical horse-power has been made between the Union Carbide Company and the Niagara Power Company, the power to be delivered some time next summer. This power is the product of three of the big dynamos in the great Niagara Central station. The existing works of the Carbide Company will be continued, but in order to utilise the additional amount of power immense new works will be constructed at once.

ON and after Christmas Day the postage to be prepaid on letters from this country for India and the under-mentioned British Colonies and protectorates will be 1d. per ½oz., instead of 2½d. as at present:—Aden, Ascension, Bahamas, Barbadoes, Bermuda, British Central Africa, British East Africa, British Guiana, British Honduras, Canada, Ceylon, Cyprus, Falkland Islands, Fiji Islands, Gambia, Gibraltar, Gold Coast Colony, Hongkong, India, Johore, Lagos, Leeward Islands, Malay States, Natal, Newfoundland, Niger Coast Protectorate, Niger Territory, St. Helena, Sarawak, Seychelles, Sierra Leone, Straits Settlements, Tobago, Trinidad, Turks Islands, Uganda, Windward Islands.

THE demolition of the houses on the western side of Parliament-street, Westminster, which has been proceeding for some months, is now nearly complete. So far have the operations for the purpose of widening the thoroughfare leading from the Local Government Board offices on the north side of Charles-street to the Houses of Parliament proceeded, that the formation of the site into a carriage-way has been commenced. The new roadway will be made and paved with wood before the meeting of Parliament. Already the effect of the improvement can be gauged. An uninterrupted view of Westminster Abbey can now be had from Whitehall, and Parliament-square, lying to the north of the Abbey, can now be seen to advantage.

THREE of the Spanish ships sunk at Manila are to be raised by a Hongkong firm of wreckers and put in thorough repair for 500,000 dols., according to a contract just made by Admiral Dewey. These ships are large gunboats; two, the Isla de Cuba and the Isla de Luzon, are 200ft. long, 30ft. beam, and 11½ft. draught, with a displacement of 1040 tons each. They are built of steel, have twin screws, a good protective deck, and a battery of six 4·7in. Hontoria guns, four 6-pounders, two 1-pounders, two Nordenfeldt guns, and three torpedo tubes. The speed is 15·8 knots under forced draught. The other, the Don Juan de Austria, is 210ft. long, 32ft. beam, 12½ft draught, and 1152 tons displacement. She was built at Carthagena in 1887, and her armament includes four 4·7in Hontoria guns, four 6-pounders, one machine gun, and two torpedo tubes.

THE French Superior Council of the Navy, which is the nearest approach France possesses to an Admiralty Board, has been reconstituted. Formerly among its members were included the naval prefects and the commanding officers of the Mediterranean and Channel Squadrons, but in 1886, on the ground of the inexpediency of calling these officers from their important posts all at once to meetings in Paris, which, however, took place rarely, they were excluded from the council. According to the *Army and Navy Gazette*, the older arrangement has now been reverted to, and the council will henceforth be composed of the Minister as president, the vice-admirals on the active list who have been in command of squadrons, the admirals commanding in the Mediterranean and Channel, the naval prefects, and the chief of the staff, the sub-chief having consultative voice.

THE first pile of the Admiralty Pier extension, forming the western arm of the National Harbour at Dover, was driven on Wednesday, those present including the representative of the Admiralty, Mr. Wilson, Mr. Maurice Lee, Mr. Thompson, resident engineer to the Admiralty, and Mr. Mayo, representing Messrs. Pearson and Son, the contractors. The piles that are being used are the largest employed in any marine work in the kingdom, being 105ft. long and 20in. square. All the requisite machinery for lengthening the pier is in position on top of the turret which contains the 80-ton guns. A very powerful crane, specially constructed for the purpose, is being used in connection with the pile-driving. The works at Eastcliffe, where the Marine Railway and reclamation wall are being constructed, are proceeding rapidly, and at the works on the shore, near Shakespeare Cliff, good progress is being made.

THE report by Sir William Crookes, F.R.S., and Professor Dewar, F.R.S., on the composition and quality of daily samples of the water supplied to London for the month ending November 30th gives the results of their analyses of the 182 samples of water collected by them during the month from the mains of the London water companies taking their supply from the Thames and Lea. Of the 182 samples one was found to be "slightly turbid;" the remainder were all clear, bright, and well filtered. The rainfall at Oxford during November has again shown a deficiency; the actual fall was 1·86in. The average fall for the past thirty years is 2·42in.; this leaves a deficiency of 0·56in., and makes the total deficiency for the year 6·67in., or 28·2 per cent. The bacteriological results for the month were satisfactory. The East London water supply was exceptionally good, the average of 26 samples being only 11 microbes per c.c, whereas the mean of 126 samples from the Thames-supplied companies was 49 per c.c. The report adds:—"Both these results prove highly efficient filtration; but it must be confessed that a reduction of a number of microbes to anything as low as ten or eleven is highly exceptional, and more than could have been expected a few years ago, when between 100 and 200 microbes per cubic centimetre were considered allowable in a potable water."

THE old adage that necessity is the mother of invention has just been illustrated in Sydney, where the long-vexed problem of remuneratively navigating the shallow inland streams of New Zealand has been solved, says the *Syren*, by the construction of a peculiarly-shaped vessel, the first of its kind seen in Australasia, having a speed of 11 knots, and drawing only 6ft. 6in. when fully loaded. The new vessel is an adoption of those characteristic of the gun and other boats on the Nile, and also the shallow waters in India. In the vessel, which has been successfully launched in the New South Wales metropolis, the stern takes the shape of a long, gradually rising tunnel, highest immediately over the propeller, thence gently sloping towards the load water mark at the extreme after end. This tunnel is in the shape of a half cylinder, the edges being always under water, the interior top of the arc being a foot above water when the vessel is fully loaded. The propeller runs through the centre of this semi-cylinder, and when the boat is stationary, the top of the screw is some little way out of the water. As soon as the engines are started the air in the semi-cylinder is expelled and replaced by water, in which the propeller works as efficiently as in vessels of heavier draught. The loss of efficiency in light craft is mainly occasioned by the propeller taking down air, which is prevented in the tunnel-like arrangement of the new vessel. The Aotea, as the vessel is named, has a length of 126ft. 6in., with 24ft. 7in. beam, and 13ft. 3in. depth of hold. She is provided with all the requirements of a first-class intercolonial steamer. The deck, which is unbroken, forms a broad promenade, giving a walk of 100ft. clear of everything. In addition to coal, water, machinery, and other deadweights, over 50 tons of cargo can be shipped.

THE ILLINOIS STEEL COMPANY'S WORKS, SOUTH CHICAGO, U.S.A.

(*For description see page 603*)

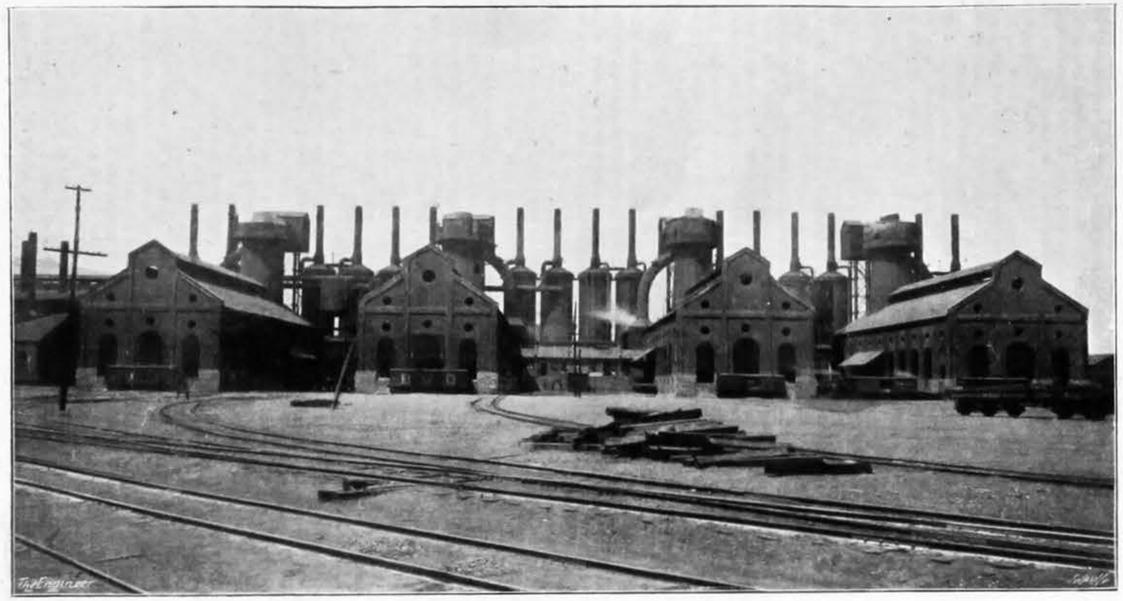


Fig. 2—BLAST FURNACES, Nos. 5 to 8

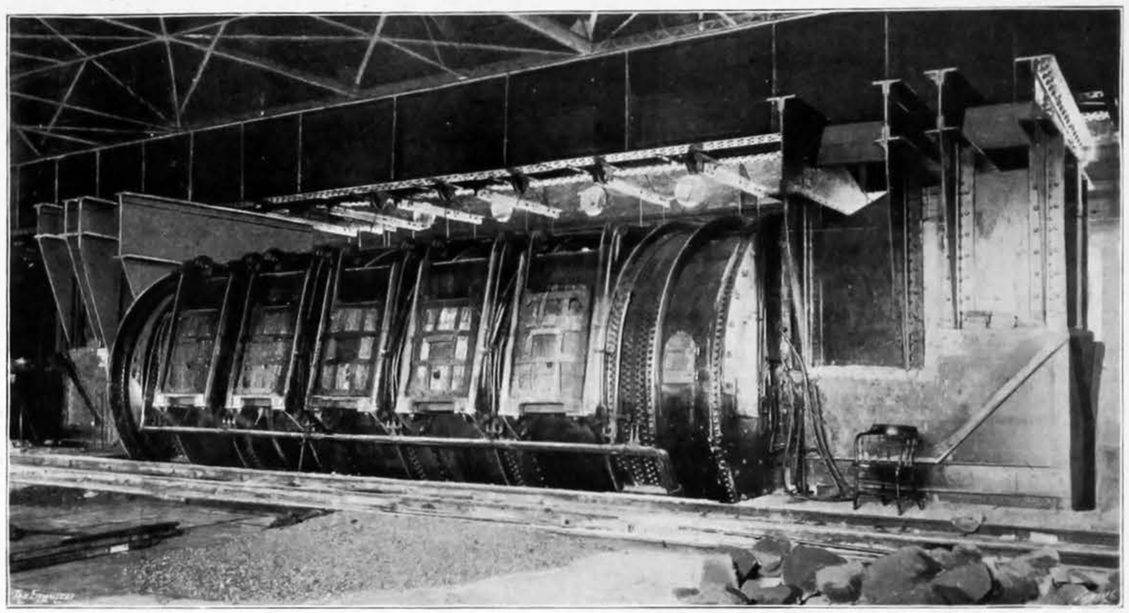


Fig. 4—CYLINDRICAL MIXER—FRONT

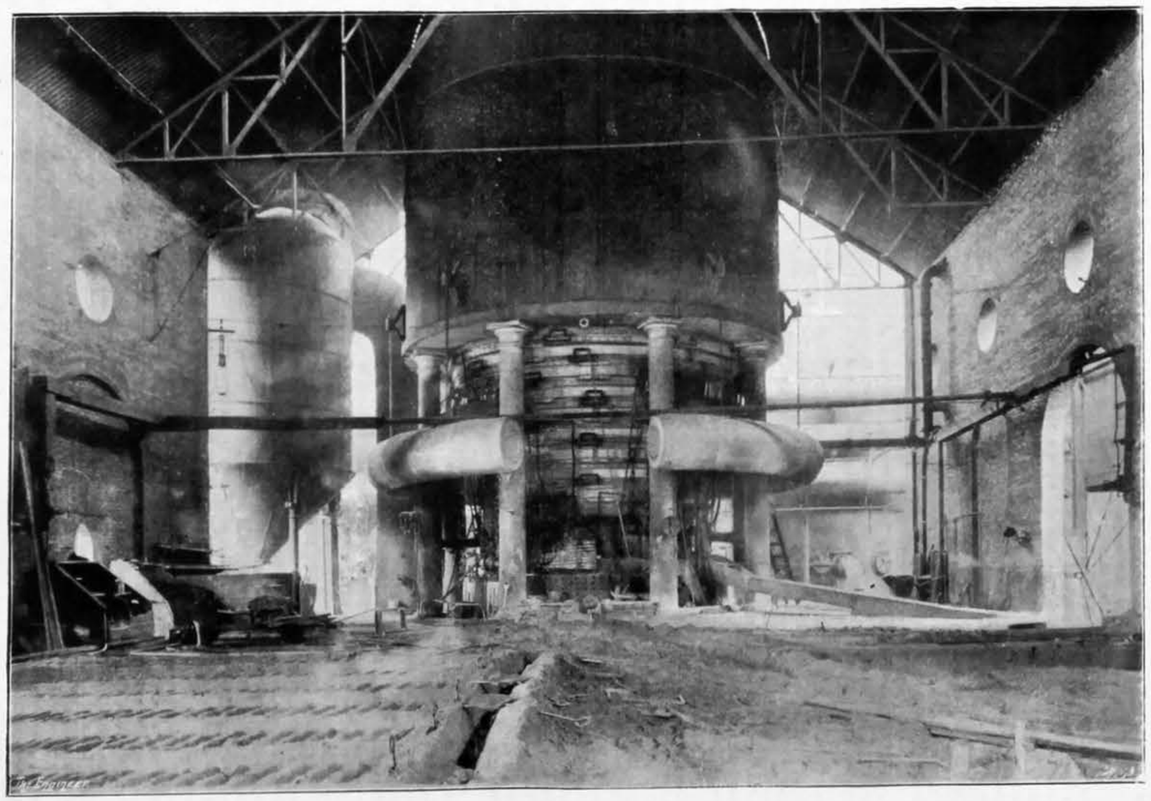


Fig. 3—FURNACE No. 5 AND DUST CHAMBER

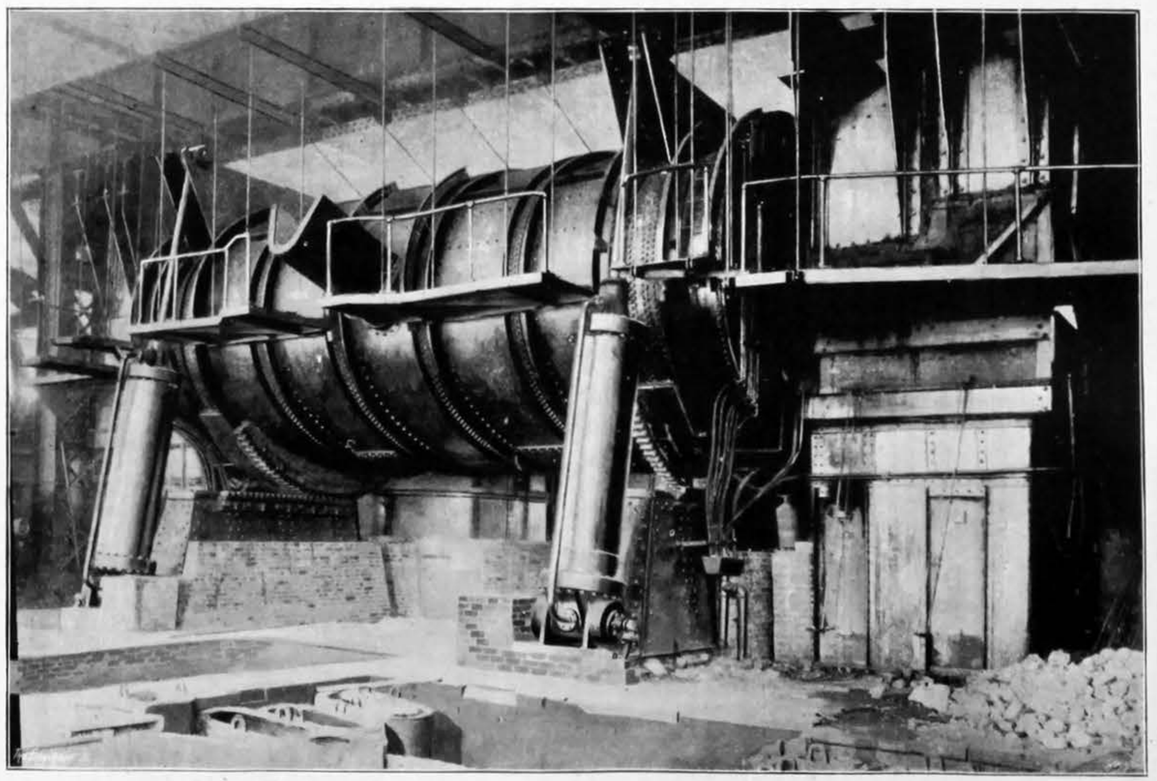


Fig. 5—CYLINDRICAL MIXER—BACK

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TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and stamped, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

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REPLIES.

A. D.—Without seeing the armature and its dynamo it is impossible to say in which direction the former should be driven. Most probably, however, the proper direction would be so that the centrifugal force would tend to tighten the end connections, or as shown in your drawing, in the same direction as the hands of a clock. The lead of the brushes will depend upon the position and shape of the fields. The best position can easily be found by trial.

W. (Richmond Hill).—To give you any information just now with regard to the gauges of railways in China would be premature and possibly misleading. Chinese politics just now are very kaleidoscopic, and the eventual railway gauges will depend upon these politics. There is no such thing as a standard gauge in China at the present day, and with England, Russia, Germany, France, America, and Belgium, all claiming and obtaining more or less authenticated railway concessions in China, the eventual standard gauge cannot at present be foretold. If you wish for trustworthy information on the subject of Chinese railways, we would refer you to our issues of March 18th and May 20th of this year.

MEETING NEXT WEEK.

ROYAL INSTITUTION OF GREAT BRITAIN.—Tuesday, Thursday, and Saturday, December 27th, 29th and 31st, at 3 p.m., Afternoon Lectures on "Astronomy," by Sir Robert Stawell Ball, D.Sc., LL.D., F.R.S.

THE ENGINEER.

DECEMBER 23, 1898.

TRAIN RESISTANCE.

THE vexed question of train resistance still attracts and deserves attention. We may remind our readers that the latest contribution to the growing literature of the subject was the paper by Mr. Smith, read at the last meeting of the Institution of Mechanical Engineers, reproduced and criticised in our columns. We are, through the courtesy of Mr. McIntosh and his assistant Mr. Weir, able this week to place before our readers a series of diagrams which teach a lesson in a way that cannot be disputed. These diagrams are a selection from some hundreds of diagrams, which form a record from minute to minute of the work done by a powerful engine in hauling a heavy and fast train on the Caledonian Railway on a run from Glasgow to Carlisle. We do not think that a similar record has ever been taken. With the chart of combined results on page 624 we shall not now concern ourselves, we shall confine our attention to the indicator diagrams, and to these only. They show what was going on in the cylinders of the locomotive at various speeds. We have perforce had to make a selection; they are typical of all the rest. If we filled page after page with these diagrams, they would be found in no way to modify or alter the lesson taught by the thirty-one diagrams which we publish.

Let us now consider what they prove. In the first place, the average pressure represents *pari passu* the average tractive effort; that is to say, as the average pressure rose so did the tractive effort of the driving wheels on the rails, and as it fell so did the tractive effort decrease, always at the same rate. It will be seen at a glance that the tractive effort invariably diminished as the speed increased. Now, there are various ways in which the problem of tractive effort and train resistance may be regarded. Thus, we may consider it from a purely theoretical point, and say that, other things being equal, the resistance of a train augments with the speed in some definite or indefinite way. Or, again, it may be said that all the variations in tractive effort are due to gain or loss of momentum in the train, brought about by constant changes of speed. Our contention hitherto has been, that all the available evidence of diagrams goes to show that the resistance of a train, instead of being augmented with the speed, is reduced. That is to say, there is some moderate velocity at which the resistance is greater than at any other speed, higher or lower. We have, however, favoured for some time a modification of this proposition. Hitherto we have not put it forward for lack of evidence; that is now supplied by the Caledonian diagrams; and we no longer hesitate to say that, be the cause or causes what they may, it is certain that in daily work the tractive effort required to haul a train diminishes as the speed augments. This is a variant, and a variant of importance on our first proposition. That would mean that on a perfectly straight and level railway the resistance of the train would decrease as the speed rose. We are not in a position to prove this, because we have not a sufficient number of diagrams taken under the stated conditions. The new, or second proposition, amounts to the assertion that in practice the tractive effort required to haul a train diminishes as the speed increases. This is not at all the same proposition in different words as that which preceded it. It takes no cognisance whatever of train resistance; but it does state a fact of the greatest possible importance to railway companies. To them train resistance is quite a secondary matter. It is well to make our meaning quite clear, even at the risk of being prolix. The received belief is that the resistance of a train is fairly expressed by D. K. Clark's formula $R = 8 + \frac{v^2}{171}$, or some other such cognate equation. This may or may not be true. It has no application in practice. If we take real trains hauled by real locomotives on real railways, the tractive effort of the engine at the rails does not agree with the formula, or anything like it. Instead of the tractive effort rising with the speed, it decreases. Inclines come in to help the engine. The train resistance may augment or it may not. So far as the locomotive is concerned, gravity is always coming into play and helping or opposing it. The actual tractive effort that must be put forth by the locomotive is the factor of interest. The pulling effort of the engine must be proportioned to the weight of the train, and has nothing to do with the speed. Given a train of 200 tons, and an engine with cylinders 18in. by 24in., and 7ft. drivers, that engine will haul that train from point to point on any average railway just as well at 70 miles an hour as at 20 miles an hour, always provided the boiler is big enough. The reason is simply that the high speeds are only reached as the result of running down hill. This is practice, and it is only with the actual running of trains that we are for the moment concerned.

Let us turn now to the proofs which we are able to adduce of the truths of our second proposition. They are supplied by the diagrams on page 625. Take the first and the last diagrams. We have an average pressure of 77 lb. and 30½ miles an hour, and 21·25 lb. and 62 miles an hour. Take the four diagrams along the top of the page, and we find 77 lb. and 30½ miles, 77·75 lb. and 29½ miles, 80·25 lb. and 29 miles, 77·25 lb. and 29 miles, and 79·5 lb. and 28 miles per hour. Take now the bottom row all across and we have 68 75 lb. and 39 miles, 66 lb. and 41 miles, 60 lb. and 43 miles, 20 lb. and 63 miles, and 21·25 lb. and 62 miles an hour. All the cards tell the same story, viz., that the average pressure fell off with the speeds, and that the speeds depended on the inclines. The slight irregularities and discrepancies are due, no doubt, to changes of velocity. It must be remembered that these cards were regularly taken at intervals of one minute, and it is noteworthy that they do not show any very violent changes due to the rise and fall of momentum. Another point claiming notice is the small variation in the power developed by the engine. The greatest power shown by any of the cards we have selected was 907, the train running at 55 miles per hour, with 51·25 lb. average cylinder pressure. The least, if we leave out those taken when the train was tearing down hill, was 712, a maximum difference of but 195-horse power. It we reject these extremes, it will be seen that the power was wonderfully uniform between 700 and 800-horse power. It is not possible, we think, for any one with those diagrams before him to maintain that the tractive effort required to haul a train from Glasgow to Carlisle increases enormously, or indeed, increases at all with the speed. We do not think we shall be far wrong if we say that the boiler of Mr. McIntosh's locomotive could regularly make steam for about 800-horse power. That was about the best average, and a very high average it is, representing an evaporation of about 17,500 lb. of water per hour. For a heating surface of 1400 square feet the rate of evaporation must be 12·5 lb. of water per foot per hour, and for a 21ft. grate and 7 lb. of water per pound of coal, the rate of combustion was about 120 lb. per square foot per hour. This is, so far as we are aware, the maximum sustained effort of any British locomotive. We do not say that it has not been beaten, but only that we have not met with any evidence that it has been beaten. The engine indicated for short periods, it is true, over 1000-horse power, but this does not affect our conclusions.

At first sight it seems curious that the power exerted should have varied so little, no matter what the speed at which the train ran. The relation which this bears to the coal consumption is a little remarkable. Let us suppose that the engine burned 3 lb. of coal per horse-power per hour, and that the train ran for one hour at 30 miles an hour, the power being 700 horses; we have then 2100 lb. of coal burned, and 70 lb. per mile. If, now, the speed is doubled, the power remaining the same, the consumption of fuel falls at once to 35 lb. per mile. All this is quite consistent with practice, but it would assuredly not be consistent if the train resistance augmented with the speed in the way we have so long been taught.

In truth, the locomotive and the train and the road are parts of a complete machine, which act and react on each other, and it is a great mistake to treat any one portion of the machine without regard to the other parts. Locomotive engines and railway companies have little or nothing, as we have said, to do with abstract questions of train resistance. What they have to consider is the effect of speed on the power required, and the consumption of fuel. The experiments carried out on the Caledonian Railway by Mr. McIntosh are distinctly reassuring; they show that the road is a prime factor in obtaining speed. With heavy trains there is no fast running except down hill. At the same time it must be taken as proved that no matter what a tractometer between the tender and the train may indicate, the tractive effort to be exerted by the engine does not augment in any rapid ratio, if it augments at all, with the velocity. The maximum effort on a long level of an English locomotive appears to be about 50 miles an hour for a 300-ton train, and that seems to meet all the demands likely to be made for some time. Higher speeds are only got when running down hill, moderate inclines being a great help to the engine. Higher average velocities mean lighter trains. The results of the trials on the Caledonian Railway, which we place before our readers this week, seem to be final on this point. It is not possible, we think, to get more out of a locomotive of the normal type running on a British railway, and 50 miles an hour is a most satisfactory datum from which to deduct something as we run up hill, and to which to add something as we run down.

A GREAT TELEGRAPH SCHEME.

SIR SANDFORD FLEMING, the eminent engineer, who has now been so long identified with every branch of engineering progress in Canada, and who has been

specially interested in telegraphic communications in general, and the mooted Pacific cable in particular, has memorialised the English Government, with the object of persuading it to establish a complete system of State-owned and worked cables all round the globe. The advantages to be gained from having an unbroken cable girdle are numerous, and not the least of these would be the fact that our possessions in time of war would be kept directly in touch with one another by what would practically be two sets of cables, so that if one cable were cut by the enemy, the other cable must remain intact; and if care were taken and adequate naval protection given, it would be extremely difficult to cut the cable at all. No doubt, too, such a complete system of cables would be of great importance to the commerce of Great Britain, for the project in question aims at the connection of practically all her Majesty's possessions and coaling stations to the main cable.

The present idea takes the following form:—The cable would start from the Canadian port of Vancouver, and would have three points of appearance above water, namely, at Fanning Island, Fiji, and Norfolk Island, before it arrived at New Zealand and Australia, to which two places branches are to be run from Norfolk Island. Australia would be crossed, and a cable would start from King George's Sound, which, after touching at Cocos Island and Mauritius, would either go to Natal or Capetown. From Cocos Island connection would also be made with Ceylon, Singapore, and Hongkong, and from Mauritius with Seychelles, Aden, and Bombay. From Capetown a cable would be run to St. Helena, Ascension, Barbadoes, and Bermuda. From this place communication would be opened up with Halifax, and then by means of the existing cables throughout Canada, and to England itself. Thus there would be a double system of British-owned cable lines the whole world over, and the route chosen seems to have been very carefully selected. In time to come, no doubt the whole scheme will be carried into effect, if not in exactly this way, at all events in a somewhat similar manner. It is only a question of time. The point to be considered is whether or not the State should carry out and control the work. We most certainly think not.

