THE JAPANESE BATTLESHIP "KATORI."

INTEREST in the official trials of the Japanese battleship Katori, which terminated on the 1st inst., centred largely in the tests of the guns and gun-mountings, as Messrs. Vickers Sons and Maxim, Limited, who designed and constructed the vessel from keel to truck, ready for war service, have embodied in the ordnance many improvements in detail, as a result of experience and experiment. Each gun is more powerful than those fitted in corresponding positions in previous ships built in this country, and collectively they give the vessel a greater power of attack than is possessed by any warship now in commission, while, moreover, the vessel attained the exceptionally high speed of the vessel, which has notably fine lines. The following are the principal dimensions :—

Length between perpendiculars ...	420 ft.
Length over all	455 ft. 9 in.
Breadth	78 ft.
Depth to upper deck	44 ,,
Draught	27 ,,
Displacement in tons	15,950
Speed in knots on trial	20.22
Normal coal supply in tons	750
Full coal supply in tons...	2100

THE ARRANGEMENT OF ARMOUR.

As shown in the elevation and plan on the opposite page, the main armour-belt has a depth of 7 ft. 9 in., of which 5 ft. 3 in. is below the water-line, and extends from end to end of the vessel, its thickness being 9 in. for a length of 240 ft. amidships, reduced gradually to 4 in. at the stem. The aftermost part of this belt consists of 2½-in. armour secured to 1-in. plating, making a total thickness of 3½ in. Armour bulkheads 9 in. thick are carried across the ship at the forward and after ends of the 9-in. belt, extending in depth from the lower to the middle armoured decks. From the main belt to the main deck a secondary armour-belt is built, extending from abreast the after 12-in. gun barbette to the stem, its thickness being 6 in. for about 185 ft. amidships, reduced to 4 in. at the stem; the main deck from the forward barbette to the stem above this belt is 1 in. thick. At the after end of this belt the protection is completed by an armoured bulkhead 6 in. thick, carried across the ship, the centre portion, 10 in. thick, forming part of the after barbette. Above the secondary belt, and extending from the forward to the after 12-in. gun barbette, there is 6-in. armour on the side up to the upper deck, carried obliquely across at each end to meet the barbettes, and forming a battery, in which are placed ten of the 6-in. guns, divided from each other by bulkheads of nickel-steel, and separated from the remainder of the deck space by longitudinal bulkheads of nickel-steel extending for the full length of the battery. The upper deck for the full extent of this battery is formed of steel plates 1 in thick. Amidships on the upper deck, extending for a length of 74 ft., is a battery 7 ft. 6 in. in height, of 4-in. armour, in the centre portion of which the remaining two 6 in guns are placed, the roof of this battery being formed of nickel-steel 1½ in. thick. The armour on the barbettes enclosing the 12 in. guns is 10 in. in thickness generally, but reduced to 5½ in. thick where protected by the belt and battery armour. The 10-in. guns are mounted in barbettes, the upper portion of the armour being 6 in. thick and the lower portion 2 in.; the tubes enclosing the ammunition hoists are also 2 in. in thickness. The armour of the conning-tower is 9 in. thick, and the observer tower 5 in. thick, the tubes for communication from these being 8 in. and 4 in. thick respectively. As in recent ships of the British Navy, entrance to the conning-tower is from the wheel-house through a hatchway in the armoured roof. The protective deck is of a minimum thickness of 2 in. on the flat, increased to 3 in. on the sloping sides, extending down to the bottom of the main belt It is of a uniform thickness of 2½ in. at the ends of the vessel.

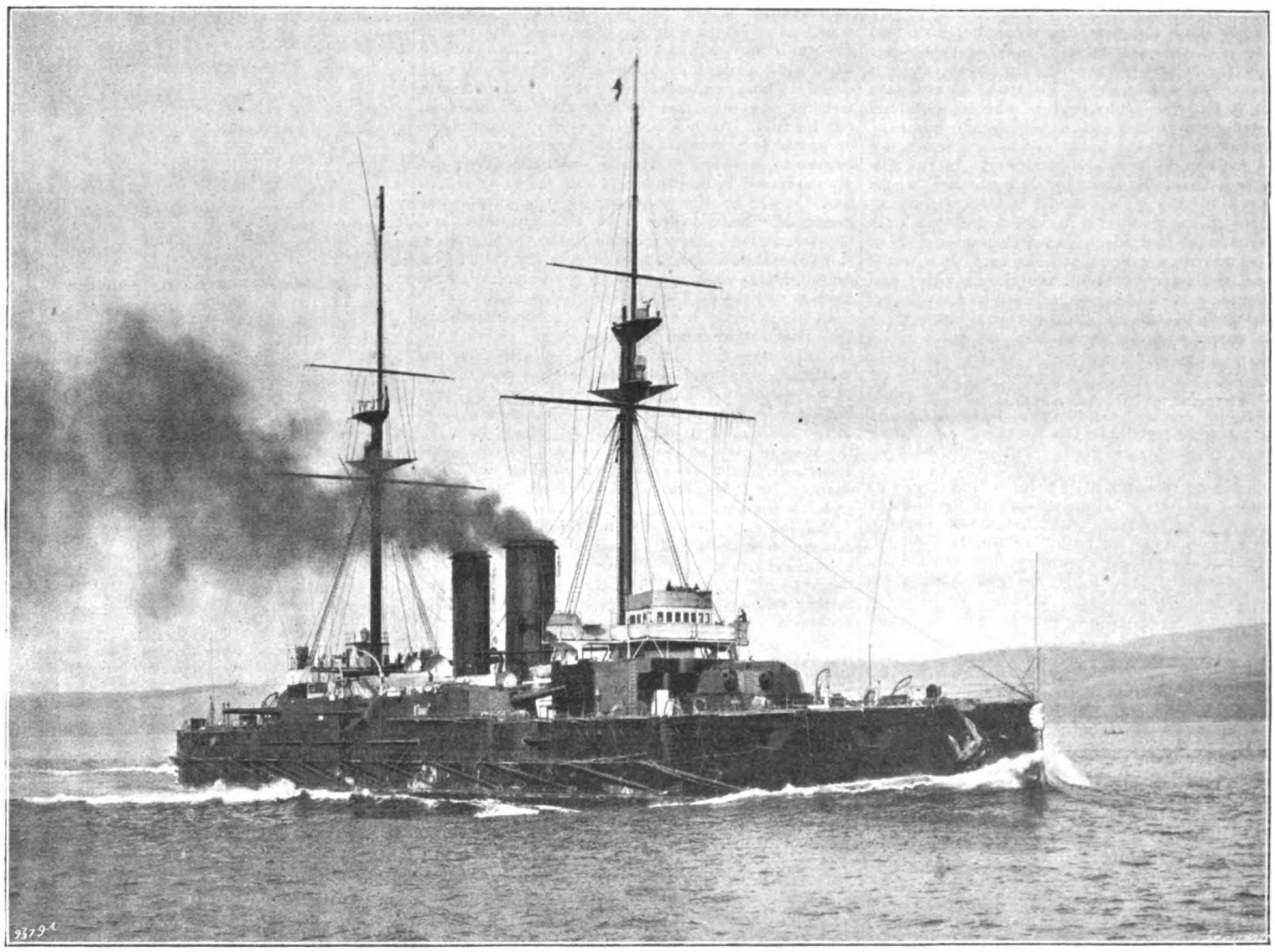


FIG. 1. THE JAPANESE BATTLESHIP "KATORI" STEAMING AT 20 KNOTS.

20.22 knots as a mean of several runs over a long course. For instance, the 9.2-in. guns in the barbettes at the four corners of the citadel in the ships of the King Edward class are displaced in the Katori by 10-in. guns, which develop 27,570 foot-tons, against 21,150 foot-tons by the smaller breech-loaders in the British vessels. The gun trials were directed first to determine the effect of the higher power of these heavier pieces on the structure of the ship, and although the guns were fired at high elevations and low depressions, and on various bearings throughout the large arc of training, no injury resulted. Another and even more important point was as to the influence on the rate of fire consequent upon the use of the larger projectiles, &c.; it was found that the 10-in. gun fired five rounds in 2 minutes 8⅘ seconds, and the 6-in. guns eight shots in 52⅘ seconds—both good performances.

THE DIMENSIONS OF THE SHIP.

The engraving Fig. 1, above, and the general drawings on the opposite page, give a good idea of

THE ARMAMENT AND ITS DISPOSITION.

The disposition of the armament is well illustrated on the plans reproduced on the opposite page. The guns fitted are :—

Four 12-in. 45-calibre breech-loading guns, mounted in pairs in barbettes, two forward and two aft, with 10-in. armour on the walls (Figs. 5 and 6 on Plate XXVII.).

Four 10-in. 45-calibre breech-loading guns, mounted

singly at each corner of the citadel in barbettes, with armour 6 in. thick (Figs. 5 and 6 on Plate XXVII., and Fig. 9 on Plate XXIX.).

Twelve 6-in. 45-calibre breech-loading guns on pedestal mountings—ten on the main deck and two on the upper deck (Fig. 10 on Plate XXIX.).

Twelve 12½-pounder quick-firing guns, for repelling torpedo attack.

Three 3-pounder quick-firing guns, with naval and boat mountings.

Six Maxim rifle-calibre guns with landing and boat mountings (Figs. 20 to 22 on page 622).

Five submerged 18-in. torpedo-tubes.

Fig. 2.

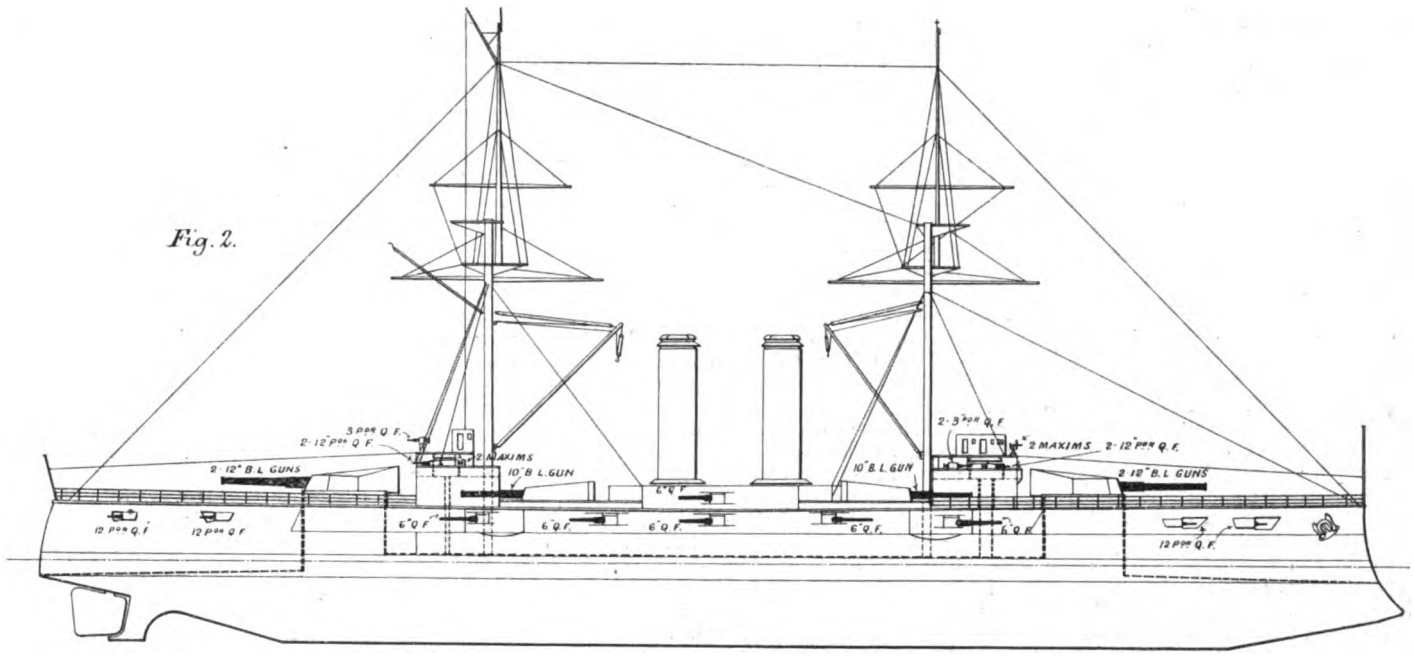


Fig. 3.
UPPER DECK.

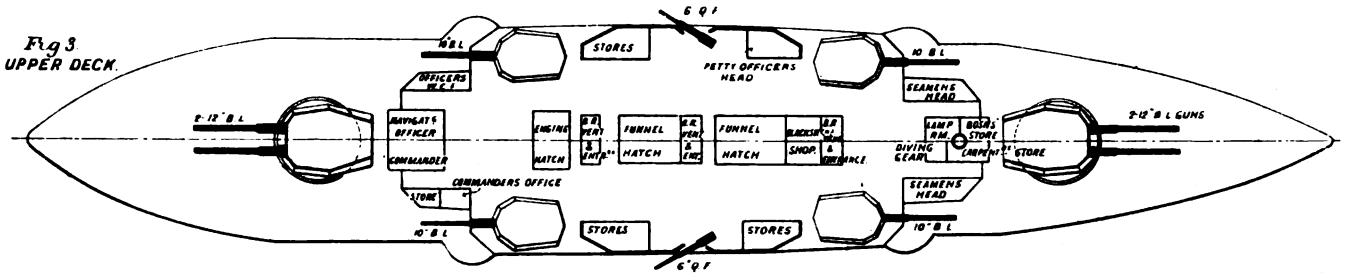
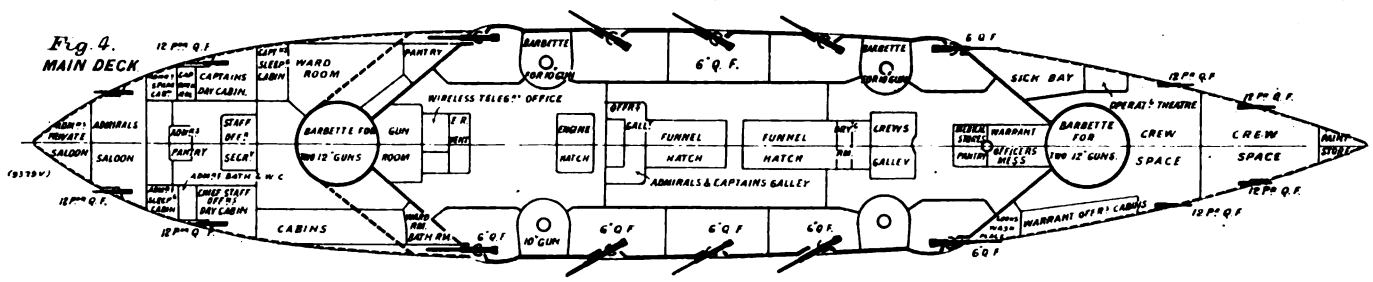


Fig. 4.
MAIN DECK



The following table gives the ballistics and principal particulars of the larger guns :—

	12-in.	10-in.	6-in.
Calibre	12	10	6
Diameter of bore in.	540	450	270
Length of bore ,,	556.5	464.6	280.07
Total length of gun ,,	17	17	17
Maximum pressure in chamber tons	850	500	100
Weight of projectile lb.	t. c. q.	t. c. q.	t. c. q.
Total weight of gun, including the breech mechanism	57 9 2	35 3 2	7 6 2
Muzzle velocity ft. per sec.	2,860	2,820	2,900
,, energy ft.-tons	48,210	27,570	5,830
Energy at 4 miles range ,,	18,950	9,190	857

THE 12-IN. GUNS AND THEIR BREECH MECHANISM.

The 12-in. guns and their position in the ship are well illustrated by Figs. 5 and 6 on Plate XXVII., while interesting views of the machinery by which they are supplied with ammunition, loaded, trained, &c., are given in Figs. 7 and 8, Plate XXVIII., and Figs. 11 and 12 on page 618. Fig. 13 illustrates one of the 12-in. guns, with others of 10-in. and 6-in. calibre, at the Vickers proving range at Eskmeals. The breech-block and mechanism is shown in Figs. 14 and 15 on page 619.

