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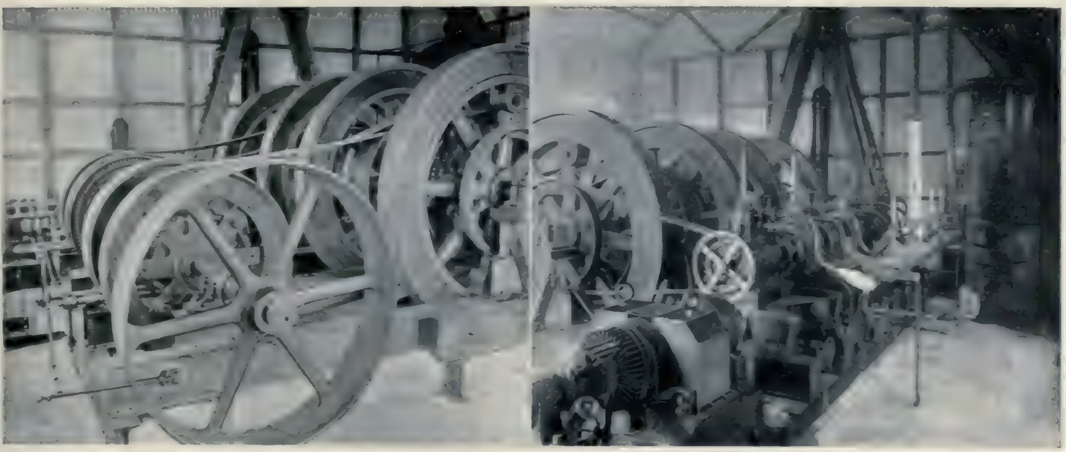

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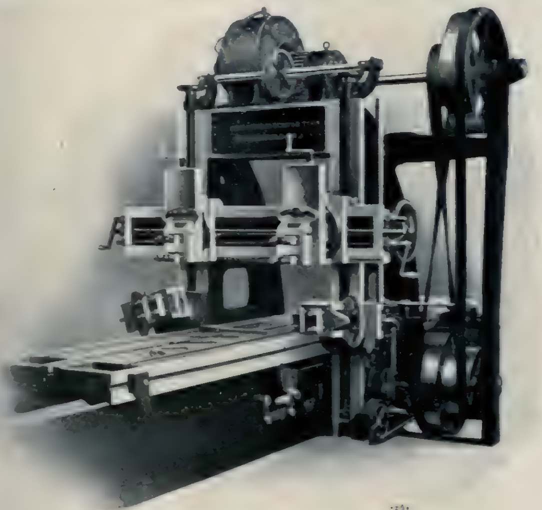

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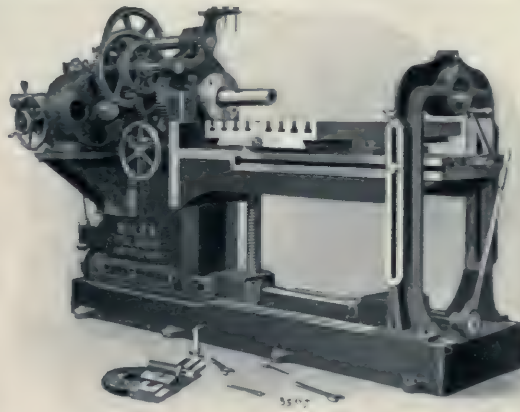

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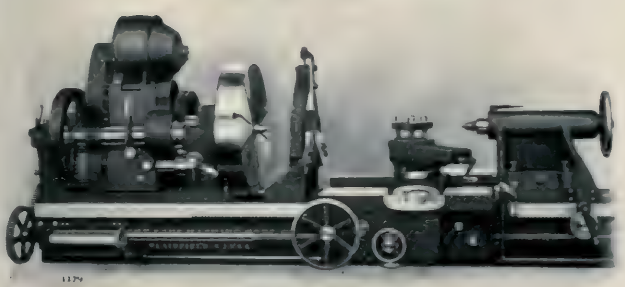

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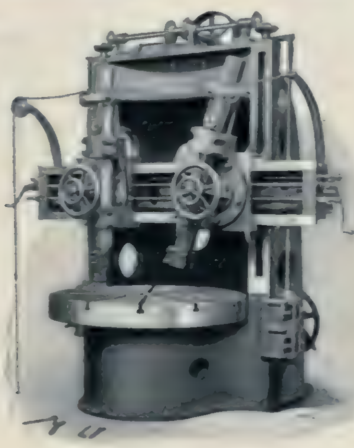

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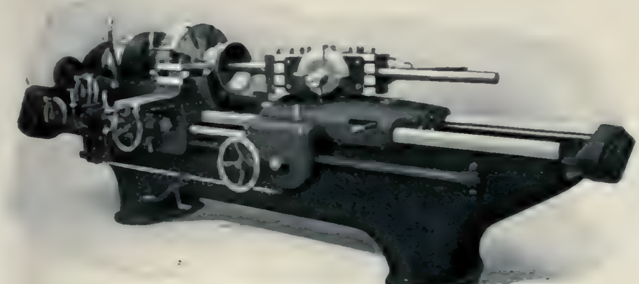

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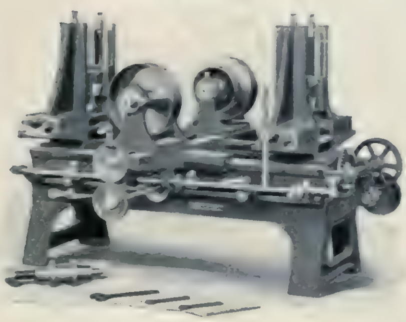

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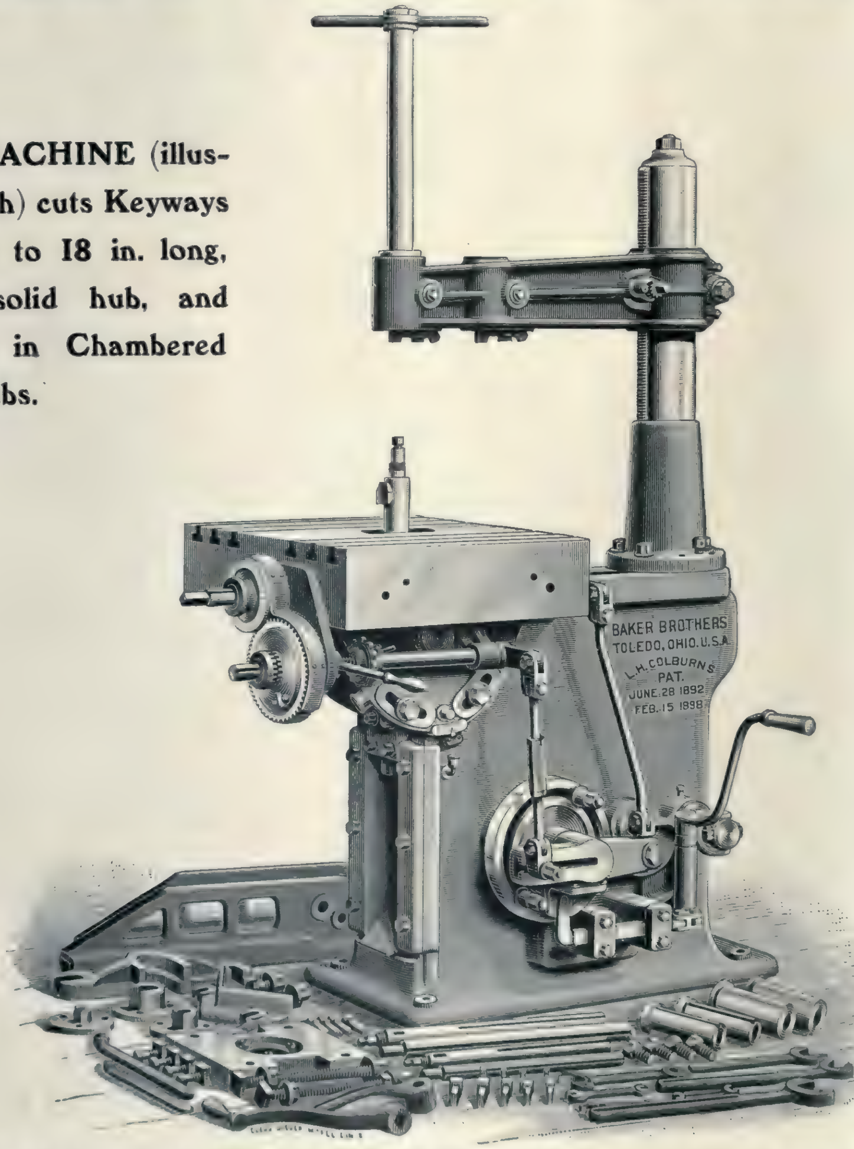

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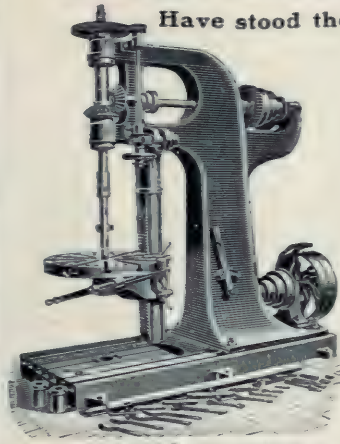