Of course it would be advantageous to have each complete cable round the world under one management, because of the time saved by messages not having to be transferred from one system to another. The only possible objection which could be urged against such a scheme of running this suggested system of cables, would be that it was unnecessary, and that by means of existing cables telegraphic communication is now possible everywhere wherever civilisation has progressed. The answer to this is very simple. All the world's cables and telegraph lines are not under British control, and in addition to this, for New Zealand to communicate with North America — to use an extreme instance — it is necessary to do so *vid* Australia, Singapore, Madras, Bombay, Aden, Suez, the Mediterranean, and London. For a single syndicate to lay the requisite new cables and to acquire existing lines would involve a very large outlay of capital, yet we are clearly of opinion that some such proceeding would be the most beneficial to the interests of everyone, in spite of Sir Sandford's staunch advocacy of State control. The cables, if run as he suggests, would be unlike our inland postal lines in that there would be only one of them between each port or point of departure, and it would not be at all an unlikely thing, considering that these points of departure would, if the State owned the cables, be in most instances naval bases, to have Government messages continually blocking the lines. Such an occurrence is by no means so likely to happen in Great Britain itself—if on no other account, at all events because of the larger number of trunk lines.

Government monopolies, as many a State has found before this, are not always all that can be desired. Generally a point is reached beyond which no further progress is made. This point is not infrequently short of perfection. There are not lacking people who assert that if the telegraphs of England had been in the hands of private bodies, the service would be much more efficient than it now is. We consider that when it is a question of such a matter as the quick conveyance of messages over the largest possible area, there should be no monopoly of any kind, State or otherwise. This remark does not so much apply to letter carrying. Here, although the Government is to some slight extent the carrier, yet it is the great railway companies and the steamship lines which form the real means of communication between different points, and the rivalry between them keeps the standard well up. The result is that there is but little to complain of in the mail service. But the whole of England groans under a telephone monopoly which practically constitutes a disgrace to the country. When one looks abroad to such places as Norway and Switzerland, both having enormous natural disadvantages in the way of contour of the country, and when one considers that these countries have a most excellent system of telephony at a mere fraction of what we in England are paying for a vastly inferior service, the utter fallacy of monopolies is brought most prominently forward. We could go on to enlarge upon the subject of State-owned railways and the not unusual condition of these, but it might seem to be beside the question, and we confine ourselves simply to cables. What would happen supposing a private firm were to construct an unbroken connection right round the globe? In a very short period we should have another firm making another—and perhaps, after that, a third. Hence exorbitant rates could not be charged. Sir Sandford's own argument can here be used against him. He instances the reducing of the tariff charges between Australia and London from 9s. 4d. per word to 4s. 9d. per word, simply because the construction of a Pacific cable came up for consideration. This supports our argument entirely. It is competition which prevents extortionate charges, and with the cables under Government control there would be no competition. Probably, too, not more than one complete cable would be laid, and the Government could charge any rate it chose. It is true, no doubt, that to have Government protection is greatly to be desired. For instance, in places where the cables land, not only the cables themselves must be protected but also the men in charge of them and of the instruments, and this in out-of-the-world places might be extremely difficult and expensive for private companies to manage. This, however, is the only way in which we can see that Government can assist with the best possible results to the country. Once let the monopoly become the State's, and there is an end to private enterprise in this direction. It is true that the State could not prevent the laying of a cable, but it could and would prevent the sending of messages unless under a royalty more or less heavy. Perhaps some arrangement might even be made by which, in exchange for a subsidy and adequate protection, Government messages might be permitted to take precedence, within limits, and these limits might be extended in time of war or national calamity, the use of the cables at other times being at the discretion of the owners. In time of war, no doubt, every possible facility would be given to the Government, even if necessary to the exclusive use of the cables, during a portion at all events of the day.

We maintain that from every point of view it would be best for the work to be carried out by private enterprise, and that there would be a profit on the undertaking. It is impossible at present to gauge the advantanges to be obtained by knitting the empire together by a continuous and unbroken bond in the shape of a complete cable uniting all our possessions. The advantages are certain to be most widely felt and far-reaching. Trade would not only be encouraged and rendered more easy between the mother country and her Colonies, but between the Colonies themselves. The time will come when Great Britain will become aged. Little by little she will need to lean more and more upon her children, the Colonies, and should they fail her, her state will be bad indeed. We are encompassed by enemies. We are not self-supporting. We need outside assistance, even for our daily bread. Our Colonies are well able to supply us, and it is for us to join them to us by every possible tie. It is, therefore, indisputable that facilitated communication is practically an absolute necessity, and we trust that private enterprise may be forthcoming, despite rumours to the contrary, and in coming forward be well paid for its trouble.

TRADE UNIONISTS IN COUNCIL.

VERY soon the trade unionists will be once more in council. The Manchester Congress next month promises to be quite as big an affair as usual, and the subjects down for discussion are, some of them, of unprecedented significance. In this connection it may be well to remind the labour leaders of the opportunities which they possess of influencing either for good or ill the course of trade in this country. The President of the Board of Trade struck the right note when, at the close of last week, he told the trade unionist deputation which waited upon him that our past industrial wars were, perhaps, more responsible than any other circumstance for the rapid strides which had been made of late years by the manufacturing export trade of our continental rivals and of America. Mr. Ritchie was well informed in putting it to the trade unionists that the people who had gained by these strikes have not been British masters nor yet British workmen. The advantage has been wholly on the side of these newer manufacturers' countries. Orders have gone in large numbers to our competitors, and it is a truism that when these orders have once gone away from the country they are not quick to return. Whether, as the President of the Board of Trade suggests, a remedy for the present state of things is to be found in the setting up of Conciliation Boards, we do not care here to pronounce, but in view of the Manchester Conference these remarks certainly deserve to be borne in mind. No more weighty question than that of strikes as affecting the prosperity of our trade and commerce can well be imagined. The leading theme to be considered next month is the proposal for the federation of all the trade unions in the kingdom into one common body, with the object of supporting each other and acting in unison in case any section is what the men term "attacked" by the employers. This is a proposal that the men should well approach with the greatest caution. The magnitude of the idea is alone sufficient to demand second thoughts. Much more, however, should the injury certain to be done to the trade of the country in case of a wrong exercise of the enormous power which such a combination would possess should give the delegates pause. The temptation to use such an organisation unfairly would, in the very nature of things, be immense; and once roused, the various units would be difficult to control, even by the strongest of leaders. It is fortunate that the theory of all combinations of the kind is founded on a belief in the existence of certain characteristics of what is known as human nature, which the past history of mankind tells us are never manifested by large bodies of men. Unselfishness and self-denial are only met with in the individual. Few men will see their own children go without food in order to fight the battles of other men.

"THE IRON MAN."

IN the Workington establishment of Messrs. Charles Cammell and Co., Limited, there is a machine called "the dummy." It is an invention for pushing the great steel ingots out of the mould—a work which, at one time, by hand and hammer, took much time and labour. The men have been heard to say that the "dummy" is the hardest worker in the place. There seems to be a similar view taken in the coalfield of what is called the "iron man." The "iron man" is a coal-cutting machine, which has been introduced in part of the Haigh Moor seam at Messrs. Pope and Pearson's, in the West Yorkshire district. The Committee of the Yorkshire Miners' Association (Alltofts No. 1 Branch) have issued a circular for help to fight the "iron man." They declare they are fighting against a big reduction in their wages through the introduction of the coal-cutting machine, "or, what is commonly called the 'iron man,'" which, they add, "is forming the principle of a low tonnage rate for all Haigh Moor seams throughout the district." Failing to agree as to a tonnage rate, the case was referred to arbitration. The umpire awarded the miners 1s. 1¾d. per ton, plus 20 per cent. The Committee urge in proof that this award is an unjust one, but the management has in some instances given as much as 10d. per ton "in order to make anything like a wage." "What we want," they add, "is a fair tonnage rate, so that we can live honestly, and not, after a week's work, have to submit to that dishonourable principle of our wages being made up." In short, they claim to be fighting afresh "this great question of a living wage." It is man *versus* machine underground, and there is little doubt that in the issue man will go to the wall. He has found out many inventions, and is continually discovering others, which help the world to do without himself. Amongst the latest is the "iron man," which can get coal at about half the price of the old system by hand and pick.

PICKETTING

IN our impression of February 19th last we had a leading article on this subject, which to some extent was called forth by the then recent decision of Mr. Justice Byrne in Lyons *v.* Wilkins. The learned judge had held that for pickets to beset the house of a workman and the place of business of his employers, although they used no violence, intimidation, or threats, was unlawful, and ought to be restrained. The defendants appealed, and on Tuesday the judges of the Court of Appeal delivered their judgments, which they had taken time to consider. The Court was unanimous in holding that the judge of first instance was right, and the appeal was dismissed with costs. We publish in another place the report of the case, which will well repay perusal. The point of the judgments is easy to see. As Lord Justice Chitty said, "attending at or near the house or place where a person lives, or works, or carries on business, or happens to be, in order merely to obtain or communicate information," is the only attending or watching that the law allows. "Attending in order to *persuade*" is not within the proviso. As the Master of the Rolls said:—"It is all very well to talk about peaceable persuasion and to draw fine lines between persuading and giving information." The learned judge then pithily observed upon the real point in these cases; without the "persuasion" element the pickets are simply dummies. Every one knows that perfectly well, and unless this decision should come to be upset by the House of Lords there can be no doubt that use may be made of it in many cases in the future for the protection of both masters and men.

BROWN KRUPP PLATE FOR JAPAN.

A TRIAL of a Brown Krupp process plate, 8ft. by 8ft. by 8·8in., weighing 10·175 tons, took place at the Elswick Company's range at Ridsdale on December 2nd. It was taken as a sample of supply of armour to the Japanese battleship Asahi. The attack was made with an 8in. gun, firing three Wheeler-Sterling shot of Elswick make, weighing 250 lb. each, with striking velocities of 1859, 1964, and 2039 foot-seconds, implying perforation through wrought iron of 17in., 18·5in., and 19·5in., whose ratios to the thickness of the plate are 1·93, 2·10, and 2·22. The plate bore this severe attack admirably, the projectiles being completely broken up, with, perhaps, 3in. maximum penetration. The back showed bulges of 1½in. or less in height with no sign of cracking.

LITERATURE.

The Discharge of Electricity through Gases. By J. J. THOMSON. London: Archibald Constable. 1898.

THIS volume is the outcome of four lectures delivered at the University of Princeton, New Jersey, in 1896, but it has been amplified by the addition of some new results, which have been published since that time. In a large measure it is an epitome of all that has been done in the way of investigation of the effect of electricity on gases. The authorities and original investigators are in all cases mentioned, and in most an indication is given where original papers and articles are to be found. On this account alone it would, we feel sure, be favourably received by all persons interested in the subject. It contains, however, in addition, the record of original experiments of Dr. Thomson's own devising, and it is attractively written. We do not mean by this that it is "popular" science; far from it, it is science for the scientist, not for the man in the street. The book is divided into three parts. The first is entitled the Discharge of Electricity through Gases; the second, Photo-electric Effects; and the third, Cathode Rays. The *raison d'être* of the whole book is found in the introduction to Part I.

"If we wish to study the relation between matter and electricity," the author says, "the most promising course is to begin with the relation between electricity and matter in the gaseous state; for the properties of a gas and the laws it obeys are simpler than for either a solid or a liquid—it is the state of matter which has been most studied, while the kinetic theory of gases supplies us with the means of forming a mental picture of the processes going on in a gas which is lacking for matter in its other states."

When the ether alone is considered, and when it is assumed to be at rest—a state in which both theory and experiment point to its being, "even when exposed to considerable mechanical forces, as it is when an electric wave is passing through it"—the electrical phenomena are fully "explained by laws which can be expressed mathematically by six very simple differential equations." It is not an easy matter to electrify a gas, and the first few pages are taken up with a discussion of the means employed by Mr. Townsend for securing this end, and the calculation of the charge carried by each particle of an electrified gas produced by the rapid electrolysis of sulphuric acid or caustic potash are worked out. This calculation depends upon the remarkable fact that when an electrified gas is admitted into aqueous vapour even far from the saturation point, a cloud is formed. The total charge in a vessel full of such cloud can be measured by an electrometer, and the radius, and therefore weight, of each drop can be calculated from the rate at which the cloud falls. The total weight of the cloud is, of course, found by direct weighing, and from these two factors the number of drops is obtained, and dividing the total charge in the cloud by the number of drops, the charge on each drop is found. The oxygen and hydrogen liberated by the electrolysis of an acid solution are

both electrified positively, but the former with only so small a charge that its presence is doubtful; whilst from caustic potash the oxygen bears a negative charge, but not so great as the hydrogen in the former case, whilst the hydrogen is scarcely, if at all, electrified. Some gases can also be electrified chemically, but one of the readiest ways is by the splashing of liquids. Thus the splashing of rain drops and the beating of the sea upon its beach both electrify the air around them; though, oddly enough, whilst the pure water from the clouds imparts a negative charge the salt-bearing water of the ocean gives a positive charge, to the air. Even when a light breeze causes ripples upon a pond a negative electric charge is imparted to the air, whilst the pond becomes positively electrified. These phenomena have led to the theory propounded by Lenard, that on the drops of water there are two superposed layers of electricity, one +, the other −; the rough treatment and the distortion of the drop when it strikes any resisting surface is enough to separate these electric layers, one adhering still to the drop, whilst the other goes into the surrounding gas or air. Thus diminishment of the area, as when the drop is flattened, liberates electricity; and, following Sir George Stokes, we may regard it as possible that when numbers of small drops come together to make one large thunder raindrop electricity is liberated, so that the large drops which fall in a thunder shower may be rather the cause than the consequence of the accompanying electrical phenomena.

The author then passes on to a consideration of the effects of electrification by Röntgen rays, and concludes the part with a few words about the marvellous results discovered by Becquerel, produced by radiation from the metal uranium and its salts, and these lead naturally to the second section on Photo-electric Effects. It is perhaps necessary to explain, as one may be easily led away by the memory of X-ray experiments, that these have nothing directly to do with photography, though the photographic plate may be used for their elucidation, but are the phenomena based on the discovery by Hertz in 1887, that ultra-violet light assisted a discharge if directed on the spark gap. With investigations of this nature the names of Elster and Geitel, of Righi and of Stoletow, are intimately connected. It is an interesting observation that "the sign of the electrification in the air produced by the action of light is the same as that produced in air by the splashing of drops of mercury or water," and it is thought that a disruption of one of two concentric layers may be caused by incident light in this case, just as it was by the concussion of the rain drops against the ground in that quoted above.

In this section some account of the experiments made on the electrification of gases by glowing metals and on the electrification in the neighbourhood of an arc discharge are given, and the conductivity of gases under different conditions is discussed. The section concludes with a very instructive record of the results and methods of electrolysis in gases. We quote the first paragraph because in it there appears to lie the key to the whole matter:—

> In the preceding account of the conductivity conferred on gases by light, Röntgen rays, and heat, we have seen that the phenomena can be explained on the supposition that the electricity gets through the gas by the movement of oppositely charged ions through the gas, the process being similar to that by which electricity is carried through an electrolyte. The passage of sparks through a gas furnishes us with additional evidence in favour of this view.

Dr. Thomson then goes on to describe Perrot's celebrated experiments made in 1860-61 on the passage of a discharge through water vapour, and passes on to an account of his own modification of Perrot's apparatus, and some of the results obtained with it. Again we quote:—

> The effect produced by electrification on the condensation of a jet of steam is shown in a very striking way by this apparatus. When the delivery tubes are open to the air, the steam after escaping from the nozzles goes some inches before it condenses sufficiently to form a cloud; as soon, however, as the coil is turned on and the sparks pass, brownish clouds reaching right down to the nozzles are at once formed. The cloud is denser in the steam which has gone past the negative electrode than in that which has gone past the positive.

The "brownish clouds" associated with the discharge, rightly or wrongly, call to one's mind the copper-coloured sky which forebodes thunder. There is another remarkable fact to which we cannot resist calling attention, and that is that, whereas in the electrolysis of water, hydrogen always comes off at the negative electrode and oxygen at the other, in the electrolysis of steam the gases come off sometimes at one and sometimes at the other terminal, according to the nature of the spark. We have so far overstepped our limits that we have no space left to devote to the last section of the volume. It deals with Cathode Rays, and fortunately the information about these is more widely distributed than that of which we have given some faint outline in this notice.

We put the book down with regret. Intentionally or unintentionally, Dr. Thomson has dealt with his subject in such a way as to keep, if we may be permitted so to express it, the *super*-natural side uppermost. It carries, therefore, with it a charm which too many scientific works lack. It is, moreover, a volume which affords no little food for conjecture and occasion for the exercise of the scientific imagination. Every page contains, briefly stated, the record of some fact, and many of these, we have little doubt, will be new to a large number of our readers. It is a book which we recommend to all the devotees of science, no matter into what particular branch their opportunities or tastes may lead them, for it is one from the perusal of which they cannot rise without feeling that their mental horizon has widened.

Railway Block Signalling. By JAS. PIGG, A.I.E.E. London: Biggs and Co., 139, Salisbury-court, E.C. 7s. 6d.

IN a short preface to this useful epitome of modern signalling, Mr. Pigg remarks that the tendency to employ automatic methods of train direction seems likely to increase, but he well observes that completely automatic systems do not admit of the selection and discrimination which are necessary where the traffic is not only very heavy but of extremely varied character. It does not appear to us that it will ever be possible in this country to dispense with the services of signalmen to any great degree, or that it would be very desirable even if practicable. The presence of skilled watchmen, as it were, looking after the general working of the whole railway machine from fixed and well-known points, able to summon assistance, and to adopt measures varying with each particular case, is an advantage not to be lightly thrown away in favour of cleverly-devised but unintelligent mechanical appliances.

Mr. Pigg's first chapter is mainly historical, and of much interest, tracing the development of block working from 1839 to the present time, with examples of the codes used on the Leicester and Swannington, and Birmingham and Gloucester Railways some fifty years ago. The extraordinary growth and complexity of modern traffic is well shown by comparing these with the elaborate signalling regulations of recent date, detailed on pages 34 to 70. A great variety of subjects unconnected directly with block signalling is discussed, such as signal whistles, head and tail lamps and discs as train describers, the reporting of trains in advance, the use of the telephone in railway working, and fog signalling, all find a place in Mr. Pigg's compendium. Block working itself begins to be treated of in Chapter IV., and is gone into very thoroughly and practically. The author is evidently quite at home in his subject, and gives cuts and full explanations of a great variety of modifications of the block system, such as the double-line block circuit instruments of Walker, Preece, Tyer, Winter, and other inventors. Elaborate diagrams illustrating the "lock-and-block" methods of Winter, Saxby and Farmer, and Sykes are given, enabling the differences between them to be easily comprehended. In all these the principal object aimed at is the same, viz., control of the starting signal at the entrance of a section by the man at the receiving end, and the rendering it impossible that a section should be entered till it is known to be clear throughout. There is an interesting description of the intricate signalling arrangements necessary at the swing bridge over the Ouse at Selby, on the North-Eastern Railway. The York and Hull lines diverging at the north end of the bridge, and the station yard commencing at the south end, whilst the traffic is very heavy, render it a most difficult place to work, but it has been successfully accomplished by the ordinary three-wire single-needle block instruments in conjunction with Sykes' lock-and-block applied to the indicators for the several lines. There are only two roads over the bridge which can be used at the same time, but the rails of two other roads are placed within these, so that the bridge is hardly any wider than usual. A cabin in the centre of the bridge is the point from which the hydraulic machinery for rotating it is worked, but it takes no part in the block working.

There is also a careful account of Sykes and O'Donnell's system of interlocking for single-needle instruments now being tried on the Great Northern at several places; and of Blakey and O'Donnell's method. Both of these are combinations of interlocking and automatic signalling, the train passing over treadles at each end of the section. In both cases there is very effective control of signals in advance by the box in the rear of them, as well as automatic intimation by the train itself of its entry into and exit from a section.

Some forty pages are devoted to various systems of single-line working, comprising especially the forms of electric staff now coming so generally into favour. In Chapter V. signal indicators are fully treated, with diagrams of the connections required to work them. This section includes indicators for signal arms, for points, as to whether lamps are alight or have gone out, and means for showing the state of the line near an out-of-sight advance signal, in order that a train waiting at it may not be forgotten. Several accidents of recent years seem to show an increasing need for ample security in the latter contingency. Mr. Pigg ably discusses methods of conveying audible signals to the drivers when fogs prevail; but the difficulty of hearing bells or gongs amid the noise of the engine, and the tremendous shock sustained by any external appliance when struck at high speed, seem to render this rather a hopeless field for improvement. We are inclined to agree with the author in his opinion that drivers should have more to do with calling out the fogmen than is now the case. The general state of the locality as regards fog must be better known to them than to the signalmen, who obviously can only judge of their own immediate surroundings. The book closes with a description of Timmin's automatic system of signalling on electric railways, and of the same inventor's ably-planned arrangements at the Earl's Court Station of the District Railway, where both signal arms, points, ground discs, and locking bars are worked by electricity, and the levers interlocked by the same agency. The book is carefully indexed, and has a table of the contents of the chapters. It will certainly be found of value to all students of practical railway business in the outdoor department.

Infinitesimal Analysis. By WILLIAM BENJAMIN SMITH Professor of Mathematics in Tulane University. Vol. i., "Real Variables." London: Macmillan and Co. 1898. New York.

THIS volume has been written on what appeared to the author, in the light of ten years' experience in teaching the Calculus, to be lines of least resistance. With this object the author has done well to restrict himself in this first volume to real variables, and to start at the outset with some familiar applications, to show the beginner the utility of the Calculus. The author has strewed some boulders in the road in the shape of definitions of infinitesimals, one-valued and many-valued functions, and of continuity, which raise difficulties, better kept out of sight of the beginner. But it is a difficult thing to settle the best order of presentation of the initial ideas; and if this order is made a strictly logical one, the effect is to make the book easier to read backwards than forwards. Integration is introduced at an early stage, and carried on simultaneously with differentiation. Here, again, the usual boulder is thrown down in the shape of Integration regarded as a summation; a method which soon gets into difficulties, and leads the author to point out the need of a better method—in short, the inverse method of differentiation, with which the student must be familiar to a certain extent before he can recognise the refinements of the arguments required in the method of direct summation. A useful table of reference is given of the principal differentiations, and the corresponding integrations; it would serve to explain a well-known difficulty if the integral 21—on page 79—was printed:—

$$\int \frac{d\,x}{x^2 - a^2} = \frac{1}{2^a} \log \frac{x \smile a}{x + a}$$

The manner in which the Elliptic Integral makes its appearance is dismissed in a useful note in § 125; the author might improve the occasion by showing the degenerance when the middle root e_2 of the cubic T approaches to coincidence with the upper root e_1 or the lower root e_3. The general treatment of Integration adopts the most recent procedure in utilising the hyperbolic functions, direct and inverse; these are denoted by *hc*, *hs*, instead of the vulgar-looking *cosh*, *sinh*. The author has done well in carrying Integration into the domain of mechanical preparation in determining centres of gravity and moment of inertia, thus clearing the ground for future applications. Numerous collections of well-chosen examples are interpolated, and the diagrams are carefully drawn; but we think the circle of curvature should be introduced into Figs. 29-32, with a view of showing its coincidence with the curve within the thickness of the line for an appreciable distance on each side of the point considered. We notice some novelties in terminology—*mediate derivative*, *prosthapheretic formula*, *absolute worth*, *anti-tangent*, *regressive differential quotient*, &c. The book is well printed on a large page, without crowding the type, and should prove useful in the country as a corrective to our arid and jejune academical treatises.

SHORT NOTICES.

Résistance des Bouches-à-Feu. Par P. Laurent. Paris: Gauthier-Villars, Quai des Grands-Augustins 55, and 20, Boulevard de Courcelles.—This work belongs to the "Scientific Encyclopædia of Aide-Mémoire," brought out under M. G. Isler. It deals with the strains falling on ordnance by mathematical investigation, beginning with the general question of gun tubes with jackets and hoops, and ending by a pretty full investigation of the conditions of wire ordnance. For a theoretical work, we think it unusually compact and business-like in each case, dealing first with the general conditions of the question, and then following it up with formula. Tables of factors of resistance are given at the end of the book.

Annuaire, 1899. Paris: Gauthier-Villars, Bureau des Longitudes, Quai des Grands-Augustins 55.—This year-book dates its origin from June 25th, 1795, when it was begun as one of many scientific efforts made by the savants of the French Republic. It has been kept up as an official work ever since that time. It contains astronomical and other scientific tables and data, and is well brought up to date, and without question is of high authority. The calculation of distances of the earth to the sun and moon are based on a value of the solar parallax adopted internationally in 1896, namely 8·8″. The tables of weights and measures, money, geographical measures, magnetic elements, and optical and electrical data, are brought up to date, and chiefly by M. Cornu. There are special chapters on balloon trials, by M. Bouquet de la Grye; geodesy, by M. Bassot; the observation and work of the Mont Blanc Observatory in 1898, by M. J. Janssen, and on the great equatorial telescope for 1900, of 60 metres focal length, and 1·25 metres aperture, now under construction by M. Gautier.

Small Accumulators: How Made and Used. An elementary handbook for the use of amateurs and students. Edited by Percival Marshall, A.I. Mech. E. Fully illustrated. The "Model Engineer" Series, No. 1. London: Dawbarn and Ward, Limited. Price 6d. net.—This forms the first of a series of popular scientific handbooks for amateurs and students, and it has been called into being, so the preface tells us, by the large number of requests for advice which have reached the author in his capacity as editor of the *Model Engineer and Amateur Electrician*. Although very little of the matter is new, yet it is all put forward in a new form, and in its sphere the book should be useful. It is practical and sound, and it contains that which is of great use to the non-technical worker, a glossary of the terms—electrical and otherwise—used throughout the book. In the beginning chapters the early history of accumulators is dealt with, and then the reader is taught how to make small batteries by constructing the cells and "pasting" and "forming" the plates. Modern commercial forms of battery are then discussed at some length, and the reader is told the firms which manufacture them. The charging of small accumulators is dealt with in an efficient and thorough manner, and useful hints given as to the arrangement of the cells with varying sources of electricity. Detailed instructions are also given as to the time taken to charge cells, and as to the way in which they should be worked. The book ends with a complete list of the uses of small accumulators, which include the lighting of domestic, factory, miners', and carriage lamps, decorations, medical uses, gas and oil engine ignition, fishing lamps, &c.

BOOKS RECEIVED.

The Behaviour of Railway Vehicles in Passing through Curves. From the German of Obermaschinenmeister. F. Hoffman, of Chemnitz. Madras: Printed at the Lawrence Asylum Press, Mount-road. 1898.