These 12-in. guns are of the wire-wound type, and the dimensions and ballistics are given in the table above. The breech mechanism is of a new and improved type, giving considerable increase of power when closing the breech, and is arranged to be operated either by hydraulic gear or by hand power. The hydraulic gear consists of an hydraulic ram mounted in suitable brackets on the end frame, above the breech mechanism, as seen in the view of the gun in Fig. 12 on page 616. The ram gears, by means of a rack, with pinion and clutch gear on the top of the hinge-bolt. This clutch is thrown out of action at any time by a hand-wheel mounted at the bottom end of the carrier hinge-bolt, and is so arranged that it is impossible to have both gears in operation at the same time. The hand-gear for operating the mechanism consists of a hand-wheel, with worm and worm-wheel gear, mounted in a bracket at the lower end of the hinge-bolt, and secured to the end-frame of the gun. The worm and wheel gear are arranged so that seventeen turns are required to completely operate the breech mechanism; 12.2 turns to unlock the breech; and 4.8 turns to swing the mechanism out to the "fully open" position.

The breech screw (Fig. 14) is of the Vickers type, described in connection with previous ships built by the firm. It is mounted and retained on the stem of a carrier by interrupted screw-threads. One of the chief features of the new mechanism consists in the application of a "couple" for rotating the breech-screw. In breech mechanisms, as at present generally constructed, the breech-screw is rotated by a turning moment which has been found to set up considerable friction, owing to the tendency of such moment to occasion axial displacement of the breech-screw. By applying a "couple" for this purpose this difficulty is obviated, so that the whole of the available turning force applied to the breech-screw is utilised in seating the obturator.

The rear face of the breech-screw is provided with two studs diametrically opposite to each other. Around these studs are fitted two sliding-blocks which engage with corresponding holes in a lever-plate having a long grooved arm. The lever-plate is pivotally mounted on the same axis as the breech-screw. It is not, however, directly pivoted on to the stem of the carrier on which the breech-screw rotates, but is fitted around a sleeve, which sleeve surrounds part of the stem of the carrier to the rear of the breech-screw. The hole in the lever-plate is slightly elongated with respect to the outside diameter of the sleeve, and the holes in the lever-plate, into which are fitted the sliding-blocks on the studs of the breech-screw, are made slightly longer than the blocks themselves; and, furthermore, a greater clearance than is usually allowed is made between the breech-screw and the stem of the carrier on which it turns. This arrangement, together with the clearances just enumerated, absolutely ensures that any small inaccuracies in the manufacture of these parts of the mechanism are automatically adjusted, and also that the breech-screw is mechanically quite independent of the lever itself, except by its engagement through the studs with their sliding-blocks. As a result, when a turning moment is given to the lever, this in turn operates on the breech-screw as a "couple." Engaging with the groove of the long arm of the lever-plate is a roller-pin projecting forward from a short crank mounted on the carrier. The form of the groove in this arm is such that the maximum possible power is exerted when seating the obturator. The pivot of the short crank is provided with a roller-bearing to eliminate as far as possible the friction of the toggle-joint action of the crank before the final operation of seating the obturator. The arrangement of the crank with respect to the groove in the long arm is such that a locking point is formed when the breech is closed. The crank has spur teeth, which gear with a pinion formed on a short horizontal shaft, having at its other end a bevel wheel which gears

with a second bevel wheel fixed on the hinge-bolt of the carrier. The hinge-bolt of the carrier is operated by the worm and worm-wheel gear at its lower end, or by the hydraulic gear. A cam-plate, with a specially-formed groove, is fitted to the crank for operating the firing gear, which latter is connected to it by means of a sliding link which directly engages with the cam groove. When the crank revolves, the firing gear is moved horizontally across the face of the carrier.

The mechanism is provided with separate electric and percussion locks. The special features of separate electric and percussion firing gear may be briefly enumerated as follows :—The same box-slide is used for either electric or percussion lock. Fitted in the box-slide is a spring-catch for the primer, so that it cannot be jerked out when slamming the breech. The extractor, which is in two parts, is specially strong, and is of a new form, whereby the operation of the lock-frame acting by means of a fine incline on a prolonged toe of extractor part I., powerfully wedges out the primer previous to its rapid ejection by the engagement of the lock with extractor part II. The box-slide has two sets of safety-slides—one for the percussion lock and one for the electric lock. The percussion striker is fully cocked automatically on opening the breech, and has a "floating" needle arranged so that in its normal position the point of the needle is always within the face of the lock-frame. The electric lock has a special arrangement, consisting of two levers, one on each side of the lock-frame, which are simultaneously operated on the first movement of the lock-frame on opening the breech. These levers are arranged so that a small projection round their boss trips against the safety slides on the box slide, and as the outer ends of these levers act directly on the electric needle, it is almost instantaneously drawn away from the primer on the first movement of unlocking the breech. The spring bolts which couple the lock-frame with the sliding-link in the carrier, and likewise the sliding-link with the operating cam on the crank, are arranged so that, should it become necessary, owing to misfire or any other cause, the lock-frame may be drawn sufficiently far away to eject the primer without its being necessary to open the breech. The breech mechanism worked admirably during the trials.

THE BARBETTE MOUNTINGS.

The mountings for the 12-in. guns are operated hydraulically, but most of the operations can also be performed electrically. Protection is afforded to the gun crew, and to the upper parts of the mounting, by a heavily armoured shield, securely attached to the upper surface of the turntable, and well shown in Figs. 5 and 6 on Plate XXVII. The turntable is of the usual built-up type used for heavy ordnance, consisting of steel plates and angles and heavy longitudinal girders, all riveted together, and carried, with all its attached fittings, on a live roller-ring. The roller-path is secured to a circular supporting structure built inside, but separate from, the barbette, and cannot be affected by any distortion of the latter when struck by projectiles.

The guns and all the machinery, including the mounting, as well as the shield, revolves with the two guns; and in referring to the interesting features of this mechanism, as illustrated on Plate XXVIII. and page 618, it may be appropriate to begin with the magazines and shell-room. Fig. 8, on Plate XXVIII., is a view taken in the shell-room at the bottom of the cylindrical ammunition trunk, which extends up to the working chamber of the barbette and revolves with the guns when being trained. In this trunk there are the hoists and passage-ways for the conveyance of the gun charge, and the ladder for access to and from the shell-room, &c. The projectile is lifted from the bins by the overhead carrier shown to the left of the two men at the base of the trunk. The two jaws on the carrier drop on each side of the projectile, and the pulling forward of the handle shown operates toggle levers which close the jaws around the shot. The carrier is then raised by its hydraulic press, and is traversed to the base of the trunk on joist rails by means of an hydraulic ram working through cables and pulleys. The shot is deposited on a receiver, and is there held in position by stops on the top, which is inclined so that when the stops are lowered—this is done by a lever—the projectile rolls on to a corresponding receiver or bogie, which can follow the rotation of the ammunition trunk by the turning of pinions engaging in the toothed rack round the base of the trunk. The traversing pinion within this bogie is operated at considerable speed by a hand-wheel and worm-gear. The pinions of this bogie may be locked in gear with the circular rack on the trunk, and thus rotate with it.

The introduction of this intermediate bogie is to bring the shot to the base of the hoist, when the latter is revolving with the guns; the fixed receiver at the same time onables additional projectiles to be on their way to the gun. Thus there may be one shot on the carrier, another on the fixed receiver, a third in the bogie, a fourth in the hoist to the shell-chamber, where the ammunition is transferred to another hoist communicating with the charging-platform, so that there may be a fifth in the upper hoist, and a sixth in the gun. The trials included the firing of the gun with the projectiles in such sequence to prove that each item in the shot-supply mechanism, even with moving loads, resisted the stress of recoil. The increase in the number of shots between the shot-bins and the gun-chamber enables a greater rapidity of fire to be maintained for a short period, notwithstanding the great weight of projectile and powder charge. Such rapidity of fire even for a short period is often an important element in demoralising an enemy's crew.

The loading of the charges of explosive compound into the hoist from the magazines for the 12-in. guns is illustrated in Fig. 11 on page 618. This is on a level above the shell-chamber, and the hoist for the charge, while within the same trunk, is independent of that for the projectiles. It will be noted that the charge is made up in quarters, within silk bags, and to the left there will be seen the large cases for storage. These have covers with screwed fixings. There are four shoots corresponding with four compartments in the hoist-cage. The sliding doors in the trunk have a self-locking gear, and before the cage can move the doors must be secured. Nor can they be opened until the cage is in position to receive the charge. A similar arrangement applies to the projectile-cage. The controlling-levers for the hoists are in the working-chamber above; and the electric communication is such that until the "all clear" signal is given the levers cannot be moved. Above the magazine is the compartment with the walking-pipes for the hydraulic gear.

Fig. 7 on Plate XXVIII. illustrates the working chamber in the 12-in. gun barbette. Here is located the machinery for all purposes, but practically every movement, except the hoisting of the projectile and charge, may be controlled from the gun position, including the rotating of the mounting for the training of the gun. Both projectiles and powder charges are arranged to come into position at the top of their respective hoists in this working chamber for direct transference to the gun-loading cages, which rise from this level to the loading-trays behind each gun. This transference is performed by hydraulic means, controlled by the levers shown. The two gun-loading hoist-cages which serve the guns are arranged to work on curved rails passing from the shell-room up into the turntable at the rear of the guns, the arrangements being such that the guns can be loaded at any angle of elevation or depression and even with the guns moving during training operations.

Fig. 12 on page 618 shows the loading position with the 12-in. gun ready for firing. The rammers, by means of which the loading of the guns is effected, are shown in the foreground. These rammers, which are carried on the rear extensions of the gun-mountings, are of the flexible chain type, and each is always in line with the bore of its gun, irrespective of elevation or training. After the projectile has been rammed into the gun and the rammer-head withdrawn, the charges, which have been carried up in a compartment at the side of the cage, are allowed to descend to the loading-tray in half charges by the manipulation of a lever, and are in turn pushed into the chamber of the gun. For opening and closing the breech-block, hydraulic power is provided, with the alternative of hand-gear; and the ram, operating through rack and worm, performs all operations, as already described.

In order to avoid errors in the working of the various hoisting and loading devices, suitable interlocking actions are provided throughout the gears and the controlling mechanisms. In the event of failure of the power-loading gears, the guns can be loaded by hand from suitable trays, having telescopic action, arranged in the rear of the armoured shield. The loading in this case is performed with the guns in a fixed position.

The guns are carried on suitable steel cradles, supported on frames, upon which they slide during recoil. Brake-cylinders are fitted for absorbing the energy of recoil, the absorption of this energy being provided for by means of a variable orifice in the brake-cylinders. Hydraulic rams are also provided in the slide-frames for returning the guns into the firing position, and the same rams can also be used for running the guns in when required. The guns are moved in elevation or depression by means of hydraulic rams, which are secured inside the turntable. These are arranged to traverse crossheads connected by means of links to suitable brackets on the underside of the slide-frames.

The complete turret, together with its guns, is arranged to be rotated by means of hydraulic engines, with the alternatives of electric power or hand-working. All the engines and gear for rotating the turret are located in a compartment of the ship below the working chamber. Two sets of hydraulic training-engines are provided for each turret, but one set has sufficient power to secure the maximum speed required for training. The hydraulic pressure for working the turrets is supplied from two sets of compound steam pumping-engines arranged at convenient stations in the ship. These pumps also supply the pressure water for the 10-in. mountings, as well as for the boat-hoists, and other hydraulic gears in the ship. The pumps are of ample capacity to supply all the requirements in action. They are interconnected by a system of pipes, so that either pump will be able to supply all the turrets in the ship. They are also fitted with automatic control gear, so that their speed will be correctly regulated for the supply of pressure water required.

In the 12-in. turret three sighting positions are provided, one centre position between the guns being fitted with two sights, with a single sight at each side position. These sights are protected by suitable armoured hoods secured to the roof of the shield. These hoods are clearly shown in the views of the guns taken from the bow and stern of the the ship (Figs. 5 and 6 on Plate XXVII.).

THE 10-IN. GUNS AND THEIR MOUNTINGS.

Much that we have written regarding the 12-in. guns applies to the 10-in. weapons, mounted singly in barbettes at the corners of the citadel.

The breech mechanism for this gun is illustrated by Figs. 16 and 17 on page 619. It is very similar in principle to that of the 12-in. gun, except that the mechanism is operated by a hand-lever, pivoted so as to swing in a horizontal plane, as shown in Fig. 17.

Fig. 9 on Plate XXIX. is a view within the barbette, from a photograph taken when the gun was being loaded. There is seen the loading-tray, on to which the projectiles are deposited for ramming into the gun. This tray is carried on an arm fixed to the gun-slide, and can be swung round from its stowed position at the side of the gun by means of a hand-wheel and gearing, bringing with it the projectile into the breech, in a position ready for ramming. In the view the hydraulic chain-rammer is shown driving the projectile home in the chamber. The man in the rear on the left side is operating the overhead traveller for conveying the projectile from racks provided at the rear of the gun-shield, where some are kept as a ready supply in case of failure of the hoisting gear. The hoist-trunk and the arrangement for bringing the ammunition from the magazine and shell-chamber embody improvements for increasing the rapidity of fire and for reducing the gun crew—an important matter in view of the dangers involved in warfare. Whereas the 12-in. guns are run out by hydraulic means to the firing position, the mounting of the 10-in. weapon includes recuperative springs which effect the return to that position. The absorption of the energy of recoil is, in this instance also, provided for by means of a variable orifice in the recoil-brake cylinders.

THE 6-IN. QUICK-FIRING GUNS.

Three of the 6-in. quick-firing guns are shown in the view of the proving-ground at Eskmeals on page 618. Fig. 10 on Plate XXIX. illustrates the loading of the gun within the concentrated casemate adopted here again, because of its proved suitability in the Mikasa—Admiral Togo's flagship, which was designed and built by Messrs. Vickers Sons and Maxim, Limited—and Figs. 18 and 19, on page

619, show the breech mechanism of the gun. This mechanism is similar to, but much smaller than, that for the 10-in. breech-loaders; but there is in this case incorporated in the breech mechanism a loading tray, which, as shown in the details, slides across the breech-face, and is brought automatically into position as the breech is swung open.

The mounting of one of the 6-in. quick-firing guns is illustrated in Fig. 10 on Plate XXIX. In this view the operator to the left is training the weapon from the gun-laying position, the next man is inserting part of the charge, a third holds another part in its silk bag, a fourth holds the hand-rammer ready to push the charge home, while in the rear is a member of the gun crew holding the lever, the movement of which closes and locks the breech ready for firing. The mounting for the 6-in. guns are of the Vickers pedestal type, especially adapted to meet the requirements of the Japanese Navy, in which the mountings may be either trained by hand or foot gear. In the latter case, an arrangement of saddle and pedals like as on a bicycle is fitted on the left-hand side of the mounting, so that the gunner, whilst sighting and laying the gun for elevation, may effect the training operation by foot-pedal. A special feature of the mountings is the sighting gear, which is telescopic and arranged for use with a separate sight-setter, so that the gun-layer is enabled to concentrate his attention on the object.

The Machine-Guns.

Fig. 13 on page 618 illustrates one of the 12-in., one of the 10-in., and three of the 6-in. guns, from the front position, at the proving-ground of the company, at Eskmeals, in Cumberland. Fig. 20, on page 622, illustrates the Maxim gun on naval pedestal mounting, and Fig. 21 the landing-carriage for the Maxim gun limbered up, while Fig. 22 illustrates the limber by itself.

The Propelling Machinery.

The propelling machinery of the Katori, Fig. 23, Plate XXX, consists of two sets of four-cylinder triple-expansion engines balanced on the Yarrow-Schlick-Tweedy system, each set having one high, one intermediate, and two low-pressure cylinders. The diameters of the cylinders are respectively 35½ in., 56 in., and 63 in., for each of the low-pressure cylinders, with a stroke of 48 in. The steam pressure at the boilers is 230 lb. per square inch, and at the engines 200 lb. per square inch. Stephenson link motion is adopted for working the valves, which are of the piston type on the high-pressure and intermediate cylinders, and of the double-ported flat design on the low-pressure cylinders. The engines are designed to turn the propellers inwards when going ahead, so that the starting-platform is in the centre of the ship; wrought steel columns form the supports of the cylinders, which are independent castings, and the back supports are of the ordinary cast-iron A framing, with ample slipper-guide surface. The condensers, which are four in number, are placed in the wings of the ship. The total cooling surface is 17,000 square feet. Each crank-shaft is in two interchangeable pieces, and the propeller shaft is 18 in. in diameter, with a 10-in. hole, while the propellers have four blades, the diameter being 17 ft. 3 in. The blades and the boss are of Stone's bronze.