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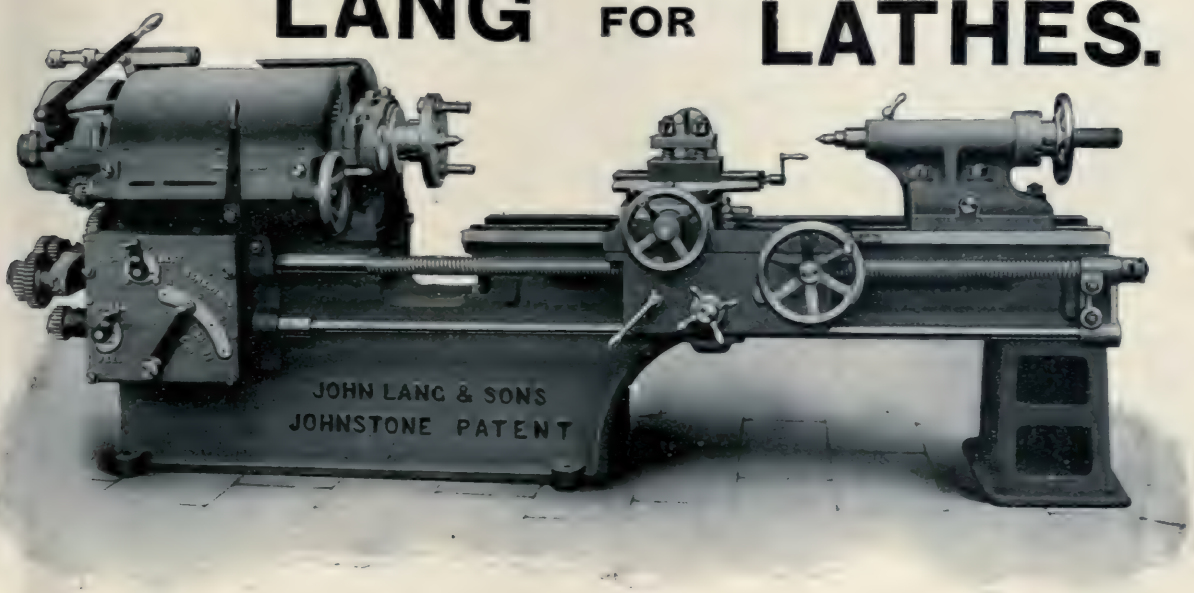

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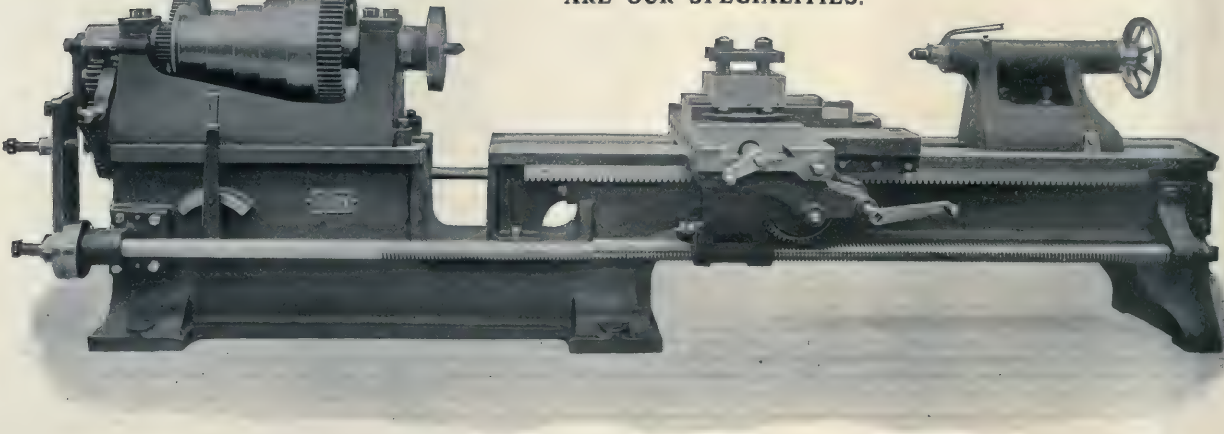

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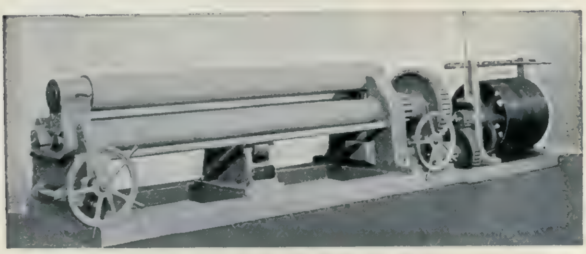

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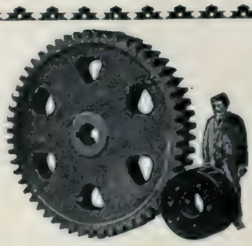

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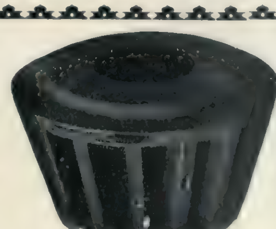

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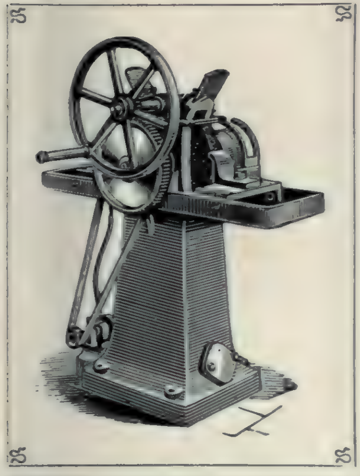

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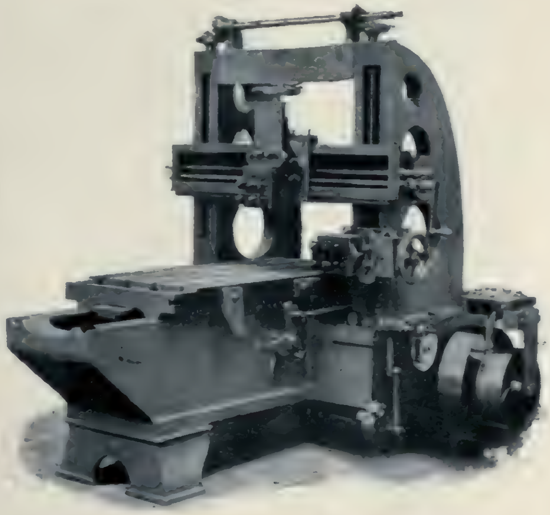

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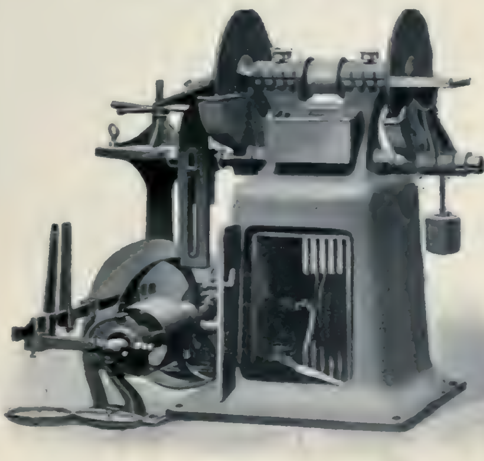

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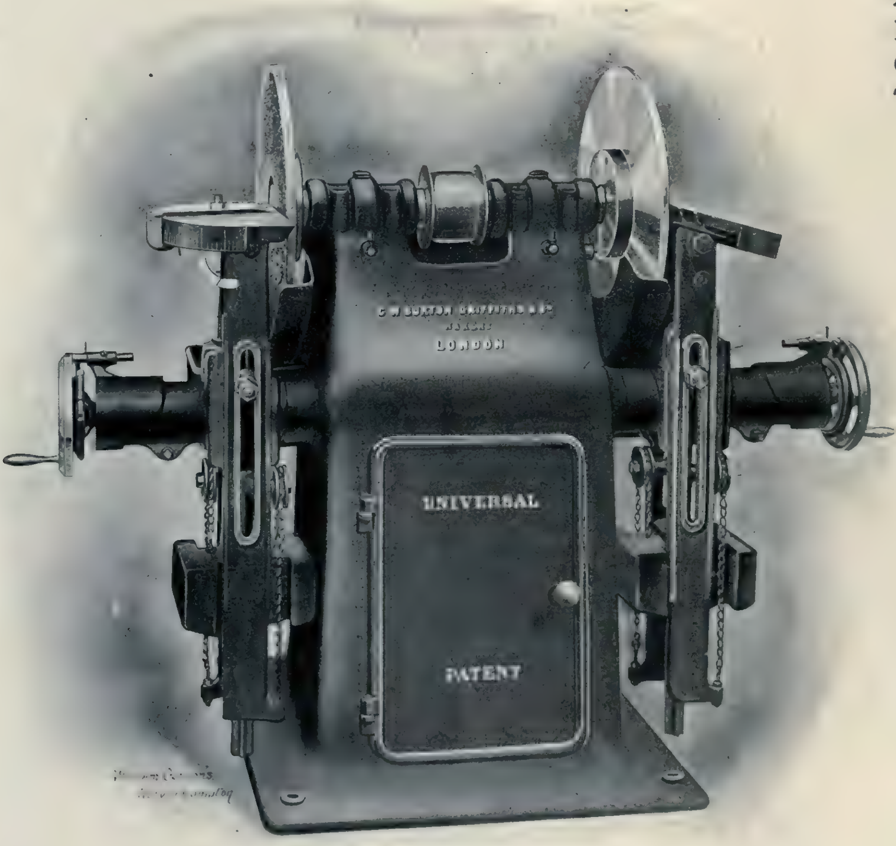