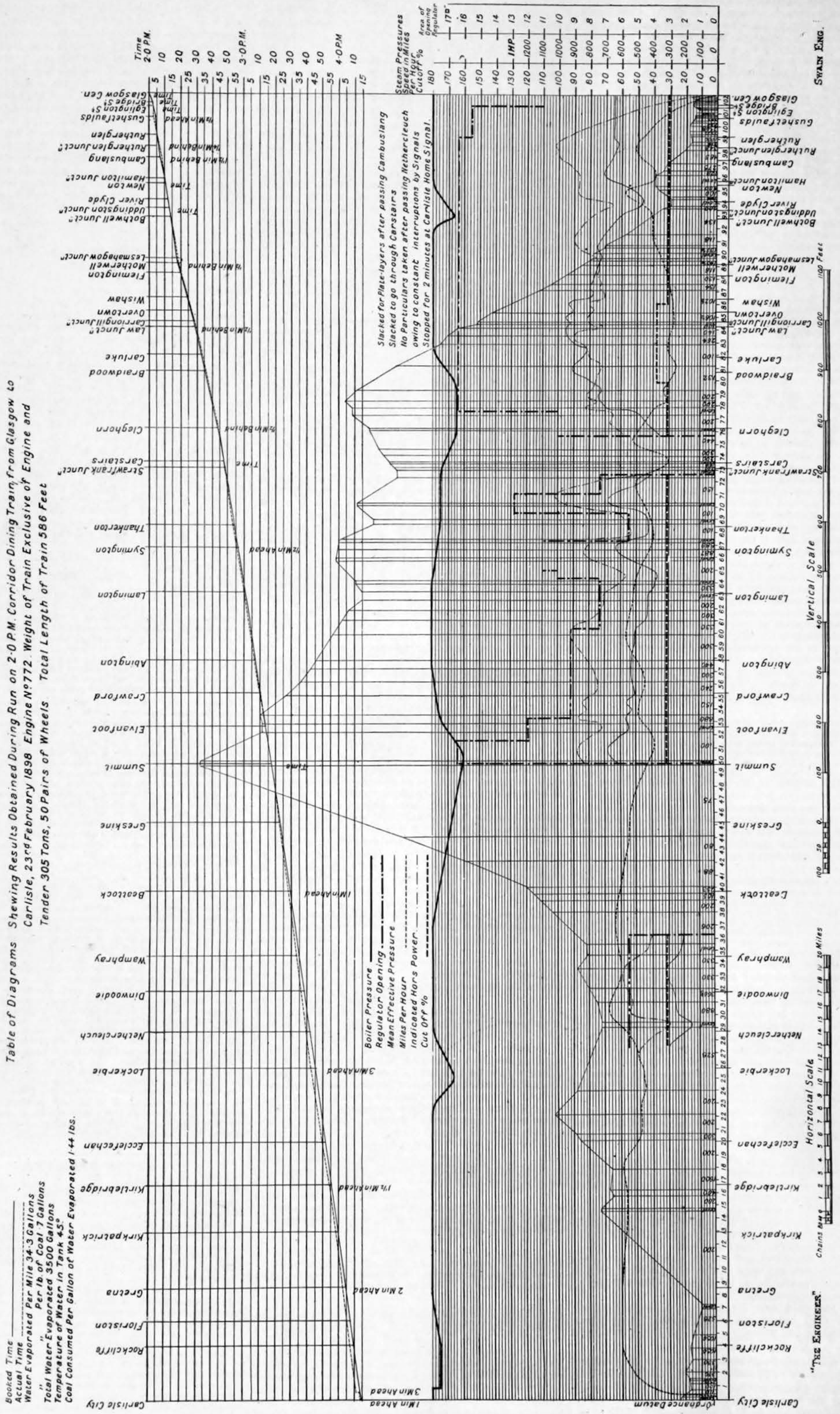
The Centrifugal Pump, Turbines, and Water Motors: Including the Theory and Practice of Hydraulics. (Specially adapted for engineers.) By Charles H. Innes, M.A. Second edition. Manchester: The Technical Publishing Company, Limited. London: John Heywood. 1898. Price 3s. 6d. net.

Excerpt Minutes of Proceedings of the Institution of Civil Engineers. Vol. cxxxiv. Session 1897-98. Edited by J. H. T. Tudsbury, D.Sc., Secretary. Chamier on "Culverts and Flood Openings," Chenhall on "Oxy-Chloride Copper Ores," Dalby on a "New Transmission Dynamometer," Dawkins on the "Relation of Geology to Engineering," Fowler on "Calcium Carbide and Acetylene," Garvie on "Latchford Lock Gates," Godfrey on the "Effects of Frost on Portland Cement," Preece on the "Electricity Supply of London," Jameson on "Testing the Strength of Materials," Stoney on "Extraordinary Floods in India," report of Committee on the "Thermal Efficiency of Steam Engines," and abstracts of papers on "Scientific Transactions and Periodicals." London: Published by the Institution, Great George-street, Westminster. 1898.

ENGINE TEST, CALEDONIAN RAILWAY

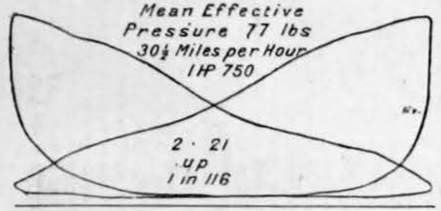
(For description see page 626)

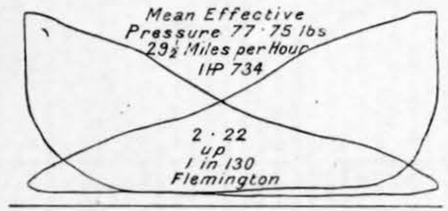
Table of Diagrams Shewing Results Obtained During Run on 2·0 P.M. Corridor Dining Train from Glasgow to Carlisle, 23rd February 1898 Engine No 772 Weight of Train Exclusive of Engine and Tender 305 Tons, 50 Pairs of Wheels Total Length of Train 586 Feet

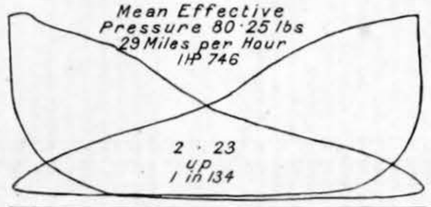


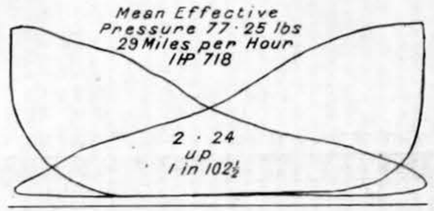
ENGINE TEST, CALEDONIAN RAILWAY

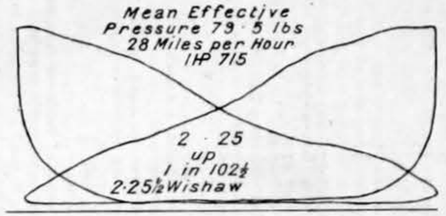
(For description see page 626)

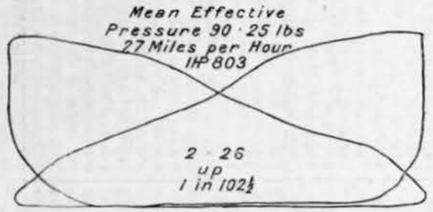


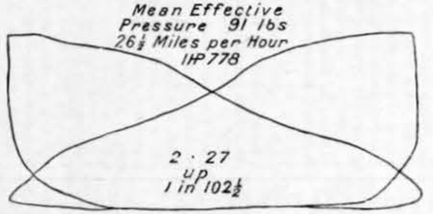


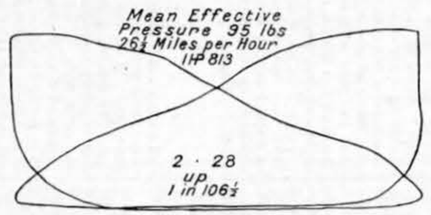


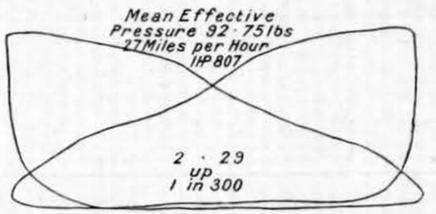


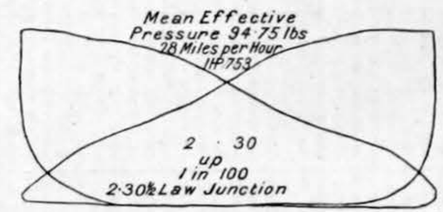




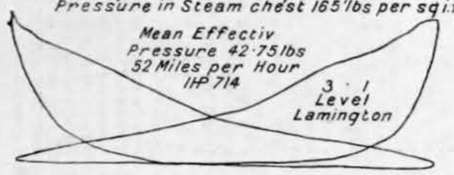


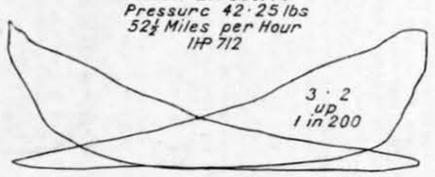


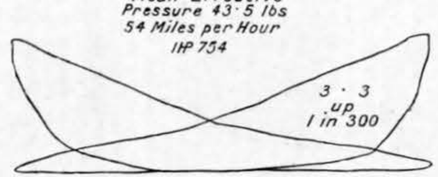


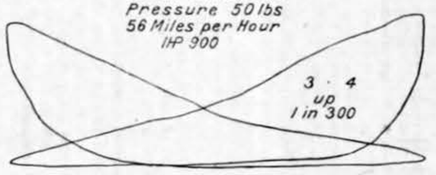


Area of opening of Regulator Valve 1·64 sq in
Rev^g Gear 4½ notch Cut off 38%
Boiler pressure 180 lbs per sq in
Pressure in Steam chest 165 lbs per sq in

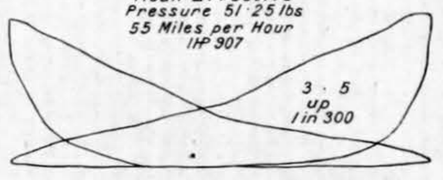




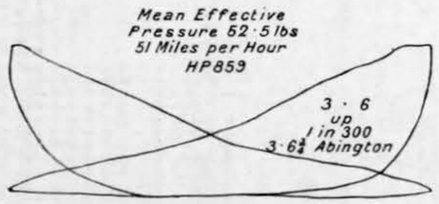


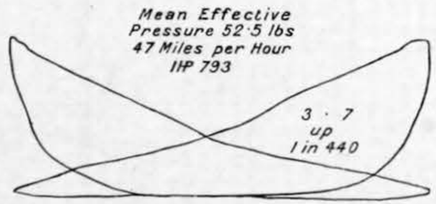


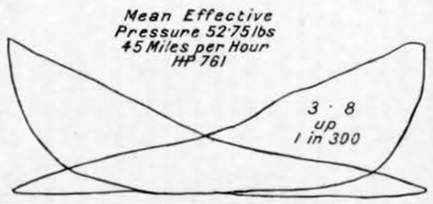
Area of opening of Regulator Valve 9·2 sq in



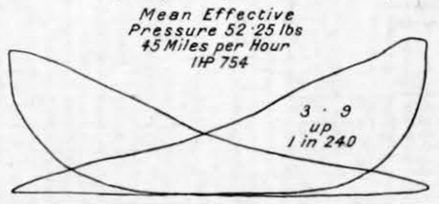
Area of opening of Regulator Valve 9·2 sq in
Rev^g Gear 5^th notch Cut off 31%
Boiler pressure 180 lbs per sq in
Pressure in Steam chest 150 lbs per sq in



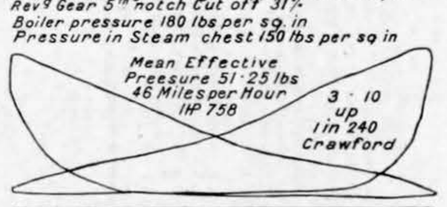




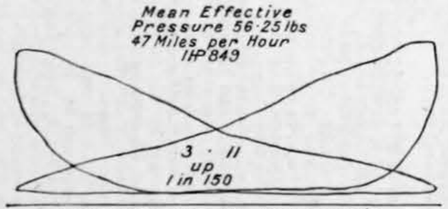
Boiler Pressure 179 lbs per sq in



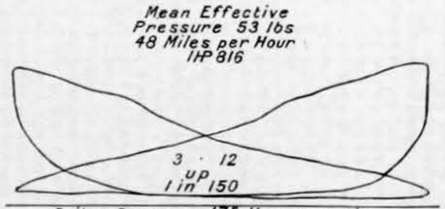
Boiler Pressure 178 lbs per sq in



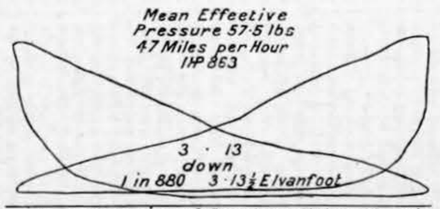
Boiler pressure 177 lbs per sq in



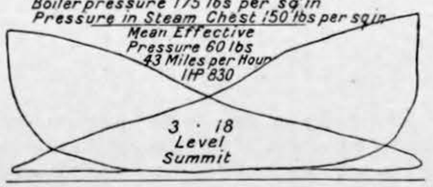
Boiler Pressure 176 lbs per sq in

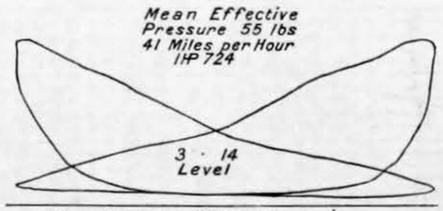


Boiler Pressure 175 lbs per sq in

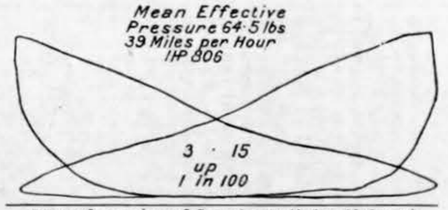


Area of opening of Regulator Valve 11·9 sq in
Rev^g Gear 5^th notch Cut off 31%
Boiler pressure 175 lbs per sq in
Pressure in Steam Chest 150 lbs per sq in

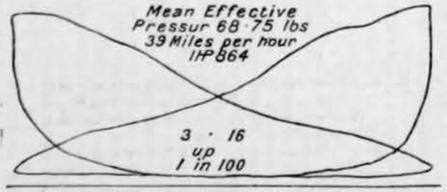




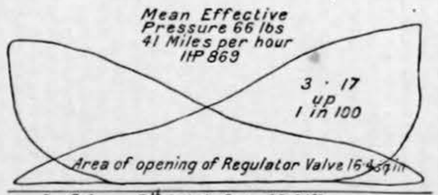
Boiler Pressure 170 lbs per sq in



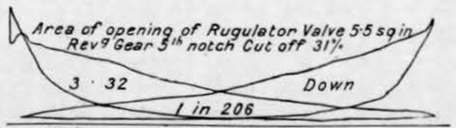
Area of opening of Regulator Valve 16·4 sq in
Boiler Pressure 166 lbs per sq in



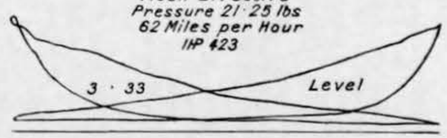
Boiler Pressure 163 lbs per sq in.



Rev^g Gear 5^th notch Cut off 31%
Boiler pressure 160 lbs per sq in
Pressure in Steam Chest 150 lbs per sq in



Boiler pressure 180 lbs per sq in
Pressure in Steam Chest 100 lbs per sq in

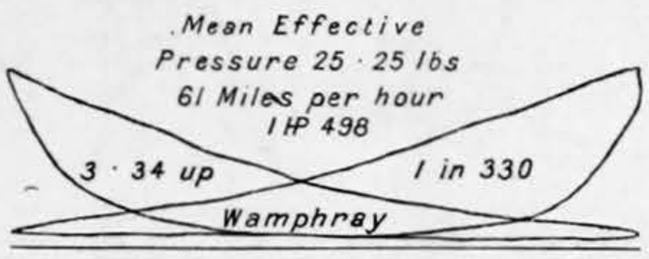


SWAIN ENG.

THE INDICATED HORSE-POWER OF LOCOMOTIVES.

IN a recent article on express locomotives in THE ENGINEER, the author, Mr. W. M. Smith, alludes to an account by Mr. Rous-Marten which appeared in our issue of 25th February, 1898, of the performance of a Caledonian engine, and states that, unfortunately, no information has been given concerning the indicated horse-power. An engine of the class in question, Dunalastair II., No. 772, was indicated by Mr. Weir and assistants, under Mr. McIntosh's direction, and the results are now published for the information of all interested.

The indicator diagrams, which show a maximum horse-power of 1019, were all taken on the same journey, Glasgow to Carlisle, at the rate of one per minute while the engine was steaming, and the running not interrupted by signals. The hour and minute are given on the diagram; thus, 3·34. The diagram on page 624 shows graphically the



general results obtained as to time-keeping, boiler pressure, regulator opened, mean effective pressure, speed, horse-power, and cut-off, in relation to the contour of the line. The weight of the train hauled, exclusive of engine and tender, was 305 tons, and is a fair sample of the daily work done by this class of engine. We have commented on these diagrams on page 621.

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE.—COURT OF APPEAL.

(*Before the* MASTER *of the* ROLLS *and* LORDS JUSTICES CHITTY *and* VAUGHAN WILLIAMS.)

J. LYONS AND SONS *v.* WILKINS.

THIS was an appeal by the defendants against the decision of Mr. Justice Byrne in a trade union case—reported in The *Times* of February 4th last and in the *Times* Law Reports, vol. 14, p. 208. The learned Judge granted a perpetual injunction restraining the defendants, Percy Cornwall Wilkins, Charles Clarke, Alexander Thompson, John Laverick, and Frederick Goodhall, from watching or besetting the plaintiffs' works or place of business and the approaches thereto for the purpose of persuading or otherwise preventing persons from working for the plaintiffs, or for any purpose except merely to obtain or communicate information, and from watching or besetting the premises of Adolph Schönthal for the purpose of persuading or otherwise preventing him from working for the plaintiffs, or for any purpose except merely to obtain or communicate information. The learned Judge also gave £5 damages in respect of a libel, but there was no appeal from that part of the judgment. The action arose out of a strike of the plaintiffs' workpeople, which took place in January, 1896. The plaintiffs were leather bag and portmanteau manufacturers in Redcross-street. Adolph Schönthal did work for them at his own premises, employing his own workmen. The defendant Wilkins was the secretary of the Amalgamated Trade Society of Fancy Leather Workers, which was registered under the Trade Union Act, 1871; the defendant Clarke was the chairman of the society, and the other three defendants were the trustees of the society. The strike arose out of a dispute about wages and the dismissal of the defendant Thompson by the plaintiffs pending the settlement of that dispute. An interlocutory injunction was granted by Mr. Justice North in 1896, and his order was afterwards affirmed, with some modification in the terms of the injunction, by the Court of Appeal—*vide* the *Times* Law Reports, vol. 12, pp. 222, 278. Before Mr. Justice Byrne gave his decision the case of "Allen *v.* Flood" had been decided by the House of Lords—the *Times* Law Reports, vol. 14, page 125, 1898, A.C., page 1—and by reason of that decision Mr. Justice Byrne refused to restrain the defendants from maliciously inducing or conspiring to induce persons not to enter into contracts with the plaintiffs. The plaintiffs did not appeal from that part of the decision. It was admitted that there had been no physical violence or obstruction by the defendants. There had been only "picketing" and peaceful persuasion by the defendants of workpeople not to work for the plaintiffs, though very strong language had been used to women in particular. By the Conspiracy and Protection of Property Act, 1875 (38 and 39 Vict., c. 86) section 7, "Every person who, with a view to compel any other person to abstain from doing or to do any act which such other person has a legal right to do or abstain from doing, wrongfully and without legal authority" (*inter alia*) "(4) watches or besets the house or other place where such other person resides, or works, or carries on business, or happens to be, or the approach to such house or place, shall, on conviction thereof by a Court of summary jurisdiction, or on indictment as hereinafter mentioned, be liable either to pay a penalty not exceeding twenty pounds or to be imprisoned for a term not exceeding three months, with or without hard labour. Attending at or near the house or place where a person resides or works, or carries on business, or happens to be, or the approach to such house or place, in order merely to obtain or communicate information, shall not be deemed a watching or besetting within the meaning of this section.' The appeal was argued on November 30th and December 1st, when judgment was reserved. The arguments on the appeal will be found reported in the *Times* of December 1st.

Mr. W. H. Cozens Hardy was for the appellants; Mr. Eve, Q.C., and Mr. Ward Coldridge were for the respondents.

The Court dismissed the appeal.

The MASTER of the ROLLS said:—The construction put by this Court on 38 and 39 Vict., c. 86, sub-sections 3 and 7, when this case was heard in March, 1896—see 1896, 1 Ch., 811—is adverse to the appellants, and was, in my judgment, correct. Having reconsidered my own judgment, I see nothing to recall or qualify. Upon the present appeal, however, one or two important questions were raised which do not appear to have been considered on the former occasion, and to them I will confine myself. The great point made by the appellants' counsel turned on the word "wrongfully" in section 7 and on the effect of "Allen *v.* Flood" (1898, A.C., 1) on the meaning of that word. He contended that to "watch and beset" another person's house was only illegal if done—(1) with a view to compel him to abstain from doing, or to do some act, which he has a right to do or not to do; (2) wrongfully and without legal authority. He further contended that nothing could be said to be wrongful which did not violate some right of the complainant; and that there was nothing wrongful in watching or besetting a house simply in order peacefully to persuade others to conduct themselves in some particular way which was not unlawful for them to follow. This argument is, in my opinion, based on a misconstruction of Section 7. This section is a penal section, and the words "wrongfully and without legal authority" must be inserted in an indictment or information framed on the enactment, and the specific acts which the complainant was to be compelled to do or not to do ought also to be specified in a conviction by a magistrate—see "The Queen *v.* McKenzie," 1892, 2 Q.B., 519. Moreover, if on the trial the evidence before the Court is consistent with the legality of the acts complained of, this reasonably possible legality must be excluded by evidence before the accused can be properly convicted. But it is not necessary to show by other evidence than that which proves the overt acts complained of the legality of them if no justification or excuse for them is reasonably consistent with the facts proved. This is the principle always applied in criminal prosecutions in which the words "feloniously," "wrongfully," or "maliciously" are introduced into the charge and have to be proved before the person accused can be properly convicted. That this is the correct method of construing and dealing with the words "wrongfully and without lawful authority" in Section 7 is, in my opinion, perfectly plain if attention is paid to sub-heads 1, 2, 3, and 5, to which those words are as applicable as they are to sub-head 4. If the overt acts mentioned in sub-head 1, for example, in using violence or intimidation are proved, and it is proved that they were done with a view to compel, &c., and there is no reasonable ground for justifying them, it is unnecessary to give further evidence to prove that they were committed "wrongfully and without legal authority" — see "The Queen *v.* McKenzie," at pages 521-3. If this be true of all the sub-heads except 4—watching and besetting—I can discover no justification for giving the words "wrongfully and without lawful authority" any different meaning or effect when applied to 4—viz., "watching or besetting." The truth is that to watch or beset a man's house with a view to compel him to do or not to do what it is lawful for him not to do or to do is wrongful and without lawful authority unless some reasonable justification for it is consistent with the evidence. Such conduct seriously interferes with the ordinary comfort of human existence and ordinary enjoyment of the house beset, and such conduct would support an action on the case for a nuisance at common law—see "Bamford *v.* Turnley" (3 Bd. Sm., 62), "Brooke *v.* Saillard" (2 Ch. D., at page 701, per Jessel, M.R.), "Walter *v.* Selfe" (4 De G. and Sm., 315), and "Crump *v.* Lambert" (L R., 3 Eq., 409). Proof that the nuisance was "peaceably to persuade other people" would afford no defence to such an action. Persons may be peaceably persuaded provided the method employed to persuade is not a nuisance to other people. Another point made by the appellants' counsel was that what was done to Schönthal gave the plaintiffs no cause of action. This point was raised and considered and decided by the Court on the former appeal, and I might say no more. But as I do not remember whether the particular argument urged by Mr. Hardy was used on that occasion, I will add that, in my opinion, his contention cannot be supported. It is based on the expression "such other person." It is said that to beset one person's house with a view to compel some one else is not within the section. Such a construction would render the Act nugatory in a great number of cases clearly within the mischief intended to be remedied. But a more direct answer to the argument is that "such other" means "any other." This seems plain if attention is paid to the language of the first part of the section where these words first occur. Moreover, the word "person" in the singular must be read so as to include "persons" in the plural—see 52 and 53 Vict., c. 63, s. 1—and if this is borne in mind, the argument is seen at once to be untenable. His Lordship then referred to "Allen *v.* Flood," which, he said, was of no real use in construing the Act now in question, and he continued as follows:—As regards the facts the evidence was amply sufficient to prove the plaintiffs' case. The whole object of what was done was to compel the plaintiff to comply with Mr. Wilkins' terms, and although there was no violence or overt threat of violence, it is quite plain that the relays of men set to watch and beset the plaintiff's house—and the house of Schönthal, who worked for him—were sent to do, and that they did, a great deal more than "attend" where they were "in order merely to obtain or communicate information." It is all very well to talk about peaceful persuasion and to draw fine lines between persuading and giving information. In this case there is no difficulty whatever in coming to the conclusion that what was done was watching and besetting as distinguished from attending "in order merely to obtain or communicate information." That the provisions of the Act were infringed appears to me to be plain and beyond all reasonable doubt. The appeal must be dismissed with costs.

LORD JUSTICE CHITTY said:—This appeal by the defendants is limited to the injunction granted by Mr. Justice Byrne against watching and besetting. The injunction is, in the terms of the order, pronounced by the Court of Appeal on the motion. He postponed giving judgment until after the decision of the House of Lords in "Allen *v.* Flood," and after consideration he held that "Allen *v.* Flood" did not affect the decision of the Court of Appeal on the motion, but that it did preclude him from granting a further injunction which the plaintiffs asked for. There is no appeal by the plaintiffs. The facts proved at the trial were to the same effect as those given in evidence on the motion, except that in two instances Mr. Justice Byrne held that the evidence of actual interference was not so strong. He found that it was clearly proved that the appellants watched and beset the plaintiffs' works or place of business and the approaches thereto for the purpose of persuading or otherwise preventing persons from working for the plaintiffs, and for purposes other than that of merely obtaining or communicating information. This finding of facts is accepted by counsel on both sides. It was admitted by the plaintiffs' counsel that the pickets, as they are called, used no violence or intimidation or threats. The picketing extended over some months, covered all the working hours of the day, and was conducted by relays of men in succession. The object in view was clearly shown by the white cards distributed by the pickets, and the other documents referred to. The picketing and the acts done by the pickets were done with a view to compel the plaintiffs to abstain from doing or to do acts which the plaintiffs had a legal right to do or abstain from doing, viz., to compel them to change the mode of conducting their own business. To avoid any possible misapprehension, I state that the strike itself was lawful. The question on the appeal, in my opinion, turns on the 7th section of the Conspiracy and Protection of Property Act, 1875. The construction and effect of that section were dealt with by this Court on the motion, and the decision then arrived at is binding on us, subject only to the point whether it can be shown to be erroneous, as being in conflict with "Allen *v.* Flood." I am unable to see that it is. The point decided in "Allen *v.* Flood" is that an act lawful in itself is not converted by a malicious or bad motive into an unlawful act, so as to make the doer of the act liable to a civil action. No such general question of motive arises in the present case. The sole question is whether upon the facts the case is brought within the 7th section. To bring a case of watching or besetting within the section it must be shown that the watching or besetting was done with a view to compel a person to abstain from doing or to do any act which such person has a legal right to do or abstain from doing. That the watching and besetting were done with that view is found by the Judge and not disputed. "View" does not import motive. It imports purpose. Speaking for myself, I prefer standing by the words which the Legislature has thought fit to employ. The acts complained of were done with the view stated in the section. Then it was urged that the watching and besetting mentioned in the fourth sub-section was not rendered unlawful by the section where it was done for the purpose of persuading workmen to abstain from taking work from the person sought to be compelled. I cannot accept that proposition. I think that where the view is established the only case in which watching or besetting is allowed, or, in other words, is not unlawful, is that mentioned in the proviso at the end of the section, viz., where the attending at or near the house or place where a person resides or works, or carries on business, or happens to be, or the approach to such house or place is "in order merely to obtain or communicate information." attending in order to persuade is not within the proviso. It is noticeable that the first section of the Act of 1871, which Act is repealed by the Act of 1875, contained no such proviso, and that the seventh section is more favourable to those who watched or beset. Mr. Cozens-Hardy, jun., in his argument for the appellants, fastened on the words "wrongfully and without legal authority," and contended that they showed that the watching or besetting mentioned in the fourth sub-section were acts lawful in themselves unless it were shown in some way other than by proof of the facts of watching or besetting with the view mentioned at the beginning of the section that the acts done were done wrongfully or without legal authority. But this argument cannot be sustained. "Wrongfully and without legal authority" applies equally to all the five sub-sections; and to take—by way of illustration—the first sub-section, the using of violence or intimidation, or injury to property there specified are all of them unlawful acts in themselves. No just or sound construction of the section would permit words which in terms apply to all the sub-sections being confined to one sub-section only. But further, the acts of watching and besetting here proved in reference to the fourth sub-section and done with the view mentioned were acts in themselves unlawful at common law, and are not made lawful by the Legislature. In my opinion they constitute a nuisance at common law. True it is that every annoyance is not a nuisance; the annoyance must be of a serious character and of such a degree as to interfere with the ordinary comforts of life. To watch or beset a man's house for a length of time and in the manner and with the view proved would undoubtedly constitute a nuisance of an aggravated character. It must be borne in mind that the 7th section, although it probably arose out of trade disputes, is not confined to trade disputes or to disputes between masters and men. It applies equally to all her Majesty's subjects of every class. It would embrace the case of besetting a man's house with a view to compel him not to receive guests or visitors. Further, I think that the whole argument on the words "wrongfully and without legal authority" is founded upon a misapprehension. The acts mentioned in the 4th sub-section being in themselves unlawful, the words "wrongfully and without legal authority" are inserted to provide for any unforeseen case in which the evidence of the overt acts may possibly show some lawful excuse or justification, or, to speak perhaps more correctly—as "authority" is said to cover "excuse," see "The Queen *v.* Harvey," L.R., 1 C.C.R., 284—lawful authority or justification. The term "wrongfully" and its meaning in law were dealt with incidentally by many of the Lords who advised the House in "Allen *v.* Flood." It will suffice to quote one passage to be found in Lord Herschell's speech, where he cites with approval the statement by Mr. Justice Crompton in his judgment in "Lumley *v.* Gye" (2 Ell. and Bl., 216) that it must now be considered clear law that a person who "wrongfully and maliciously or, which is the same thing with notice interrupts the relation subsisting between master and servant, commits a wrongful act." With regard to Schöntal, it was decided on the motion that the watching and besetting of his house or shop with a view to compel the plaintiffs were illegal acts on the part of the defendants for which the plaintiffs could sustain an action against them. On this appeal Mr. Cozens-Hardy raised what may have been a new point founded on the words "such other person" which run throughout the 7th section. It was urged that besetting the house of one person with a view to compel another is not within the section. I think it is. Grammatically, "such other" refers to "any other person," the immediate antecedent. Besetting a workman to compel a master and besetting a master to compel a workman are both plaints within the mischief aimed at. Schöntal was an outworker for the plaintiff. The result is that the appellants have failed to show that the decision of the Court on the motion is in any way overruled by "Allen *v.* Flood," or by any principle laid down in that case.