The boilers are of the latest Niclausse type, 20 in number, disposed in three separate boiler-rooms, five with 16 sections, and fifteen with 15 sections, each section consisting of 24 tubes. The total heating surface is 44,000 square feet, and the total grate area 1334 square feet. There are two funnels, the forward one being 12 ft. 9 in. in diameter over the casings, and the after one 12 ft. 9 in. by 8 ft. 1 in. over the casings, the height from the fire-grate being 90 ft.

There is the usual complete system of pumps, with the addition of the independent air-pumps, which are now a recognised improvement over pumps driven from the main engines.

Lighting, Heating, and Ventilation.

The vessel (which will have a total complement of 980 officers and men) is lighted throughout by electricity, and ventilated by electrically-driven fans. The thermo-tank system of ventilation has been adopted for the cabins and crew-spaces, and for ventilating, and also for cooling the magazines and shell-rooms. A complete system of steam-heating is fitted for the officers' quarters and the crew-spaces. The steering-engines and gear, electric generating plant, refrigerating, air-compressing and other auxiliary machinery, are all of the most improved types, and the vessel generally is fitted up in accordance with the most modern practice for ships of this class.

The Steam Trials.

The specification provided that the vessel should run at her fully-loaded draught for 24 hours at four-fifths of the designed power, in order to determine the coal consumption when steaming at what is regarded as the continuous speed in action. This trial took place on Wednesday and Thursday, April 25 and 26. The vessel, steaming right down the Irish Sea, experienced very rough weather; but proved very steady in a sea-way. On this trial, when the speed was 17.8 knots, the coal consumption worked out at 1.6 lb. per indicated horse-power per hour, which is proof alike of the ability of the Japanese stokers after their long war experience, and of the general economy of the machinery. On Saturday, April 28, the vessel proceeded on her second trial, which, as prescribed, was to include four runs over a deep-sea course not less than 10 nautical miles long. The estuary of the Clyde offers splendid opportunities for such tests, and two points were decided upon by the Japanese staff on board. Four runs between these points gave a mean of means speed of 20.22 knots, with the engines developing their full power, and making about 130 revolutions per minute. They continued at this rate of revolution in order to make a complete eight-hours' run. The trials were carried out, and all the data taken, by a Japanese staff, under the direction of the Special Commission in this country, which includes Captain Tanaka and Captain Fujii. The Katori was in command of Captain Sakamoto, who will take over the ship on behalf of his Government, and hoist his pennant probably on the 20th of this month. The short period elapsing between the trials and the formal commissioning of the vessel, as well as the fact that she remains at her anchorage in the Firth of Clyde off Greenock during the process of completion, is evidence of the small amount of work remaining to be done, as a consequence of the inspection of the ship after the severe tests through which she has passed.

ELECTRICALLY-DRIVEN "ALL-GEAR" LATHE.

The lathe illustrated on page 607 has been designed so as to do away entirely with the necessity for countershafting, the operator having perfect speed control, and the workshop being unencumbered with shafting, which obstructs light and requires attention. There are sixteen direct spindle speeds, or double the number obtainable with the usual four-step cone pulley and back gear, and any of the speeds may be obtained by moving one of the three levers in front of the head-stock.

In an ordinary lathe, where change of speed is obtained by cone pulleys, on the slow speeds the velocity of the belt is proportionally low, and hence the power which can be transmitted is also low. In the present case, however, at whatever speed the lathe is running, the full power is available at the cutting surface. This naturally much increases the average output of the lathe. It is quite possible for a well-designed lathe, in which the speed variation is effected by cone pulleys, to be only able to transmit half its full power when the belt is on the large cone of the head-stock, whereas with an "All-gear" lathe the power, and consequently the output, may always be kept at its maximum.

With a test cut, recently taken on an 8½-in. "all-gear" lathe, the weight of the metal removed, turning on all diameters, was at the rate of 283 lb. per hour, the area of cut being ⅜ in. by $\frac{1}{10}$ in., and the cutting speed 60 ft. per minute. The whole of the "All-gear" head is enclosed in a box. The gears are of steel, and run in an oil bath, and the sixteen variations of speed are obtainable in approximate geometrical progression, and are varied by moving levers from right to left. The motor is fixed above the gear-box and drives by a silent chain. The bed is of the box type with square lips, and has cotter adjustment for the carriage, so that any adjustment of the carriage on the bed is always equal, and the carriage is pulled up lineable with the heads. The whole of the twist of the carriage is taken on the front shear, so that the thrust of the pinion on the rack exercises a straight pull with absolute minimum of twist and a consequent steadier feed. This applies whether the carriage is feeding by screw or by rack.

The loose headstock is so designed that it is always pulled up lineable with the fast head before it is clamped with the keep-plate. The cross-traverse is engaged by a friction cone.

There is a handle at the front of the carriage which engages or disengages the longitudinal traverse, so that the operator can either use this motion or the reversing motion on the carriage, as suits his convenience.

There is an index for screw-cutting. This device has a revolving dial at the top, with numbers thereon, and in cutting odd threads note is simply taken of the number on the dial when it is opposite a pointer, and by dropping the nut-box when the same number on the dial is opposite to this pointer it will go right in, and no mistakes can occur when cutting odd threads, and no marking of wheels or screw with chalk is necessary, and neither longitudinal or cross-traverse can be engaged simultaneously with the screw.

The reversing motion for sliding carriage in either direction is placed on the apron, to save the operator's time in going to the end of the lathe to reverse the direction of the carriage. The whole of the wheels are carried in a double apron, so that the feed-shaft and wheels are supported in two bearings, and not overhung. This gives increased strength and coarser feeds, and diminished liability to breakage. An automatic knock-off for longitudinal traverse, and also for cross-traverse, can be fitted to these lathes if required.

The feed-box is fitted on the front of the lathe bed, and by turning the index-wheel any of the four speeds on the sliding shaft can instantly be obtained whilst the lathe is in motion. The total range of cutting speed is from 60 ft. to 260 ft. per minute.

These lathes are made in various sizes and designs for repetition work, with holes through the spindle, and a variety of turrets; also with or without motor drive. "All-gear" heads of the above type are also supplied for fitting on existing lathe-beds, drilling, and other machines.

The makers are Messrs. Pollock and Macnab, Limited, of the Britannia Machine-Tool Works, Bredbury, near Manchester.

Personal.—Messrs. Goodwin and Co. inform us that their Australian representative, Mr. C. O. White, is now on a visit to Birmingham, and is interesting himself in any new lines of machinery which he thinks would be likely to suit their friends abroad. Mr. White's address is Messrs. Goodwin and Co's offices, Fleet-street, Birmingham.

The Humber.—Several changes have taken place recently in the upper reaches of the Humber, and are causing some inconvenience, if not danger, to navigation. About eight miles above Hull there is an island, and sometimes the channel is on the north, and sometimes on the south. Up to July of last year the channel had been for several years on the south; then it changed to the north in the course of a day or two. It continued in that position until the beginning of the present month, when it suddenly went back to the south. Now the south channel is blocked, and the north is opening out.

Fourteen Streams Railway.—The Klerksdorp and Fourteen Streams Railway has just been inaugurated. The line, 144 miles in length, has been built under an agreement entered into between the De Beers Company and the Inter-Colonial Council, and, besides bringing the diamond fields into closer touch with the Rand, it connects the Cape and Bulawayo line and the Kimberley mines with the coal-fields of Natal and the Transvaal. The undertaking was financed by the De Beers Company. Construction was commenced from both ends simultaneously in March, 1905, and was practically completed a month since. The opening of the line provides a route from Cape Town to Johannesburg 60 miles shorter than that through the Orange River Colony, and it very considerably reduces the railway distance between the Transvaal and Rhodesia, besides opening up the Western Transvaal.

Contracts.—The Natal Government Railways have decided to put down a modern electrical generating station at their Durban works, and the complete contract for the turbo-alternators and surface-condensing plant has been given to Messrs. Willans and Robinson, Limited, of Rugby, by Messrs. Hubert Davies and Spain, the main contractors to the Natal Government Railways.—The Mirrlees Watson Company, Limited, have a long list of orders in hand for condensing plants, among which are a number of surface-condensing sets, the total duty of which is 271,900 lb., besides several jet-condensing sets.—Messrs. Edgar Allen and Co., Limited, Sheffield, have received instructions from the Belfast Corporation for the supply, delivery, and erection of complete coal-handling plant for their electricity works. This contract includes twelve of Messrs. Allen's patent dust-proof measurers.—The Power-Gas Corporation, Limited, London, have secured the contract for one of their special power-gas installations of 1000 brake horse-power capacity, from the Arizona Copper Company, Limited, and a plant of 750 indicated horse-power capacity for the Nostell Colliery, Wakefield. In each case the plant is being installed for supplying gas to gas engines.

THE JAPANESE BATTLESHIP "KATORI."

CONSTRUCTED BY MESSRS. VICKERS SONS AND MAXIM, LTD., AT THEIR NAVAL CONSTRUCTION WORKS, BARROW-IN-FURNESS.

(*For Description, see Page* 614.)

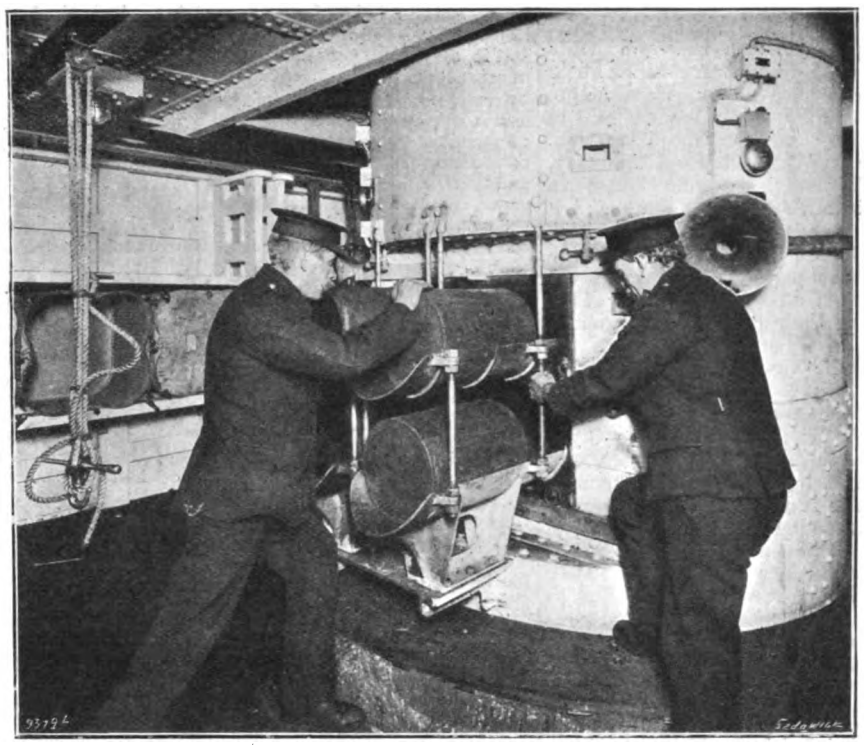


FIG. 11. LOADING CHARGES FOR 12-IN. GUNS INTO HOIST-TRUNK.

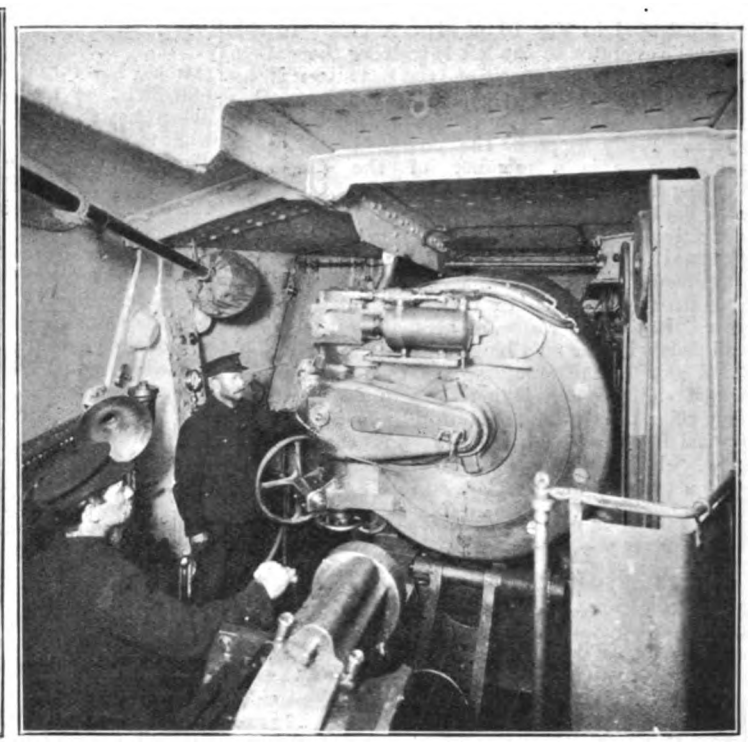


FIG. 12. VIEW INSIDE 12 IN. GUN BARBETTE.

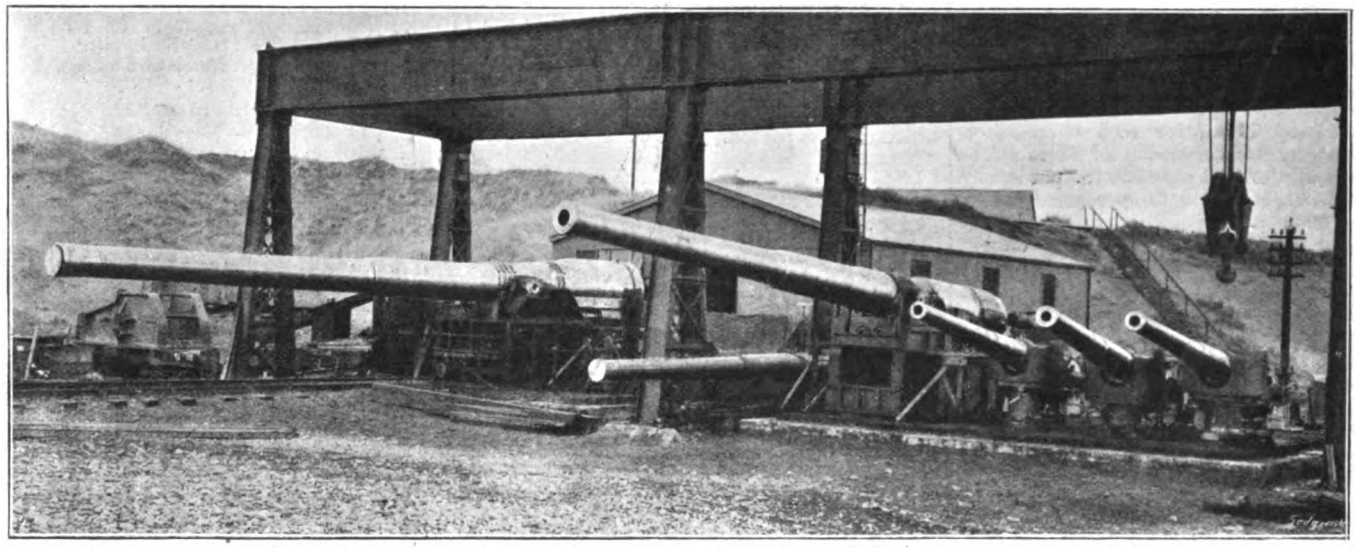


FIG. 13. VIEW OF ONE 12-IN., ONE 10-IN., AND THREE 6-IN. GUNS AT ESKMEALS GUN-RANGE.

NORTHERN OF FRANCE RAILWAY.—The revenue of this company's French lines last year amounted to 10,191,384*l.*, as compared with 9,592,661*l.* in 1904. The working expenses last year were 5,406,704*l.*, as compared with 5,118,430*l.* in 1904. The ratio of the working expenses to the traffic receipts stood last year at 53.06 per cent., as compared with 53.36 per cent. The dividend for 1905 is at the rate of 17 per cent. per annum.

MESSRS. HEMINGWAYS, LIMITED (IN LIQUIDATION).—The freehold works of this company, at Haverton Hill, near Stockton-on-Tees, are to be sold by auction upon the premises, at 10.30 a.m., on the 15th inst., by Messrs. Wheatley, Kirk, Price, and Co. In the event of no sale in one lot, several of the machinery and other items are to be sold separately. The land contains an area of nearly six acres. The main shop is in three spans, 380 ft. in length and 155 ft. in width. Other shops and offices are distributed over the ground. There are also about 2000 yards of 4-ft. 8½-in. gauge lines which establish communication between the different shops and the North-Eastern Railway Company's system.