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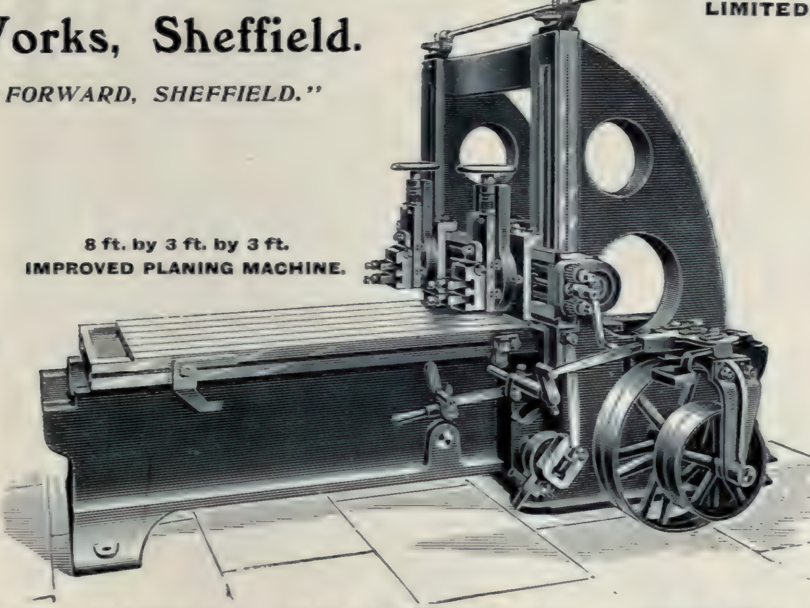

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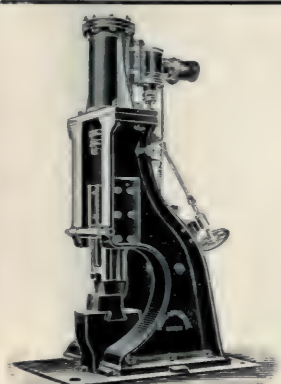

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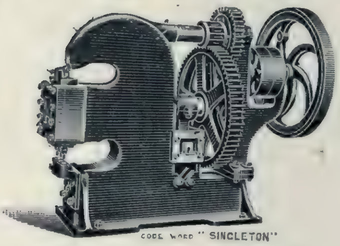

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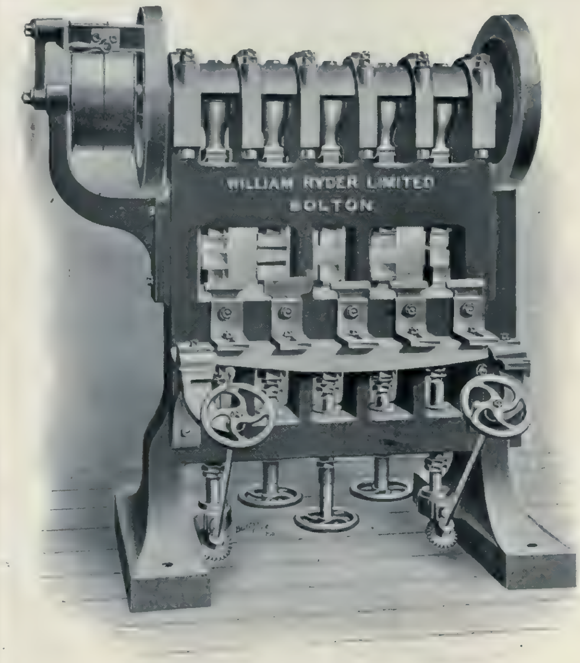

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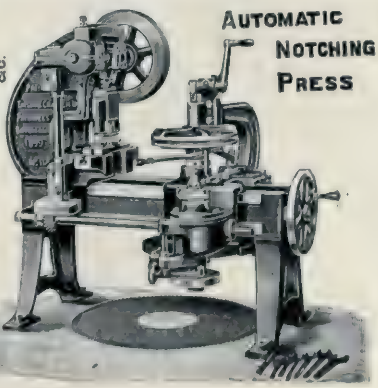

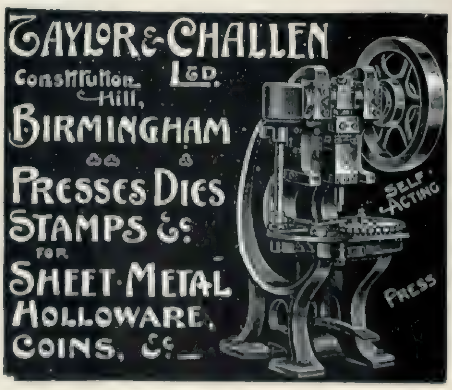

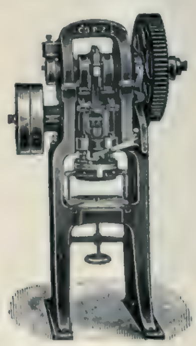

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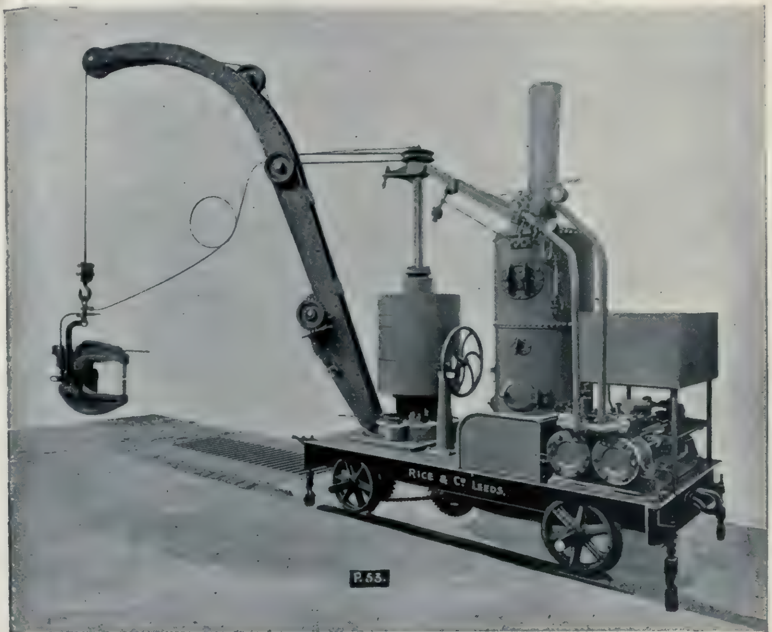

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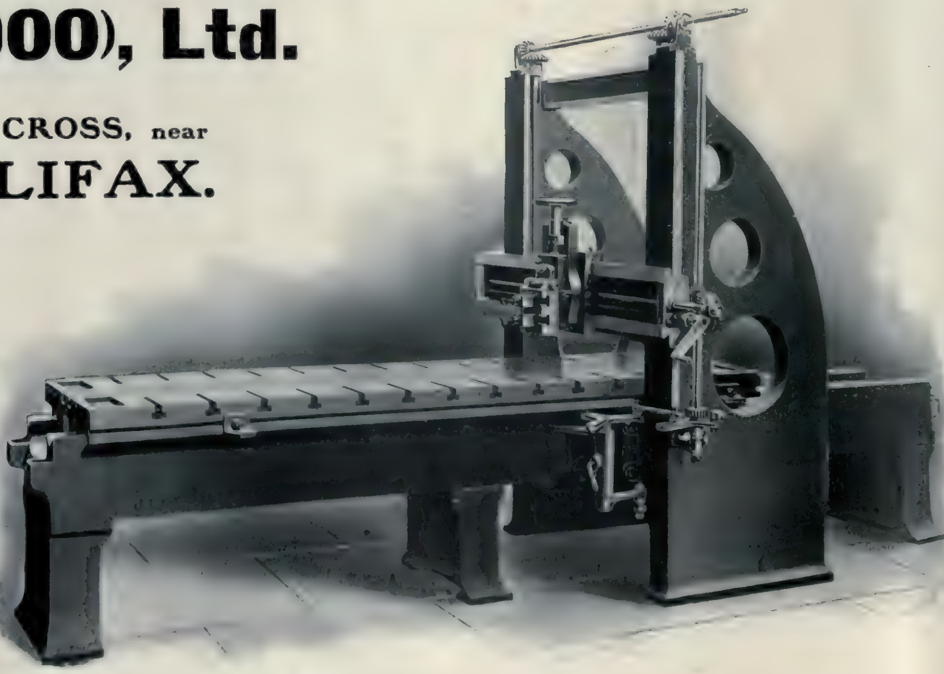