LORD JUSTICE VAUGHAN WILLIAMS, in concurring, thought that the case was concluded by the judgment of the Court of Appeal on the interlocutory application, and that it was not affected by the decision of the House of Lords in "Allen *v.* Flood."—*Times.*

TUNNEL VENTILATION.—In order to prevent dampness and too low a temperature in the Boston subway, four ventilating fans have been put in, and periodical observations of temperature and humidity are being taken in order to show the results. The subway is partly tunnel and partly cut-and-cover work of steel and concrete, built to carry the electric tramways under a congested section of the city where the narrow streets have a heavy traffic. It is partly two-track and partly four-track. The fans are placed in chambers, with trumpet-mouth openings into the side of the tunnel, and the air exhausted is discharged through chimneys, those for the double-fan installations being 11½ft. diameter. The fans are of the Sturtevant cone type, each consisting of a cast iron conoidal centre, with steel annular back plate, and a series of reverse curve blades of steel plate, by which the direction of the air current is changed from axial to radial. They are placed vertically, close against the opening into the tunnel, and are all designed to have a capacity equivalent to a complete change of air every fifteen minutes in the section ventilated. Two of the fans are 7ft. in diameter, delivering 30,000 cubic feet of air per minute when running at 175 revolutions per minute. These require about 7-horse power each under ordinary atmospheric conditions, or 1-horse power at half speed under the same conditions. Two other fans are 8ft. diameter, with capacities of 37,000 cubic feet of air at 170 revolutions, requiring 10-horse power at full speed and 1¼-horse power at half speed. Each fan is driven by a Sturtevant electric motor, direct connected to the fan shaft by an insulated coupling. They are shunt-wound for maximum speed at 550 volts, and arranged for series or parallel operation. The maximum rise of temperature for ten hours' continuous operation is 45 deg. for the armature and 50 deg. for the commutator or fields.

FIREPROOF WOOD FOR WARSHIPS.—The lessons of the battle of the Yaloo in regard to the danger from fire on warships in action, and the similar lessons of the recent battle of Santiago, have influenced the Navy Department in deciding upon the use of fireproof wood for the three new battleships. This wood has been in use on a monitor and nine gunboats since 1895, but in 1897 a board of naval officers advised its abandonment as being heavier, harder, and weaker than untreated wood, while the chemicals contained corroded metals in contact, injured wearing apparel in drawers made of the treated wood, and prevented the adhesion of paint. Mr. Hichborn, the Chief Naval Constructor, however, claimed that these objections were largely imaginary, and of far less importance than the fireproof properties. This latter view has been sustained, and it is recognised that all woodwork in the superstructure should be made non-inflammable. The process employed in treating the timber for the new battleships somewhat resembles that of creosoting. The timber is placed in a cylinder 7ft. diameter, and 105ft. long, built of ⅜in. steel plate, and holding 15,000ft. board-measure of timber. When the ends have been closed and hermetically sealed, low-pressure steam or aqueous vapour at a temperature of 110 deg. to 200 deg. is admitted, and continued for from one to eight hours, or until the cells of the wood are well opened. The moisture is then drawn from the wood by creating a vacuum in the cylinder. When all the moisture has been extracted and drained off, the cylinder is filled with the fireproofing solution, which consists essentially of phosphate of ammonia and sulphate of ammonia, and this solution is forced into the cells of the wood under pressure. When the gauge shows that the absorption is complete, the solution is drawn off, the cylinder is opened, and the wood taken out. It is then kiln dried at a temperature not exceeding 125 deg. The Navy Department requires that the dry timber, when subjected to a heat of 600 deg., will remain uninflammable and safe against the spread of fire from the point of contact.

A NOTEWORTHY BOILER EXPLOSION.

IN THE ENGINEER for September 9th, 1898, we published a short article under the heading above, dealing with an explosion of a vertical boiler which took place at Norwich a few days before. According to the reports which reached us and were current in Norwich, the boiler in question was being tested at the time by Messrs. Tidman and Sons, and we wrote, "We are somewhat at a loss, in the first place, to understand what Messrs. Tidman endeavoured to find out, and, in the second, to know how the Board of Trade will deal with them." The report of the Board of Trade has just been issued, and we reproduce it in full. It will be seen that Messrs. Tidman have been entirely exonerated. We have only to add that we did not intend to cast any imputation of any kind on Messrs. Tidman. The case appeared to us to be one in which a boiler exploded while it was being tested—a novel event, and one well worth recording. It appears, however, that no test was being carried out, that Messrs. Tidman and Sons were in no way concerned in the getting up of steam by the owner of the boiler, and their very small share in the matter will be gathered from the evidence, and the decision of the Board of Trade inquiry.

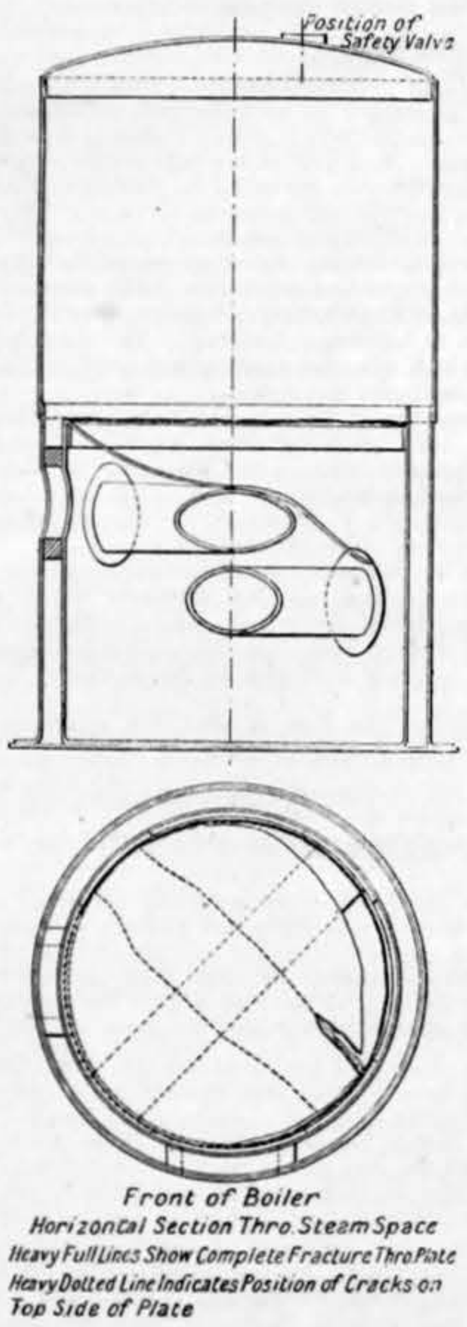
EXPLOSION OF A BOILER AT ST. GEORGE'S, BRIDGE-STREET, NORWICH.

IN pursuance of our appointments, dated September 10th, 1898, we held a formal investigation in the above matter, at the Council Chamber in the Guildhall, Norwich, on October 13th, 14th, and 15th, 1898. Mr. Gough appeared for the Board of Trade, Mr. E. C. Wild was counsel for Mr. Samuel Warburton, and Mr. Bousfield, and Mr. Jones represented Messrs. Tidman and Sons, and Mr. John C. Archer, a fitter in their employ. Having heard and carefully considered the evidence, we beg to report as follows:—

Date and place of explosion.—The explosion occurred on September 5th, 1898, on the site of the new Technical school, Norwich.

Name and address of owner.—Mr. Samuel Warburton, Lord-street, and Clifton-street, Miles Platting, Manchester.

Persons killed and injured.—Robert Watts died on September 9th from injuries received. John Crickmore Archer, William Proudfoot, and Edward Rivett were all more or less seriously scalded.



Front of Boiler
Horizontal Section Thro. Steam Space
Heavy Full Lines Show Complete Fracture Thro Plate
Heavy Dotted Line Indicates Position of Cracks on Top Side of Plate

Description and principal dimensions of the boiler.—The boiler was of the vertical cylindrical type, and was made throughout of iron. It was 7ft. 1in. high, and 4ft. in mean diameter, and was fitted with two cross tubes in the fire-box, and a side flue leading to an external uptake. The cylindrical portion of the shell was made up of two belts of plates, with two plates ⅜in. thick in each belt. The bottom edge of the lower belt was flanged outwards for attachment to a foundation plate ½in. thick. The shell crown was formed into the segment of a sphere; it was ⅜in. thick, and it was dished upwards about 5in. and flanged downwards at its outer edge for attachment to the shell. The fire-box was 3ft. 2in. high and 3ft. 6½in. in external diameter, and was composed of two plates originally ⅜in. thick, flanged inwards at the bottom for attachment to the foundation plate. Its crown plate, also ⅜in. thick, was flanged similarly to the plate which formed the shell crown. The cross tubes were each 8in. in external diameter, welded longitudinally, and flanged at their ends for attachment to the fire-box. The flue was at the side and near the top of the fire-box; it was 9in. in diameter, formed with a solid ring 2½in. thick, fitted between the shell plate and the fire-box. The boiler was lap-jointed and single riveted throughout with rivets ¾in. in diameter, spaced 2½in. apart. A manhole 9½in. by 14in. was cut through the front portion of the crown plate of the boiler, and a mud-hole 4½in. by 3in. was cut through the lower part of the shell—Fig. 1. The mountings consisted of one safety valve 1¾in. diameter, loaded by lever and movable weight; one glass water gauge, one steam pressure gauge, one cock between the boiler and the feed check valve, one blow-off cock.

Name of maker and age of boiler.—The boiler was made by Mr. A. Hollins, of Farsley, near Leeds; we were unable to ascertain its age.

Particulars and dates of repairs.—A patch was put on the mud-hole in 1894 by Mr. Tom Naylor Brown, a dealer in contractors' machinery, of Leeds, but we heard of no substantial repairs.

Persons or societies who have inspected the boiler.—The boiler was regularly inspected by inspectors in the employ of the Boiler Insurance and Steam Power Company, now the Vulcan Insurance Company, from 1890 to 1893, the last examination made by them being on the 23rd February, 1893.

Nature of the explosion.—The crown plate of the fire-box ruptured round its circumference at the knuckle of the flange, and was torn away for a distance of about 7½ft., forming a large aperture, through which the contents of the boiler escaped into the fire-box, and from thence out of the fire hole—Fig. 1.

Cause of the explosion.—The explosion was caused by the crown of the fire-box having been forced down by excessive pressure, whereby it was fractured nearly through at its outer edge, and in consequence it was unable to withstand the pressure to which it was subjected.

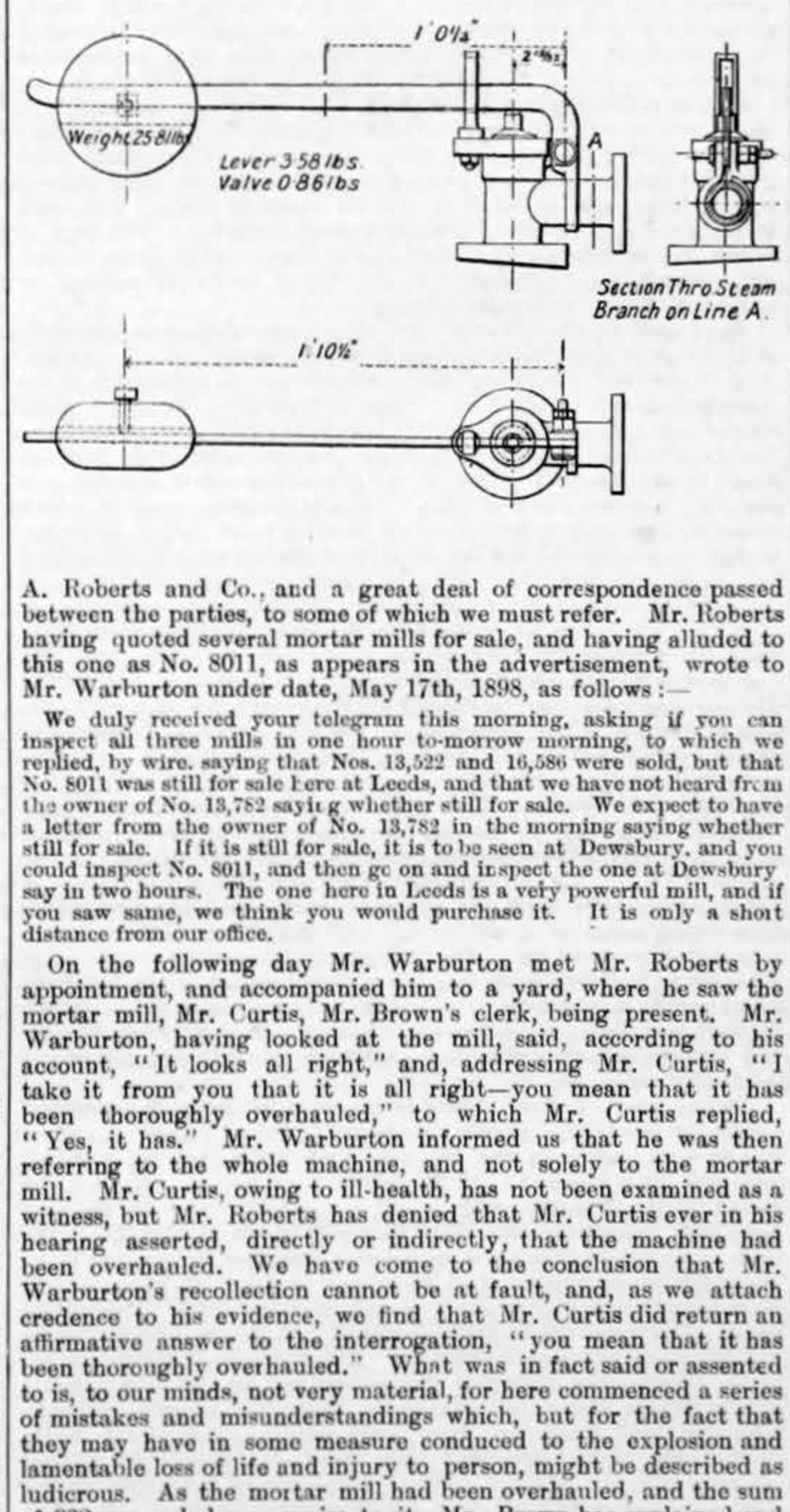
Remarks.—At the conclusion of the evidence we were asked by Mr. Gough to state whether the explosion was caused by the neglect of Mr. Thomas Curtis, and, if so, whether Mr. Tom Naylor Brown was responsible for such neglect? Whether the explosion was caused by the neglect of Mr. Tom Naylor Brown? Whether the explosion was caused by the neglect of Mr. Arthur Roberts? Whether the explosion was caused by the neglect of Mr. William H. Bousfield, and, if so, whether Mr. Samuel Warburton was responsible for such neglect? Whether the explosion was caused by the neglect of Mr. Samuel Warburton? Whether the explosion was caused by the neglect of Mr. Robert Tidman, or by the neglect of Mr. John C. Archer, and, if so, whether Mr. Robert Tidman, senior, Mr. Frederick Tidman, and Mr. Robert Tidman, junior, trading as Messrs. Robert Tidman and Sons, are responsible for such neglect?

Having heard the respective parties, and Mr. Gough in reply, we stated as follows:—"In or about the year 1890, Mr. George Lax, a builder, of Leeds, was the owner of a boiler made by Mr. A. Hollings, of Farsley, near Leeds, at a date which we have been unable to ascertain."

Having described the construction of the boiler, as appears on page 1, we further stated as follows:—"From 1890 to 1893 the boiler was insured by Mr. Lax with the Boiler Insurance and Steam Power Company, now the Vulcan Insurance Company, by whose inspectors it was regularly examined from time to time. The maximum working pressure, as stipulated in the policy, was that of 60 lb. per square inch; but Mr. Lax worked the boiler at a pressure of 45 lb. or 50 lb. per square inch. Mr. Lax, having no more use for the boiler, instructed Messrs. Oliver and Appleton, auctioneers, of Leeds, to sell it, and in 1894 it was bought by Mr. Curtis, on behalf of Mr. Tom Naylor Brown, a dealer in contractors' plant, at Leeds, for the sum of £50. Mr. Brown only once subjected it to steam pressure, and that not exceeding 40 lb. per square inch, for the purpose of ascertaining whether the connection to one of the cylinders which had been made on his premises was tight. Having put a patch on the mud-hole, where it appeared to have been leaking, and having supplied a new false bottom to the mortar mill, he caused it to be advertised in the *Machinery Register*, published by Messrs. A. Roberts and Co., of King-street Chambers, Leeds. This advertisement, which appeared in the May issue of the *Register*, was seen by Mr. Samuel Warburton, a builder and contractor, of Manchester, who was then under contract with the Corporation of Norwich to erect some new technical schools in that city. It was as follows:—

"8011.—One 6ft. 6in. pan, with double cylinder, vertical engine and boiler combined, under-driven on strong wrought iron girder carriage, 20ft. long, on road wheels, new false bottom, &c.; strong."

Having read this advertisement, Mr. Warburton communicated with Mr. Arthur Roberts, the sole member of the firm of Messrs.



A. Roberts and Co., and a great deal of correspondence passed between the parties, to some of which we must refer. Mr. Roberts having quoted several mortar mills for sale, and having alluded to this one as No. 8011, as appears in the advertisement, wrote to Mr. Warburton under date, May 17th, 1898, as follows:—

We duly received your telegram this morning, asking if you can inspect all three mills in one hour to-morrow morning, to which we replied, by wire, saying that Nos. 13,522 and 16,586 were sold, but that No. 8011 was still for sale here at Leeds, and that we have not heard from the owner of No. 13,782 saying whether still for sale. We expect to have a letter from the owner of No. 13,782 in the morning saying whether still for sale. If it is still for sale, it is to be seen at Dewsbury, and you could inspect No. 8011, and then go on and inspect the one at Dewsbury say in two hours. The one here in Leeds is a very powerful mill, and if you saw same, we think you would purchase it. It is only a short distance from our office.

On the following day Mr. Warburton met Mr. Roberts by appointment, and accompanied him to a yard, where he saw the mortar mill, Mr. Curtis, Mr. Brown's clerk, being present. Mr. Warburton, having looked at the mill, said, according to his account, "It looks all right," and, addressing Mr. Curtis, "I take it from you that it is all right—you mean that it has been thoroughly overhauled," to which Mr. Curtis replied, "Yes, it has." Mr. Warburton informed us that he was then referring to the whole machine, and not solely to the mortar mill. Mr. Curtis, owing to ill-health, has not been examined as a witness, but Mr. Roberts has denied that Mr. Curtis ever in his hearing asserted, directly or indirectly, that the machine had been overhauled. We have come to the conclusion that Mr. Warburton's recollection cannot be at fault, and, as we attach credence to his evidence, we find that Mr. Curtis did return an affirmative answer to the interrogation, "you mean that it has been thoroughly overhauled." What was in fact said or assented to is, to our minds, not very material, for here commenced a series of mistakes and misunderstandings which, but for the fact that they may have in some measure conduced to the explosion and lamentable loss of life and injury to person, might be described as ludicrous. As the mortar mill had been overhauled, and the sum of £32 expended on repairs to it, Mr. Brown has explained and contended that it was the mill only to which Mr. Curtis was alluding when he assented to Mr. Warburton's question, and with this contention we agree, and find that Mr. Warburton's question referred to the whole machine, mortar mill, engine, and boiler, but that the answer of Mr. Curtis referred only to the mortar mill.

On 21st May Mr. Roberts wrote to Mr. Warburton as follows:—

We have also carefully estimated the weight of the above—referring to the mortar mill—and calculate it to weigh about 10 tons, as near as possible. It is a very good mill, the one we could recommend you to go in for.

In a letter written by Mr. Roberts on the 26th May the following is contained:—

We shall be very pleased to have your order for this—the mortar mill—as it seems the one best adapted for your purpose, but, privately, we should advise you to settle about it quickly, as we have it on offer elsewhere.

On June 2nd Mr. Roberts wrote thus:—

Re the mortar mill with engine and boiler, which you inspected here in Leeds. We have seen the owner *re* this, and he informs us that he cannot reduce the price at all. P.S.—This is a very strong mill, and we think it is very cheap. We may say that if you don't take it, the price will be advanced to £120.

On the 30th June Mr. Roberts wrote another letter, to which the parties to this investigation attach great importance. It reads as follows:—

We thank you for your letter of yesterday *re* No. 8011. One 6ft. 6in. mortar mill with vertical engine and boiler combined, as inspected by you here in Leeds. We accept the offer you make of £115, and have accordingly purchased the mortar mill from the present owner. We will load it up at Leeds Station for £105, thus allowing you £10, which amount the carriage will about come to, as we never pay carriage on second-hand goods, and we cannot afford to risk anything in carriage, as we have not much more than 2½ per cent. on it. We presume this will be satisfactory to you, and shall be pleased to have your further confirmation. We may say that you are getting a bargain, as we have again inspected the mill to-day, and everything seems in very good condition, some of the parts being new, as you would no doubt notice when you were over. You will also remember that we said there was no chimney with it, but we have since found a chimney which belongs to it, and we will send same along with the mill. It is as strong a mill as we have ever seen.

We have to consider the proper meaning to be put on the words "we have again inspected the mill to-day." To any ordinary person we think this language would imply that Mr. Roberts had inspected the mill, which word he has admitted must include the whole machine, having done so on some previous occasion, in the sense that he had thoroughly examined it. Mr. Roberts, however, has told us that he never meant to convey such an impression, and, while admitting the word "inspected" was infelicitous, has stated that what he meant to convey to Mr. Warburton was that he had seen the machine, and, considering it a heavy and powerful one, would, if sound, suit Mr. Warburton, and that, in fact, the word "inspected" should have been written "seen." In furtherance of this contention he has stated that it is not the custom of dealers in second-hand machinery to inspect what they are trying to sell to intending purchasers, but the latter buy at their own risk, and in this contention with regard to the usage of the trade he has been confirmed by Mr. Brown, and he has also prayed in aid of it the footnote which appears at the end of all his letters:—

Second-hand goods.—An inspection is often advisable, as after goods have left senders no liability can be acknowledged.

We give as much credence to the evidence of Mr. Roberts as we do to that of Mr. Warburton, for we believe that they are both reliable and truthful witnesses. We accept Mr. Roberts' explanation of the meaning of that letter; but at the same time we must accept what Mr. Warburton told us—that he was led to believe from a perusal of this and the other letters that the machine as a whole had been inspected by Mr. Roberts, and by him found to be in very good condition. Hence there was another misunderstanding between the parties.

On July 2nd, 1898, Mr. Warburton again went to see the mortar mill, principally for the purpose of measuring its height so as to ascertain whether he could get it into the place where he desired to work it. Mr. Roberts saw him at that time and said to him:—"I hope you will take it because I have bought it from the owner."

The mortar mill was definitely bought by Mr. Warburton in August, 1898, for the sum of £105, it having been previously purchased by Mr. Roberts from Mr. Brown for the sum of £95.

It was then delivered by railway at Norwich, and taken to the site of the new technical schools, where it was received by Mr. William Harker Bousfield, the foreman at Mr. Warburton's works, who erected it on the iron frame. Finding the rods and scrapers of the mill to be bent, Mr. Bousfield summoned Mr. Robert Tidman, a member of the firm of Messrs. Robert Tidman and Sons, engineers, of this city, who in consequence, on Monday, 29th August, sent Robert Green, a blacksmith in his employment, to do the necessary repairing work. About the same time Mr. Tidman was asked by Mr. Bousfield whether he could couple the engine with the boiler, which Mr. Tidman undertook to do, but advised that, as the engine appeared to be very rusty, it should be first taken to pieces, and its rusty portions cleaned. Mr. Tidman also engaged to fit the boiler with a new glass water gauge, the old one having been broken in transit. To do this work Mr. Tidman sent Mr. Archer, a fitter in his employ. No instructions were ever given as to an examination of the boiler, as has been admitted by all the parties.

While receiving the above-mentioned order, Mr. Tidman saw the lever of the safety valve of the boiler lying on the ground, and as it was both bent and rusted, he suggested to Mr. Bousfield that he should make a new one, and on the latter assenting, he did so. The new one was of the same length, but a little heavier. It was afterwards fitted in place, but by whom we have not been able to ascertain.

Mr. Archer proceeded with his work, and on the afternoon of Wednesday, August 31st, was engaged with William Downes, an engine-fitter's assistant, in fitting the new water gauge. The manhole lid had been removed from the boiler, and Downes went inside to fix the nuts to secure the gauge. During this operation he observed that the crown of the fire-box was down about 4in. or 5in. He put his head through the manhole and acquainted both Mr. Archer and Green with this fact; and he also told Mr. Bousfield, when he shortly afterwards appeared. Mr. Archer then looked through the hole in the boiler intended to receive the bottom gauge pipe, and having satisfied himself that the furnace crown was down, he reported the fact to Mr. Tidman, his employer, shortly afterwards.