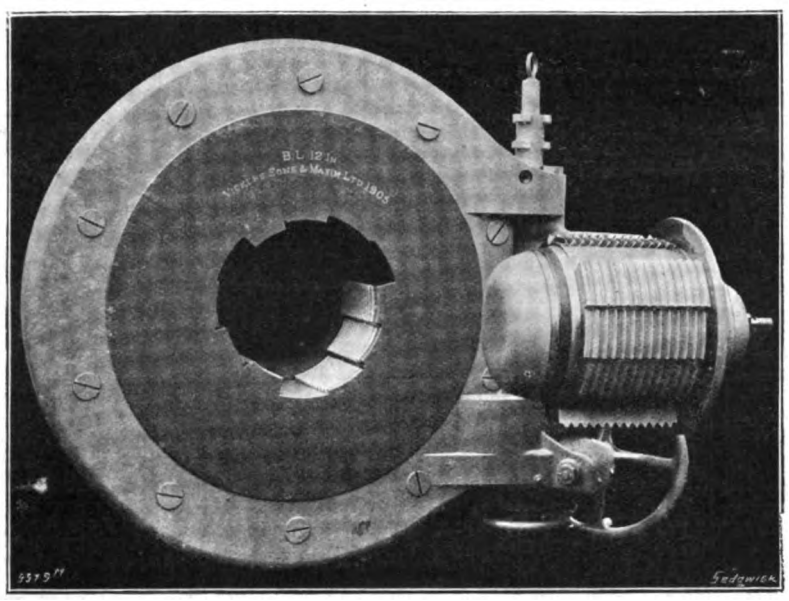
NEW ZEALAND TRUNK RAILWAY.—Great activity is observable in the construction of the New Zealand Main Trunk Railway; and notwithstanding the Makatote viaduct and an ascending spiral, involving two tunnels, near Raurimu, which are both heavy works, the line can be completed within three years. From Taumarunui on to Oio, about 18 miles, the line is formed and the rails are laid. An engine is running through to that point. At the southern end a section from Taihape to Turangarere, about 16 miles, is expected to be completed before the winter sets in. This will leave some 45 miles between the north and south ends to connect through.

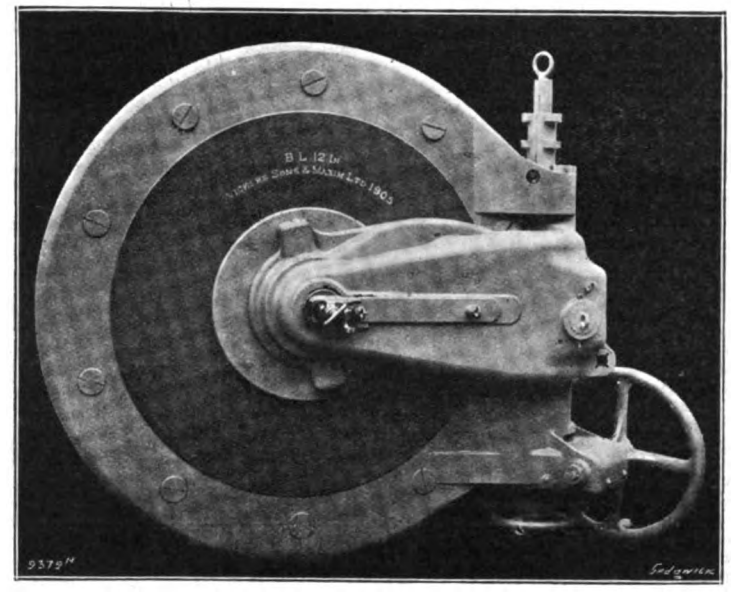
RE-ROLLING OLD STEEL RAILS AND SCRAP.—Old steel rails that have been removed from tracks consequent on renewals, form, as is well known, a vast accumulation of material, which is not always easy to dispose of, and the re-melting and re-rolling of which has been an expensive operation. Many attempts have been made to utilise this material and by some process of re-rolling to render it again serviceable, at a cost that would repay the operation. With the exception, however, of the McKenna process of re-rolling rails (described by us on pages 262, 296, 375, and 439 *ante*), there does not appear to have been any method by which the value of old steel rails could be raised above that of scrap. Vast stocks of these old rails have, therefore, grown, until now it is estimated that in the United States alone the amount reaches 40,000,000 tons. In addition to the process to which we have already alluded, there seems to be a prospect that the problem may be solved by a process invented by Mr. James E. York, of New York, which process is a radical departure from all previous methods of rolling rails. The machinery by which Mr. York effects his purpose consists of two rolling-mills, one of which he calls a "Universal" mill, and the other a "Transverse" mill. By means of the former the head of a worn rail can be re-rolled to any desired shape, and a rail somewhat lighter in section than the original be formed, which can be used on parts of the railway not requiring the heaviest sections; while with the "Transverse" mill old steel rails and scrap can be re-rolled to almost any section, in lengths up to 9 ft. or 10 ft. It is from this Transverse mill that the inventor expects the greatest results, for by it steel sleepers of almost any shape can be rolled from old rails at a very low cost; and, in view of the fact that the available supply of timber for sleepers is decreasing so rapidly that it cannot be very long before the price of such sleepers is prohibitive, it will be absolutely necessary to use some other material. We will not now enter into a full description of the new process, as we hope at a future date to place before our readers a detailed account of the method of rolling to which we have alluded, together with complete drawings of the machinery employed. We understand from the inventor that, during the coming summer, he will have a small mill at work in London, when he will be able actually to demonstrate his various methods of re-rolling steel. He will also read a paper on the subject at the coming meeting of the American Institute of Mining Engineers, to be held in London in July. The firm who have taken up the process in this country, and who are working with Mr. York, are Messrs. Edward Le Bas and Co., Dock House, Billiter-street, London, E.C

GUNS OF THE JAPANESE BATTLESHIP "KATORI."

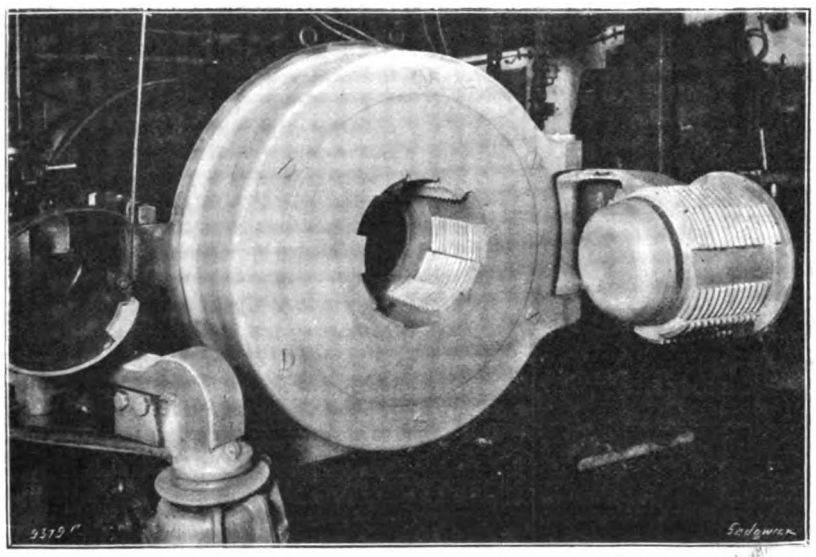
CONSTRUCTED BY MESSRS. VICKERS SONS AND MAXIM, LTD., AT THEIR RIVER DON WORKS, SHEFFIELD.

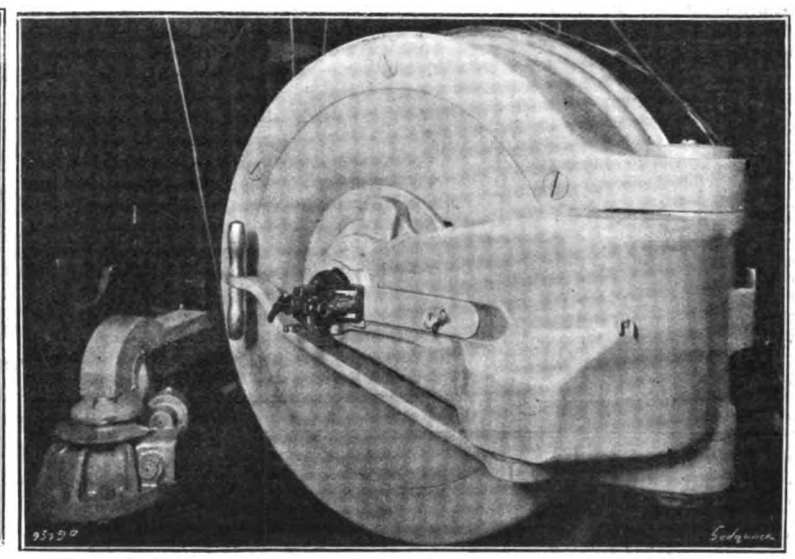
(*For Description, see Page* 614.)



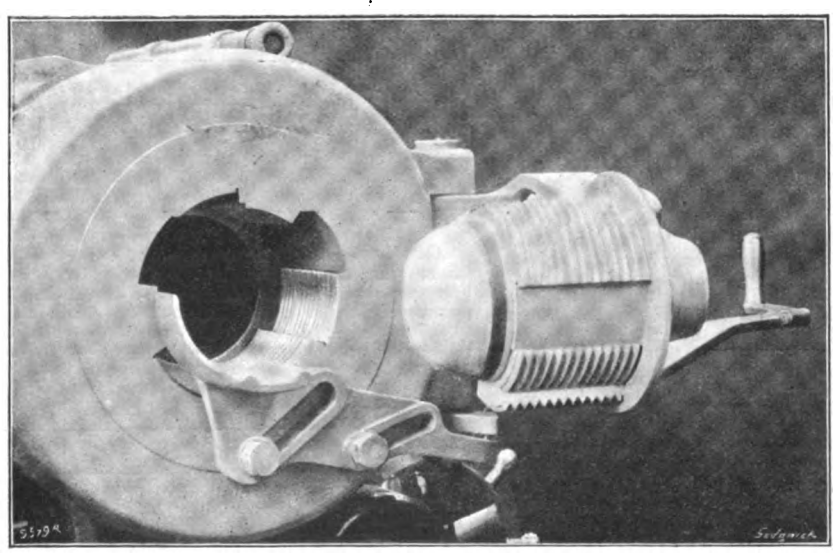


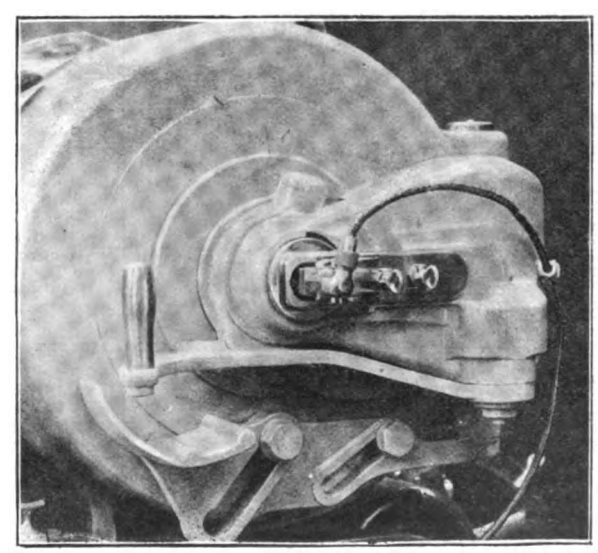
FIGS. 14 AND 15. BREECH MECHANISM OF 12-IN. GUN.





FIGS. 16 AND 17. BREECH MECHANISM OF 10 IN. GUN.





FIGS. 18 AND 19. BREECH MECHANISM OF 6-IN. QUICK-FIRING GUNS.

NOTES FROM THE NORTH.

GLASGOW, Wednesday.

Glasgow Pig-Iron Market.—Last Thursday morning the pig-iron market opened easy, with Cleveland warrants at 49s. cash and 49s. 3d. one month, but these prices afterwards improved by 1d. in each case. Other dealings were at 49s. five days and 49s. 3d. twenty-one and twenty-five days, and the closing quotations were 49s. 1d. cash and 49s. 4½d. one month sellers. The turnover was 10,000 tons, and also 3000 tons of hematite at 63s. 2½d. cash, 63s. 9d. and 63s. 6d. one month. In the afternoon Cleveland warrants again declined, and about 12,000 tons changed hands at 48s. 10½d. and 48s. 11d. cash, 49s. 0½d. twenty days, 49s. 1d. twenty-two days, and 49s. 2d. to 49s. 1½d. to 49s. 2d. one month. The closing quotations were 48s. 11d. cash and 49s. 2½d. one month sellers. Hematite was steady, and one lot was done at 63s. 7d. one month. On Friday morning the tone was strong, and Cleveland warrants advanced from 49s. to 49s. 2d. cash and from 49s. 3d. to 49d. 5d. one month, while five days' iron fetched 49s. 3½d. The business amounted to 6000 tons, and the closing quotations were firm at 49s. 4½d. cash and 49s. 7½d. one month. Hematite was also firm at 64s. one month buyers. The improvement continued in the afternoon, and Cleveland warrants were done at 49s. 4½d. and 49s. 4d. cash, 49s. 8½d. twenty-four days, and 49s. 9d. one month. The dealings were 4000 tons, and the closing quotations were 49s. 5d. cash, and 49s. 8d. one month. Hematite was firm, and 1000 tons changed hands at 64s. 6d. one month, closing with sellers at 64s. 9d. one month. Monday was observed as a holiday, and the pig-iron market was closed. On Tuesday morning a strong tone prevailed, but the business was confined to 4000 tons of Cleveland warrants. Cash iron rose from 49s. 8d. to 49s. 10½d., and one month iron from 50s. to 50s. 2d., while there was also some dealing at 50s. 1d. and 50s. 1½d. twenty-four days. At the close there were sellers at 49s. 11d. cash, and 50s. 2½d. one month, and buyers at 1d. less in each case. At the afternoon session the market was again strong, and the announcement that the Clyde labour dispute had terminated had, perhaps, the effect of forcing up prices a bit. Cleveland warrants were done at 50s. to 50s. 2d. to 50s. 1d. cash, from 50s. 3½d. to 50s. 5d. one month, and at 51s. 1½d. three months. The turnover was 12,000 tons, and the closing quotations were 50s. 1d. cash and 50s. 4½d. one month sellers. Hematite was quoted 65s. 6d. one month sellers. When the market opened to-day (Wednesday) Cleveland warrants were firm, and 11,000 tons were done round 50s. 2d. cash and 50s. 5d. one month, and there was also some dealing at 50s. 2½d. nineteen days. The closing quotations were 50s. 2½d. cash and 50s. 6d. one month sellers. Hematite advanced, and 500 tons changed hands at 65s. 1d. one month, with closing sellers at 65s. 3d. one month. In the afternoon the tone was rather easier, and 6000 tons of Cleveland warrants were done at 50s. and 50s. 1½d. cash, 50s. 3½d. nine days, 50s. 4d. and 50s. 4½d. one month. At the close prices were firmer at 50s. 2d. cash and 50s. 5½d. one month sellers. Hematite was quoted 65s. 6d. one month sellers, but no business was done. The following are the market quotations for makers' (No. 1) iron:—Clyde, 65s. 6d.; Calder and Gartsherrie, 66s.; Summerlee, 67s. 6d.; Langloan, 69s.; and Coltness, 73s. 6d. (all shipped at Glasgow); Glengarnock (shipped at Ardrossan), 66s.; Shotts (shipped at Leith), 66s. 6d.; and Carron (shipped at Grangemouth), 68s.

Scotch Steel Trade.—The position in the Scotch steel trade is unaltered, and there is little fresh to report. New business is scarce, and work on old contracts continues to keep the various works employed. The departments turning out sectional material, however, are experiencing a difficulty, as specifications have been very scarce of late. Plate-mills are being kept going at full pressure. The foreign market is still sending some good inquiries here, and some of them have resulted in business. There has not been any alteration made in the last official list of prices.

Sulphate of Ammonia.—During the past week there has been a fairly good business done in sulphate of ammonia, but although the market is quiet at the moment, the price remains steady round 12*l.* 5s. per ton, Glasgow or Leith. The shipments from Leith last week amounted to 1055 tons.

Shipbuilding.—An order has been placed with the Fairfield Shipbuilding and Engineering Company, Limited, Govan, for a steamer, 345 ft. in length, for the Italian emigrant trade.