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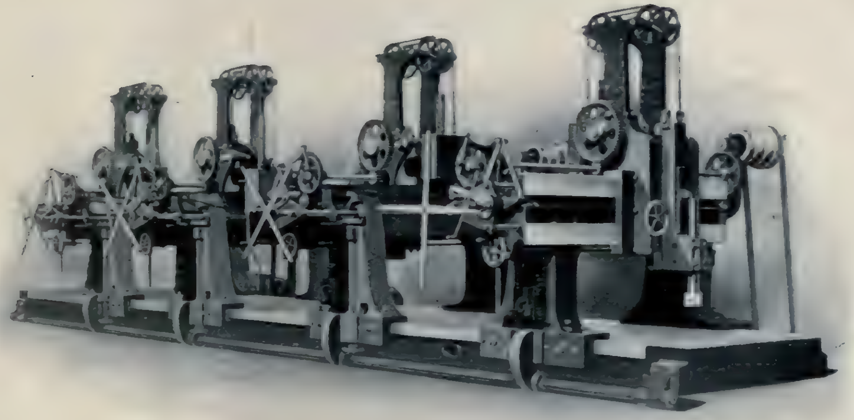

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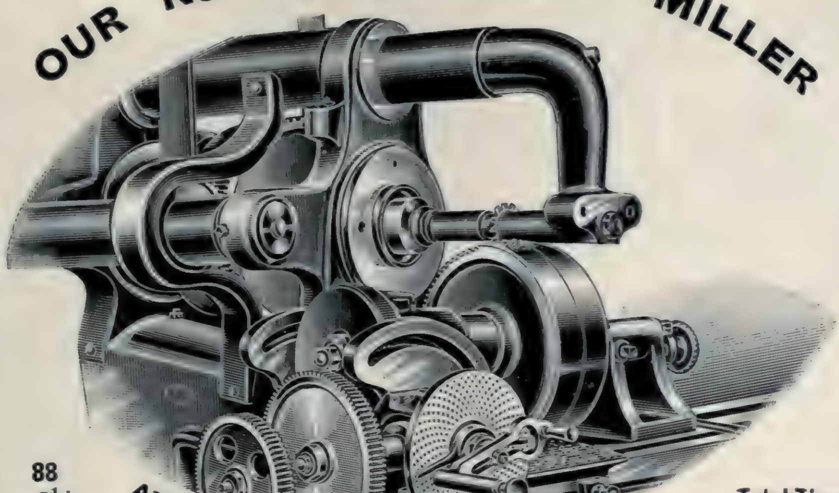

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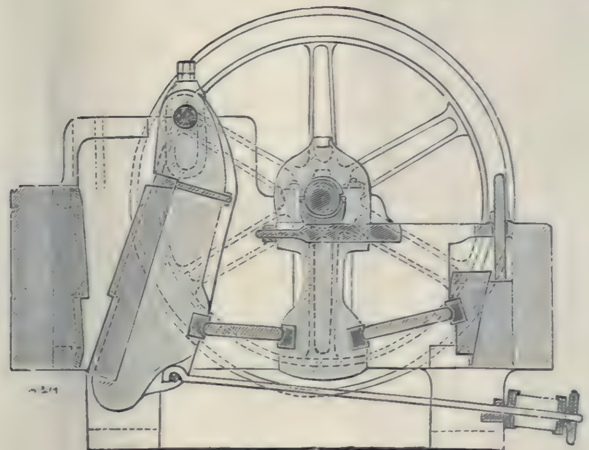

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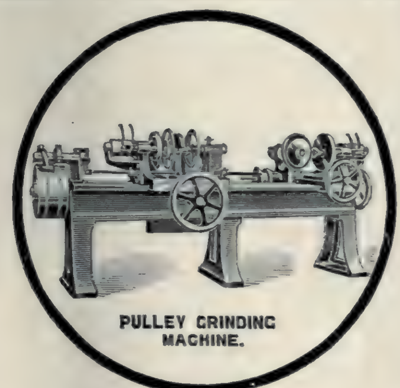

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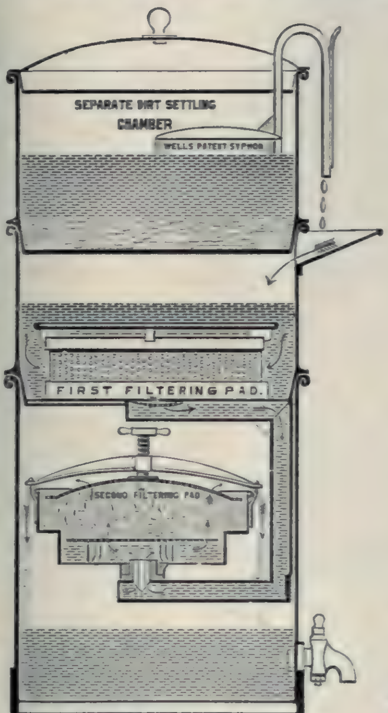

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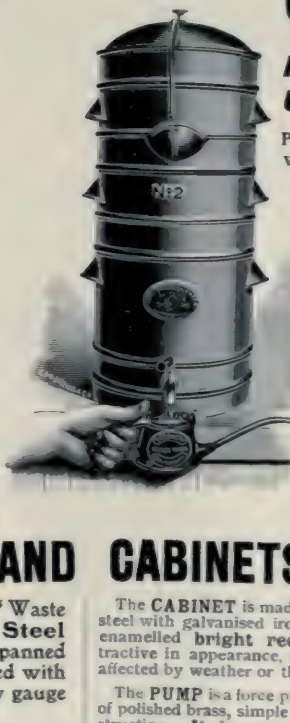

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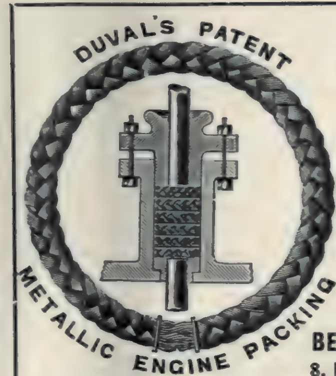

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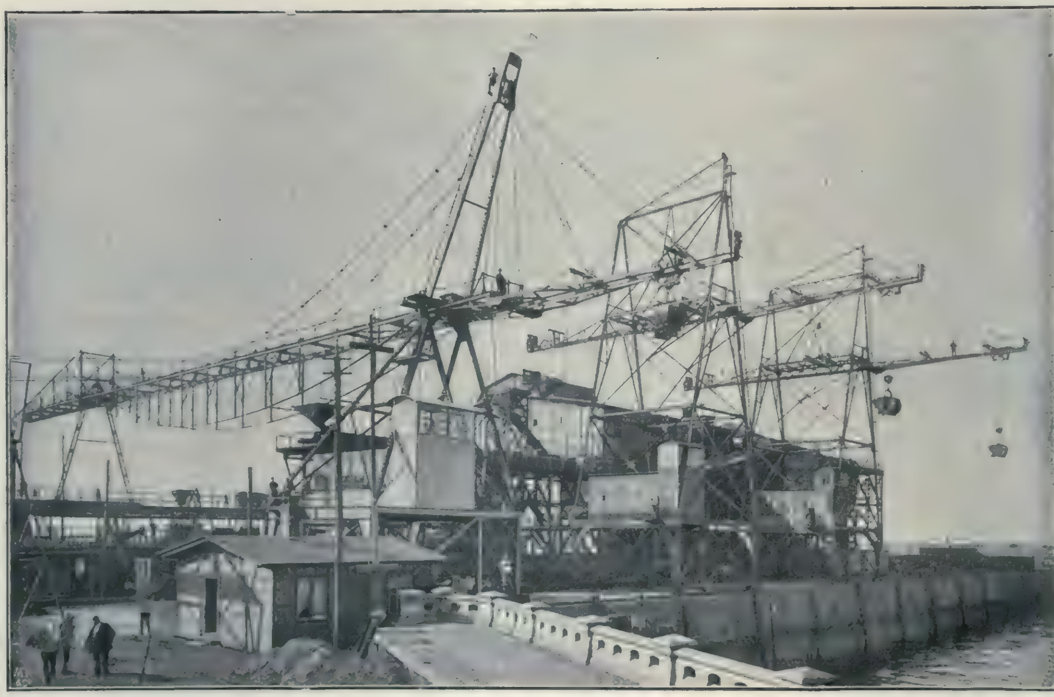

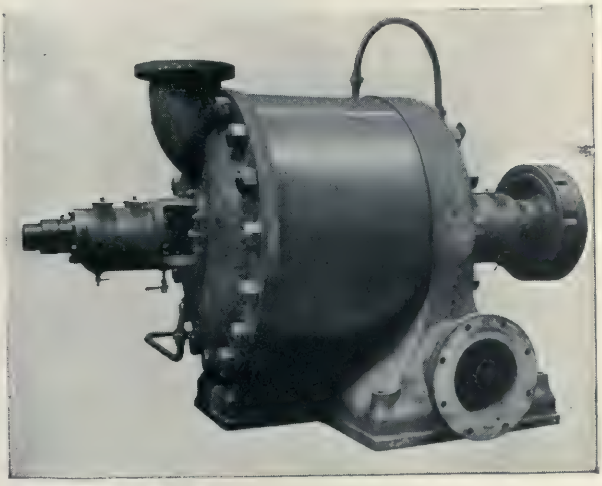

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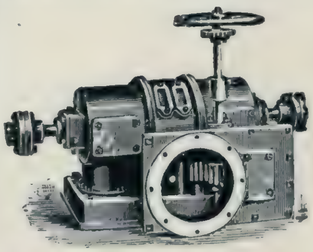