Subsequently, Mr. Bousfield determined to subject the boiler to hydraulic pressure, to ascertain whether it was tight. Accordingly, on September 1st, a pump having been lent by Mr. Tidman, Mr. Bousfield instructed Green, the blacksmith, to connect the pump with the boiler, and having filled the boiler, to work the pump. This Green did until Mr. Bousfield called out 80; meaning that the steam pressure gauge registered 80 lb., there being no gauge on the pump; the water then leaked though the safety valve, which was subsequently held down, and a little more pressure was applied.

Slight leakage was then discovered from the flange of the crown of the fire-box below the rivets. Green caulked the flange, and having put the pump on again, ascertained that the job was tight.

On Saturday, September 3rd, it was determined to get up steam for the purpose of running the engine, to ascertain if it was in working order. Reuben Chance, an engine driver in the employ of the Corporation of Norwich, who was in charge of a Pulsometer close at hand, was asked to light the fire, and did so. Steam was got up to 50 lb. or 60 lb., the glass of the water gauge being three quarters full, and the engine having been run for about half an hour, the fire was drawn.

On Monday, September 5th, Reuben Chance again lit the fire; steam showed at 9 a.m., and subsequently the engine was started, the glass of the water gauge showing three quarters full. After running for a short time, the engine was stopped on account of some of the caps of the bearings being loose, when Mr. Archer heard the safety valve blow off. He did not, however, look at the pressure gauge, but put on the feed pump to reduce the pressure, and kept it on for twenty minutes. The engine having been again started, Mr. Archer found that the scrapers were loose; he therefore stopped the engine and fastened them up. Having again started the engine, he ascertained that the bolts of the frame of the mortar mill were loose. He stopped the engine again, and was proceeding to fasten the bolts when the boiler exploded.

The crown plate of the fire-box was ruptured round its circumference at the knuckle of the flange, and was torn away for a dis-

tance of about 7½ft. A large aperture was thus formed, through which the contents of the boiler escaped into the fire-box, and from thence out from the fire-hole.

Unfortunately, Mr. Archer, William Proudfoot, Edward Rivett, James Riches, and a boy named Robert Watts were all more or less seriously scalded. They were removed to the hospital, where Watts succumbed to his injuries on the 9th September. On his body an inquest was held, and the jury found that "he died from the accidental explosion of a defective boiler."

After the explosion, the boiler was examined by Mr. Joseph Williams, engineer surveyor to the Board of Trade, who found that the crown of the fire-box was fractured nearly through the plate, there being evidence of other and old fractures. Mr. Williams was of opinion that the crown had come down from over pressure, as he discovered no signs of overheating to account for its collapse, and that in its condition at the time of the explosion it was not fit for any steam pressure at all. Assuming the crown to be in its original form, and the plates $\frac{9}{32}$in. thick, allowing something for deterioration from their original thickness, Mr. Williams calculated the collapsing pressure to be that of 130 lb. per square inch, and thought that the boiler might have been worked with a factor of safety of 4, or at about 33 lb. per square inch. Mr. Williams found that the safety valve was loaded to 100·47 lb. per square inch, and that it was in an indifferent condition, for its top was not level, and the centre of rotation of the fulcrum was considerably lower than the top of the valve, so that when the valve attempted to lift, friction was produced. The centre of gravity of the weight, too, was not in line with the centre of gravity of the lever. On testing the steam pressure gauge, Mr. Williams found it to be about 5 lb. light.

Having examined the boiler, we have come to the conclusion that the explosion was caused by the crown of the fire-box having been forced downwards by excessive pressure, whereby it was fractured nearly through at its outer edge, and was in consequence unable to withstand the pressure to which it was subjected.

We have been unable to ascertain the age of the boiler, but although, as far as we saw, the shell plates were in good condition, we have no doubt but that it was of very considerable age, which is shown by its design, the crown of the fire-box having no support at all, and the uptake passing through its side.

In answer to the questions which have been asked us by the Board of Trade, we have to state that the boiler was not in good condition when it was sold by Mr. Tom Naylor Brown in or about the end of June last.

Mr. Tom Naylor Brown did not represent to Mr. Samuel Warburton that the boiler was in good condition and fit for the purpose of supplying steam to the engine to work the mortar mill, but we think that Mr. Warburton was justified in thinking that such representations were made by Mr. Curtis, Mr. Brown's clerk, although the latter did not intend to make them.

Mr. Arthur Roberts did not verbally represent to Mr. Warburton that the boiler was in good condition and fit for the purpose of supplying steam to the engine to work the mortar mill. But Mr. Warburton thought that such representations were made in the letters from Mr. Roberts; and we are of opinion that he was in some measure put off his guard by the expressions contained in those letters, and thought that the whole machine was represented as being fit to work; but we must observe that Mr. Roberts never stated at what pressure it could be safely worked.

Before purchasing the mortar mill Mr. Warburton did not cause it to be examined by any competent person, and, notwithstanding the representations which he thought had been made to him by Mr. Curtis and by Mr. Arthur Roberts, he was not justified in neglecting to have the boiler so examined. He should have employed some independent person to have examined it.

Mr. Warburton did not ascertain the pressure at which the boiler could be safely worked.

Mr. William Harker Bousfield did not ascertain the pressure at which the boiler could safely be worked.

Mr. Bousfield was informed that the crown of the fire-box was bulged downwards, but he then took no measures, proper or otherwise, to ascertain the condition of the boiler, and the pressure at which it could safely be worked.

The boiler was tested by hydraulic pressure to ascertain whether it was tight, and for no other purpose; the test was neither judiciously nor properly applied, and the boiler was not examined before, during, or after the test, as it should have been.

Mr. Robert Tidman was aware that the crown of the fire-box was bulged downwards, but he was not informed how much it was down, and did not apprehend danger from this fact. Being aware that Mr. Bousfield's attention had been called to it, he did not think that it was his duty, not having been consulted as to its condition, nor even asked to look at it, or to interfere in the matter. He assumed, and, in our judgment, was justified in assuming, that the foreman to a contractor like Mr. Warburton would take the necessary steps to keep his plant in safety. We are of opinion that under the circumstances it was no part of his duty to have given any warning to Mr. Bousfield.

Mr. Archer was aware that the crown of the fire-box was bulged downwards. He appeared to have at first apprehended danger from this fact, although his fears were afterwards, so he told us, lulled by the application of the water test. Having reported the fact to his employer, his duty, we find, was then performed.

We cannot find that any person was in charge of the boiler during repairs. But we are of opinion that some person should have been appointed to have charge. We find that Mr. Archer was not in charge, and there was no duty cast on him to ascertain the pressure at which the boiler could safely be worked.

No measures were taken either by Mr. Warburton or by Mr. Bousfield to ensure that the boiler was being worked under safe conditions.

The explosion was not caused by the neglect of Mr. Curtis.

The explosion was not caused by the neglect of Mr. Tom Naylor Brown.

The explosion was not caused by the neglect of Mr. Arthur Roberts.

Mr. Wild, the learned counsel for Mr. Warburton, has stated that that gentleman desires to take all the blame, if any, that may attach to Mr. Bousfield or any other of his employés. We are, however, prepared to say that no blame attaches to Mr. Bousfield, for he did not know, nor did he at any time pretend to know, anything about the management of this or any other boiler.

The position of Mr. Samuel Warburton is very different. He has told us that he has bought numerous other boilers second-hand, and has mentioned the names of two eminent firms from whom he has so purchased, and by whom he has been informed that the boilers they sold had been overhauled. We think, therefore, that he was justified in assuming that those particular boilers were fit for some pressure; but he never ascertained by inquiry or otherwise for what pressure they were fit.

In this case he thought, and, as we have already stated, had some reason for thinking, that the boiler had been overhauled, but he never inquired even from the vendor, at what pressure it could be worked, much less did he appoint some competent person to ascertain this pressure for him. With his other boilers he has been singularly fortunate, for he has met with no mishap with them. His good fortune has now deserted him, not without cause. He had obtained from the Corporation of Norwich an important contract, and that Corporation would expect that the plant he used in the performance of it would be kept in a reasonably safe condition, so as not to be dangerous to their own workmen—and there was one employed close to the boiler at the time of the explosion—to his workmen, and to the inhabitants of this city. To ensure this what should Mr. Warburton have done? Before purchasing the boiler he should have satisfied himself, beyond all doubt, by independent advice, that the boiler was fit for steam pressure, and should not have relied on supposed representations made to him by a vendor, of whom he knew nothing, but to whom he was merely introduced by means of an advertisement. Having bought the boiler, he should then have definitely determined at what pressure it could safely be worked with a reasonable margin of safety, and this it is not disputed that he did not do. If he had employed some competent person to examine the boiler before it was bought, or afterwards, before it was used, he would have most certainly been advised that it was not fit for any steam pressure at all in the condition in which it was. His neglect to adopt these precautions has caused the explosion, and for this neglect we must hold him to blame.

There is another point which, we regret to say, we must make against Mr. Warburton, and that is that there was no competent person in charge of the boiler, for he does not pretend that Mr. Bousfield was competent. If there had been, the explosion would have been prevented, for when the crown of the fire-box was reported to be down, such competent person must have examined it, and he would forthwith have ascertained that there was a crack through it.

We very much regret having to make these remarks, because we are of opinion that Mr. Warburton did not neglect this boiler from any unworthy motive, such as parsimony; but this neglect arose from immunity from danger with regard to his other boilers, which, from what he has told us, have probably often been worked under circumstances of grave danger, and beyond doubt without reasonable precautions to ensure their safety.

Mr. Warburton has frankly stated the course he has adopted with this and his other boilers, and has not attempted to conceal anything from us, but has throughout the matter behaved like an honourable gentleman. It would be impossible, however, for any reasonable person to maintain that he has not been guilty of negligence. In our judgment he has been guilty of very serious negligence, for which we have to pronounce him to blame.

For the reasons which we have already stated, the explosion was not caused by any neglect on the part of Mr. Archer or of Mr. Tidman.

We directed that Mr. Samuel Warburton should pay to the solicitor to the Board of Trade the sum of £100 towards the costs and expenses of this investigation.

Dated the 25th day of October, 1898.

Howard Smith, } Commissioners.
J. H. Hallett, }

The Assistant-Secretary, Board of Trade.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

A new crusher and pulveriser.—The Williams hinged-hammer mill is a new form of crushing mill which is being used for grinding, crushing, and pulverising stone, cement, coal for foundry facings, brick, bones, ore, oil cake, &c., and also for shredding bark for tannery use. On a 4in. horizontal shaft are keyed a series of discs, on the faces of which are projecting bolts. On each bolt is loosely hung a hammer bar, which is a rectangular bar, rectangular in section, 4in. by 1½in., and fitting loosely on the bolts, so that it has an arc of movement of about a third of a circle. Each disc carries thirteen hammer bars, and there are six discs in the machine, making seventy-eight hammers. The machine runs at about 1000 to 1500 revolutions per minute, and the hammers grind the material fed to it by a combination of abrasive and percussive action. As each hammer strikes the material it recoils, passing such of the material as is not shattered by the blow. A movable breaker plate forms the lining, and the material is crushed between this and the hammers, passing out through a cage screen at the back of the machine. The plate and cage bars can readily be renewed, and the bars can be set out as they wear, or replaced by new bars made at blacksmiths' shop. In case of foreign matter—such as railway spikes, or horseshoes—getting into the machine, the hammers will give enough to let it pass. Special advantages are claimed for the direct blows as compared with a mere dead grinding pressure; it can be used for wet as well as dry material, and is employed in brick yards for working clay. For such material a steam jacket is used to prevent clogging. The cage or screen can be set for any desired size or degree of fineness of output, according to whether the material is to be granulated or pulverised to an impalpable powder.

The Lowell Textile School.—This school was opened in January, 1897, to give the practical instruction necessary in the cotton, woollen, worsted, and other textile industries, and instruction in the sciences and arts as applied to these industries. The equipment consists of high-grade machinery, specially built to afford facilities for experimental work, and of much greater variety than is to be found in any one mill. The plant represents a cost of £15,000. In the day classes there are four separate courses, each of which requires three years for its completion—(1) the cotton manufacturing course, (2) the woollen manufacturing course, (3) the designing course, (4) the chemistry and dyeing course. One term of preliminary instruction is given in the first year, consisting of principles of mechanism, machine drawing, textile calculations, elementary designing, and elementary chemistry. Towards the end of this term, each student decides which course he will follow. The evening classes are intended for those who are at work in the mill during the day. They include the manufacture of cotton and woollen yarns, weaving on all kinds of looms, designing, cloth construction, analysis and reproduction, colour, textile calculations, chemistry and dyeing. There are day classes for women in art subjects, especially in textile designing. Popular illustrated lectures on subjects connected with the textile industries are also given. The fees for the evening classes vary with the courses. For the day classes the fee is £20 per year, with a cost of about £3 for text-books, tools, instruments, &c. Of the 257 students, seventy-two are day students. The school is incorporated under the Massachusetts State laws, by officers and directors of several of the great textile corporations of the State. The professorships include those of mechanics, decorative art, weaving, cotton spinning, woollen and worsted spinning, chemistry and dyeing, and textile design and fabric structure.

Marine notes—A shipbuilding company at Chicago has received orders for two of the largest vessels on the Great Lakes, and these will be used mainly in the ore, coal, and grain-carrying business. One will be a steamer, and the other a barge, or consort to be towed by the steamer, each vessel being 433ft. long on the keel and 500ft. long over all. The cost will be about £80,000. The same company is also building a large and fast steamer to make the run between Chicago and Mackinac, on Lake Michigan, in less than twenty-four hours, the guaranteed speed being 17 miles per hour. The vessel will be 240ft. long and 40ft. beam, with a draught of 12½ft., and will cost 50,000 dols. The Bessemer Steamship Company, which owns a fleet of the newest and largest freight boats on the Great Lakes, has placed an order for a steamer 475ft. long and 50ft. beam, to carry 8000 tons of ore, and a barge 460ft. long, 50ft. beam, and 30ft. deep, to carry 7500 tons of ore on a draught of 17½ft. The barge will be a consort of the steamer, which will have quadruple-expansion engines. The new fireboat for the Chicago fire department, which has recently been launched, has a steel hull 118ft. long, 24ft. beam, and 12½ft. deep, with a draught of 10ft. It will be equipped with three sets of vertical double-acting steam pumps and two boilers, and will be propelled by a single screw and triple-expansion engine. It will throw 24 streams of water, the largest stream being from a 5in. nozzle, and the streams can be thrown to a height of 200ft. The new double-deck double-screw ferry boat put on by the Southern Pacific Railway to run between San Francisco and the railway terminal at Oakland, across the bay, has seats for 1000 passengers in the cabin and for 735 more passengers at the open ends of the boat. The vessel is a double-ender, with a screw at each end, and does not have to turn round.

Portable pneumatic riveters.—The various forms of portable pneumatic riveting devices which are now in use—and some of which have been illustrated in The Engineer—are effecting a considerable improvement in the time and cost of riveting on structural and other work, and especially in shipbuilding, where there are numerous corners and cramped spaces in which it would be difficult and tedious to do hand riveting. For deck plating, &c., a little riveter mounted on an iron frame on wheels is used in conjunction with a pneumatic "hold-on" or "dolly" underneath. The machine leaves a slight burr and cap over the countersink, which is chipped off with a chisel, and a few blows from the machine smooths off the surface. The work is remarkably rapid, and is excellent in quality, the fierce shower of sharp blows heading up and compressing the metal before it has time to cool as much as in hand riveting. The machines are so small that they can be used in any confined space. With a pneumatic riveter and pneumatic hold-on, three men and a heater boy can drive 800 to 1000 rivets per day. The wide introduction of these machines has been influenced largely by the strikes among the ship riveters, which have caused delay and annoyance at most inconvenient times. The saving over piecework prices for hand riveting in the shipbuilding yards on the Lakes is from a halfpenny to a penny per rivet, with an aggregate saving of £800 to £1000 over hand work for an ordinary Lake steamer of 4000 tons. Owing to the rapidity of the work, and the heat at which it is finished, the joints are better and tighter than those made with hand riveting and require less caulking. On one of the steel skeleton frame buildings in Chicago the field riveting was done with portable pneumatic riveters.

AUSTRALIAN NOTES.

(From our own Correspondent.)

After a considerable amount of controversy between the Newcastle colliery proprietors and men, over the "weighing" question, it has been agreed among the proprietors to advance the price of coal from 6s. 9d. to 8s. per ton, which is to take place from January 1st next; at the same time the hewing rate is to be advanced from 2s. 9d. to 3s. 2d. per ton. The question of weighing the skips was not discussed, and it is expected that this matter will now be dropped by the men.

Negotiations have been pending for some time past for treating the New Caledonian copper and nickel ores by the Smelting Company of Australia, Lake Illawarra, N.S.W. The manager of the company, Mr. Weinberg, has gone to New Caledonia to arrange for the smelting to be done at these works instead of shipping the ore to Europe. It is stated that upwards of 100,000 tons of nickel ore will be shipped during the current year, and the output of copper ore will be from 6000 to 7000 tons per month.

The total gold exports of Australasia last year were £13,476,347, made up by the various Colonies, as follows:—

New South Wales	1,563,920
Victoria	4,379,264
Queensland	2,598,723
South Australia	361,301
West Australia	3,143,857
Tasmania	176,288
New Zealand	1,252,994
	£13,476,347

One of the greatest law cases on record in New South Wales has just been brought to a conclusion. The case arose over extras claimed by Mr. M'Sharry, the contractor, over the building of the Cootamundra to Gundagai Railway. The amount claimed was £115,000, to which was afterwards added another £35,000 for delays in connection with the waterways.

The writ was issued by Mr. M'Sharry against the Government in February, 1894, at which time Mr. C. G. Heydon, Q.C., was appointed arbitrator, who, after disposing of some preliminary matters, resigned his position.

In June, 1896, Mr. T. Barton, Q.C., was appointed arbitrator, under a compulsory order of reference.

The case for Mr. M'Sharry closed on February 11th, having lasted 113 days, the evidence of Mr. M'Sharry alone covering 2439 pages of type-written foolscap. The Crown entered upon its defence on February 17th, and continued for ninety-two days; the evidence in reply tendered by Mr. M'Sharry occupied thirty days.

The outcome of the case is that the arbitrator has allowed £13,408, out of the £150,000 claimed.

ALMANACS, DIARIES, &c.

We have received some very tastefully produced calendars and blotters, which serve pleasingly and usefully to remind us of that old-established and well-managed institution—the Sun Fire Office, from which they emanate. We find that the Sun Fire Office was established as far back as the year 1710. The premium income in 1897 exceeded £1,000,000, insuring a sum of over £425,000,000.

Amongst the issues for next year coming under the category of the above, we have received this week a neat wall calendar from the Hunslet Engine Company, Leeds; from the works of Messrs. E. R. and F. Turner, Limited, Ipswich, there is a calendar of the "tear-off" pattern, and on the back of the card is given, in legible type, a quantity of useful postal and other information. Some firms appear to us to make a mistake in sending out wall calendars of unwieldy size, very effective no doubt as posters, but too big for valuable office space. Such a calendar has been sent us by the Rugby Portland Cement Company. It is extremely well done, but we feel sure that it would be found more universally acceptable if only about half the present size.

The Institution of Junior Engineers.—A meeting of this Institution was held at the Westminster Palace Hotel on December 9th. Mr. Kenneth Gray, vice-chairman, presiding, in the absence of the chairman, Mr. Basil H. Joy, who had not returned from the United States. The paper read was on "British Cable Tramways and their Construction," by Mr. E. A. Heath. For towns in hilly districts requiring tramway communication, the author claimed that cable haulage had no rival. Being independent of rail adhesion the steepest gradient could be ascended or descended with absolute safety, provided that, for descending an emergency brake were employed which would grip the slot rails. A brake of this description was fitted to the cars on the Douglas tramway—gradient 1 in 10—and on those of the Matlock line with a gradient of 1 in 4½. The system of constructing the track and cable tube were described in detail. A very good fish joint for track rails was shown which formed practically a continuous running surface for the car wheels. The rail head was planed off half its width, and the outside fish-plates rolled to fill the recess. Main and terminal pits were dealt with; also machinery for hauling the cable, and method of threading it. Approximate figures were given for calculating the horse-power required to haul the cable; to arrive at anything approaching the actual figure, mature experience of the various conditions under which the tramway was to be operated, had to be applied. The special features in the construction of Highgate cable tramway, Streatham, Douglas, Matlock, and others, were reviewed, particulars being furnished. In the discussion which ensued, Messrs. Julian, R. Marshall, T. Meacock, Gentry, C. Lean, W. J. Hunter, H. B. Vorley, H. Durtnall, R. Krall, A. P. Macalister, E. A. Berry, J. Pearson, L. H. Rugg, and W. J. Tennant took part. The proceedings concluded with the announcement of the ensuing visit to Messrs. Yarrow's works, Poplar, on the 17th December, and of the meeting on January 27th, when Professor J. A. Ewing, Hon. M. Inst. J.E., would deliver a lecture on "Measurements of Elasticity."

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(From our own Correspondent.)

THE activity reported last week in the manufactured iron branches in preparation for the holidays has continued throughout this week, but the new orders given out have been necessarily limited. Prices, however, are thoroughly well preserved, and there is no expectation of consumers being able to secure easier terms next year. There is no shaking the marked bar makers in their demands for the full price of £8 per ton, and considering the way in which pigs and fuel are keeping up, the chances are that a further advance of 10s. per ton in this class of finished iron may be recorded in 1899. Customers, therefore, having orders to place cannot do wrong in giving them out. There is an improved demand for best iron from abroad, more particularly from Australia and other British Colonies, and this is always regarded by the marked bar houses as a very healthy sign. The common bar makers remain very busy, and the manner in which this department of the market keeps up is one of the most favourable features of the whole trade. Makers hold firmly to £6 10s., and are declining deliveries for next year at less than £6 12s. 6d. to £6 15s. per ton. An official advance to the latter figure is regarded as likely early next month. Hoops are moving off freely at £6 15s. to £7, and best ditto, £8; rivet iron, £8 10s.; tube strip stands at £6 to £6 2s. 6d. per ton.

The sheet iron makers are sharing more than previously in the revival, though the aggregate output in this district is still far below that of recent years. This circumstance is, of course, to be accounted for by the entry into the trade as producers of the Principality and other new districts. Sheets of 20 w.g. are quoted £6 17s. 6d. to £7 2s. 6d.; 24 w.g., £7 2s. 6d. to £7 5s.; and 27 w.g., £7 15s. to £8 per ton. Large orders were reported as having come to hand for galvanised corrugated sheets from the Antipodean and South African markets. The association price continues at £11 to £11 10s. at outports, and it is by no means improbable that at the January quarterly meeting, owing to the continued advance in spelter and black sheets, a further advance may be declared. In the best-informed quarters of the market a distinct feeling is becoming manifestly opposed to the too rapid forcing up of prices for any class of manufactured iron and steel, as certain only to give an additional handle to the already troublesome American and Belgian and German competition. And this caution is entirely wise. What course the finished iron makers are, however, to pursue in self-defence, if the pig iron makers and the coalmasters continue to demand higher rates, it is difficult to see.

Pig iron values are firm, with a strong tendency to a higher level, although rates are now nearly 3s. per ton more for Staffordshire sorts, and about 6s. more per ton for Midland brands than before the present revival. Stocks of pig iron are smaller than they have been for a long time, but although the pig iron business must be remunerative, smelters show no disposition at present to blow in more furnaces. While, however, manufactured iron masters complain of the high prices of pig iron, smelters in their turn bewail the dearness of ironstone and cokes. Ironstone for Staffordshire has now to be procured from distant parts instead of being mined close to the furnaces. Oxfordshire ironstone raised in the Banbury district is now being used at Bilston, at which latter place there is plenty of ironstone in the earth, but at too great a depth for its mining to be undertaken as a commercial speculation.

Staffordshire forge iron is, at date, 92s. for cold blast; 66s. 6d. to 69s. 6d. for hot-air all-mine; 56s. to 57s. 6d. for ordinary ditto; 48s. to 50s. for part-mine; and 45s. to 46s. for cinder. Both forge and foundry are scarce and dear, and prices now rule at the best level of the year. Northamptonshire forge is 49s. to 50s., and North Staffordshire, Derbyshire, Nottinghamshire, and Leicestershire are quoted 50s. to 52s. Staffordshire part-mine foundry is offered at 55s., common foundry at 47s. 6d., and all-mine foundry at 72s. and upwards.

Local engineering houses note with satisfaction that some large engineering contracts are under execution in New Zealand and West Australia, and that although the contracts are placed with colonial houses a considerable share of the work appears to be finding its way into English hands. The West Australian Government is spending money very freely, both for minting machinery and waterworks. The low freights charged from the United States to Australia are, however, evidently contributing very much to the development of American competition in the colonial markets.

Copper values have on the week increased by about 6s. 3d. per ton. Quotations are about as follows:—G.M.B. cash, £55 16s. 3d. to £56 1s. 3d.; three months, £56 1s. 3d. to £56 6s. 3d.; tough, £58 15s. to £59 5s.; best selected, £59 10s. to £60, strong sheets, £66.

The district steel works are very busy, and arrangements are being made to curtail the holidays as much as possible. The prospects for next year are extremely promising, and a good weight of this year's orders will have to be carried over in spite of great efforts to work off as many contracts as possible before the year's end. Heavy sections are in great demand, and a large tonnage of steel boiler plates are under order. The great demand for steel in the shipbuilding industry, &c., in the North is restricting the importation of Scotch and North of England steel into this district. Local steel makers, consequently, get more orders and are able to ask better prices. Boiler plates have been advanced to £8 per ton; superior qualities, £9; rivet steel bars, £7; and manufactured rivets, £8. On rivet steel the advance is £1 per ton from the bottom, and on boiler plates 30s. Steel sheets for working up have been advanced to £7 15s. for 24 gauge, and £8 7s. 6d. for 27 gauge. Best deep stamping sheets are £10 to £12, according to gauge. Basic steel bars are £7 to £7 2s. 6d., and girders £6 5s. to £6 10s. Agents for imported steel quote £5 to £5 5s. for Bessemer blooms and billets, and £5 5s. to £5 10s. for best Siemens.

Work is still abundant in the engineering and machinery branches, and most of the heavy ironfounders are busy, more particularly on gas and water mains and structural work. There is not quite so much doing in machine tools as lately reported, and the cycle and cycle-fitting branches continue remarkably dull for the time of year. The cycle tube branch continues in an unremunerative state, but for steel boiler tubes a very fair demand is experienced, more particularly from the national dockyards and arsenals, and in this branch some revival of earning power ought to be shortly apparent. Makers of brass and copper tubes are doing fairly well, but their harvest is still to come, when the numerous vessels now under construction on the Clyde and elsewhere are approaching completion. The various Birmingham and district industries connected with railway enterprise continue to exhibit a good deal of vitality. Orders are still pouring in for railway rolling stock, underframes of iron and steel, axles, springs, nuts, bolts, rivets, &c.

It is alleged this week that a "ring" exists in North Staffordshire among the producers of puddling mine for ironworks fettling purposes, with a view to keep up prices, and that producers are very conservative as to whom they supply. Even regular consumers are at the mercy of the "ring," and as regards outsiders it is practically impossible for these people to buy at all. Prices which twelve or eighteen months ago were about 13s. per ton have now advanced to 19s., or something like that. Purple ore, also used for fettling the furnaces in the forges, has advanced still more. Prices of this material have advanced some 100 per cent., the old quotation of 10s. 6d. per ton having now advanced to 20s. 6d. One occasion for this is that a stock of some 25,000, formerly held by one producer in South Staffordshire, has now entirely disappeared, and current supplies have therefore run short. Tap cinder from the forges, and which is now a valuable aid to the steel smelters, has also doubled its price.

NOTES FROM LANCASHIRE.

(From our own Correspondents.)

Manchester.—Throughout the iron and steel trades of this district the business of the year is closing very satisfactorily, with a strong tone all through, and a sound, healthy outlook for the future. Much the same applies to the engineering trades, where, with the exception that loom makers are rather quiet—some of them not running full time—all the principal branches are not only fully engaged, but in many cases have orders on their books that will carry them over the greater portion of the year.