AUSTRALIAN COAL.—The production of coal in the Australian Commonwealth is steadily increasing. This is shown by the following table illustrating the yearly output for the fifteen years ending with 1904 inclusive:—

Year.	Tons.	Year.	Tons.
1890	3,467,633	1898	5,409,669
1891	4,377,890	1899	5,450,860
1892	4,105,686	1900	6,385,546
1893	3,668,499	1901	6,334,299
1894	4,145,363	1902	6,859,488
1895	4,290,608	1903	7,112,078
1896	4,554,210	1904	6,852,520
1897	5,021,379		

New South Wales is the great coal-producing country of the Antipodes, its output having risen from 3,060,876 tons in 1890 to 6,019,809 in 1904. The production of coal in Victoria, South Australia, Western Australia, and Tasmania made little progress during the fifteen years; but Queensland increased its output from 338,344 tons in 1890 to 512,015 tons in 1904. The production of coal in New South Wales has probably been stimulated by the ready sale arising from the shipping facilities afforded by the great port of Sydney.

NOTES FROM SOUTH YORKSHIRE.

SHEFFIELD, Wednesday.

Sheffield University Degrees.—On Monday the Court of Governors of the Sheffield University met and approved of ordinances respecting the work of the university and the granting of degrees, subject to possible modifications after consultation with other university authorities. Three excellent proposals were made, and to which it is hoped no objection will be taken. In the first place degrees are to be granted in metallurgy, which is of the utmost importance to Sheffield. In the next place it is proposed that, in engineering, evening classes shall count as university attendances, and it is also hoped that education will be included as one of the possible subjects for a degree, either in arts or science.

Sheffield Chamber of Commerce.—The Council of the above Chamber at their meeting on Monday considered the Trades Disputes Bill, and expressed strong disapproval of the clause which seeks to place trade unions in a preferential position and render their funds not liable for any acts, however illegal, which might be committed by their members.

South Yorkshire Coal Trade.—The returns of the Hull Chamber of Commerce and Shipping show that business received a great impetus by the stopping of the French mines. The weight of coal shipped to France last month was 40,629 tons, against 3788 tons in the corresponding month of last year. The weight of coal sent to France during the four months reached 46,693 tons. During April there was sent to Hull 377,696 tons, being an increase of 77,680 tons on April, 1905. In the four months of the year 1,406,218 tons were consigned to the port, against 1,151,392 tons last year, or an increase of 254,826 tons. The business done coastwise has been on the increase, and the exports generally have been very satisfactory.

Iron and Steel Trades.—Many firms in these branches report that business has fallen off since the Easter holidays, and that prospects are not so encouraging as they were. There are other firms who are so full of orders that they have to obtain outside help to secure deliveries. The local firm who recently commenced the manufacture of soft basic steel is developing a satisfactory trade. There have been any number of requests for quotations for spring steel, more especially from the Midland countries; but, so far, business has not followed. Prices, it is stated, are too high. There is not the pressure of work now at the rolling mills and forges. Although most of them are running full time, they are practically dependent on what comes in from day to day. Where bright-steel rolling is done work is plentiful, as the demand from makers of cycles and motors is heavy. Business with manufacturers of machine-knives keeps up, and the activity in the file trade is well maintained.

Coal and Coke.—This week there has been a falling off in the sales of house coal, and prices are weaker. Merchants are buying more reservedly, as it is felt that a revision of quotations cannot be long delayed. For steam coal there is an increasing demand, but the output is now so large that there is no difficulty in meeting it. Common coal continues to move off freely. Coke makers report that business is not as brisk as it was.

WIRELESS TELEGRAPHY.—It is possible that wireless telegraphy may take the place of a cable which it is proposed to lay at a cost of nearly 1,000,000 dols. between the United States and the Isthmus of Panama. The cable will run from Key West to Guantanamo, and from Guantanamo to Porto Rico, and from Guantanamo to the Isthmus of Panama. There is now no telegraphic communication in this quarter which does not go through foreign countries. There is an American cable line which runs through Mexico, and reaches Panama by the western coast. There is an English line which, after running in a great many different directions, finally lands in Jamaica, and thence goes to Panama. The only method Americans have of communicating with Guantanamo is by the French cable line, and thence to Porto Rico. The American military authorities are emphatic as to the necessity for direct cable communication between the United States and these four important positions—important strategetically, and important as regards the property and interests of the United States Government. The objection to a cable arises from the fact that it may be cut during war, and so fail to provide communication.

THE MANHATTAN BRIDGE.—It is probable that there is now not likely to be any further delay in the building of the Manhattan Bridge, New York, for the much-discussed question as to whether the bridge should be constructed with eye-bar chains or with cables appears to have been definitely settled in favour of the latter. It will be remembered that it was originally intended that the bridge should have cables, and it was so designed; but the advisability of substituting eye-bars for these was afterwards brought forward, and as a result of much discussion the idea of using cables was abandoned. When the present administration of the Bridge Department of New York came into power the old question was again raised, in order to ascertain if it would not be better after all to use eye-bars, and a public hearing was given for the purpose of providing the opponents of the cables a further chance of explaining their objections. As no advocates for the eye-bar system came forward, however, the matter was finally settled, and the bridge will be built with cables. It is now thought that no further hindrance to the work will be met, except, of course, from difficulties that may occur in the actual construction of the work.

NOTES FROM CLEVELAND AND THE NORTHERN COUNTIES.

MIDDLESBROUGH, Wednesday.

The Cleveland Iron Trade.—Yesterday there was only a thin attendance on 'Change, but the market was very cheerful in tone, quotations moved upwards, and a fair amount of business was transacted. The improvement was largely due to the good Board of Trade returns, the continued heavy shipments from the Tees, and the steadily decreasing stock of Cleveland iron in the public warrant stores, where there is, however, still 690,000 tons odd. At the opening of the market, sales were recorded at 50s. 3d. for early f.o.b. delivery of No. 3 g.m.b. Cleveland pig, but the price stiffened later on, and by the close the general quotation was 50s. 6d. There was considerable confidence in the future, as was shown by inquiries on forward account, but sellers appeared unwilling to do business ahead, believing that still better quotations would rule in the no distant future. The other qualities of pig also improved in value. No. 1 became 52s.; No. 4 foundry, 50s.; grey forge, 49s. 6d.; mottled, 49s. 3d.; and white, 49s. East Coast hematite pig was steady and firm, with the output well taken up, and values not at all affected by competition of other districts. Mixed numbers remained at 67s. 6d. for early delivery. Middlesbrough warrants opened 49s. 10d., and closed 50s. 0½d. cash buyers. Spanish ore was quiet, but by no means easy. Rubio (50 per cent. quality) was put at 19s. 6d. ex-ship Tees, but many dealers would not quote below 20s., and some firms held out for even more. To-day the market was again firm and fairly brisk. Quotations were unaltered, with the exception of Middlesbrough warrants, which advanced a penny, the price becoming 50s. 1½d. cash buyers.

Manufactured Iron and Steel.—Little new can be said of the various branches of the manufactured iron and steel industries. Most firms are turning out a good deal of work, and some fairly good inquiries are said to be in the market, but little is heard of the booking of new orders of any particular consequence. Quotations are stationary. Common iron bars are 7*l.* 5s.; best bars, 7*l.* 15s.; iron ship-plates and iron ship-angles, each 7*l.* 5s.; iron ship-rivets, 7*l.* 17s. 6d.; steel ship-plates, 7*l.*; steel ship-angles, 6*l.* 12s. 6d.; steel boiler-plates, 8*l.*; steel joists, 6*l.* 7s. 6d.; steel sheets (singles), 8*l.*; steel sheets (doubles), 8*l.* 5s.; and heavy sections of steel rails, 6*l.* 7s. 6d.—all less the customary 2½ per cent. discount, except rails, which are net cash at works.

Order for Middlesbrough Engineers.—An order has been placed with Messrs. Richardsons, Westgarth, and Co., of Middlesbrough, to instal at the works of Messrs. Guest, Keen, and Nettlefolds, Limited, Dowlais, a central condensing plant capable of dealing with 144,000 lb. of steam per hour. Included in the plant, which will rank as one of the largest of its kind in Great Britain, will be a Weiss patent barometric condenser, with a duplicate set of pumps, and three patent water-cooling towers to deal with 360,000 gallons of water each hour.

Coal and Coke.—On the whole, demand for coal is good. The home consumption of gas coal is, of course, now small and still dwindling, but exports keep good and quotations are maintained. Bunker coal is in good request, and unscreened Durhams range from 9s. 4½d. to 9s. 9d. f.o.b. Coking coal is firm. Local consumption of coke is heavy, but the supply is plentiful. Average blast-furnace qualities are 16s. 6d. to 17s. delivered here.

OUR RAILS ABROAD.—The exports of rails from the United Kingdom in April amounted to 32,841 tons, as compared with 37,190 tons in April, 1905, and 30,174 tons in April, 1904. The general features of the export rail trade remain much the same, there being a good demand upon South African and Indian account, while little is being done with Australia and Canada. It is satisfactory to note, however, that there has been rather more inquiry for rails in South Africa. The shipments to the Argentine Republic in April were 7446 tons, as compared with 7414 tons and 4245 tons in the corresponding months of 1905 and 1904 respectively. The Colonial demand moved on as follows:—

Colonial Group.	April, 1906.	April, 1905.	April, 1904.
	tons	tons	tons
British South Africa ..	3489	509	4234
British India	8144	9126	9255
Australasia	252	1544	566
Canada	3	5012	nil

OUR LOCOMOTIVE EXPORTS.—The exports of locomotives from the United Kingdom in April showed some progress, being valued at 225,977*l.*, as compared with a corresponding value of 149,980*l.* in April, 1905, and 187,701*l.* in April, 1904. Last month's return was considerably helped up by large shipments of British locomotives to South America, principally to Argentina. The colonial demand was represented by the following values:—

Colonial Group.	April, 1906.	April, 1905.	April, 1904.
	£	£	£
British South Africa ..	6,073	3,624	96,394
British India	106,366	59,762	13,248
Australasia	2,697	4,117	7,962

It will be observed that there was a great improvement last month in the Indian demand for our locomotives.

NOTES FROM THE SOUTH-WEST.

Cardiff.—The steam-coal trade has not been particularly active, but in consequence of the comparatively limited supplies offering, the best large steam coal has made 15s. 9d. per ton for early delivery; secondary descriptions have ranged from 14s. to 15s. 3d. per ton. The house coal trade has shown little change; the best ordinary qualities have made 14s. to 14s. 6d. per ton, while secondary descriptions have brought 11s. to 13s. per ton. No. 3 Rhondda large has been quoted at 15s. per ton. Patent fuel has shown rather an upward tendency. Coke has not varied; foundry qualities having been quoted at 18s. to 19s. per ton, and furnace ditto, at 16s. 6d. to 17s. per ton. As regards iron ore, Rubio has been quoted at 18s. 3d. to 18s. 6d. per ton; and Almeria at 18s. to 18s. 3d. per ton, upon a basis of 50 per cent. of iron, and charges, including freight, insurance, &c., to Cardiff or Newport.

Newport Corporation Water Works.—The success of the Newport Corporation Water Works, at Westwood, has given the engineer to the scheme, Mr. Baldwin Latham, an opportunity to apply to the Town Council for a declaration that his responsibility should now cease. The matter has been considered by the Water Works Committee, and that body felt that now that the work is completed, and the course which they consistently pursued with considerable anxiety to all concerned has proved to be thoroughly successful, they should place on record their satisfaction with the way in which Mr. Latham persevered with his plans. The committee therefore resolved that, in releasing Mr. Baldwin Latham from further responsibility in connection with the Westwood works, they congratulated him upon the complete success of the undertaking.

Cardiff and Newcastle.—The Great Western Railway Company, with the help of the Great Central, the Great Northern, and the North-Eastern companies, has inaugurated a new express service from Cardiff to Newcastle-on-Tyne. The distance from Cardiff to Newcastle is 345 miles, and the new service constitutes the longest through run in England. The new route is a varied and interesting one. Branching off at Severn Tunnel Junction, the train proceeds by way of Chepstow, and then follows the western bank of the Severn to Gloucester and Cheltenham. Use is made of a branch connecting Cheltenham and Banbury. North of Banbury the train takes the Great Central branch to Woodford, and then proceeds on the Great Central Railway, *viâ* Leicester, Nottingham, and Sheffield. From York it is forwarded over the North-Eastern main line to Newcastle.

Dowlais.—The Big Mill, which has been running regularly, has been principally engaged upon fish-plates for South Africa, a large contract being in course of execution. Angles and colliery rails have also been turned out. The Goat Mill has had a good output of heavy steel rails, principally for the London and South-Western Railway.

The "Minotaur."—The cruiser Minotaur will be launched at Devonport on June 6. No member of the Royal Family is expected to visit Devonport this summer, and the new cruiser will be named by the Countess of Crewe.

Cardiff Corporation Water Works.—At the last meeting of the Water Works Committee of the Cardiff Town Council, a sub-committee was appointed to confer with Mr. Priestley, the city water works engineer, as to a new supply from the Ely, or any new source other than Taff-fawr Valley. The scheme will involve the softening of the water by a special process.

The Swansea Valley.—There has been a normal output of pig, and a large proportion of the production has been converted into steel. The output of tin-plate bar has been below the average. The coal trade has shown more activity.

Electricity at Bristol.—The electrical committee of the Bristol City Council asks for authority to borrow 103,554*l.* "to meet the growing demand" for current. The committee sets out 10,400*l.* (including 2122*l.* expended after the fire) for additions at Temple Backs Works; 57,100*l.* for additions at Avonbank; and 40,800*l.* for additions to the external system (including a special sub-station for the docks supply, Underfall Yard). This makes 108,300*l.* altogether, and towards this 4745*l.* is in hand surplus from previous works.

Devonport Electricity Works.—The financial year of the Devonport electricity undertaking closed March 31, and the accounts have now been prepared for presentation to the town council. The gross profit for the year amounts to 10,300*l.*, against 8000*l.* odd last year. After provision is made for interest and sinking fund, the net profit of the year is just over 4000*l.*, as compared with last year's net profit of 2728*l.* Of the net profit of 1905-6, over 1100*l.* was applied to suspense account, and the balance to reserve and depreciation. The electric power committee hopes to be able to reduce the price of current during 1906-7.

CANADA AS A FIELD FOR INVESTMENT.—This forms the title of a special supplement to the *Financier and Bullionist*, of Saturday, the 28th ult. It gives various historical notices; also very detailed particulars with reference to the agriculture of the Dominion, and its mineral and industrial wealth. Canada's shipping lines, railways, electric power and traction installations, and finances, are reviewed in detail. The supplement will prove interesting to all classes of readers.

MISCELLANEA.

IN his paper recently read before the Civil and Mechanical Engineers' Society, Dr. W. Owen Travis states that, as the result of his experience at Hampton, only about a quarter of the sludge in sewage is got rid of in the septic tank, leaving three-quarters to be otherwise disposed of. At Hampton this is done by conveying it to trenches on the land, which are covered over as soon as the sludge will bear the weight of the earth. He estimates that with 6 acres of land the sludge from 1,000,000 gallons of sewage daily could thus be disposed of for an indefinite period.

The *Verein Deutscher Ingenieure* will hold its general annual meeting in Berlin from June 10 to 14, and will celebrate at the same time the fiftieth anniversary of its foundation. The reception of the members and visitors takes place on Sunday, June 10, in the Wintergarten. An opening meeting and a banquet will be held on the 11th. Meetings for the discussion of engineering subjects will follow on the mornings of the 12th and 13th in the Technical High School; the afternoons and the whole of the 14th will be set apart for the visit of technical and industrial installations in Berlin and the suburbs.

The *Journal fuer Gasbeleuchtung und Wasserversorgung* contains an article by Dr. Karl Roth, analytical chemist, Frankfort, in which he reviews various inadequate classes of composition used for the coating of cement constructions and iron work under water, and which have failed either through chemical or through mechanical action. Dr. Roth states he has brought out a composition he calls "Inertol," the substances forming which are not affected in any way by carbonic acid, are not subjected at all to the wasting effects of oxygen or of organic matter, and which resist the mechanical action of water; it forms a soft, elastic, neutral, and water-tight coating; it is durable and gives complete satisfaction, as is evidenced by two letters the Journal prints as testimonials from the Municipal Councillor in charge of the Frankfort Water Works.