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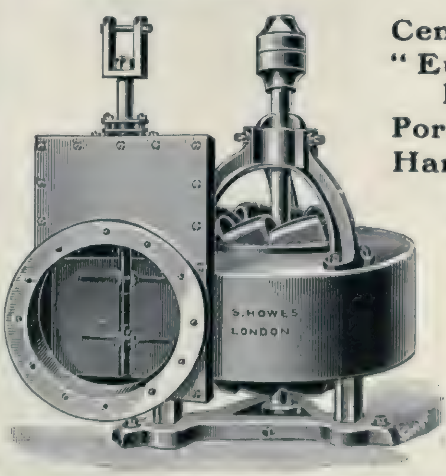

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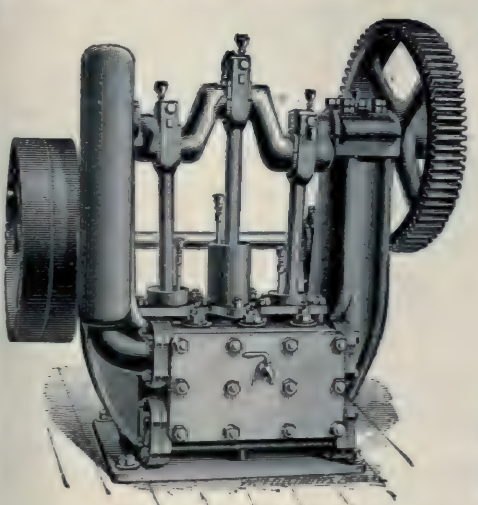

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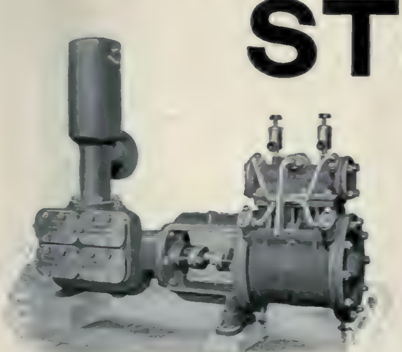

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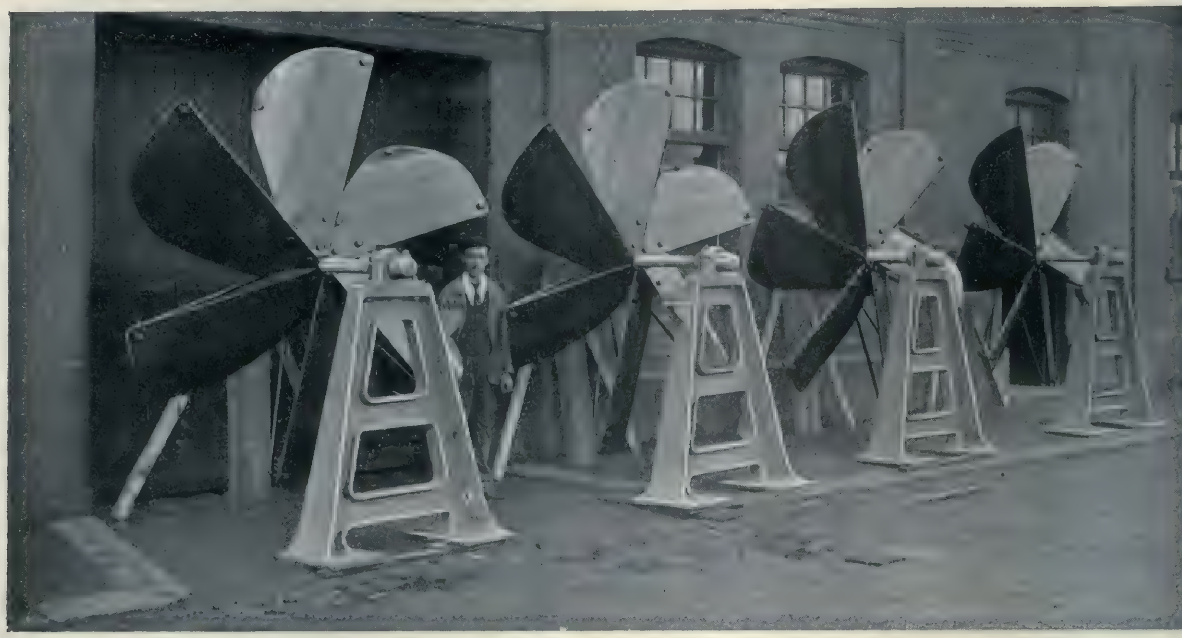

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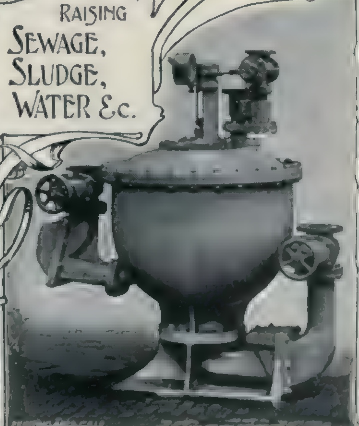

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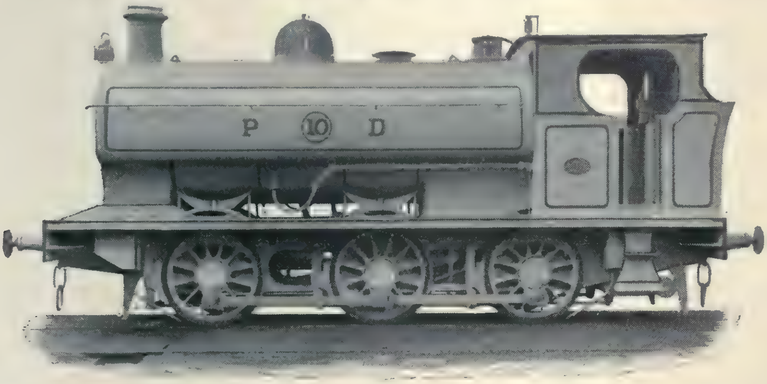

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THE . .

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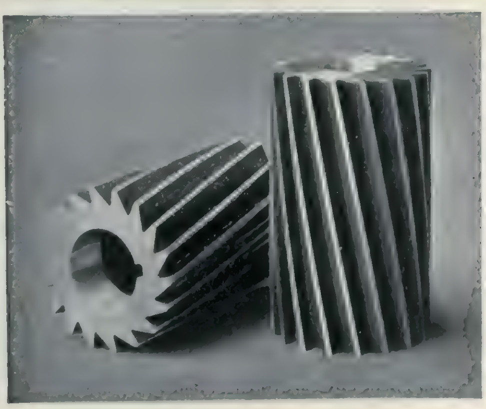

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ON BOARD THE FRENCH BATTLESHIP "REDOUTABLE."
Firing one of the breech-loaders.

PAGE'S MAGAZINE

An Illustrated Technical Monthly, dealing with the Engineering, Electrical, Shipbuilding, Iron and Steel, Mining and Allied Industries.

VOL. V. LONDON, SEPTEMBER, 1904. No. 3.

PORTABLE STEAM ENGINES OF TO-DAY.

BY

J. C. R. ADAMS.

Mr. Adams continues the review of leading types of portable engines, which he commenced in the August number. The first article of the series appeared in the July issue of PAGE'S MAGAZINE, and dealt with the conditions to be observed in designing a successful portable steam engine.—ED.

III.

MESSRS. ROBEY AND CO., LTD.

THE portable engine made by Messrs. Robey and Co., Ltd., of Lincoln, may fairly claim on its merits to stand in the very front rank. All the qualifications enumerated in our preliminary sketch are embodied in its design. The cylinder is bolted to a planed steel bracket, riveted to the firebox casing, as are also the crankshaft brackets, not a single bolt being employed to attach any of the working parts to the boiler, the intermediate support for carrying the piston-rod guide-bars being formed by a casting spanning the two stay-rods. Thus no part of the engine is affected by the varying length of the boiler as it is heated and cooled.

The steam bend through which the main supply is taken to the cylinder not only contains the starting valve, but being extended upwards, forms a seating for the Ramsbottom safety-valve—a particularly neat and compact arrangement. Even the pressure-gauge is attached to this casting, so that the number of steam-joints in connection with the boiler shell is reduced to the absolute minimum. Thus the feed-pump is attached to the steel crankshaft bracket, the feed-water inlet itself being the only fixing actually connected to the boiler.

We have already alluded to Messrs. Robey's method of staying the firebox crown (see fig. 3), which relieves the firebox from the crushing stresses tending to distort the front and back plates, and allows of free access for cleaning purposes to every part of the crown plate—a very important matter in cases where incrustation is present.

This is a good engine, strikingly simple and direct in the application of all its parts, and well calculated to stand not only the rough usage generally accorded this class of engine, but also to give effect to the high boiler pressures now employed.