During the past week there has perhaps been an absence of any special briskness in the iron market here, but a steady business has been coming forward, with deliveries on account of contracts freely taken, and, in fact, in quite as large quantity as either makers or manufacturers are able to meet, and prices exceedingly firm at the full current rates.

Barrow.—The hematite pig iron trade remains very steady, and prices are unchanged at 57s. to 58s. per ton for makers' iron at usual West Coast ports. In warrant iron the depression of a week ago has given way to an improvement, and a large speculative business has since been done, prices, which were down as low as 55s. 10½d., having improved to 57s. net cash sellers, 56s. 11½d. buyers. Makers are very fully employed. They have put an additional furnace in blast this week, and now are blowing 41 furnaces, as compared with a similar number in the corresponding week of last year. Stocks of warrant iron have been further increased this week by 1819 tons, and now stand at 173,547 tons, or 11,445 tons less than at the beginning of the year. It is quite expected from the movements in the market that stocks will further increase before the end of the year to a large extent.

Iron ore is in very brisk and active demand, and raisers are as busy as possible, but have not as much ore to dispose of as is in demand. Prices are very steady at 14s. for good ordinary sorts net at mines. Much prospecting is going on in the district, and a good find of ore is reported at Alcoats, in the Cleator district.

Steel makers are well off for orders, and report a very brisk demand for all classes of steel, but more particularly for shipbuilding material, which is in large and increasing consumption, and makers are being pushed to complete deliveries on old contracts, and are being offered new contracts of heavy tonnage. £6 17s. per ton is the quotation for heavy plates of ordinary specification, and £6 12s. is the price of angles. Orders are being given out for steel rails to a large extent, and prices are undisturbed at £4 12s. 6d. per ton net f.o.b. In billets, tin-bars, hoops, merchant steel, and heavy steel castings a good business is being done. The steel works at Barrow are closed for a fortnight for the holidays.

Shipbuilders are very busy, and marine engineers have a full programme of work on hand. They have tendered this week for further additions to the British Navy. Other tonnage is in smaller demand at present.

Coal and coke are in good demand, and full prices are ruling.

Shipping is very well employed at West Coast ports. The exports of pig iron last week were 7422 tons, and of steel 10,080 tons, as compared with 3910 tons of pig iron and 6350 tons of steel in the corresponding week of last year, showing an increase of 3512 tons of pig iron and 3730 tons of steel. The aggregate shipments for the year have totalled up to 503,894 tons of pig iron and 504,165 tons of steel, as compared with 420,089 tons of pig iron and 449,394 tons of steel in the corresponding period of last year, showing an increase of 83,805 tons of pig iron and 54,771 tons of steel.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE year's work is quietly drawing to a close, and it finds the Yorkshire coal trade in a fairly satisfactory condition, with a cheerful outlook for 1899. When the figures for this year can be made up it will be found that the output of coal, in South Yorkshire particularly, has been largely in excess of the previous twelve months. With the demand slowly overtaking the supply, there has been a steady weeding out of unprofitable pits. Steam coal has risen about 1s. per ton on the year, and the twelvemonths gas contracts entered into in June last, were 1d. to 9d. per ton higher than the prices in June of 1897. It is a somewhat singular fact in connection with the gas-coal trade that the regular output of gas coal during the winter months is not equal to the demand. If it were not for the stocks in collieries and gasworks, the ordinary production would not be adequate for the requirements of the gas companies. At the beginning of the winter months last season stocks in South Yorkshire were exceptionally small, and there are indications that all the gasworks will not be able to obtain the coal they require. It has to be remembered, of course, that against the increase in the selling prices of coal has to be set the higher wages, the cost of the Workmen's Compensation Bill, and dearer colliery stores.

At the time of writing, house coal in best Silkstones is making 9s. to 9s. 9d. per ton; in some instances 10s. per ton. Ordinary qualities range from 7s. 6d. per ton. Barnsley house is steady from 8s. to 9s. per ton; seconds, from 7s. per ton. There is now a slight weakening in the export trade in steam coal, but the weight forwarded to the Humber ports is still in excess of the average in the closing month of the year. Large consumers, such as railway companies, are now negotiating for further supplies, for which it is expected an advance of 6d. to 1s. per ton will be given. Barnsley hards make from 8s. to 9s. per ton, seconds fetching 7s. per ton. Manufacturing fuel has kept in good demand during the larger part of the year, the textile and other industrial districts of Lancashire and Yorkshire being particularly active. Nuts are at 6s. 6d. to 7s. per ton; screened slack ranges from 5s. per ton; pit slack for coking purposes, 2s. 6d. to 3s. 6d. per ton. Coke keeps exceptionally firm, best washed fetching 11s. to 12s., and in some instances 13s. per ton, while ordinary is readily saleable at 9s. 6d. to 10s. and a little over.

NORTH OF ENGLAND.

(From our own Correspondent.)

THE manufactured iron and steel industries of this district are exceptionally active; indeed, they have probably never been so fully employed at this season of the year, and in the case of steel it may safely be said that so large a production has never been reported at any other time. The pig iron market has apparently recovered from the reaction that followed the close of the recent "rig" in warrants, and is showing improvement; certainly more is being done than has been noticeable during the last four weeks, and prospects are very good. The ironfounding, engineering, and shipbuilding industries are also as brisk as they can well be, and there are to be extremely short holidays for Christmas and the New Year. If employers had their way, there would be none at all, for as a rule they are a good deal behind with the execution of their contracts, and their customers are pressing strongly for what they need. A couple of days at most are all that employers can afford to give, but a good many of the men are likely to take the greater part of the week, as they have been kept hard at it for months, and have worked a good deal of overtime, so that funds will not generally be lacking. Masters cannot well insist on regular working next week, because there is difficulty in getting plenty of hands now. There has been much complaint of late in the shipbuilding industry because of lost time, the men get such good wages that they can earn enough to satisfy them, in many cases, with three or four days' work per week, so that they are sometimes indifferent about working the full week, to the great inconvenience of the masters. The secretary of the men's association has several times of late in his periodical reports had to admonish them for the large amount of lost time that is reported.

It is satisfactory to note that consumers of pig iron are beginning to buy more freely for forward delivery, and that they will pay more for forward than for prompt delivery. The influence of the late "gamble" in warrants has pretty well disappeared, and has left the price of No. 3 Cleveland G.M.B. pig iron with a gain of something like 1s. 6d. per ton, as 43s. was the price when the "rig" set in at the beginning of October. Thus 1898 is closing with the price 2s. 6d. per ton above the average of the year, and 4s. 6d. above the minimum. This week consumers have been readily offering 44s. 3d. per ton for prompt f.o.b. deliveries of No. 3 Cleveland pig, but they would give 44s. 6d. for next quarter. These prices have been accepted, but generally makers have quoted 44s. 6d. for prompt, and 44s. 9d. to 45s. for next quarter. The fact that consumers will pay a premium for forward delivery is a very good indication.

No. 1 Cleveland pig iron has been quoted this week at 46s.; No. 4 foundry at 44s.; grey forge and mottled at 42s.; and white at 41s. 9d. per ton for early delivery. Forge qualities of pig iron are relatively cheaper than foundry, the reason being that while the latter are not readily obtainable, the supply of forge is in excess of requirements. Grey forge under ordinary circumstances is only 1s. per ton below No. 3, to-day it is 2s. 6d. cheaper, and as it costs almost the same to produce it, the makers are not well satisfied. There is a larger proportion of forge qualities made, and too little of foundry, the reason being that the furnaces are not working so well as in years past.

The demand for hematite pig iron is fair, and prices are decidedly stiffer, because producers are well off for orders, and also know that steel manufacturers are getting such good prices that they can afford to pay higher rates for their iron. Besides this the cost of production is increasing, as well because of dearer coke as of dearer ore. Consumers will readily pay 55s. per ton for mixed numbers, and some business has been done at this, but most of the makers quote 55s. 6d. for early delivery. They are buying Rubio ore more freely, as there is a probability of the duty on ore, proposed by the Spanish Government, being 10 per cent. *ad valorem*, and that would add 10d. per ton to the present price of the ore, thus increasing the cost of ore per ton of iron made to 1s. 8d. Merchants do not hesitate to enter into contracts for supplying ore, but they add a clause that the buyer is to pay any duty in excess of that at present levied.

Shipments of pig iron from the Cleveland district should improve, there being nothing now to interfere with them, the "rig" being over, and the weather open, so that supplies can be sent to the Continent. The quantity shipped this month to Wednesday night amounted to 54,027 tons, as compared with 60,418 tons last month, and 59,154 tons in December, 1897. Cleveland iron is still going more freely into the public warrant stores—more freely than was expected; on the 21st, Messrs. Connal and Co. held 133,501 tons, an increase of 9757 tons this month. Of hematite pig iron 34,419 tons were held, there being a decrease for the month of 2239 tons.

Prices of manufactured iron and steel are very favourable, and the year is closing with them at the highest, this being from 20s. to 25s. above the minimum for plates, bars, angles, and sheets, but rails have only gone up about 2s. 6d. The increases in prices have nearly all accrued during the second half of the year, and the quotations are now higher than they have been for years. No changes, however, from last week can be recorded.

The Central Marine Engineering Company this year have supplied engines for 29 vessels with 47,300 indicated horse-power, while in 1897 they supplied 22 vessels with 27,350 indicated horse-power, and in 1896, 18 vessels with 24,950 indicated horse-power. In the boiler department they constructed 60 boilers for the 29 vessels above referred to, and 15 other marine boilers of various classes, making altogether 75 marine boilers. The company have a large amount of work in hand for the coming year, including another of Mudd's patent five-crank engines, and a powerful set of twin-screw engines for an Atlantic liner. Sir Christopher Furness, Westgarth, and Co., at Middlesbrough, have constructed 20 sets of marine engines of 29,672 indicated horse-power, and various land engines of 2500 indicated horse-power in the aggregate; total, 32,172 indicated horse-power. These include engines for two Atlantic liners.

The Darlington Forge Company have just completed some very large steel castings for H.M.S. Venerable, now building at Chatham. They have supplied a cast steel ram which weighs 32 tons, in the casting of which 51 tons of steel were used; also two stern posts, each 14 tons, as well as two shaft brackets, each of 11½ tons, and a rudder weighing 18 tons. The company are enlarging their establishment, having bought the site of the Darlington Steel and Ironworks for extensions. New furnaces are now being constructed.

The coal trade is very active as far as regards deliveries, but it being so near the holidays buying is rather quiet. Where consumers or shippers have to buy steam coal for early delivery they have to pay 10s. 6d. for best, and 4s. 6d. for seconds, f.o.b. in each case. Best gas coals are about 9s. 6d., and seconds 8s. 9d. per ton f.o.b., and best bunker coals are at 8s. 9d. per ton f.o.b. The North-Eastern Railway Company's coal contracts for the next twelve months have been placed at 9s. per ton delivered into their wagons, this being 9d. per ton above the price they paid for this year. The average price of coke is 15s. 6d. per ton delivered at the furnaces. The old Adelaide Colliery, near Shildon, has been bought by Mr. R. A. Brown, of Darlington, and the pit, which has been idle for some years, is likely to be re-opened.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE manufacturing branches of the Scotch iron trade are very well employed. In view of the holidays, which will call for some cessation of work, in connection with the New Year week at least, it may be said that there has been increased activity finishing up work that is urgently required to be done. But the pig iron market has been inactive. There has been little inquiry on the part of consumers, and speculators have had little inducement to participate in the business. With the market in this condition it has been difficult to maintain former prices. Indeed, the business done has been for the most part at lower rates.

Scotch warrants have sold from 49s. 7½d. to 49s. 1½d. cash, and 49s. 10½d. to 49s. 4½d. one month. In ordinary Cleveland iron there has been very little doing, the effect of the recent "corner" still preventing business being done. A few transactions only occurred in this class of iron from 45s. down to 44s. 5½d. one month, there being no demand for immediate delivery. Business took place in Cumberland hematite warrants at 57s. to 56s. 8d. cash, and 57s. 5d. to 57s. one month. There was practically nothing doing in Middlesbrough hematite warrants.

Hematite pigs have been in good demand, and the output of this class of iron is now greater than at any former time. Merchants quote 60s. 6d. per ton for delivery at the steel works, and the consumption is understood to be equal to the production, although as regards that some are inclined to have their doubts, after the surprise occasioned by the report of increased stocks in the North-West of England.

The prices of Scotch makers' pigs are steady, as follows:—Govan and Monkland, f.o.b. at Glasgow, Nos. 1, 50s. 1½d.; Nos. 3, 49s. 4½d.; Wishaw and Carnbroe, Nos. 1, 50s. 3d.; Nos. 3, 49s. 6d.; Clyde, No. 1, 55s. 6d.; No. 3, 50s. 6d.; Gartsherrie, No. 1, 56s.; No. 3, 51s.; Calder, No. 1, 57s.; No. 3, 51s.; Summerlee, No. 1, 57s.; No. 3, 51s. 6d.; Coltness, No. 1, 58s.;

No. 3, 51s. 6d.; Glengarnock, at Ardrossan, No. 1, 55s.; No. 3, 50s.; Eglinton, at Ardrossan or Troon, No. 1, 52s.; No. 3, 50s. 6d.; Dalmellington, at Ayr, No. 1, 51s. 6d.; No. 3, 50s.; Shotts at Leith, No. 1, 56s.; No. 3, 51s.; Carron, at Grangemouth, No. 1, 56s.; No. 3, 51s. per ton.

There are 48 furnaces making hematite, 30 ordinary, and four basic iron, the total of 82 thus in operation in Scotland comparing with 80 at this time last year.

The shipments of pig iron from Scottish ports in the past week amounted to 4601 tons, compared with 4189 in the same week of 1897. To South America 50 tons were despatched, India 170, Australia 150, France 405, Italy 185, Germany 60, Holland 215, Belgium 10, Spain 20, China and Japan 100, other countries 262; the coastwise shipments being 2974, against 2309 in the same week of 1897.

The finished iron and steel works are actively employed. They will be running full time, and in not a few cases doing overtime, till near the end of next week, the holidays beginning then instead of at Christmas. Prices of all goods are steady.

In the coal trade there has been continued activity, but much interruption to traffic. The recent block on the railways is still making its effect felt in the detention and reduction of the quantity of coals dealt with. This has been notably the case in the coal-shipping department, and the quantities despatched are less than they were at this time last year. The prices of coal are firmly maintained, owing to the difficulty of prompt delivery.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The year is coming to a close with undiminished vigour in all the leading industries. Coal is particularly brisk, and notable shipments are on the increase. The utmost energy is displayed in looking after the coaling stations, showing that preparedness for contingencies is constantly borne in mind. In the closing part of last week 5500 tons went to Colombo, 4100 to Port Said, and 5400 tons to Aden from Cardiff. Saturday was exceptionally brisk, 12,590 tons going to Port Said, and 9500 tons to Genoa. The demands of the Italian railways are well maintained, and the needs at Alexandria and Madeira well looked after. Nor again is there any falling off in consignments to France. On Saturday they were very large, St. Nazaire taking 7600 tons. Amongst the large shipments of this week from Cardiff have been 3800 tons to Colombo, 4000 tons to Port Said, another cargo of 3200 tons to Colombo, and 4000 tons to Suez.

House coal is steadily improving. The total coal shipments from Cardiff last week slightly exceeded 360,000 tons, or 30,000 tons in excess of the previous week. It is not at all improbable but that the rush to secure coal before the holiday season will bring totals up to close upon 400,000 tons from all the Cardiff ports. The Orient contract is one of the last that has been concluded. The agents in this were Dinham, Fawcens, and Co., London, the total 50,000 tons; it was secured by Lewis Navigation Company. Last week coal business was very brisk at Newport, Mon., foreign totalling up close upon 63,000 tons, and coastwise 18,963 tons. At Swansea there was similar gratifying activity, coal shipments nearly amounting to 50,000 tons, and patent fuel close to 12,000 tons. France, as usual, has been a considerable customer, Italy following, and being well imitated by Sweden and Germany. In respect of Cardiff port business I note a steady increase in vessels leaving for America in ballast. These are despatched from the States to England with cotton or grain, and simply touch at Cardiff for bunkering on return journey.

The seamen's agitation at Cardiff, Newport, and Swansea has, in the phraseology of the parties concerned, "fizzled out." There never was any vigour in the movement. Seamen, after the late stagnation, were only too glad of having vessels offered, and there never was any real difficulty in shipping a crew. On Friday last four steamers were rapidly served, the Enterprise, Recta, Angerton, and Drayton. Crews were obtained at the rate of £4 5s. to £4 10s. per month all round. In addition, a number of men were signed on to fill up vacancies in other vessels at £4.

Cardiff, like Swansea, continues a brisk trade in patent fuel, and some unusually good shipments of late have been recorded. One to Marseilles amounted to 2350 tons, and there were smaller ones to Norway and other destinations.

Prices of coal have not fluctuated much of late, the variations being at the most 3d. to 6d., and no difficulty has been experienced by leading coalowners in securing best prices for principal coal.

Closing figures at Cardiff this week were as follows:—Best steam, 12s. 9d. to 13s. 9d.; seconds, 11s. to 11s. 6d.; dry, 10s. 6d. to 10s. 9d.; best Monmouthshire, 10s. 9d. to 11s. 3d.; seconds, 9s. 3d. to 9s. 6d.; best steam, small, 6s. 3d. to 6s. 9d.; seconds, 4s. 9d. to 5s.; inferior sorts from 4s.; best house coal, 13s. to 14s.; No. 3 Rhondda, 12s. 6d. to 13s.; No. 2 Rhondda, 8s. 6d. to 9s. 6d. Swansea prices:—Anthracite, 14s. to 14s. 6d.; seconds, 12s. 6d. to 13s.; ordinary, 11s. to 11s. 6d.; small rubbly culm, according to portion of stem; steam, 11s. 6d. to 12s.; seconds, 9s. 6d. to 10s. 3d.; bunkers, 7s. 9d. to 8s. 3d.; small, 4s. 6d. to 5s. 9d.; house No. 3 Rhondda, 12s. to 13s.; No. 2 Rhondda, 9s. to 9s. 6d.; through, 7s. to 8s.; small, 5s. to 5s. 6d.

The iron and steel works show no signs of lessening prosperity. At all there is the fullest vigour, and the aim is stated in iron circles to clear off as much of the accumulations as possible, as it is certain that the new year will bring in a lot of new business. While home works are thus thoroughly occupied, it is no matter for surprise that some trade is of necessity, where urgency is great, sent abroad. It is currently reported that substantial orders have been given to America by the Midland Railway. At the same time home firms are not overlooked. Wales is doing good work for the Midlands. At one time it used to be a subject of comment that little or no engineering work was turned out in the Principality, and in the matter of manufactured iron even a bundle of nail rods had to be obtained from Bristol, though in the first instance sent by Welsh ironmasters. Lately some fine winding engines have been turned out, and recently large consignments of powerful machinery have been sent to India from Messrs. Taylor and Sons, Briton Ferry.

One noticeable feature of last week was the large importation of pig iron. Swansea received 1400 tons, and Newport largely, one consignment of 2010 tons coming from Middlesbrough, and another of 1300 tons from Barrow. Millom, Grimsby, Workington, and Ulverstone figured well. The importations of pig iron from Bilbao have been exceptional. Last week Ebbw Vale received 1060 tons, and Jones, Heard, 670. In addition Bilbao has been sending large supplies of ore to all the leading works, 5380 tons coming to Swansea. Duddon ore is also coming to the Upper Forest works.

On 'Change, Swansea, this week, it was a matter of comment that the pig iron market was recovering, Scotch showing 5d. a ton better, hematite about the same. Middlesbrough remains. It was stated that the consumption of pig iron in America had quite overtaken production, and that no imports here need be apprehended. The impression upon members is that this will strengthen the market, and make it firmer for all classes of iron in Wales. At present it was reported that the iron and steel market was strong, being materially influenced by the large amount of work in hand in shipbuilding, guns, &c., Welsh steel being in high repute, this is but to be expected from the extreme care taken in all details, from selection of ore to the analysis of the first "tap" from the furnace. Possibility of higher value is fairly assured.

At present closing prices, Swansea, were as follows:—Glasgow warrants, pig iron, 49s. 3d., 49s. 1½d. cash; Middlesbrough No. 3, 44s. 5½d. prompt, other numbers in proportion; Hematite warrants, 56s. 9d. for mixed; Cumberland, according to brand. Welsh bars, £6 7s. 6d. to £6 12s. 6d.; sheets iron and steel, £7 to £7 2s. 6d., with usual extras for higher gauges. Steel rails, heavy, £4 12s. 6d. to £4 15s.; light, £5 2s. 6d. to £5 12s. 6d.; Bessemer steel bars, £4 12s. 6d.; Siemens, best, £4 15s. Tin-plates, Bessemer steel cokes, 10s. 6d. to 10s. 9d.; Siemens, 10s. 9d. to 11s.; ternes, 19s. to 21s. 6d.; best charcoal, 12s. 9d. to 13s. Finished black plate, £8 10s. to £9; Canada, £7 2s. 6d. to £7 12s. 6d., delivered Swansea cash, less 3 and 1. Block tin, £82 7s. 6d. to £83. Lead, £13 5s.; Spanish, £13 2s. 6d. Iron ore in good demand. Tafna, 14s.; Rubio, 14s. 6d. Coke firm and in good request, at all ports.

There has been a considerable amount of business done in tin-plate, close upon 60,000 boxes being shipped at Swansea and 46,000 boxes brought into stock last week. Stocks are now at 203,085 boxes. Prices are still much below what they should be, considering the increased price of materials. Trouble is anticipated in labour questions with the new year, especially at Llanelly, where friction appears to be the normal element, and no amount of lost markets produce any effect in imparting common-sense views. The tin-platers at the Old Castle, Old Lodge, and Western are conceding a 15 per cent. reduction, but as in most other districts the concessions have been 22½ and 25, the men have been asked to re-consider. If they do not agree a stoppage is imminent. In the Swansea Valley, owing to a trifling dispute, two of the mills at the Foxhole Works were idle last week. The wash-house wage is to the front in the district, and employers point out that the reduction of a third is imperatively needed. Worcester Works are now busy. The mills at the Morriston and Midland were idle, but the prospects are now better, and both certain to be brisk next week.

In all quarters the output of steel has been great, and that of bars equally so, but not up to the demand. A good deal of local business is going on. Thus a large proportion of the bars turned out at the Duffryn is being worked up at Llantrissant and Maesteg.

The large Bessemer Works appear unaffected by the increased self-supplying capacity of tin-plate and auxiliary works, and the output of tin bars in addition to billets and rails is considerable.

The principal iron and steel consignments of the week have been to home districts, but Newport, Mon., despatched 700 tons rails to London, and 115 tons to Highbridge.

At Briton Ferry the output of hematite is very satisfactory. Six furnaces at the steelworks were in full operation last week, and the mills of the district were well occupied.

The improved state of the trade in the leading industries is giving a more hopeful condition to the railway and general stock and share list. This week there was a general improvement in prices for railway and colliery stock and shares, and not in a solitary case was there a fall. Barry Deferred changed hands at 41½, and Rhymney Preference advanced a point. Rhymney, Mon., shares, old and new, have gone up 6d., and the Mortgage Debentures ⅛, Tredegar iron and coal are firmer. Dry Dock shares are in better demand, and a further improvement is anticipated.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

Steam coal shippers are well off for tonnage. Prices firm and an upward tendency. House coal is in good demand; prices remain same as last week. Steel and finished iron is in very good demand, and every prospect of advance in prices for coming year. Exports for week ending December 17th were:—Coal, foreign, 62,865 tons; coastwise, 18,963 tons. Imports for week ending December 20th were:—Pig iron, 4450 tons; iron ore, 5177 tons; manganese, 2400 tons; pitwood, 6429 tons; scrap, 445 tons; 190 tons cement.

Coal: Best steam, 11s. to 11s. 3d.; seconds, 10s.; house coal, best, 13s.; dock screenings, 6s. 6d.; colliery small, 5s. 3d. to 5s. 6d.; smith's coal, 7s. 6d. Pig iron: Scotch warrants, 49s. 3d.; hematite warrants, 57s. f.o.b. Cumberland; Middlesbrough No. 3, 44s. 4d. prompt. Iron ore: Rubio, 14s. 3d. prompt; Tafna, 13s. 3d. to 13s. 6d. Steel: Rails, heavy sections, £4 12s. 6d. to £4 15s.; light ditto, £5 5s. to £5 12s. 6d. f.o.b.; Bessemer steel tin-plate bars, £4 12s. 6d.; Siemens steel tin-plate bars, £4 15s., all delivered in the district, cash. Tin-plates: Bessemer steel, coke, 10s. 6d. to 10s. 9d.; Siemens—coke finish—10s. 9d. to 11s. Pitwood, 18s. London Exchange Telegram: Copper, £55 12s. 6d.; Straits tin, £82 12s. 6d. Freights: Rather easier owing to the difficulty of arranging stems, on account of approaching holidays.

NOTES FROM GERMANY.

(From our own Correspondent.)

Trade in the iron and allied industries over here continues to improve, and, owing to the increased demand that is experienced in most branches, the tendency of prices is all in an upward direction. In many departments makers are so heavily booked forward that it is exceptional where they can entertain new orders for delivery within the next eight or ten weeks. The engineering and bridge-building establishments are particularly active, and there is reason to believe that employment will become even more brisk in the New Year. At a recent tendering for bridge-building material in the Haag, the iron company Styrum, near Oberhausen, tendered lowest, and has consequently secured contracts for 41 bridges at 49,700ft., and 18 bridges at 64,700ft.

A very strong tone prevails throughout the pig iron markets of Rheinland-Westphalia and in Silesia, the greater part of production of third quarter in next year having already been sold. Activity at the rolling mills is, likewise, very brisk, and the last weeks of the year will, therefore, not be quiet, as they generally are, but, on the contrary, extremely busy, as consumers and dealers like to place orders at very short terms of delivery. Many articles are in much better request now than in autumn. In Silesia tubes, for instance, are in healthy demand now, while some time ago foreign competition prevented the inland works from doing much business. Heavy plates remain in very good call, and numerous orders from shipbuilding and engineering establishments are being secured, so that platemakers are entering the new year with plenty of work and fair prospects for the future. Sheets are less animated, but then winter is not a good time for that article, and spring will probably bring more orders. Prices are generally tending upwards, though but in a slight degree, and may, on the whole, be considered as rather low when the present strong position of most branches of the iron trade is considered. The Prussian State Railways have given out orders for 550 locomotives, which is a much larger number than was expected.

Last week's list quotations for raw and manufactured iron were:—Spiegeleisen, 10 to 12 p. c., M. 67 to 68; white forge pig, M. 58 to 60; German Bessemer, M. 68; basic, free place of consumption, M. 60; Luxemburg forge pig, M. 49·60; Luxemburg foundry pig, M. 52, free Luxemburg; German foundry pig No. 1, M. 68; No. 3, M. 62; German hematite, M. 68 per ton at works. Bars: M. 140 to 142; common plates in basic, M. 137·50 to 142·50; heavy plates for boiler-making purposes, M. 160 to 192·50, according to quality; sheets, M. 140 to 150, all per ton free at works.

The Austro-Hungarian iron business appears to be indulging in a sort of winter sleep, from which it will probably not awake till late in spring; the next weeks, or perhaps months, are not likely to bring any change, the raw and finished iron trades being all in a state of extreme dulness.

Crude iron, as well as the different sorts of manufactured iron, are meeting with very good demand on the Belgian iron market. Plates for export have been sold at 160f. p.t., merchant iron fetching, as a rule, 135f. p.t., though less has been offered and taken.

In coal and coke an exceptionally lively trade is done in Belgium, and a rise is expected to take place in the quotations for coal, those for coke having, to all appearance, reached the highest point, 18 to 23f. p.t. being quoted.