Two officials of the Chicago, Burlington, and Quincy Railroad have been fined 2000*l.* each, and the company itself fined 8000*l.*, for giving a secret rebate on tin-plates being exported from America to Vancouver. The reason alleged for making this rebate was to enable American manufacturers of tin-plate to compete with the Welsh product. The United States Steel Product Company found that, in order to meet this competition, they would not only have to sell very close to the cost of production, but that the railroads must co-operate in giving them a large reduction in freight. The railways concerned consented to do this, and quoted a rate of 1s. 3d. per 100 lb. from Chicago to Vancouver, though the regular rate for Californian and Washington seaports was 2s. 3½d. per 100 lb. As there was no desire to alter this, it was decided to keep the new rate secret; but now the facts have come out, the courts have, as stated, inflicted heavy fines on the officials and company.

A supplement on the railroads of the United States has recently been published in book form by the *Statist*. The information it gives is most interesting. Among other data, it states that in the ten years from 1882 to 1892 there was a growth of about 100 per cent. in traffic—ton-miles and passenger-miles—and this was attended by an increase of 56 per cent. in the capital outlays upon the road and equipment. In the ten years ending 1904, the expansion of 104 per cent. in traffic was accompanied by an increase of only 20 per cent. in the capital cost of railroad and equipment. In this country we should consider our railways very economical if their traffic grew twice as quickly as their capital expenditures increased; but, as a matter of fact, for every 100 per cent. of growth in their traffic, their capital expenditures increase about 70 per cent. The small additional capital expenditure on the American railways means that the people of the United States have had the use of about 600,000,000*l.* of capital for investment in other reproductive works. Detailed information is given as to each individual railway.

The Swedish Government has laid before the Riksdag a Bill introducing new regulations with regard to steam-boilers. It is intended to come into operation on January 1, 1907, and owners of steam-boilers which are in use at that date must, within two years, have them examined in accordance with the new Act, if they want to continue using them. Should any stationary steam-engine, at the date of this law coming into force, be required for use at a place different from that which the law permits, such permission can only be obtained provided other conditions of the law are complied with. The law does not apply to boilers used on board the Swedish Navy, nor boilers belonging to the State railways, nor on board passenger steamers, nor on Swedish steamers sailing exclusively between foreign ports. The boilers are divided into three classes, according to their evaporative power, and the law contains regulations for installations of steam-boilers, and particulars of the conditions subject to which boilers can be taken into use. Regulations for the appointment of the proper surveyors rests with the Government, and the fines which may be incurred for breaches of the new regulations range from 5s. 8d. to 28*l.*

In a paper recently read before the American Physical Society, Mr. H. M. Dadourian gives the results of certain experiments made to determine whether there was any truth in the claim sometimes made that the different preparations of thorium were unequally radioactive, and that it was possible to obtain thorium which was entirely inactive. These observations had thrown some doubt upon the elementary character of thorium itself. In the result it was found that the activity of thorite and thorianite, taken as natural minerals, was strictly proportional to the thorium content, whilst thorium nitrate prepared by the Welsbach Light Company from North Carolina and Brazilian monazites, had an activity one-half as large. On the other hand, the thorium separated from some of the North Carolina monazite, by Dr. B. H. Boltwood, had an activity equal to that of thorite and thorianite. The conclusion reached is that the radioactivity of thorium, and consequently the radio-thorium in a mineral, is proportional to the quantity of thorium present, and that the radio-thorium is a disintegration product of thorium. The methods of preparing thorium nitrate adopted by the Welsbach Company appeared to remove one-half the equilibrium quantity of radio-thorium, which accounts for the reduced activity of the product received from them.

In an interesting paper on the "Lubrication and Temperature of Bearings," read before the American Society of Mechanical Engineers by Mr. A. M. Mattice, the author referred to the remarkable economy of lubricating oil which follows the adoption of the Parsons system of supplying the oil to the bearings under a slight pressure, varying in different instances from a few inches to several feet, but which is in all cases just enough to allow the oil to flow freely through the bearings, from which it carries off the heat generated by friction; it is then cooled by a tubular cooler before being returned to them. As the oil is nowhere exposed to the outer air, but circulates only in a closed system, it collects no dirt and does not require filtration, but circulates over and over again continuously, the entire supply passing through the journals every few minutes. As instances of the astonishing economy of oil thus realised, Mr. Mattice cites a 400-kilowatt turbine running at 3600 revolutions per minute, which used only 50 gallons of oil in twelve months; whilst at another plant, consisting of two units rated at 750 and 400 kilowatts respectively, only three barrels of oil were used in sixteen months. The turbine steamer Virginian, he stated, made four successive round trips between Liverpool and Montreal without any addition of oil to her tanks, and the supply was still not appreciably diminished from its initial figure of 115 Imperial gallons. In this case the whole supply passes through the bearings every four minutes. The figures quoted are, of course, those for the turbine bearings only, since the line shafting has ordinary lubrication.

OUR COAL ABROAD.—The chief feature in our export coal trade in March was a large increase in the shipments to France, in consequence mainly of labour troubles in the French northern departments. The whole exports of British coal for March were 4,632,766 tons, as compared with 3,789,996 tons in March, 1905, and 4,036,926 tons in March, 1904. The principal importing countries figured in these totals as follows:—

Country.	Mar., 1906.	Mar., 1905.	Mar., 1904.
	tons	tons	tons
Denmark	209,886	225,716	212,378
Germany	583,719	711,322	518,643
France	560,553	562,561	669,506
Spain	240,500	208,237	266,807
Italy	796,954	643,659	683,824
Egypt	272,965	164,549	229,706
Argentina	213,531	133,358	100,613

The falling-off in German imports is, of course, explained by the absence this year of the labour troubles which prevailed in the German coal trade during the first quarter of 1905, and which rendered it necessary for Germany to rely, to a larger extent than usual, upon foreign supplies of combustible. The aggregate exports of coal from the United Kingdom in the first three months of this year showed a large increase, especially to France and Italy. The shipments to March 31, this year, amounted to 12,552,914 tons, as compared with 11,041,534 tons in the corresponding period of 1905, and 10,506,869 tons in the corresponding period of 1904, the contributions made to these totals by the principal coal-consuming countries being as follows:—

Country.	1906.	1905.	1904.
	tons	tons	tons
Denmark	594,395	518,498	527,981
Germany	1,530,466	1,884,382	1,114,457
France	2,115,428	1,658,648	1,835,654
Spain	726,207	567,478	693,249
Italy	2,171,137	7,654,592	1,717,682
Egypt	679,012	506,255	648,337
Argentina	580,522	399,238	295,357

Our coal exports have also increased this year to Russia, Sweden, Norway, Belgium, Portugal, Greece, Turkey, Brazil, Uruguay, Gibraltar, British India, and Ceylon; but they have decreased to Holland, Algeria, the United States, Chili, and British South Africa. Including coke and patent fuel, our total exports of combustible in all directions in the first quarter of this year were 13,084,796 tons, as compared with 11,460,386 tons in the first quarter of 1905, and 11,007,622 tons in the first quarter of 1904. To these totals we may add 4,544,419 tons, 4,145,653 tons, and 3,951,082 tons respectively for coal, &c., shipped for the use of steamers engaged in foreign trade. The quantity of coal which left the United Kingdom in one form or other in the first quarter of this year was accordingly 17,629,215 tons, as compared with 15,606,039 tons, and 14,958,704 tons in the corresponding periods of 1905 and 1904, respectively. The annual rate of export was thus 70,516,860 tons this year, as compared with 62,424,156 tons and 59,834,816 tons respectively. It will be seen that our export coal trade is increasing by leaps and bounds.

NOTES FROM THE UNITED STATES.

PHILADELPHIA, May 2.

THE order for 43,000 tons of structural material for the new Manhattan Bridge has not been placed, as injunctions have been filed against it, and the matter will come up for future adjudication. The reasons for the injunctions are of a technical nature, and it is intimated that some disappointed bidders may have had something to do with it.

Large orders are already coming in for steel for construction purposes for San Francisco. It is the purpose of the builders to use steel very largely, and it is the intention of the steel-makers to, as far as possible, give preference to Californian orders over others. The work of rebuilding the city has already set in, and thousands of labourers are now employed in preparing foundations.

The rail market is still active, but most of the deliveries arranged are for early next year. A Pacific railroad has just contracted for 7000 tons. Quite a number of additional inquiries have been received, and these inquiries increase the aggregate of business before the rail-mills, to 350,000 tons. Electric traction companies are also large buyers; 20,000 tons of girder rails were contracted for during the past week. The Colorado Fuel and Iron Company, the Tennessee Coal, Iron, and Railroad Company, and one other company have secured large orders for standard rails for delivery next year. The price of 28 dols. has been determined upon by the United Steel Rail Company. The total volume of business now on the books has reached 3,500,000 tons. The total present capacity is only 3,000,000 tons, according to some estimates; but this is believed to be below production possibilities.

More rail capacity is needed, and it is being furnished in a quiet way. There will be no "boosting" of prices for next year. The steel mills are buying large quantities of raw material. The Jones and Laughlin Company have purchased 35,000 tons of iron at 17.25 dols.

The latest rumours, which are probably well-grounded, are that certain railroad companies have arranged to place orders for 25,000 steel cars. This has had the effect of hardening the price of steel plates, which began to show some evidence of weakening. The market for structural material is very active, and the demand for bar iron is only moderate, but the mills are well supplied with business. Bar iron has declined within a few months from 2 dols. to 1.55 dols.

Electrical companies and engineering plants continue to buy liberally of special brands of iron, the effect of which is to keep prices firm. The tone of the market, with the exception of bar iron, is strong, and the presentation of inquiries daily has the effect of maintaining confidence. All branches of the steel industry are active—some branches have business for months ahead—and, where business is coming in rather slowly, there is enough of it to keep the plants working full time. The fuel problem is still unsettled and the appearance to-day is that the anthracite operators intend to court a suspension of work, as they have a coal supply which will last for several months. The hardware industry is in an exceptionally prosperous condition, and capacity is strained, especially in builders' hardware.

MORE YORKSHIRE COAL.—The Barnsley seam has been proved at Frickley Colliery at a depth of 664 yards; and when the colliery is in full working, it is expected that 3000 tons of coal per day will be raised. The Dinnington Main Colliery, where the Barnsley seam has been reached at a depth of 667 yards, is being fitted up for a large output, and it already employs 655 persons in and about the mine. Under the same proprietary two shafts are to be sunk near Maltby. At Bentley, near Doncaster, sinkings for a large colliery have been commenced; the work is being delayed, however, by an encounter with quicksand. At Brodsworth, also near Doncaster, the Barnsley bed is expected to be reached at a depth of nearly 900 yards. At Elsecar shafts are being sunk to the Parkgate seam, and good progress is being made with sinkings to the lower seams at Wrenthorpe Colliery, near Wakefield, and Middleton Colliery, near Leeds.

THE TELEPHONE AT HULL.—The first financial statement covering a full year's working of the Hull municipal telephone service has been submitted to the telephone committee of the Hull City Council. On revenue account there was an income of 7234*l.* and an expenditure of 4371*l.* Of the balance of 2863*l.*, 1451*l.* (less 273*l.* interest on current account) has been applied to the payment of interest on loan, 1109*l.* has been placed to suspense account as an instalment towards repayment of loan, and 100*l.* has been set aside as provision for bad and doubtful debts. A net balance is thus left of 476*l.*, which is reduced by a deficit of 73*l.* in 1904-5 to 403*l.* It is pointed out that while no amount has been expressly provided to cover depreciation, a full year's instalment has been taken into account towards the repayment of capital. On capital account during the past year 15,064*l.* was expended, making, with 30,369*l.* previously paid out, 45,433*l.*

THE JAPANESE BATTLESHIP "KATORI."

CONSTRUCTED BY MESSRS. VICKERS SONS AND MAXIM, LTD., BARROW-IN-FURNESS.

(*For Description, see Page* 614.)

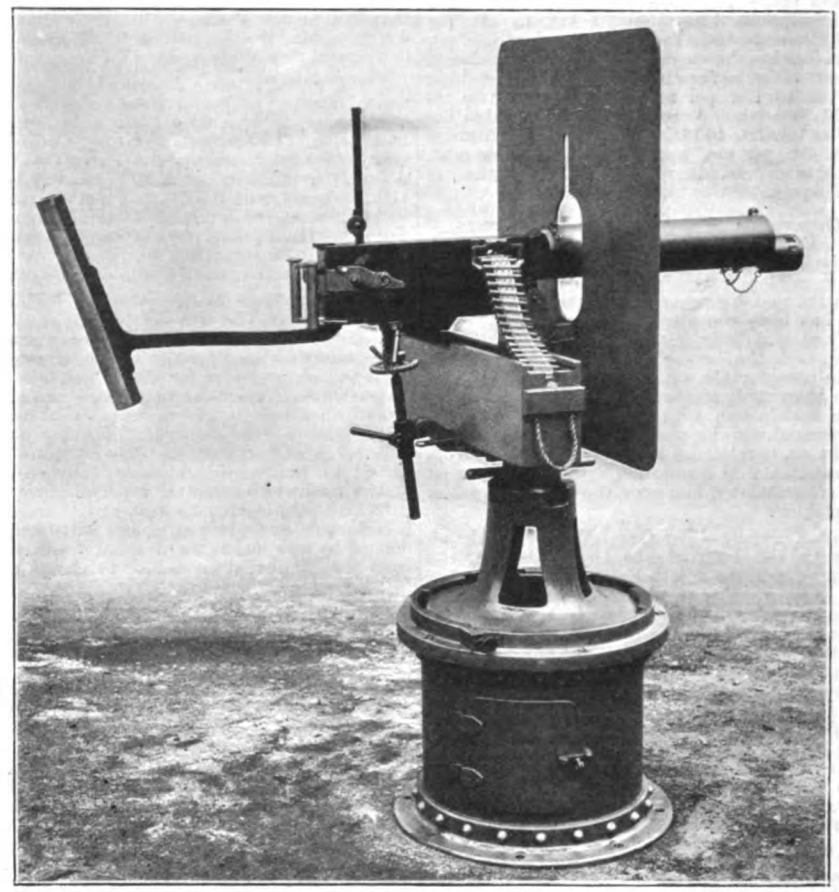


FIG. 20. MAXIM GUN ON NAVAL PEDESTAL MOUNTING.

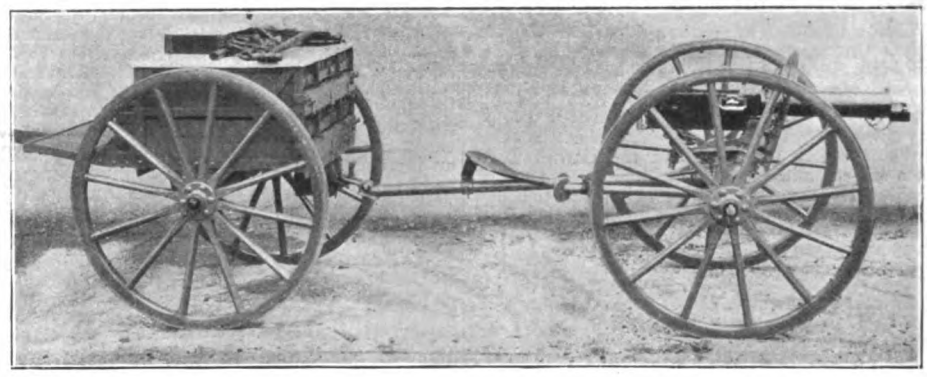


FIG. 21. MAXIM GUN AND LIMBER FOR SERVICE ASHORE.

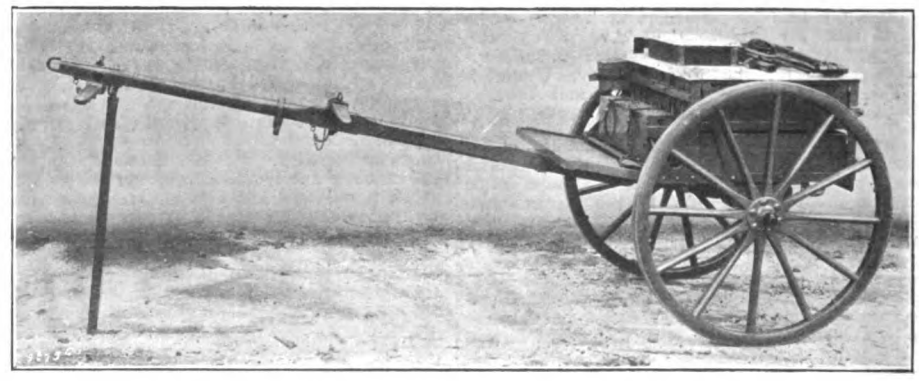


FIG. 22. LIMBER FOR MAXIM GUN FOR SERVICE ASHORE.