We may note in passing that Messrs. Robey and Co. manufacture these single-cylinder portable engines up to 15 nominal or 45 effective horse-power, a larger size than is usual in this class of engine.

Messrs. Robey also send us a photograph, which we have pleasure in reproducing, of what they state to be the largest portable engine ever constructed. This gigantic machine is capable of developing no less than 200 effective horse-power.

We hope to have more to say about this under the head of Compound Portable Engines, but in the meantime we publish it as a curiosity. It must be nearly as large as a railway locomotive.

MESSRS. RUSTON, PROCTOR AND CO., LTD.

Messrs. Ruston, Proctor and Co., Ltd., of Lincoln, send us a photograph of their latest type of single-cylinder portable engine (fig. 18), into which a very remarkable development is introduced. The idea, itself is not a new one, but it is safe to say that its revival in the form adopted by Messrs. Ruston is only rendered possible by the use of modern machine tools of exceptional size and power.

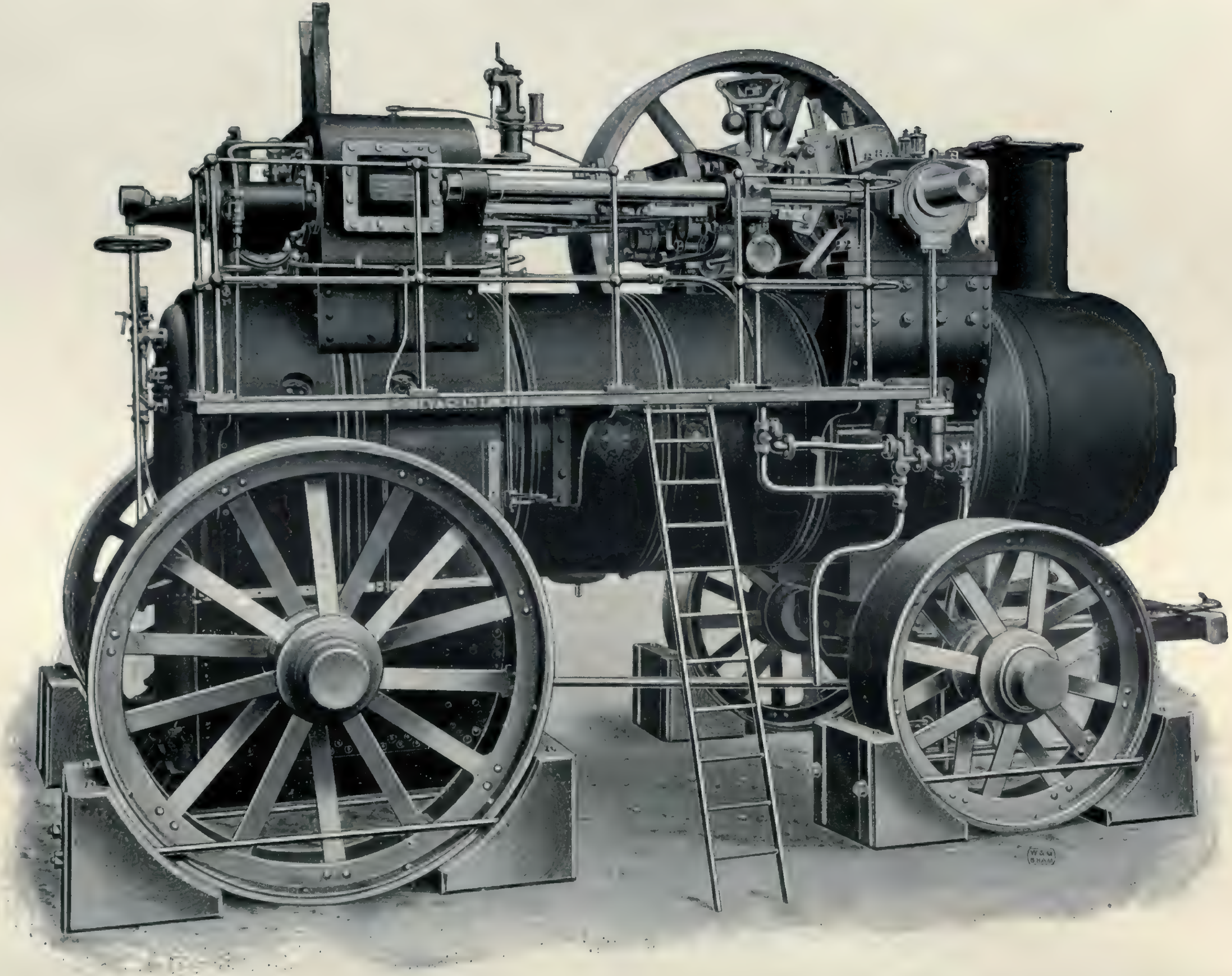


FIG. 17. MESSRS. ROBEY AND CO.'S 200-HORSE-POWER PORTABLE ENGINE. THE LARGEST PORTABLE ENGINE EVER CONSTRUCTED.

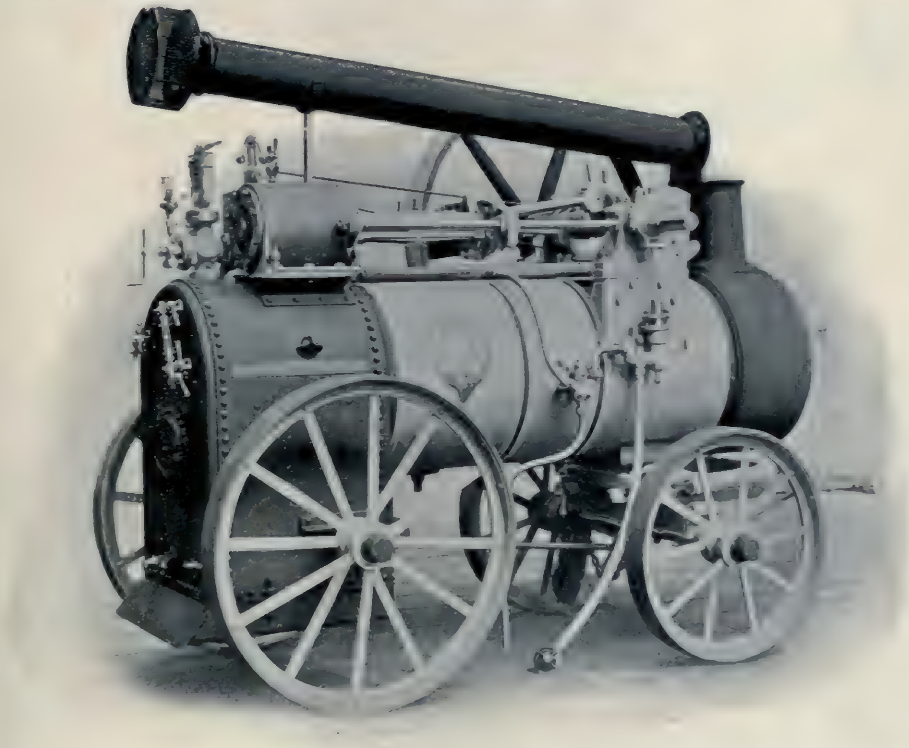


FIG. 16. MESSRS. ROBEY AND CO.'S SINGLE-CYLINDER PORTABLE ENGINE—6 TO 15 NOMINAL HORSE-POWER.

To the top of the firebox casing is riveted a large square cast-steel seating of size equal to the flat bottom of the cylinder. The included portion of the firebox top is perforated by a number of holes (42 in the example before us). Upon this seating the cylinder is bolted by a strong and wide flange, passing all round the latter, the combination forming to all intents and purposes a square steam-dome having the cylinder formed within it; the boiler steam, by the holes already mentioned, being in free communication with the steam-jacket right round the liner which forms the cylinder barrel. Dry steam and an absolute immunity from priming are the advantages claimed, and with good reason, for this new departure.

Of the strength and solidity of this arrangement there can be no two opinions; that the huge steam-joint under the cylinder will give no trouble is practically guaranteed by the fact that the entire boiler, after the seating and brackets are riveted upon it, is put into a planing machine, and the flat surfaces for the reception of the cylinder and plummer-blocks machined to a true and level plane. Still, we must be pardoned for saying that on the whole we should prefer to put our money on Messrs. Ruston's previous type, where the cylinder, completely isolated from the boiler (save for the external steam-inlet forming the starting-valve), made a dry joint, secured by only eight bolts on the top of a pair of steel brackets double-riveted to the boiler. However, we believe Messrs. Ruston are quite willing to supply their previous type (which made an admirable horizontal stationary engine when detached from the boiler) to those who prefer it.

Our notice of this great firm's engine would not be complete if we omitted to mention their famous "steam-heated expanding stay" (fig. 19—a tubular tie-rod connecting cylinder and one bracket in free communication with the boiler at both ends, with the intention of keeping pace with the varying length of the latter. The small pipes connecting the interior of the tubular stay with the boiler are visible in the illustration of Messrs. Ruston's portable engine.

It would seem to be a defect in this arrangement that, until steam is actually formed, no more expansion of the stay takes place than would occur in the ordinary course if the stay were solid, and heated merely by conduction.