According to an official statement, given by the General Director of the Belgian Mining Department, the 256 collieries in Belgium have yielded in 1897 21,492,446 t., worth 220,672,100f., or 240,076 t. more than in the year before. Value per ton was 10·26f., or 0·75f. more than in previous year. Price of sale per ton was, on an average, 10·74f. Average depth of the coal mines is 472m. in the Hennegan, 285m. in the Namur district, and 333m. in the Liége district.

Producers of crude and finished iron are doing a satisfactory if not very large business in France; the general tone of quotations is reported as being firm.

Price of Gas in South London.—It is announced that the directors of the South Metropolitan Gas Company, of which Mr. George Livesey is chairman, have decided to reduce the price of gas 1d. per 1000 cubic feet, making it 2s. 2d., as from Christmas, and to increase the quantity of gas sold by slot meters from 27 to 29 cubic feet for 1d. as soon as the 80,000 meters of this kind now in use in the company's district can be altered. When the previous reduction was made no concession could be allowed to the pre-payment consumers, owing to the large amount of work entailed for so small a reduction, but this is now more than made up, the additional quantity of gas to be given being equal to 2½d. per 1000 cubic feet.

Manchester Association of Civil Engineering Students.—At a meeting of the Manchester Association of Students, in connection with the Institution of Civil Engineers, held on Wednesday last, Mr. A. H. Tyack read a paper on "Turbines," in the course of which he remarked that owing to their simplicity, compactness, and high speed, turbines were preferable to any kind of water motor. Classified according to the action of the water, turbines might be considered under the heads of "reaction wheels" and "impulse wheels." Sub-divided according to construction there were the radial flow, axial flow, and mixed flow wheels. Reaction wheels were particularly suited to low falls with constant and large volumes of water, whilst impulse wheels were more adapted to high heads and small volumes, or medium falls with largely varying volumes. Considering the various types of reaction wheels, Mr. Tyack described the Fourneyson as an example of the outward radial flow; the Vortex as an illustration of the inward radial flow; the Jonval as an axial flow motor, and the Victor turbine as an example of the mixed flow type. Impulse wheels, generally known as Girard turbines, were constructed on the inward flow principle for falls up to 60ft., but in higher falls, on the partial injection system. The Pelton wheel was the simplest form of water motor, resembling the ordinary water-wheel in form, but not suitable for falls under 100ft. It was very necessary to consider the circumstances for which a motor was required, and the conditions of the water supply, before choosing the turbine suitable to each particular case.

Coal in Kent.—The second ordinary general meeting of the Kent Coal Syndicate was held on Wednesday at the Cannon-street Hotel. Mr. C. H. Tindal presided, and moved the adoption of the report. He said they had not yet developed any considerable results, and up to the present those achieved were incomplete and inconclusive. As regarded the Kent coal enterprise generally, and the manner in which it was going on at Dover and elsewhere, he thought he might say that there was no doubt that at Dover they would obtain coal within a measurable distance of time—he supposed in the course of a few months. Mr. W. J. Cousins, in seconding the resolution, remarked that the various companies with which he was connected had enabled him to become thoroughly acquainted with the whole of the borings. As regarded the Penshurst boring, the progress had been delayed during several months, but the work had been recommenced, and the boring was now proceeding satisfactorily. At the present time that shaft had been sunk down to 1511ft. The Pluckley boring, which was stopped for the considerable period of ten months, from the same difficulties which were met with in the case of the Penshurst bore, was recommenced about three weeks ago, and at the time of restarting the depth which had been reached was 815ft. They were now down 850ft., which was very good progress, and he trusted that within a short period they would be able to make the same rate of progress in the Penshurst boring. Having given particulars of the other borings in Kent, he stated that the cores at Ropersole were coming up quite straight, there was no dip. At Dover there was a very slight dip. The indications at Ropersole were practically the same as at Dover.

Mediterranean and Persian Gulf Railway.—It is stated that the scheme for uniting the Mediterranean with the Persian Gulf by a railway from Tripoli to Koweyt, which has been under consideration by the Sultan and the Sublime Porte for some time, meets with favour in both instances. According to the *Times'* Vienna correspondent, the application for the concession has been made by Count Vladimir Kapnist, in the name of an international syndicate. It is proposed to build a main trunk line from Tripoli, on the Mediterranean, to Koweyt, on the Persian Gulf, and to establish ports and harbours at each terminus; as also a branch line from Khanikin, on the Persian frontier, to Kerbela and to Nedjef—*viâ* Bagdad and Musseyib, on the Euphrates. Preferential rights for the construction and exploitation of a series of branch railways are included in the project, as also the exclusive right to establish landing-stages and wharves on the rivers, and bonded warehouses and goods depôts in the stations and towns traversed by the railway. Other rights are included in the concession, such as those of draining and irrigating large extents of territory, and of working all mines, petroleum wells, bitumen and salt deposits not yet conceded, within fifty kilometres on each side of the line. The report estimates that, without diminishing to any great extent the receipts of the Suez Canal, the shortening of the journey between Europe and the East would create and develop a through traffic for passengers and mails, and for lighter and more valuable articles of merchandise. In the opinion of the chief engineer the two terminus ports—namely, Tripoli and Koweyt—could easily be made safe and commodious for almost any number of vessels of the largest tonnage; and the sea journey to the East by this route would thereby be rendered the shortest possible, and would be free from the many dangers and inconveniences which are encountered in the present transit through the Red Sea and the Arabian Gulf. The report goes on to say that from Tripoli the line would follow the sea coast as far as the Nahr-el-Kebir, and then up the course of that river over the lowest and easiest pass which could be found through the chain of mountains running parallel to the Syrian coast. The line would reach a summit level of about 2000ft. above the sea between Tripoli and Homs, on a plateau of hard black basalt. Thence it would proceed to Homs, which is about 1500ft. above the sea, and on through Palmyra, past numerous villages to Rahaba, on the Euphrates, following, in the main, the present caravan route. The railway would go down the valley of the Euphrates as far as El Kaim, then over the plains to Hit, where it would cross the river and proceed to Iskanderieh, the junction for Bagdad and for Khanikin—on the Persian frontier—and to Kerbela and Nedjef, the famous shrines and burial-places of the Persian Mahomedans, on the south; thence, in as nearly a straight line as possible, across the great alluvial plain between the two rivers to Kurna, where it would again cross the Euphrates and be continued to Basra, and thence across country to Koweyt, on the Persian Gulf.

ENGINEERING NOTES FROM SOUTH AFRICA.

(*From our own Correspondent.*)

MANUFACTURERS of refrigerating plant are afforded an opportunity just now in South Africa which they should be eager to embrace. The combined effect of the drought and the rinderpest which have lately afflicted the country has been so severe upon South Africa's flocks and herds that at the present moment a positive famine is threatened in meat. There is a consequent rush to erect cold storage plants, and the various Governments are actually being called upon to apply public funds to this purpose. A Bill is now before the Parliament of the Cape Colony enabling local authorities to erect cold storage plant, the Government advancing the money out of the Public Loan Act. It is also understood that the Cape Government Railways is about to introduce a greatly improved service of refrigerator cars.

The unsatisfactory system upon which municipal works are undertaken in the Transvaal has received another illustration. Recently the Johannesburg Town Council attempted to raise a loan of £150,000 for the extension of its electric lighting plant, and was unable to obtain the money. Now it is stated that that body has approached the famous German engineering firm of Siemens and Halske, which already possesses a contract for part of the lighting of the town, with a view to obtaining the necessary funds. The impropriety of a public body borrowing money off its own contractors is a point which needs no insisting upon, but the incident is certainly a striking illustration of the energy and astuteness which German engineering firms show in cultivating trade in foreign markets.

The commercial community in Capetown is asking that half a million should be spent upon the construction of a new railway station at Capetown. This expenditure the Railway Department is not prepared to incur, but it is proposed to spend £25,000 on the station between now and next session, and a further outlay will be made in the following session.

No decision has yet been arrived at with respect to the loan which the Transvaal Government is endeavouring to raise in order to carry out railway and other public works. Two offers have been submitted to the Pretoria authorities, but one was considered too severe as to terms of interest, while the other stipulated that the lenders should be given the contracts for the construction of the Pretoria-Rustenburg and Belfast-Lydenburg railways. The Volksraad has rejected these proposals, and has instructed the Government to raise a loan of two and a-half millions, without entering into any engagements with respect to railway concessions. It is practically certain that the loan will be placed with continental capitalists, and that all the engineering plant and material upon which it will be expended will be obtained in Germany or Holland.

Business is not particularly brisk in engineering and mining stores on the Witwatersrand, and bitter complaint is made, both of the mines' system of local buying, and of the growing practice of importing supplies direct from manufacturers in Europe and the States. On the other hand, trade is reported excellent in Rhodesia. Two new ironfoundries have lately been started in the neighbourhood of Johannesburg, and the local engineering industry is certainly advancing.

A compressor of unusual capacity—thirty-six drills—is under order for the New Modderfontein Company, where the new mill engine is also to be of the exceptional size of 1000-horse power. The compressor is of the King-Riedler Company, which is in great favour amongst Witwatersrand mine managers.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, December 10th.

THE latest reports throughout the interior concerning movements in iron and steel reveal anxiety among certain buyers to guard themselves against an advance during the winter, which many regard as probable. Steel rail contracts are being snatched up by agents of Pittsburgh mills at 17 dollars or less, and there is quite a scramble among the Pennsylvania mills for work. A good deal of business, amounting at least to 500,000 tons, was provisionally done during the progress of negotiations, and when they failed the business was announced. Contracts for over one hundred thousand tons are now in the balance.

Old rail buyers are making strong bids for large supplies of old iron rails. The Lakes are closed and business by water is practically over. Railway freight traffic is heavy and rates on some classes have been advanced. The holiday season is at hand, and for the present iron and steel orders will be at a minimum. Bar iron makers will end the year with more contract work to enter the new year with than ever before. The strong basis for this demand is the call for car-building iron. Boiler-plate and tank iron have been unusually active, and within a week small shop managers have been asking for quotations on January deliveries. Bridge builders enter the winter season with their hands full of work, but it will slack up late in January, except on a few big jobs that are to be leisurely prosecuted. In a general way pig iron is stronger, because of the clearer comprehension of the fact that the production is not far enough ahead of demand to make it safe. The Bessemer Pig Association is working well, and the Tinplate Association has absolute control. The rail makers could have sold their product higher, but a unification of interests has been made a practical impossibility by reason of the economic advantages which Pittsburgh interests have secured through ownership of ore mines, coal mines, coke plants, Lake transportation, and rail deliveries. There is a feeling in the trade that surprising developments may be expected.

The improving traffic condition and the practically positive assurances of a great relative increase next year over this are the grounds for the remarkable expansion of demand for steel rails, locomotives, cars, and railway equipment generally. The latest railroad figures are these:—The gross earnings of 119 roads in November increased 2,187,476 dols., or 4·58 per cent., or 21 per cent. over same month last year. These roads have a mileage of 93,621 miles. For eleven months to November 30th, the increase in gross earnings on 119 roads was 39,464,378 dols., against an increase of 30,884,222 dols. same time last year, or over 70,000,000 dols. in two years. The excess of exports for three years furnishes, in one sense, an additional capital of 1,000,000,000 dols., which is a safe basis for credit to two or three times that amount. The savings banks are lowering their rate of interest, and this will induce many depositors to withdraw their money for some other form of investment, and thus stimulate trade. This points to the possibility of a large number of what are termed in the States "wild cat" schemes. Hence investors must be doubly careful. The iron trade is gaining strength every week. Prices are threatening to advance. Pig iron production is barely equal now to demand. Makers look with concern on the foreign demand, which from their standpoint will be heavy. There are many orders coming in for transatlantic delivery. Furnace capacity is being engaged ahead. The same is also true of other iron and steel products. Steel rails are also in active demand at 17 dols. at Pittsburgh, and 18 dols. at Chicago. A great many roads have not yet ordered. January will be an eventful month in the way of forming the policy for the coming year. Plate mills are oversold, and Australia is calling for 75,000 to 85,000 tons, of which nearly one-half have just been placed under contract. All lines are active, and business is increasing. The tin-plate combination is perfected. Other lesser combinations are under way.

LAUNCHES AND TRIAL TRIPS.

MALANG, steel screw steamer; built by, Messrs. Wigham Richardson and Co.; to the order of, Rotterdamsche Lloyd; dimensions, 333ft. by 44ft. 2in.; trial trip, December 12th; 11¼ knots.

RECOVERY, special service; built by, Messrs. Wm. Simons and Co., Limited; to the order of, The British Admiralty; for use in connection with Plymouth breakwater. Fitted with three lines of rails for conveyance of sixteen trucks, loaded with stones. She has also sheer legs and 20-ton crane complete; launch, December 13th.

CLAVERDALE, spar-decked, screw steamer; built by, Thornaby Shipbuilding Yard; to the order of, Messrs. E. H. Haslekust and Co.; dimensions, 341ft., 45ft., 28ft. 6in. moulded; to carry, 5500 tons deadweight; engines, triple-expansion, 24in., 38in., 64in. by 42in., pressure 160 lb.; constructed by, Messrs. Thomas Richardson and Sons, Limited; launch, December 15th.

BERGENHUS; built by, Messrs. Irvine's Shipbuilding and Dry Docks Company, Limited; to the order of, Captain Andreas Olsen, of Bergen; dimensions, 352ft., 48ft., 27ft. 9in.; engines, triple-expansion, 25in., 40in., 66in. by 45in., pressure 160 lb.; constructed by, Central Marine Engine Works.

ALEXANDER GOLOVATCHEFF, barge-loading dredger; built by, Messrs. Wm. Simons and Co., Limited; to the order of, The Russian Government; launch, December 16th.

MILES COVERDALE; built by, Messrs. Wm. Gray and Co., Limited; to the order of, Messrs. John Coverdale and Son; dimensions, 312ft., 43ft., 22ft. 3½in.; engines, triple-expansion, 22in., 35in., 59in. by 39in., pressure 170 lb.; trial trip, December 20th.

TRADE AND BUSINESS ANNOUNCEMENTS.—Messrs. Bell, Thompson, and Co. inform us that they have been appointed agents for The Tyne Brass and Copper Tube Manufacturing Company, Jarrow-on-Tyne.—Messrs. Alfred Dickinson and Co. have now removed from Colmore-row, and taken offices in the Telephone-buildings, Newhall-street, Birmingham.—The Horsfall Furnace Syndicate, Limited, has established a London office, at 36, Great George-street, Westminster, in charge of Mr. Somerset Butler.—We are requested to state that the offices of *Locomotive Engineering*, a New York journal, were entirely destroyed by fire, and everything, including the mailing list, is lost. The publishers ask their subscribers to send their name, address, and date of expiration.—Messrs. Bell, Thompson, and Co. have been appointed agents for Liverpool district for Messrs. Wilkinson and Co., Dudley.—Several Lancashire towns have ordered steam fire engines of Merryweather's "Gem" type.

ASSOCIATION OF BIRMINGHAM STUDENTS OF THE INSTITUTION OF CIVIL ENGINEERS.—At the last meeting Mr. H. R. Thomas, B.Sc., Stud. Inst. C.E., read a paper on "Axles for Road Carriages and Motor Cars, and their Manufacture." In discussing ball bearings, the author considered they were not applicable to cart and carriage axles, as it is very difficult to properly harden the large bearings necessary, and either the balls or the races would crush under the excessive weight. Roller bearings have a great future before them, as in this case the rollers run the whole length of the axle. Faggoted axles are the best, as should there be a flaw in any one piece of iron, it would not materially affect the strength of the axle. In designing axles, the author usually allows a factor of safety of 8 or 9, in view of the many various strains which come upon it. "Foregathering," that is, inclining the arm forward, which is supposed to cause the wheel to run against the collar instead of the nut, interferes with the free running of the vehicle, and is therefore not recommended. The resignation of Mr. Henry C. Adams, after five years' service as honorary secretary, was accepted, and Mr. G. T. Phelps, B.A., Stud. Inst. C.E., was appointed in his stead.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

***** When inventions have been "communicated" the name and address of the communicating party are printed in italics.**

8th December, 1898.

25,923. CONSTRUCTION of SCARVES, &c., H. Thomson, London.
25,924. PROJECTING MOVING OBJECTS, T. W. Barber, London.
25,925. HYPOCHLORITE of SODA. M. Muspratt, E. S. Smith, and the United Alkali Company, Limited, London.
25,926. PURIFIERS for STEAM GENERATORS, T. Sugden, London.
25,927. PENS, G. Varley, London.
25,928. FASTENING for LABELS and TAGS, J. Proctor, London.
25,929. SHIRT CUFFS, W. H. Yearron and J. H. Fox, London.
25,930. TAKING BEARINGS, A. J. Boult.—(*C. Solmond, United States.*)
25,931. BRIDGES, C. Horton and C. H. Bradley, London.
25,932. COAT and VEST HOLDERS, D. W. Axene, London.
25,933. PADDLE-WHEELS for VESSELS, J. S. Terrell, London.
25,934. RAIL-CLAMPS, J. M. Henigan and C. W. Watt, London.
25,935. NON-REFILLABLE BOTTLES, J. Merigan, London.
25,936. NON-REFILLABLE BOTTLES, A. M. Legrand, London.
25,937. MAIL POUCHES, S. C. and J. E. Reese, London.
25,938. TROLLEYS, O. W. Swanson, London.
25,939. LABEL HOLDER for LUGGAGE, C. R. Mitchell, London.
25,940. SADDLE CLIPS for CYCLES, H. Mills, Birmingham.
25,941. ADVERTISING, P. A Ganacheau and L. Gamotot, London.
25,942. SHIPS' BERTHS, C. Johnson and W. Griffin, Birmingham.
25,943. PROTECTING GLAZED BRICKS, &c., J. Webb, London.
25,944. TRUSSES, S. A. D. Hardy, London.
25,945. COMPOSITION for PAVING BLOCKS, W. H. Coward, London.
25,946. ACETYLENE GAS GENERATORS, H. C. Hill, Manchester
25,947. CYLINDERS for PRINTING MACHINES, F. Frisch, London.
25,948. CYLINDERS of VERTICAL MOTORS, A. R. Lucas, London.
25,949. TIRES for VELOCIPEDE WHEELS, A. Drucker, London.
25,950. FOG HORNS, A. Camilleri, London.
25,951. CIGARETTE-MAKING MACHINE, G. F. Zimmer, London.
25,952. BOLTING MILLS, SCREENS, &c., H. Dietz, London.
25,953. STENCILLING MACHINE, P. Jensen.—(*F. E. Clark, United States.*)
25,954. COVERINGS for CYCLE HANDLES, A. H. Gladwin, London.
25,955. DYNAMOMETERS, W. P. Thompson.—(*H. S. Elicorthy, Russia.*)
25,956. MANUFACTURE of OATCAKE, R. H. Clarkson, Liverpool.
25,957. BUSKS, W. H. Cooper and G. E. Gather, Liverpool.
25,958. TOY, J. Robinson, Manchester.
25,959. JAWED CHUCKS, C. and G. B. Taylor, Birmingham.
25,960. ANNEALING MUFFLE FURNACE, W. G. Moore, Birmingham.
25,961. BRACKETS for ELECTRIC CONDUCTORS, C. Pellenz, London.
25,962. HYPOCHLORATES of ALKALIES, E. S. Smith, and The United Alkali Company, Limited, London.
25,963. HYPOCHLORATES of ALKALIES, C. L. Higgins, M. Muspratt, E. S. Smith, and The United Alkali Company, Limited, London.
25,964. COLOURING MATTERS, G. W. Johnson.—(*Kalle and Co., Germany.*)
25,965. COLOURING MATTERS, G. W. Johnson.—(*Kalle and Co., Germany.*)
25,966. INDIGO, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
25,967. STOVES, G. T. Epstein, Bristol.
25,968. ACETYLENE-STORING APPARATUS, G. M. A. Claude, London.
25,969. ROLLER BEARINGS, J. A. W. O'N. Torrens, London.
25,970. ORNAMENTAL FABRICS, A. Briggs, London.
25,971. APPARATUS for STERILISING, A. S. Barham, London.
25,972. DRIVING MOTOR CARS, A. F. Spooner.—(*H. Baudry, France.*)
25,973. ANIMAL FOOD, C. Jung, A. Brecher, and A. Kittel, London.
25,974. MANUFACTURING CIDER, J. Imray.—(*La Société Anonyme des Matières Colorantes et produits Chimiques de St. Denis and D. A. Rosenstiehl, France.*)
25,975. CYCLES, G. W. Manson, London.
25,976. SPOONS, W. Evans, London.
25,977. WATER-TUBE BOILERS, H. Blessingen, London.
25,978. APPARATUS for STRINGING PEARLS, L. Dosch, London.
25,979. TREATING ORES, F. W. Martino and F. Stubbs, London.
25,980. VALVE GEAR for STEAM ENGINES, J. Damlos, London.
25,981. TUBES, W. H. Beck.—(*C. Bléry, France.*)
25,982. INCANDESCENT GAS BURNERS, H. P. Salsbury, London.
25,983. EXTRACTION of PRECIOUS METALS, A. Lavoix, London.
25,984. EXPLOSION MOTORS, P. Pichard, London.
25,985. METHOD of ELECTRIC IGNITION, P. Pichard, London.
25,986. AUTOMATIC BRAKE for VEHICLES, J. Martin, London.
25,987. FRAMING for CANDLE HOLDERS, C. E. Green, London.
25,988. PUMPS, J. Gwynne and E. W. Sargeant, London.
25,989. COIN-FREED APPARATUS, S. Landsberger, London.
25,990. NON-REFILLABLE BOTTLES, W. Creasy, London.
25,991. JAM, E. G. Scott, London.
25,992. WATER HEATERS, G. A. Perram, London.

9th December, 1898.

25,993. BED RESTS, E. G. Payne, London.
25,994. RACKS for DRYING CLOTHES, J. G. Hicks, Sheffield.
25,995. DETACHABLE MUDGUARD, F. W. Thompstone, Salford.
25,996. BRACKET for COAT HOOKS, R. Beckett, Shrewsbury.
25,997. ACETYLENE GENERATOR, H. Jellett, Dublin.
25,998. TOYS, G. F. Lütticke, Berlin.
25,999. MATTRESS FRAME, W. Rankin.—(*E. Woodbury, Cuba.*)
26,000. BACHELOR'S FRIEND, F. G. N. Mills and C. F. Hirth, London.
26,001. BRACKET for TRAWL OTTER BOARDS, R. W. Lewis, Aberdeen.
26,002. PNEUMATIC TIRES, J. G. Surman, Healing, Lincolnshire.
26,003. LAYING PLANKS on SHIPS' DECKS, T. Wallace, Manchester.
26,004. DOOL used in MAKING WHEELS, S. Newland, London.
26,005. PNEUMATIC LEG GUARD, W. R. J. Forsyth, Folkstone, Kent.
26,006. WINDOW-SASH FASTENER, N. J. Butler and T. Minty, Brighton.
26,007. LOCOMOTIVES, W. Simpson, W. L. Bodman, and D. H. Simpson, Manchester.
26,008. COUPLINGS, W. Simpson, W. L. Bodman, and D. H. Simpson, Manchester.
26,009. TIE-HOLDING COLLARS, M. B. Kendrick, Glasgow.
26,010. ARTIFICIAL IVORY, J. A. Boden, London.
26,011. LIGHTING LAMPS, R. J. Urquhart.—(*R. Rete-Meyer, Germany.*)
26,012. TRAVELLING CARDING ENGINES, R. Taylor, jun., Manchester.
26,013. DRAWING FRAMES, J. McQueen and D. Barker, Manchester.
26,014. ELECTRIC STOP MOTION for DRAWING FRAMES J. McQueen and D. Barker, Manchester.
26,015. SPRING FORK for CARRYING BICYCLES, P. G Ebbutt, Birmingham.
26,016. PRINTING MACHINES, F. Shaw and J. D. Athey, Stockton-on-Tees.
26,017. GAME, L. M. Gibson, Birmingham.
26,018. PORTABLE GAS HOLDERS, A. G. Adamson, Glasgow.
26,019. VALVE UNION for WATER COCKS, H. Crane, jun., Birmingham.
26,020. ELECTRIC SWITCHES, H. W. Cox, Nottingham.
26,021. BUSK for CORSETS, L. M. Silverwood, Eastleigh, Hants.
26,022. DISC WHEELS for RAILWAY VEHICLES, J. Baker, Sheffield.
26,023. "REVOLUTION" INDICATORS, J. H. Gibson, Liverpool.
26,024. TUBULAR POLES, W. W. Richardson, Halifax.
26,025. TAPERED TUBES, W. W. Richardson, Halifax.
26,026. GALVANIC BATTERIES, W. G. Heys—(*S. Silberberg, United States.*)
26,027. TOY TEAPOT, A. E. Hanks, London.
26,028. INTERNALLY-STOPPERED BOTTLES, A. E. Baldock, Birmingham.
26,029. FRAMES for VELOCIPEDES, T. B. Sharp, Birmingham.
26,030. PORTABLE TANKS for OIL, G. W. Gooding, London.
26,031. LOCKS for KNITTING MACHINES, H. Donner London.
26,032. WHEEL TIRES, T. W. Jones, London.
26,033. CONNECTOR for ELECTRIC WIRES, H. W. Miller, W. Turvey, and G. C. Weston, London.
26,034. ANTI-VIBRATOR GAS FITTING, J. B. Colbran, London.
26,035. CHAFF-CUTTING MACHINES, J. Walker, London.
26,036. CYCLE and VEHICLE BRAKES, F. Beauchamp, London.
26,037. REMOVING HUSKS from GRAIN, P. Rakhmanoff, London.
26,038. ELECTRICALLY OPERATING CLOCKS, W. B. Buer, T. W. Legge, and J. Tabrar, London.
26,039. WATER-TUBE BOILERS, J. S. and J. L. White, and A. Forster, London.
26,040. POCKET FOLDING SCREW WRENCHES, C. Bach, London.
26,041. HOLDFAST PIN for DRYING GROUNDS, A. Stromberg, London.
26,042. GAME, J. Klauder, London.
26,043. LEARNING MUSICAL SCALES, H. Woolley, London.
26,044. HORN BUTTONS, C. Franze, London.
26,045. ATTACHING INFLATORS to CYCLES, W. G. Hurst, London.
26,046. ROTARY ENGINES, W. H. Bond, Kingston-on-Thames.
26,047. RIDING ATTACHMENT for AGRICULTURAL IMPLEMENTS, G. W. Babcock, W. H. Clark, and W. W. Redman, Kingston-on-Thames.
26,048. SECURING PUMP to BICYCLE, R. W. Smith, Birmingham.
26,049. BALL BOTTLE STOPPERS, J. Seyboldt, London.
26,050. CORNICE POLES for WINDOWS, J. Snuggs, London.
26,051. TOY, J. T. Lawrence, London.
26,052. PREVENTING BOTTLE RE-FILLING, G. H. Jones, London.
26,053. WATER GAUGES, G. H. Jones, London.
26,054. BALL and ROLLER BEARINGS, J. Yeomans, London.
26,055. STERILISING APPARATUS, T. F. A. Leclerc, London.
26,056. COIN-FREED APPARATUS, E. P. Riessner, London.
26,057. DRYING APPARATUS, W. P. Thompson.—(*P. J. Rossen, Germany.*)
26,058. WAGONS, R. Gill, Liverpool.
26,059. OXIDES, C. S. Bradley and C. B. Jacobs, Liverpool.
26,060. SOLUBLE SALTS, C. S. Bradley and C. B. Jacobs, Liverpool.
26,061. ANTHRACENE, C. S. Bradley and C. B. Jacobs, Liverpool.
26,062. POLISHING or GLAZING LEATHER, F. Breidenbach, Manchester.
26,063. SWITCHBOARD for USE with SIGNS, W. A. Gent, Birmingham.
26,064. INSERTING MATTER in PRINTING PLATES, J. Cowley, London.
26,065. HEATING WATER, Maiche, Limited.—(*L. Maiche, France.*)
26,066. BROWN POLYAZO DYESTUFFS, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
26,067. ELECTRIC LAMP, H. C. Gover and C. F Proctor, London.
26,068. GLOW LAMPS, Siemens Brothers and Co, Limited.—(*Siemens and Halske Aktiengesellschaft, Germany.*)
26,069. TWO-WHEELED VEHICLES, W. Dickson, London.
26,070. PRODUCING PRINTED MATTER, J. F. Duke, London.
26,071. METAL BOXES, F. A. Walker and J. Baker, London.
26,072. PERAMBULATORS and MAIL CARTS, J. Ashton, London.
26,073. TRANSMITTING ELECTRICAL ENERGY, A. F. Hills, London.
26,074. ELECTRO-MOTORS, A. F. Hills, London.
26,075. FERRIES, A. F. Hills, London.
26,076. EXPLOSION ENGINES, R. Edwards, London.
26,077. CASH TILLS, H. Davidson, London.
26,078. ADVERTISING APPARATUS, R. von Scharrenhorn, London.
26,079. CYCLES, R. E. Phillips, London.
26,080. WRINGING MACHINES, J. H. and T. B. King, London.
26,081. SHELLS for HIGH EXPLOSIVES, L. Gathmann, London.
26,082. WORKMEN'S TIME RECORDERS, W. le G. Bundy, London.
26,083. TENT POLES, G. F. Beyts, London.
26,084. MACHINES for CUTTING CHAFF, A. Dyball, London.
26,085. EXHIBITING MOVING PICTURES, C. Raleigh, London.
26,086. MEANS for GRINDING TOOLS, N. Dedrick, London.
26,087. A CLIP for RAZOR STROPS, &c., J. Pepper, London.
26,088. CEMENTS, D. M. Sutherland, London.
26,089. ORNAMENTS, W. Sanders and G. E. Seymour, London.
26,090. CYCLE TIRES, E. Apperly, Stroud, Gloucestershire.