GOLD-DREDGING.—Captain C. C. Longridge, M. Inst. Mech. E., &c., has written an illustrated supplement for 1906 to his treatise of last year on gold-dredging, which we reviewed in a previous issue (see ENGINEERING, vol. lxxx., page 506). This supplement contains the latest information available with regard to machinery, and the improvements made in its construction; the separation of the material dredged; gold-recovery appliances, and so forth. The new data are classified under the headings given in the original book, which is thus admirably completed. It is proposed to issue a supplement on similar lines every year. The publishers are the *Mining Journal*.

THE JAPANESE BATTLESHIP "KATORI."

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(*For Description, see Page* 614.)

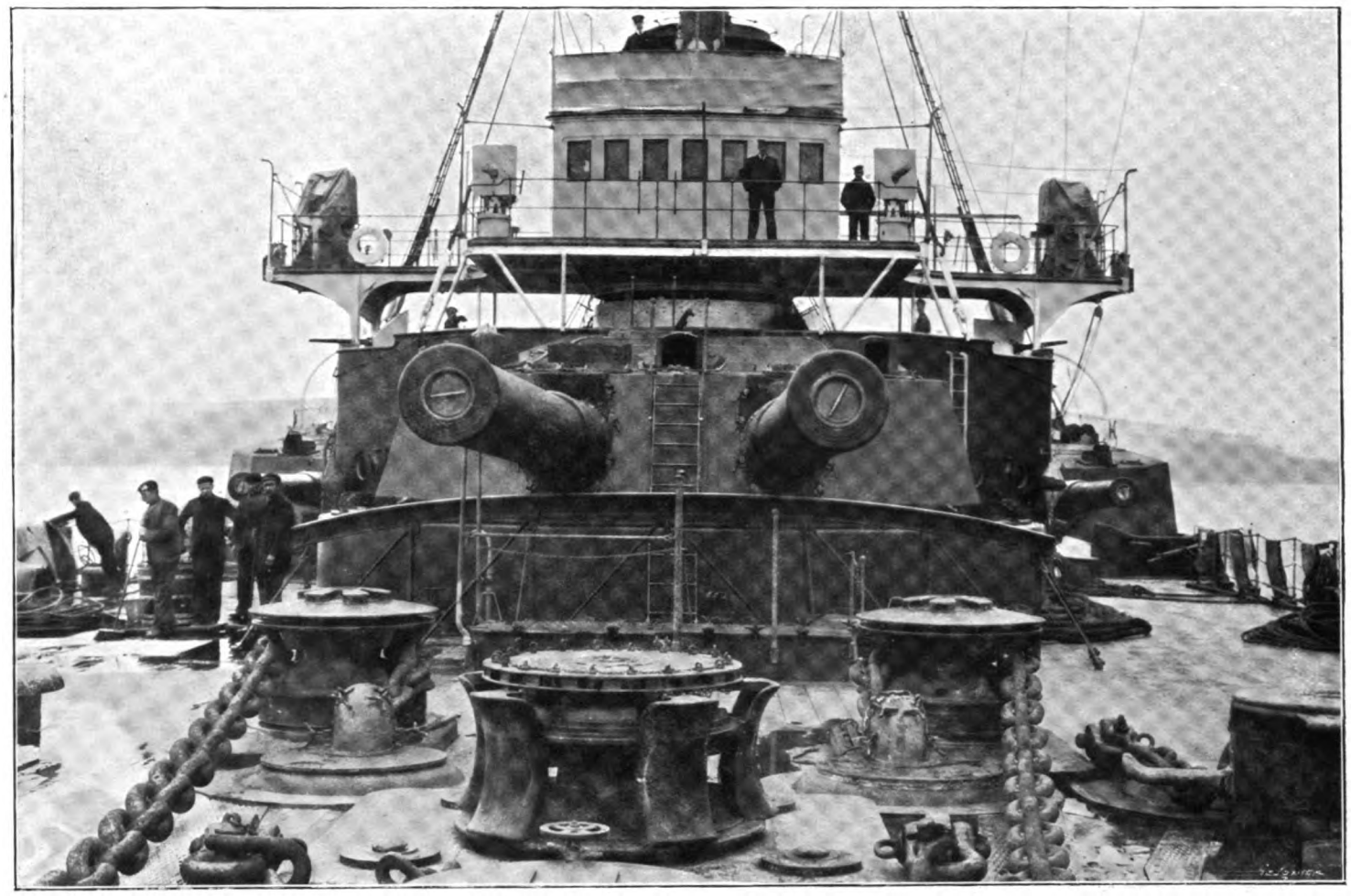

FIG. 5. VIEW FROM BOW, SHOWING TWIN 12-IN. GUNS AND SINGLE 10 IN. GUNS ON EACH SIDE.

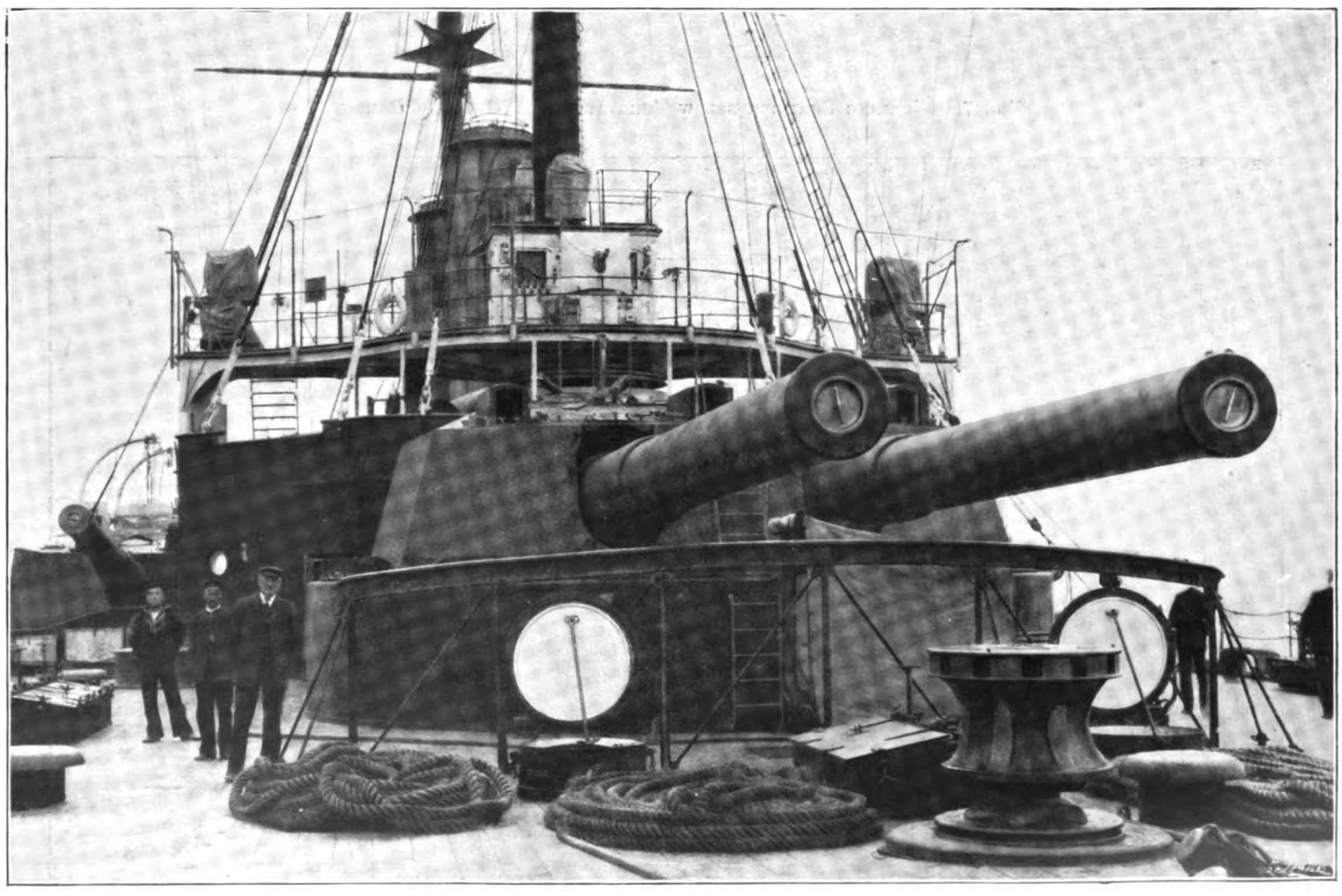

FIG. 6. VIEW FROM QUARTER-DECK, WITH TWIN 12-IN. GUNS AND AFTER PORT 10-IN. GUN.

(*To face Page* 614.)

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(*For Description, see Page* 614.)

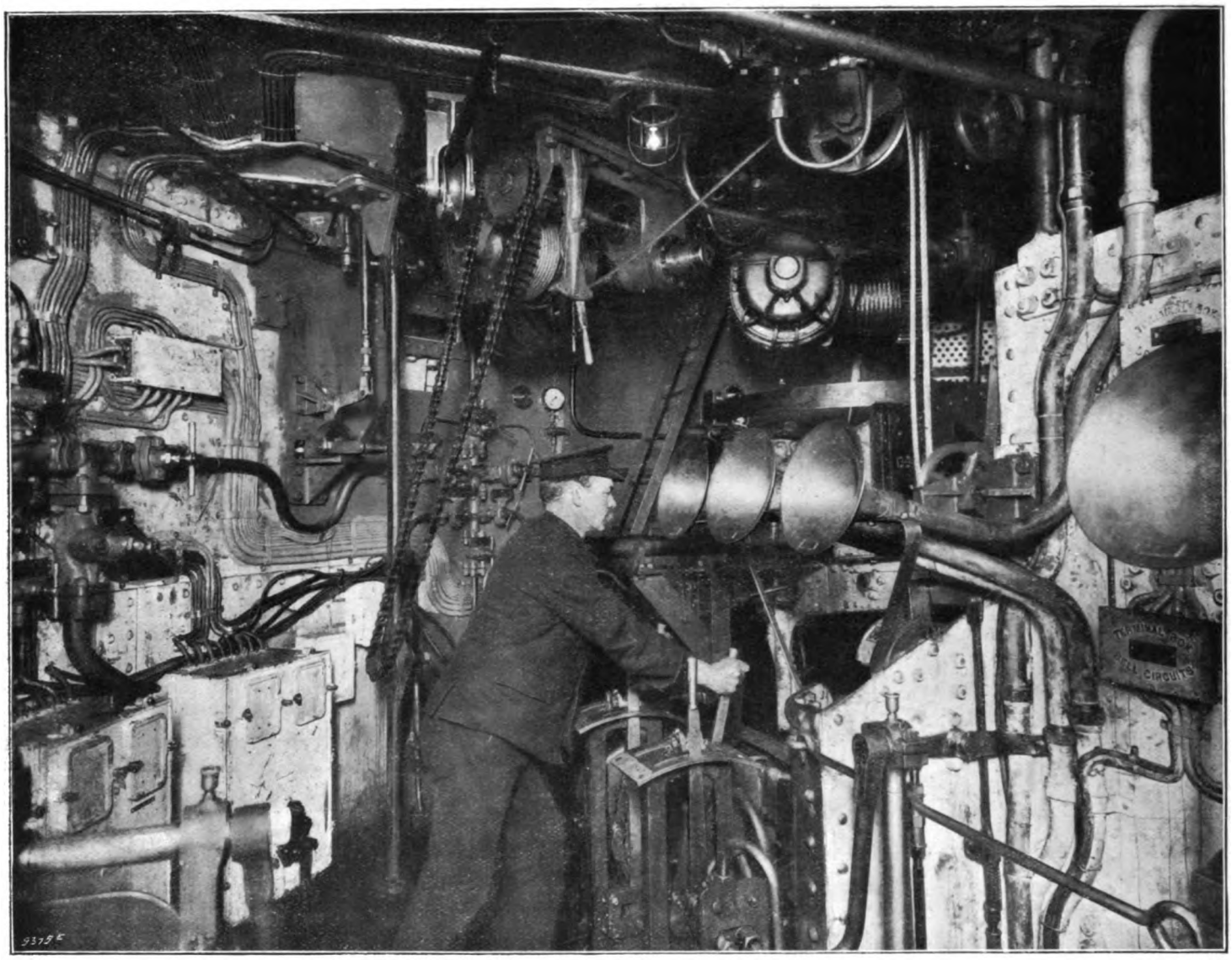

FIG. 7. WORKING CHAMBER BELOW TURNTABLE IN 12-IN. GUN BARBETTE.

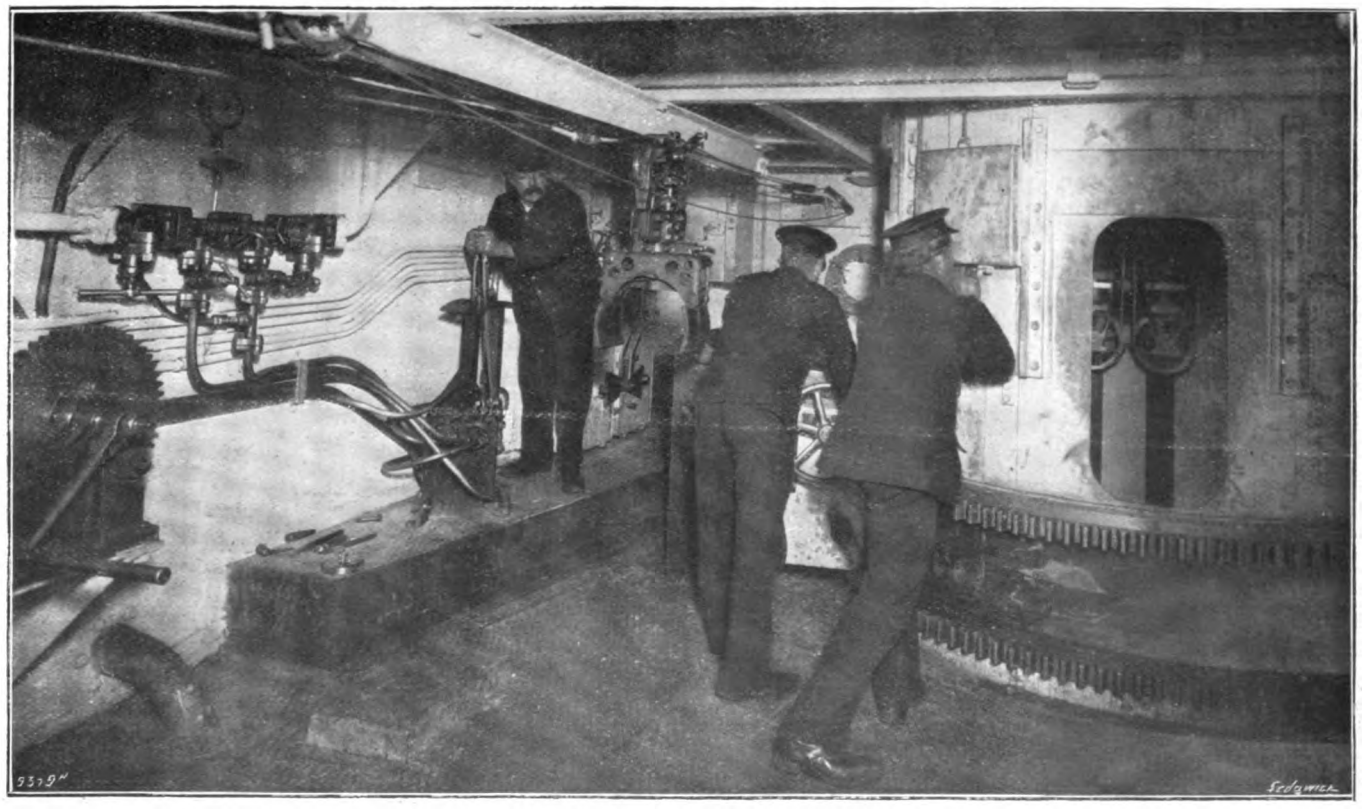

FIG. 8. SHELL-ROOM FOR 12-IN. GUN-MOUNTING, SHOWING LOWER END OF HOIST-TRUNK.

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(*For Description, see Page* 614.)