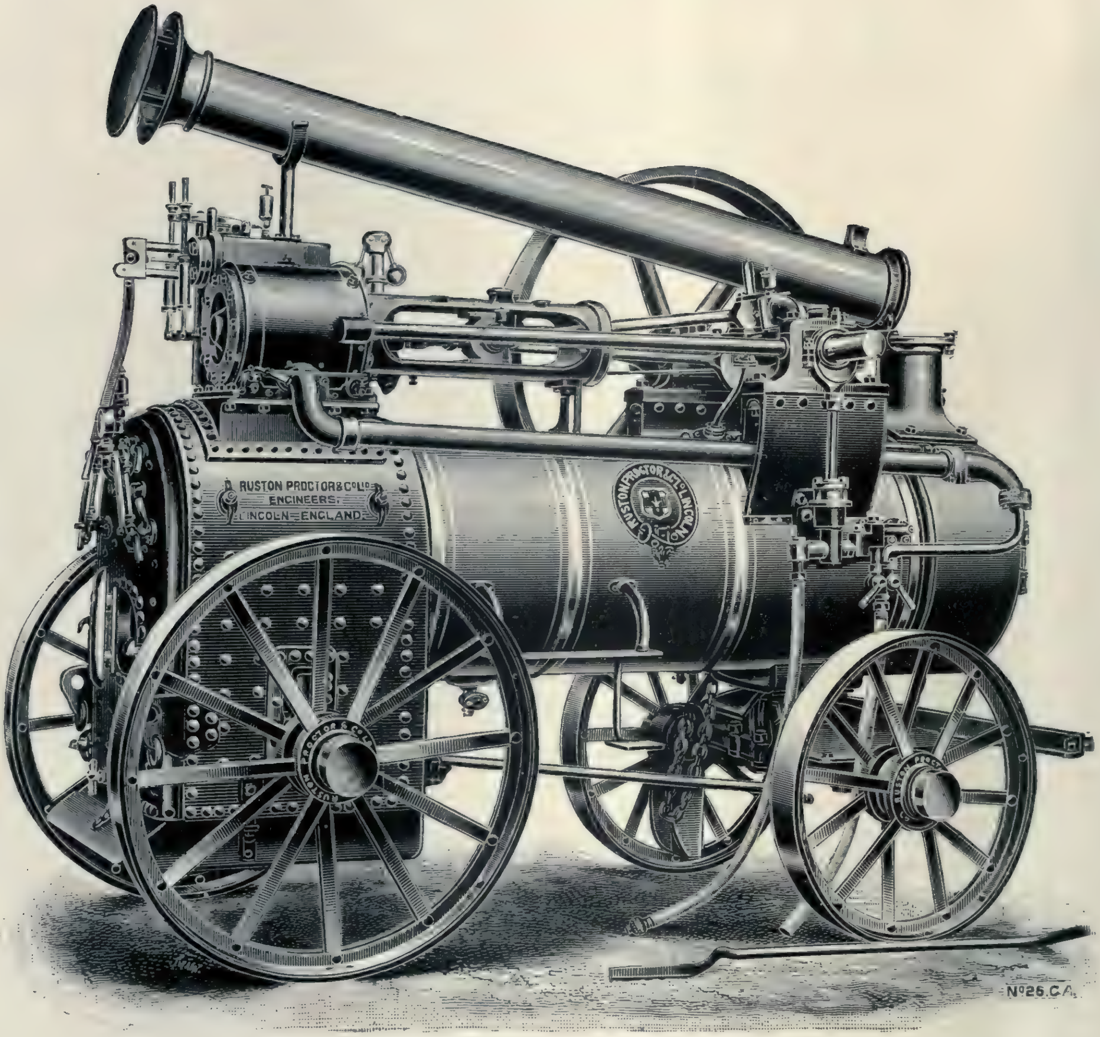


FIG. 18. MESSRS. RUSTON AND PROCTOR'S PORTABLE STEAM ENGINE WITH ONE CYLINDER.

FIG. 19. STEAM-HEATED EXPANDING STAY.

(Messrs. Ruston and Proctor.)

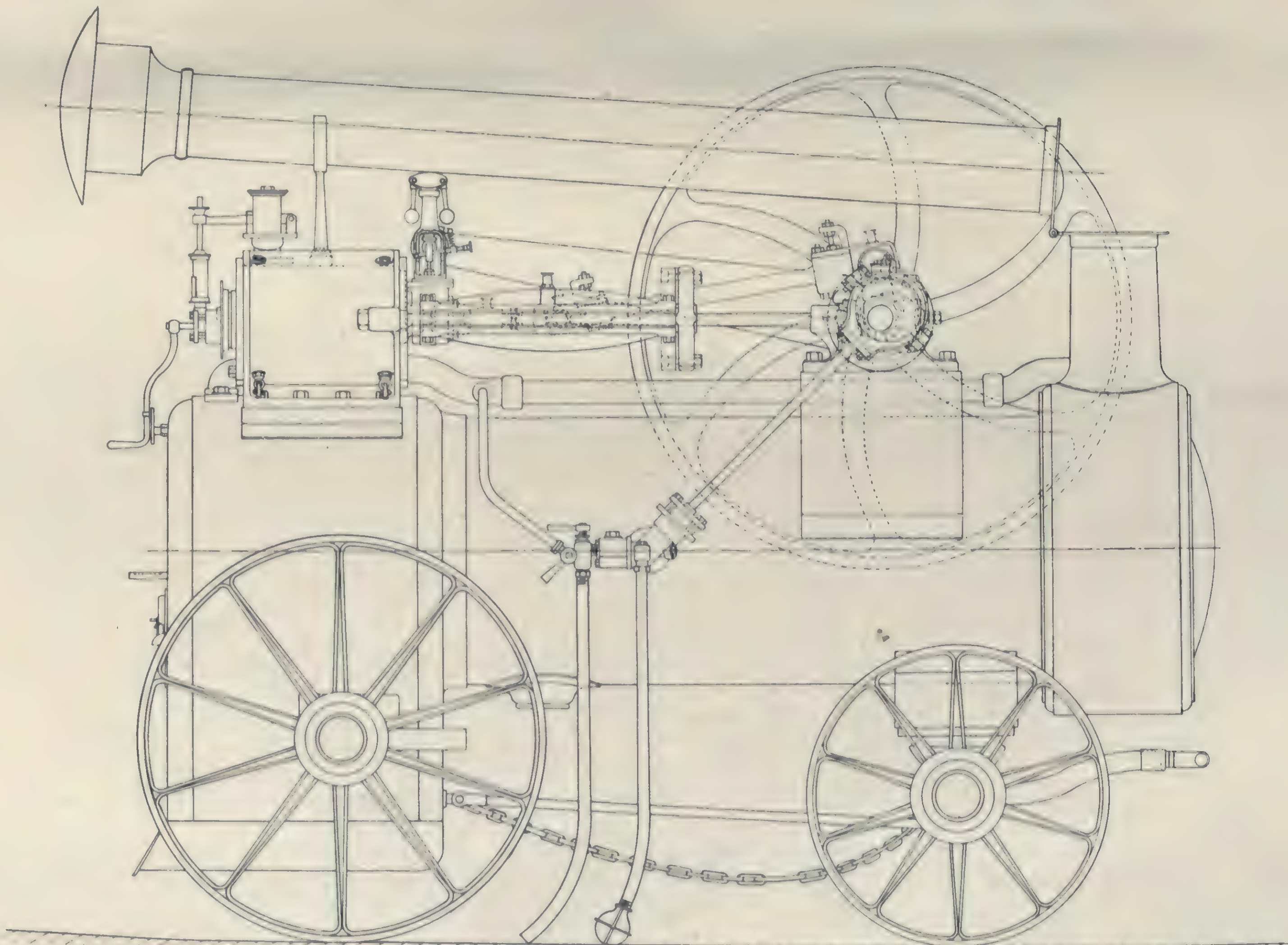


FIG. 20. ELEVATION OF MESSRS. DAVEY, PAXMAN AND CO.'S, LTD., PORTABLE STEAM ENGINE.

The temperature of saturated steam of 100 lb. pressure above the atmosphere is 328 deg. F., and assuming that during the process of steam raising the stay has heated by conduction to 100 deg.—a liberal estimate, while the boiler has reached a temperature of 212 deg.—we have at the boiling point a difference of 112 deg., the stay being operative only during the remaining 116 deg. This may or may not be a practical objection; at any rate, theoretically it only meets the difficulty half-way.

It should be noted that the stay is only applied to one of the crankshaft bearings—that next the crank—and that of course no provision for sliding the plummer-blocks is necessary. One more little criticism before we conclude our notice of one of the best portable engines ever manufactured.

The slowly rotating Watt governor, with its heavy balls, always strikes us as a peculiarly dignified and appropriate adjunct to the ponderous movements of a great beam-engine. On the contrary, when seen mounted on the end of a cast-iron cantilever bracket attached to the cylinder of a small portable engine, exposed to all the jolts and jars incidental to the rough travelling it is pretty sure to encounter, we are inclined to pity its hard lot. It has indeed seen better days.

Messrs. Ruston, Proctor, and Co. are, however, prepared to supply the quick-speed type of governor when required. (See fig. 18.)