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26,091. MACHINES for CASTING TYPE, H. E. Moul, London.
26,092. ARMATURES for DYNAMOS, A. G. G. Cumming, Leith, Scotland.

26,093. Cleaning Latex, T. Christy.—(*J. H. Hart, Trinidad.*)
26,094. Brakes for Bicycles, G. A. Parkin, Shotton, Flintshire.
26,095. Appliance for Fastening Boots, A. Marshall, Bristol.
26,096. Brake, H Filmer, London.
26,097. Cleaning the Interior of Pipes, G. F. Restall, London.
26,098. Spanner, S. P. Bowen, G. Graham, and W. Smith, Middlesbrough.
26,099. Means for Producing Patterns, O. St. L. Davies, Manchester.
26,100. Advertising Toy, W. H. C. D. Charity, Manchester.
26,101. Bottle Stoppers, E. Scholes, Manchester.
26,102. Cycle Forks, J. B. Dunlop and J. B. Dunlop, jun., Dublin.
26,103. Press for Making Golf Balls, W. H. Smith, Bradford.
26,104. Fire-escapes, W. and J. Jack, Glasgow.
26,105. Valves for Pneumatic Tires, J. F. Brown, Manchester.
26,106. Safety Lamps for Miners, A. Howat, Manchester.
26,107. Flexible Ladders, J. Hargreaves, Farnworth-in-Widnes, Lancs.
26,108. Manure-distributing Device, J. F. Witthold, Glasgow.
26,109. Operating Bolts, A. Brown and H. C. Pruce, Birmingham.
26,110. Fastening Stair Rods, W. J. and T. Dobbs, Wolverhampton.
26,111. Cors, T. Perry and Son, Limited, and H. Garner, Wolverhampton.
26,112. Rivets, J. W. Wailes, Liverpool.
26,113. Mail Carts, The Perambulator Manufacturing Company, Limited, Birmingham.
26,114. Brakes for Bicycles, J. Mills and G. Jepson, Sheffield.
26,115. Sash Window Frames, C. W. Davenport, Manchester.
26,116. Galvanic Batteries, W. G. Heys.—(*S. Silberberg, United States.*)
26,117. Portable Sanitary Urinal, H. J. Barratt, Canterbury.
26,118. Mowing Machine Frames, A. C. Arter, Canterbury
26,119. Cycle Tires, J. Telford, Maryport, Cumberland.
26,120. Wood-boring Machines, J. Whittle, Manchester.
26,121. Paste for Stationery Purposes, J. H. Bignell, London.
26,122. Envelopes, E. M. M. Whitehouse, Birmingham.
26,123 Producing Pure Lead Oxide, R. Bayer, London.
26,124. Steam Generator, J. Judge, Newcastle-on-Tyne.
26,125. Coin-freed Apparatus, T. Harrison, Newcastle-on-Tyne.
26,126. Action for Pencils, E. Murrle.—(*O. Ungleuk, Germany*)
26,127. Clip for Pumps of Bicycles, &c., A. Rose, London.
26,128. Machine for Sawing Stone, E. Rhodes, London.
26,129. Flushing Apparatus, H. F. Standing and C. F. Dixon, London.
26,130. Machine for Washing Wool, H. C. Longsdon, Keighley.
25,131. Supplying Air to Cylinders, T. W. Marshall, London.
26,132. Sharpener for Scissors, C. H. Marshall, London.
26,133. Handle Bars for Velocipedes, D. N. Thomas, London.
26,134. Obtaining High Temperatures, F. J. Bergmann, London.
26,135. Treatment of Raisins, J. G. Gibson, Liverpool.
26,136. Electrical Measuring Instrument, K. Lehner, Liverpool.
26,137. Brooch Fastenings, A. R. Connop, London.
26,138. Combined Device for Holding Goods, G. Eastwood, London.
26,139. Fasteners for Gates, W. N. Rowell and A. Bell, London.
26,140. Photographic Cameras, T. E. Meadowcroft, London.
26,141. Washing Coke, J. E. and E. L. Joselin and M. B. Wild, London.
26,142. Looms for Weaving, F. W. and B. Franklin and J. Clarke, Birmingham.
26,143. Scaffolding, P. T. L. Toelpe, London.
26,144. Propelling Velocipedes, A. H. P. Blunt, London.
26,145. Continuous-current Dynamos, A. O. Berry, London.
26,146. Knife Sharpener, J. Smith, London.
26,147. Tool-grinding Appliance, H. S. Ilsley, London.
26,148. Mechanism for Transmission of Power, A. M. Craig, London.
26,149. Regulating the Position of Projectiles, The Joint Stock Company and A. Totte, London.
26,150. Clearing Deposits from the Mouths of Harbours, W. Critchlow, London.
26,151. Winding Fabrics on Card, B. J. B. Mills.—(*A. Dauvergne, France.*)
26,152. Liquid Meters, C. D. Abel.—(*La Compagnie Generale des Compteurs [Société Anonyme], Belgium.*)
26,153. Telephonic Apparatus, Siemens Bros. and Co., Limited.—(*Siemens and Halske Aktiengesellschaft, Germany.*)
26,154. Heating, D. Tschernoff, London.
26,155. Incandescent Gas Burners, W. Hooker, London.
26,156. Targets, R. Haddan.—(*C. Chevallier, M. Lallement, and E. Cadet, France.*)
26,157. Extraction of Rubber, J. de la Fresnaye, London.
25,158. Switch for Changing Lights, W. L. Campbell, Brighton.
26,159. Chain Wheel, W. and A. Robertson, Manchester.
26,160. Chains, J. Westaway, London.
26,161. Cotter Pin Driver for Cranks, W. H. J. Grout, London.
26,162. Brazeless Cycle Frames, J. J. Underwood, Birmingham.
26,163. Spring Mattresses, H. de Stedingk, London.
26,164. Resistance Switch, C. B. Callow and J. Eck, London.
26,165. Time Measures, R. T. and J. G. Glover, London.
26,166. Brake Apparatus for Ships, A. E. Sorby, London.
26,167. Colouring Matter, H. R. Vidal, London.
26,168. Colouring Matter, H. R. Vidal, London.
26,169. Concentrating Sulphuric Acid, J. L. Kessler, London.
26,170. Letter-cards, R. Davis and B. Roussat, London.
26,171. Plugging Material for Teeth, A. Biber, London.
26,172. Castors for Furniture, W. P. Spooner, London.
26,173. Puzzle, E. Eckenstein, London.
26,174. Cigarette-making Machine, W. G. Pedersen, L. Adler, and P. N. Holst, London.

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26,175. Advertising Devices, A. R. Boaz, London.
26,176. Injectors and Water Elevators, A. H. Smith, Nottingham.
26,177. Cocks and Valves, A. H. Smith, Nottingham.
26,178. Corsets, C. L. Reynolds, London.
26,179. Ring Joints for Flanges, J. E. Slack, Manchester.
26,180. Billiard Detachable Appliances, J. W. Dean, Stroke-on-Trent.
26,181. Cycle Support, J. Attridge, Bournemouth East.
26,182. Ashpits for Fireplaces, C., F., and W. Riley, Burnley.
26,183. Coupling Link, G. F. Nicholson and F. Moss, Great Grimsby.
26,184. Cycle Back Fork End Adjustment, B. Gorton and T. S. Yardley, Coventry.
26,185. Vehicle Wheels and Bearings, R. B. Hellivell, Liverpool.
26,186. Steam-condensing Apparatus, J. I. Booker, Leeds.
26,187. Self acting Mules Ring Frames, J. Seville and R. Clegg, Manchester.
26,188. Spinning Mules, J. D. White, Manchester.
26,189. Automatic Steam Injector Pumps, E. A. Charters, Plymouth.
26,190. Tobacco Pipe Cleaner, A. W. Sale, Northampton.
26,191. Electric Switchboards, E. W. Cowan and A. Still, Bowden, Cheshire
26,192. Cycle Steering Lock, P. Spencer, Liverpool.
26,193. Securing Cycle Handle Bars, P. Spencer, Liverpool.
26,194. Moulding Socket Pipes, &c., F. Herbert Durham.
26,195. Cinematographic Apparatus, J. E. Thornton, Altrincham.
26,196. Cinematographic Pictures, J. E. Thornton, Altrincham.
26,197. Lithographic Machines, H. Erskine, Glasgow.
26,198. Locking Devices for Nuts, H. R. Walker, Liverpool.
26,199. Surface Condensers, W. B. Thompson, Dundee.
26,200. Preserving Embossed Designs on Paper, G. Bathgate, Glasgow.
26,201. Bung for Casks, N. F. Debroux, Glasgow.
26,202. Pneumatic Tires, J. Brooker and J. Cruickshank, London.
26,203. Cycle Driving Gear, J. Brooker and J. Cruickshank, London.
26,204. Ice and Snow Vehicle, V. Seeser, United States.
26,205. Smoke Flues, J. I. Bruce, Low Gosforth, near Newcastle-on-Tyne.
26,206. Vaporising Oil for Oil Engines, H Austin, Wolverhampton.
26,207. Curtain Rings, L. J. Steele, London.
26,208. Jointing Pipes, R. and W. Mark, Cumberland.
26,209. Automatic Dustless Coal, H. R. Reynolds, Ontario, Canada.
26,210. Electric Motors, F. O'C. Prince, London.
26,211. Weaving Shuttles, W. C. Priestley, Pudsey, Yorks.
26,212. Bending Metal Tubes, G. Chisholm, jun., Glasgow.
26,213. Boat, G. Davis, Aberystwyth.
26,214. Electrical Furnace, E. B. Phillips and W. H. Bray, Leicester.
26,215. Enriching Gases by Acetylene, W. J. Rodwell, London.
26,216. Elastic Mouldings for Floors, W. Houben, London.
26,217. Appliance for Moderately Heating, K. W. Hedges, London.
26,218. Bearings for Bowl Centres, W. and J. Partington, London.
26,219. Speech-recording Apparatus, J. Y. Johnson.—(*The American Gramophone Company, United States.*)
26,220. Cycle Cranks, J. Turnbull, London.
26,221. Incandescent Gas Mantles, F. and M. L. Missire, London.
26,222. Combination Furniture, L. Wolz, London.
26,223. Wheels for Vehicles, P. Samois, London.
26,224. Automatic Railway Signals, C. de M. da S. Lobo, London.
26,225. Candlesticks, W. Langbridge, Doncaster.
26,226. Straw Hat, L Delaunay and A. Garde, London.
26,227. Propelling Boats and Vessels, W. White, London.
26,228. Cycles, S. B. Hill and F. W. Schroeder, London.
26,229. Fastening Gloves, E. C. Vaudrey, London.
26,230. Power Generating Machine, C. Bondiek and F. Sievers, London.
26,231. Bandage for Injured Limbs, E. Kohlmetz, London.
26,232. Hair Comb, R. Charlton, London.
26,233. Bookbinding, W. C. Leechman, London.
26,234. Paper, W. C. Leechman, London.
26,235. Regulating Devices for Gas Burners, W. Knopf, London.
26,236. Valves for Pneumatic Tires, E. F. Pickitt, Buffalo, New York.
26,237. Generating Acetylene Gas, D. J. van Praag and F. W. Harker, London.
26,238. Valves, The Economical Gas Apparatus Construction Company, Limited, and A. I. Payne, London.
26,239. Electric Measuring Instruments, J. Wetter.—(*The Elektrizitäts Aktiengesellschaft vormals Schuckert and Co., Germany.*)
26,240. Metallic Pipes, R. A. Lowe and H. Line, London.
26,241. Velocipedes, G. P. Mills, London.
26,242. Balancing Window Sashes, G. Massey, London.
26,243. Bottle Stopper and Capsule, J. S. Barr, London.
26,244. Steam Generators, J. Brotan, London.
26,245. Map Holders, C. M. Stuart, London.
26,246. Percussion Table, R. F. and G. A Waller, London.
26,247. Heating Devices, W. P. Thompson.—(*R. Tochtermann, Germany.*)
26,248. Starting Switches, J. W. Gibbs, Liverpool.
26,249. Rods of Explosive Materials, H. Maxim, London.
26,250. Automatically Delivering Liquids, A. E. Phare, London.
26,251. Electrical Transformers, O. T. Bláthy, London.
26,252. Preventing Air Receding in Tubes, G. H. Buckeridge, London.
26,253. Coking, R. Brunck, London.
26,254. Mantles for Gas Lighting, W. H. A. Sieverts, London.
26,255. Land-cultivating Implements, T. C. Darby, London.
26,256. Treating Peat, W. F. Browne, London.
26,257. Regulating Difference of Potential, L. de Coincy, London.
26,258. Opener for Tinned Goods, T. J. Turner and C. Hindle, London.
26,259. Production of Hydrocyanic Acid, J. Büeb, London.
26,260. Nickel Alloys, J. Patrick, London.
26,261. Paraxanthine, J. Y. Johnson.—(*C. F. Boehringer and Soehne, Germany.*)
26,262. Colouring Matters, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
26,263. Preventing Erosion in Guns, H. Maxim, London.
26,264. Actuating Automatic Machines, C. Ramspeck, London.
26,265. Infusing Tea, H. F. E. Harris, London.
26,266. Cycles, C. W. Atkinson, London.
26,267. Damping Envelopes, C. von Kanitz, London.
26,268. Tires, C. H. Guest, London.
26,269. Coke Oven, H. Poetter, London.
26,270 Effecting Smokeless Combustion, A. Koeppe, London.
26,271. Combination Brace and Bits, W. H. C. Harrison, London.
26,272. Shoddy Mills, U. Kohllöffel, London.
26,273. Automatic Gas Igniter, C. F. P. Standebach, London.
26,274. Templet for Drilling Sleepers, L. Gross, London.
26,275. Jar Holder, A. Saunders, London.

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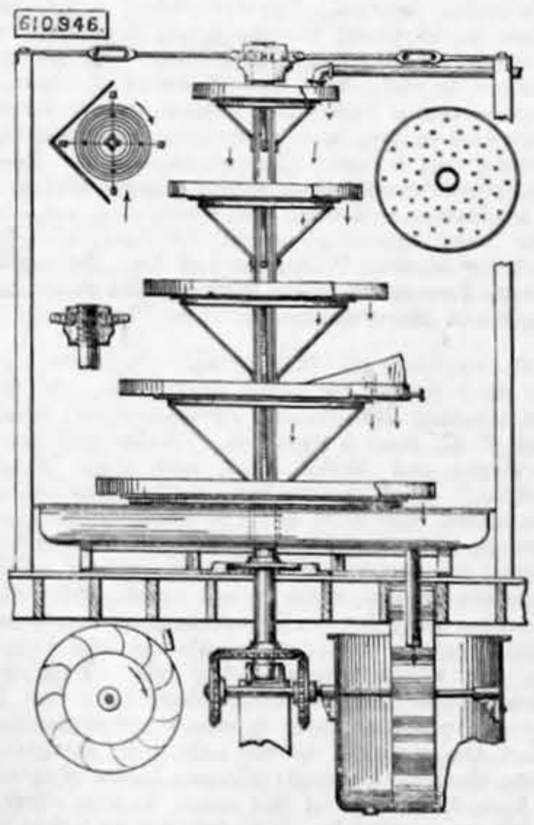
26,276. Trouser Braces, H. Withers - Lancashire, Stockbridge, Hants.
26,277. Slide Valve Releaser, P. Buckley, O. Holmes, and H. Hemingway, Leeds.
26,278. Potato Cleaner, J. H. Johnson. Carlisle.
26,279. Pipe Joint and Coupling, D. Anderson, London.
26,280. Bottle, C. E. Cummins, Bishop Auckland.
26,281. Calculating Photographic Exposures, A. Watkins, Hereford.
26,282. Charring Furnace, G. I. Cree, Dublin.
26,283. Securing Tires on Wheel Rims, A. T. Collier, London.
26,284 Disinfecting Apparatus, J. Lee, New Ferry, Cheshire.
26,285. Switches, S. H. and H. W. Heywood, Manchester.
26,286. Revolving Riddles, D. Gillies, Bonnybridge, Stirlingshire.
26,287 Mausser Rifle, R. M. Ramirez, London.
26,288. Mechanical Stokers for Furnaces, J. F. Pool, London.
26,289. Automatic Loom "Knock-off" Mechanism, J. W. Hill and E. Bardsley, Manchester.
26,290. Stop Valves, J. Hodkinson, Nottingham.
26,291. Cut-out Letters and Figures, J. Y. Johnston, London.
26,292. Dabbing Motions for Combing Machines, J. E. Stephenson, Bradford.
26,293. Bronzing Machine, F. G. Job, E. Marsden, and J. A. Hunter, Bradford.
26,294. Attaching Harness Weights to Wire Mails, J. A. Greenwood, Bradford.
26,295. Steering Locks for Velocipedes, B Yates, Coventry.
26,296. Miners' Tokens M. McDicken, Glasgow.
26,297. Fanlight-closing Apparatus, G. F. Newman, Birmingham.
26,298. Eyes for Hoes, F. Parkes, Birmingham.
26,299. Furniture Castors, J. Cooper and F. G. Bensly, Birmingham.
26,300. Lead Tray-making Machines, G. Thompson, Edinburgh.
26,301. Fronts, T. C. Fawcett, Halifax.
26,302. Apparatus for Corking Bottles, G. Bowen, Keighley.
26,303. Letter Files, P. Spencer, Birmingham.
26,304. Tires, W. T. Shaw, I. W. Boothroyd, and A. Sydenham, London.
26,305. Marine Propellers, G. Gay, London.
26,306. Attachments to Buoy Lamps, W. T. Parrott, Hull
26,307. Packing Cases, H. H. Macaulay, Glasgow.
26,308. Means for Propelling Cycles, W. Goodlet, Glasgow.
26,309. Gas Motor Ignition Tube, A. E. Heckford, Birmingham.
26,310. Distribution Boards for Electric Wiring, G. A. Clark, W. McAulay, and J. A. McLaren, Glasgow.
26,311. Petroleum Engines, R S. Blackwood.—(*G. H. Rogers, South African Republic*)
26,312. Coffins, J. Murray and D. McGregor, London.
26,313. Lithographic Transfer Paper, C. H. Veale, London.
26,314. Sash Locks, A. J. Boult.—(*T. A. Stevens, United States*)
26,315. Ball Bearings for Electric Motors, J. M. Murphy, London
26,316. Ships' Ventilators, R. Thompson, S. J. Glover, and J. Porter, Newcastle-on-Tyne.
26,317. Covers of Jugs, M. Stern.—(*C. Kayser, Germany.*)
26,318. Sliding Bolts for Doors, J. May, London.
26,319. Water Tap and Filter Combined, H. Barraud, London.
26,320. Folding Machines, F. H. Wendt, London.
26,321. Cycling Skirts, E. and G. Slatter and G. W. Richardson, London.
26,322. Regulating the Difference of Potential, L. de Coincy, London.
26,323. Frigorific Electro Spray, E. S. D'Odiardi, East Croydon.
26,324. Volatilisers of Metals, E. S. D'Odiardi, East Croydon.
26,325. Electrodes of Deep Penetration, E. S. D'Odiardi, East Croydon.
26,326. Abscess Bells and Electrolysers, E. S. D'Odiardi, East Croydon.
26,327. Electro Inhalers and Nascent Ozone Producers, E. S. D'Odiardi, East Croydon.
26,328. Electro Vapourisers and Ozonisers, E. S. D'Odiardi, East Croydon.
26,329. Bail for Pails, S. R. and H. R. Docking, London.
26,330. Vices, H. B. Bryan, London.
26,331. Folding Racks, H. H. B. Rust and J. Dupiérris, London.
26,332. Match, W. P. Jones and H. M. Bates, London.
26,333. New Game, H. Theobald, London.

SELECTED AMERICAN PATENTS.

From the United States Patent-office Official Gazette.

610,946. Water-cooling Device, *W. F. Niebling, Cincinnati, Ohio.—Filed December 23rd*, 1897.

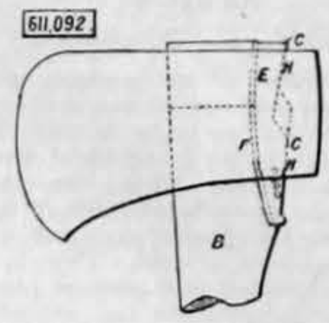
Claim.—In a device for cooling water, the combination of a number of pans having perforated bottoms, a



water pipe discharging into the uppermost pan, a central upright shaft on which they are supported, one below the other with a space between them and means to rotate said shaft.

611,092. Means for Securing Heads of Axes, Hammers, &c., to their Handles, *F. Baker, Caulfield, Victoria.—Filed February 7th*, 1898.

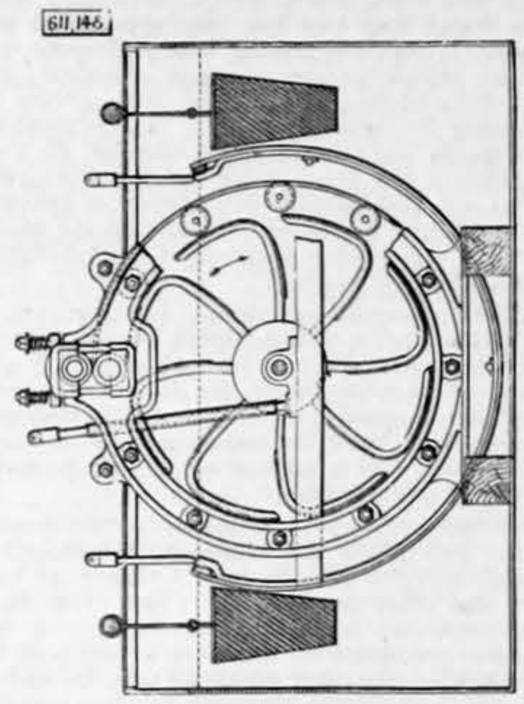
Claim.—The combination with a tool provided with an eye having one edge constructed with an inclined plane, of the handle B inserted through the eye of the tool and constructed at the edge facing the aforesaid inclined plane with a longitudinal concaved edge E,



and the locking piece C inserted through the eye of the tool and formed at its opposite edges respectively, with the convex face F and taper H, the convex face of the locking piece fitting the concaved edge of the handle, and the taper of said locking piece fitting the inclined plane of the eye in the tool, all substantially as described and shown.

611,148. Apparatus for Electrically Coating Wire, *W. S. Rawson, London, England.—Filed December 24th*, 1897.

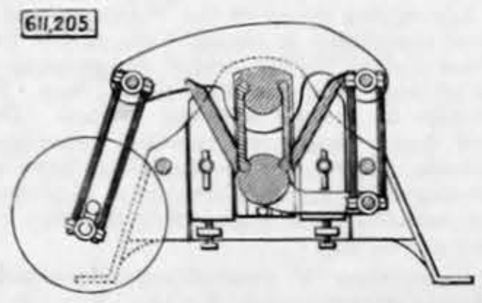
Claim.—An apparatus for electrolytically coating wire, consisting of a tank for containing the electrolyte liquid, an upright insulated frame arranged to be partly immersed in said liquid, a plurality of pulleys



circularly arranged on the insulated frame, an anode outside the circular pulleys, an anode located in the space within the circularly-arranged pulleys, and a cathode connection arranged to contact with the wire coiled about the pulleys, substantially as described.

611,205. Rock Breaker and Crusher, *J. R. Moffitt, Denver, Colo.—Filed June 22nd*, 1897.

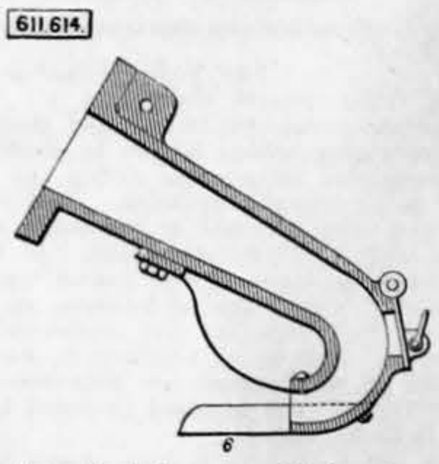
Claim.—In an ore pulveriser, the combination of two rock shafts, one located above the other, two pulverising plates or jaws having their extremities movably connected with said shafts on opposite sides, the ex-



tremities of the two jaws engaging the same shaft lying in a horizontal plane passed through the shaft to one side of its centre co-operating pulverising plates located in suitable proximity to said jaws, and suitable means for operating the rock shafts.

611,614. Dredging Drag, *J. Edwards, New York, N.Y.—Filed March 21st*, 1898.

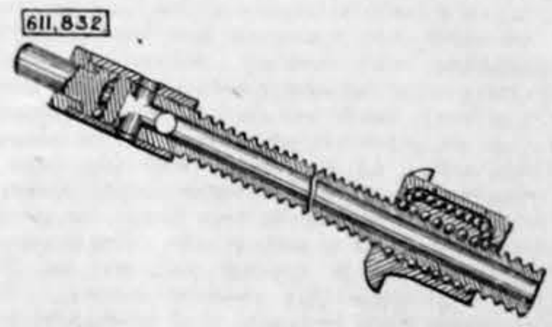
Claim.—On a suction dredging drag the elongated under-thrust shovel 6 having its rear end attached to the lower lip of the mouth of the drag, whereby the



materials to be elevated are secured before they come within range of the suction of the drag, as and for the purpose set forth.

611,832. Jack Screw, *T. Coughlan, Chicago, Ill.—Filed March 7th*, 1898.

Claim.—In a jack screw, the combination with a shank externally threaded and a sleeve to receive said shank and internally threaded, of balls adapted to project partially into said threads of said sleeve and shank to form a connecting thread between the same, and means for removing and re-entering said balls



between said threads during relative movement of said shank and sleeve, comprising a passage communicating with the central opening in said sleeve at the points of termination of the thread therein, flanges on each side of said passage, and a removable key adapted to be secured between said flanges to cover said passage, substantially as described.