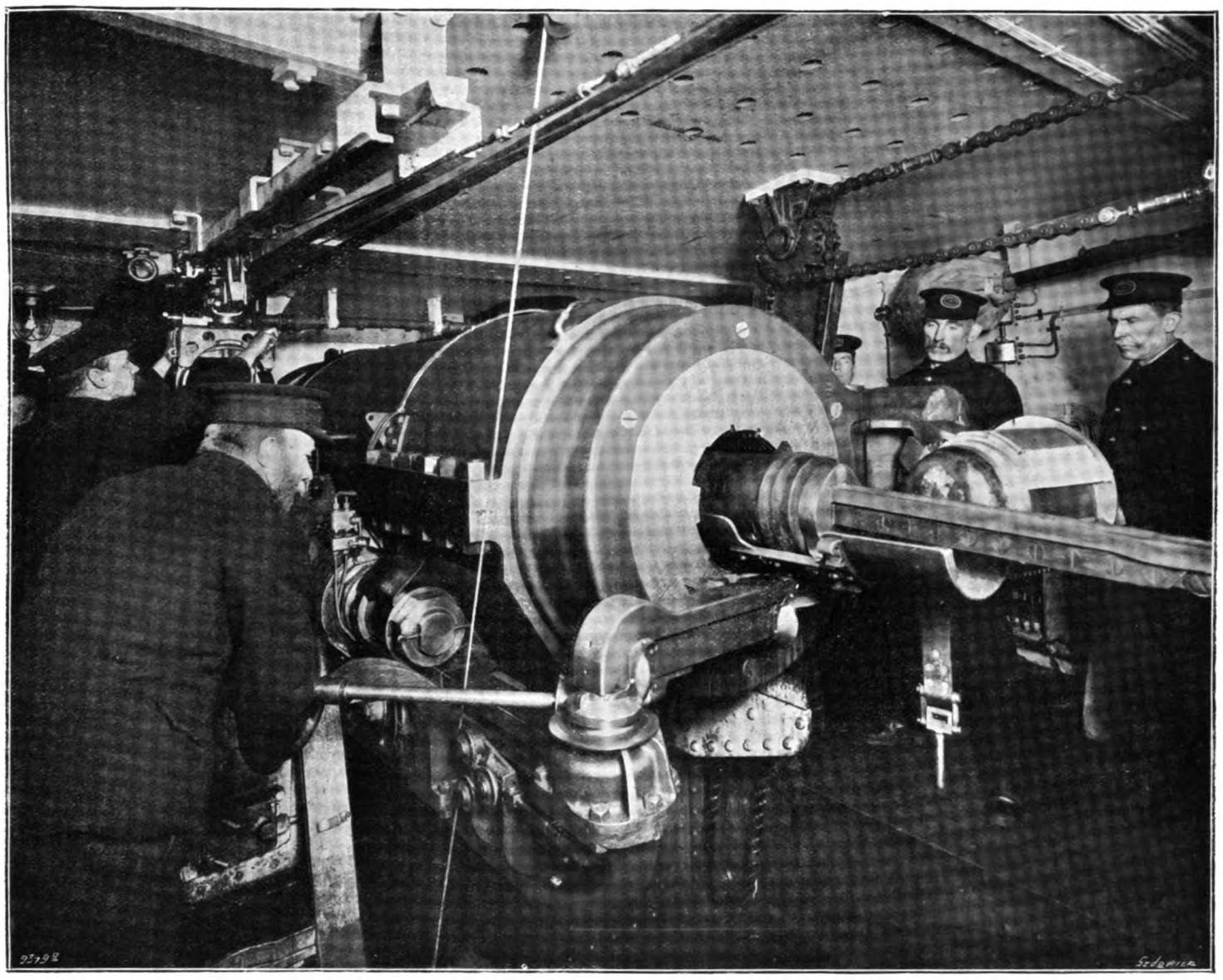

FIG. 9. LOADING 10-IN. GUN IN BARBETTE.

FIG. 10. LOADING 6-IN. QUICK-FIRING GUN.

FOUR-CYLINDER TRIPLE-EXPANSION T.-S. ENGINES OF THE JAPANESE BATTLESHIP "KATORI."

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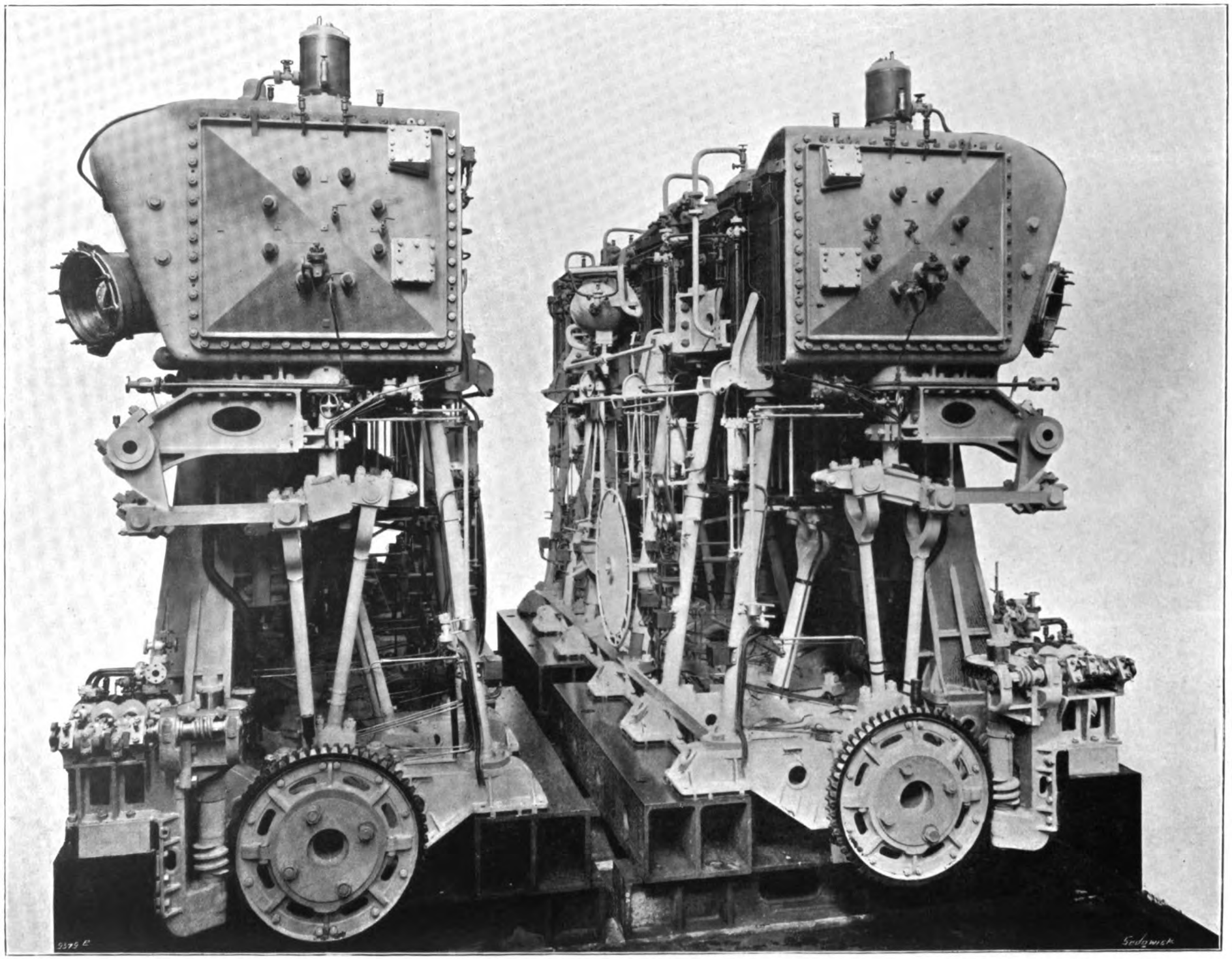

FIG. 23.

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CONTENTS.

With Four One-Page Plates of the JAPANESE BATTLESHIP "KATORI."

NOTICES OF MEETINGS.

THE INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' ASSOCIATION.—Monday, May 14, a paper will be read by Mr. M. Wesney Ward, graduate, on "The Construction of the Blast-Furnace." Mr. A. Tannett-Walker, Member of Council, in the chair.

THE SOCIETY OF ARTS.—Monday, May 14, at 8 p.m. Cantor Lectures. "Heraldry in Relation to the Applied Arts," by Mr. George W. Eve. (Three Lectures.) (Lecture I.)—Wednesday, May 16, at 8 p.m. "The Development of Water-Marking in Hand-Made and Machine-Made Papers," by Mr. Clayton Beadle. Sir Francis Haydn Green, Bart., will preside.

THE JUNIOR INSTITUTION OF ENGINEERS.—Wednesday, May 16, at 7.30 p.m. Joint meeting with the Discussion Section of the Architectural Association, at 18, Tufton-street, Westminster, to continue the discussion on the paper on "Ferro-Concrete," by Mr. S. N. Bylander.—Saturday, May 19. Visit to Hornchurch, Essex, for inspection of a wharf being constructed in ferro-concrete. Train leaves Fenchurch street (London, Tilbury, and Southend line) at 2.40 p.m. Special return ticket, 1*s.*, to be obtained from the Secretary.

THE ROYAL METEOROLOGICAL SOCIETY.—Wednesday, May 16, at 4.30 p.m., in the rooms of the Society, 70, Victoria-street, Westminster, S.W. Papers to be read:—1. "An Instrument for Testing and Adjusting the Campbell-Stokes Sunshine-Recorder," by Dr. W. N. Shaw, F.R.S., and Mr. G. C. Simpson, M.Sc. 2. "The Development and Progress of the Thunder Squall of February 8, 1906," by Mr. R. G. K. Lempfert, M.A.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, May 17, at 8 p.m., at the Society of Arts, John-street, Adelphi, W.C. "Notes on Overhead Equipment of Tramways," by Mr. R. N. Tweedy (Associate Member) and Mr. H. Dudgeon. Paper read at meeting of the Birmingham Local Section on February 14, 1906.

THE INSTITUTION OF MINING AND METALLURGY.—Thursday, May 17, at 8 p.m., at the rooms of the Geological Society, Burlington House Piccadilly, London, W. The following papers will be discussed:—1. "The Ancient Auriferous Conglomerates of Southern Rhodesia," by Mr. J. W. Gregory, Member. 2. "Huntington Mill Notes," by Mr. C. E. Parsons, Member. 3. "Notes on Some Copper Deposits in Rhodesia," by Mr. C. Brackenbury, Associate. 4. "Chert Mining in England and Wales," by Mr. H. L. Terry, Associate. 5. "A New Form of Platinum Parting Apparatus," by Mr. A. Jarman, Associate.

THE ROYAL INSTITUTION OF GREAT BRITAIN.—Friday, May 18, at 9 p.m., Professor Arthur Schuster, Ph.D., Sc.D., F.R.S., F.R.A.S., on "International Science." Afternoon Lectures next week:—Tuesday, May 15, at 5 p.m. Professor William Stirling, M.D., LL.D., D.Sc., Fullerian Professor of Physiology, R.I., on "Glands and their Products." (Lecture II.).—Thursday, May 17, at 5 p.m. The Rev. J. P. Mahaffy, C.V.O., D.D., D.C.L., on (II.) "The Influence of Ptolemaic Egypt on Græco-Roman Civilisation."—Saturday, May 19, at 3 p.m. Professor Sir James Dewar, M.A., LL.D., D.Sc., F.R.S., M.R.I., Fullerian Professor of Chemistry, R.I., on "The Old and the New Chemistry." (Lecture I.).

ENGINEERING.

FRIDAY, MAY 11, 1906.

THE RELATIVE SPEED OF NAVAL CONSTRUCTION.

THE day upon which the French Press was rejoicing in the fact of the launch of the Ernest Renan, the most powerful armoured cruiser yet launched in France, a discordant note made itself heard amid the chorus of congratulation. This was provided by the *Evening Standard*, which stated that the Ernest Renan was a standing example of the bad effect of slow construction in this epoch, when rapidity, above all else, was the thing most to be desired in all relating to naval science. This ship was begun in 1902, and will not be actually finished until 1908; the result will probably be that somewhere about the beginning of 1910 the French Navy will be augmented by a vessel which will have cost 1,480,000*l.* sterling, and which will be practically old-fashioned and out of date before she is fairly in commission. The price, to English ideas, certainly seems excessive, to use no stronger language, when we consider what France is to get for nearly a million and a-half sterling: the Renan class, consisting of the Ernest Renan and Jules Michelet, are armoured cruisers of 13,644 tons; length on water-line, 515 ft.; beam, 72 ft.; and mean draught, 27 ft. They carry four 7.6-in. and twelve 6.4-in. guns, twenty-four 3-pounders, with two above-water and two submerged torpedo-tubes. Their total weight of armour is 3400 tons, made up of a 6¾-in. Krupp belt amidships, a 3-in. belt at the ends, an after 6-in. bulkhead, 8-in. turrets and conning-tower, and four 5½-in. casemates. The machinery comprises three sets of triple-expansion engines, three propellers, and Niclausse boilers; the designed horse-power is 38,000; speed, 23 knots; maximum coal-carrying capacity, 2300 tons. Their estimated cost was 1¼ millions sterling, but this has been enormously exceeded. Speaking on the subject of slowness of construction, the *Temps* says:—"We should like to be in a position to contradict the English journal (the *Evening Standard*), but we are obliged to admit that we build slowly, too slowly—far more slowly than should any Power which desires to possess a real war fleet; and, what is worst of all, more slowly than some other nations whose resources are really inferior to our own. We build slower than England, Germany, the United States, or Japan; and of these four Powers, two—Germany and Japan—have naval budgets smaller than ours; at all events, up to the present the credits voted for new construction are smaller, from which we deduce that not only do we build more slowly, but that what we do build costs us more money."

This is not the first time that the *Temps* has raised this question, as in 1897 it devoted a series of articles to prove that delays in construction were the most fruitful means of wasting money. Since that date the same paper has from time to time returned to the charge, but has failed to awaken the powers that be to a sense of the remarkable disadvantages of their procedure in this respect. Socialism, strikes, "Liberty, equality, fraternity," and the rights of man, have all had a hand in bringing about this state of affairs, and a nation may well say that it cannot afford to maintain a big fleet if construction, ship for ship, is to cost it one-third more than it does its rivals. Construction is, after all, largely in the hands of contractors nowadays, and it would appear that in France no great complaint is made in the national dockyards of these persons (as all alike are more or less the subjects of King Demos); but it is frankly recognised that no effort comparable to that just performed in England in the building of the Dreadnought could possibly be accomplished across the Channel. It is recognised, of course, how much contracting out was done in the case of the English battleship; but although a certain amount of facilities of this sort exist in France, the parts could not be assembled in the way in which this has been done at Portsmouth.

The French shipbuilding industry is neither so well organised, nor so well furnished, as is that of England, and the cause thereof is not far to seek; in England, at all events for some considerable number of years now, a certain continuity of naval policy has been followed by the responsible authorities of the nation, whereas in France no man could tell what the morrow might bring forth. Thus in 1890 M. Barbey, then Minister of Marine, attempted to undertake a decennial programme of new construction; he entered into negotiations with contractors and their workmen, and his demands entailed certain sacrifices which were made with the idea that they would be good for trade in the future; these hopes being disappointed by the course of internal politics, the contractors and the *industriels* very naturally adopted the attitude of the "once bit twice shy." Uncertainty, lack of any guarantee for the future, is the most deadly of all diseases from which a constructive policy can suffer; and thus it has been in France that, while other nations have been going ahead with a certain rhythmical expansion, her progress, such as it has been, has been by fits and starts. If we take mercantile tonnage, we find that in 1899 she launched 89,794 tons; in 1900, 116,853 tons; in 1901, 177,543 tons; in 1902, 192,106 tons. In 1903 the total suddenly fell 100,000 tons, and in 1905 only 78,124 tons were launched. In a very similar measure, the same irregularity went on in the building of warships, and it need hardly be said that this extraordinary instability in an important industry had the most disastrous results. Nowadays skilled artisans for warship construction are not the product of weeks or even months of employment, and when this latter fluctuates in the manner just demonstrated, your artisan may often be hard to find when most he is wanted. Perpetual employment for everybody connected with a shipbuilding establishment is, of course, an ideal state of affairs, which, *pace* the English Labour Party, never has obtained, and never can obtain; no shipbuilder can keep his yard open unless a certain continuity of business is more or less assured to him, as it is impossible to pass from a state of complete inactivity to that of strenuous activity in complex industrial matters.

Apart from the industrial question, there is another, equally grave, which vexes the souls of constructors and economists in France; this is the want of foresight on the part of those who are responsible for warship construction. It is bad enough to work by fits and starts, to have a hot fit followed by a cold one in voting credits in the Chamber, but worst of all is it when, by want of ordinary prudence, ships are kept waiting after they are built. A man-of-war, of no matter what tonnage, is, after all, a gun-carriage, destined to