MESSRS. DAVEY, PAXMAN AND CO., LTD.

Messrs. Davey, Paxman and Co., Ltd., of Colchester, have favoured us with advance copies of drawings of their newly revised series of single-cylinder portable engines.

From these drawings more complete and detailed views of the different parts are possible than from perspective views.

From the plan (fig. 21), it will be seen that the engine is quite up to the standard of requirements for a fully detachable engine. The crankshaft plummer-blocks upon both sides of the engines are cottered to steel rods connecting them with lugs cast upon the cylinder, the expansion of the boiler being provided for by a sliding arrangement permitting the plummer-blocks to slide upon the steel brackets riveted to the boiler. The outer ends of the guide bars are carried by a cast-iron bridge-plate spanning the two tie-rods, so that there is no intermediate attachment to the boiler.

The steam-inlet to the cylinder is through an independent bend, having an external and visible joint with the boiler; and the feed-pump is bolted to a steel flanged seating riveted to the side of the boiler barrel, and has a particularly neat and serviceable double valve-box and feed-water heating apparatus.

Altogether, Messrs. Davey, Paxman and Co. have gone straight to the point in their new type, and have produced a pattern for which we have nothing but praise.

(To be continued.)

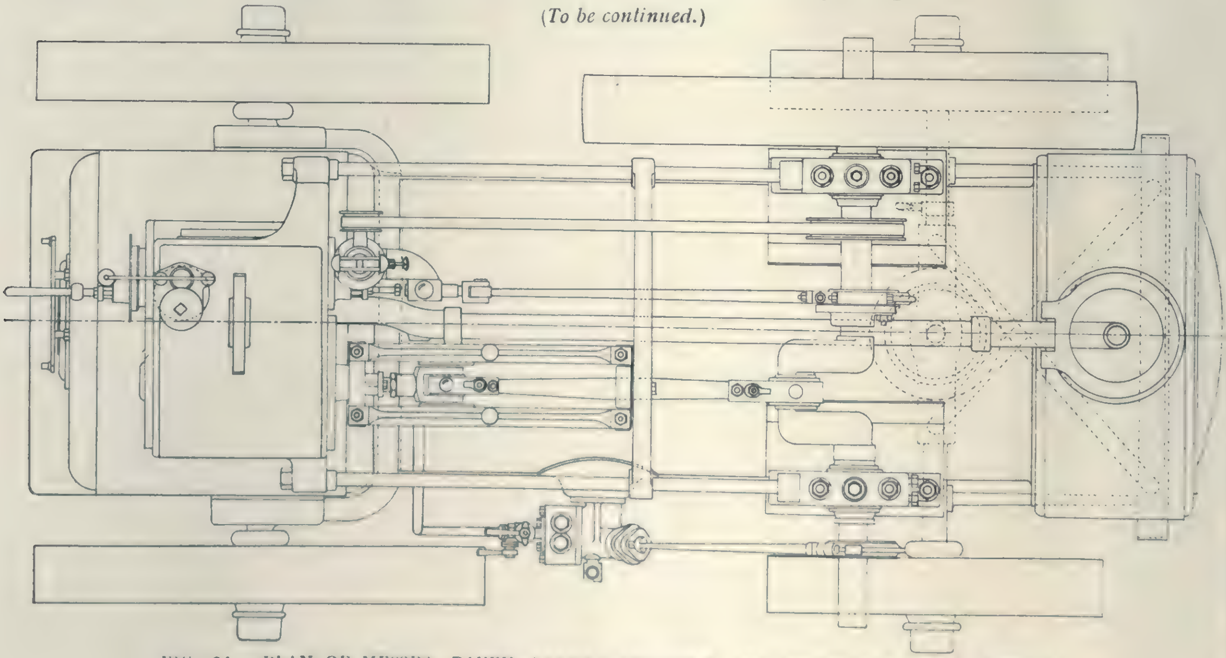


FIG. 21. PLAN OF MESSRS. DAVEY, PAXMAN AND CO.'S, LTD., PORTABLE STEAM ENGINE.

THE ARCHED CONCRETE DAM AT BAROSSA.

DESIGNED BY

ALEX. B. MONCRIEF, M.Am.Soc.C.E., M.Inst.C.E.,

Engineer-in-Chief, South Australian Government, Adelaide, Australia.

The Barossa Water Works, constructed for the supply of Gawler, South Australia, and district, offer several points of interest to the civil engineer, the chief feature being the arched concrete dam of unusual dimensions, designed by the Engineer-in-Chief to the South Australian Government, which is here described with the aid of illustrations specially taken for PAGE'S MAGAZINE.—ED.

THE highest arched concrete dam in Australia, which has recently been completed by the South Australian Government at Barossa, near Gawler, is 94 ft. above the ground line, and is only 4 ft. 6 in. wide at the top. The greatest thickness of concrete above the line of foundation is 34 ft. at the ground line. The dam is an arch with a radius of 200 ft. and the total length of the arc of the circle formed by the top of the dam is 472 ft.

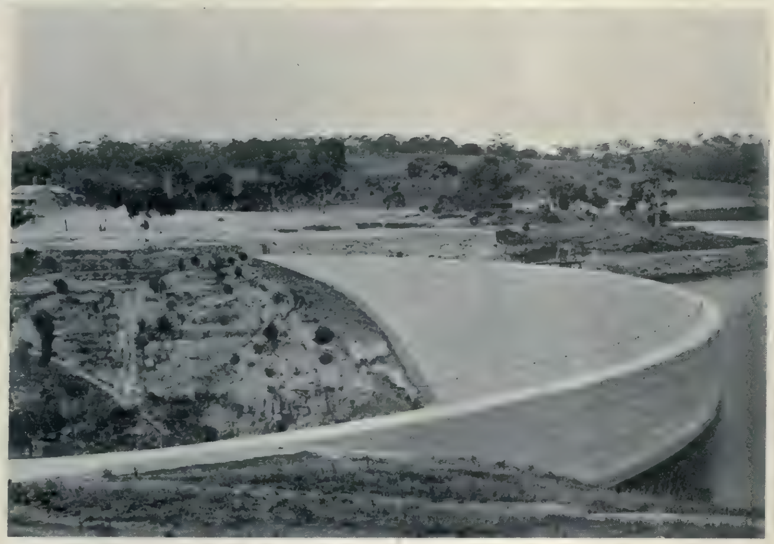
The Barossa Water Works were constructed for the supply of the town of Gawler, South Australia, and the surrounding farming district, the water to be delivered in cast-iron pipes under pressure for domestic purposes and stock, with a small surplus for garden irrigation, the supply being estimated at 1,000 million gallons per annum. The total expenditure approved by Parliament in November, 1898, for the original scheme was £225,000. The work was commenced in March, 1899, and was completed in February, 1903, at a cost of £169,947—the saving on the original estimate being due to the substitution of an arched concrete dam for a structure of gravity type, as originally proposed.

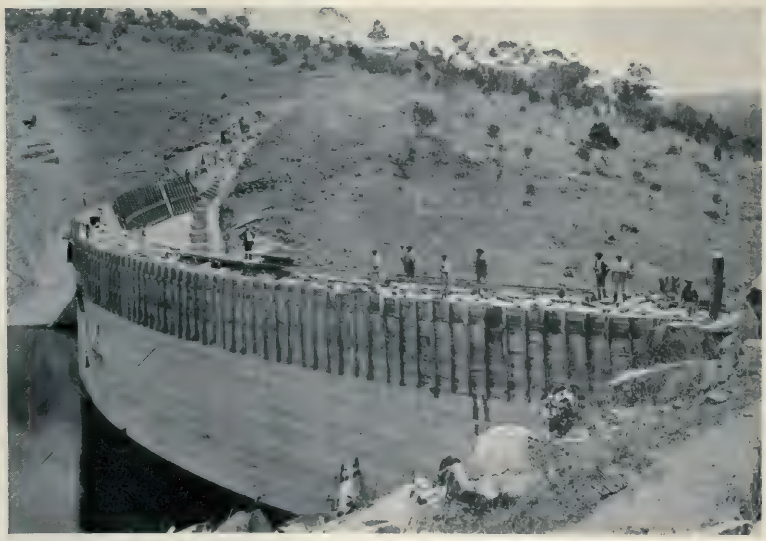
The original scheme included a concrete weir across the Para River, from which, when the dirty floods have passed, water is taken through a tunnel into a storage basin having a capacity of 1,000 million gallons. The tunnel is 7,400 ft. long, about 7 ft. 6 in. in diameter, and lined with concrete for about half its length. The storage basin is protected against impure drainage by an intercepting channel 1¼ miles in length, and is provided with outlet works, there being a main 22 in. and 18 in. in diameter, and about 7 miles long to the town of Gawler, the said main being constructed of steel on the locking-bar principle.

The chief interest of the works lies in two particulars, viz., that the supply from the intermittently flowing river is under complete control by means of cast-iron doors at the entrance to the tunnel, and that an arched concrete dam is employed of the unusual dimensions given above.

The dam is situated in a narrow valley with a steep rock cliff about 100 ft. in height on one side and a gently sloping spur of the range on the other. The accompanying cross-sections and plan of the dam show the general dimensions and quantities.

The foundations throughout were carried down to



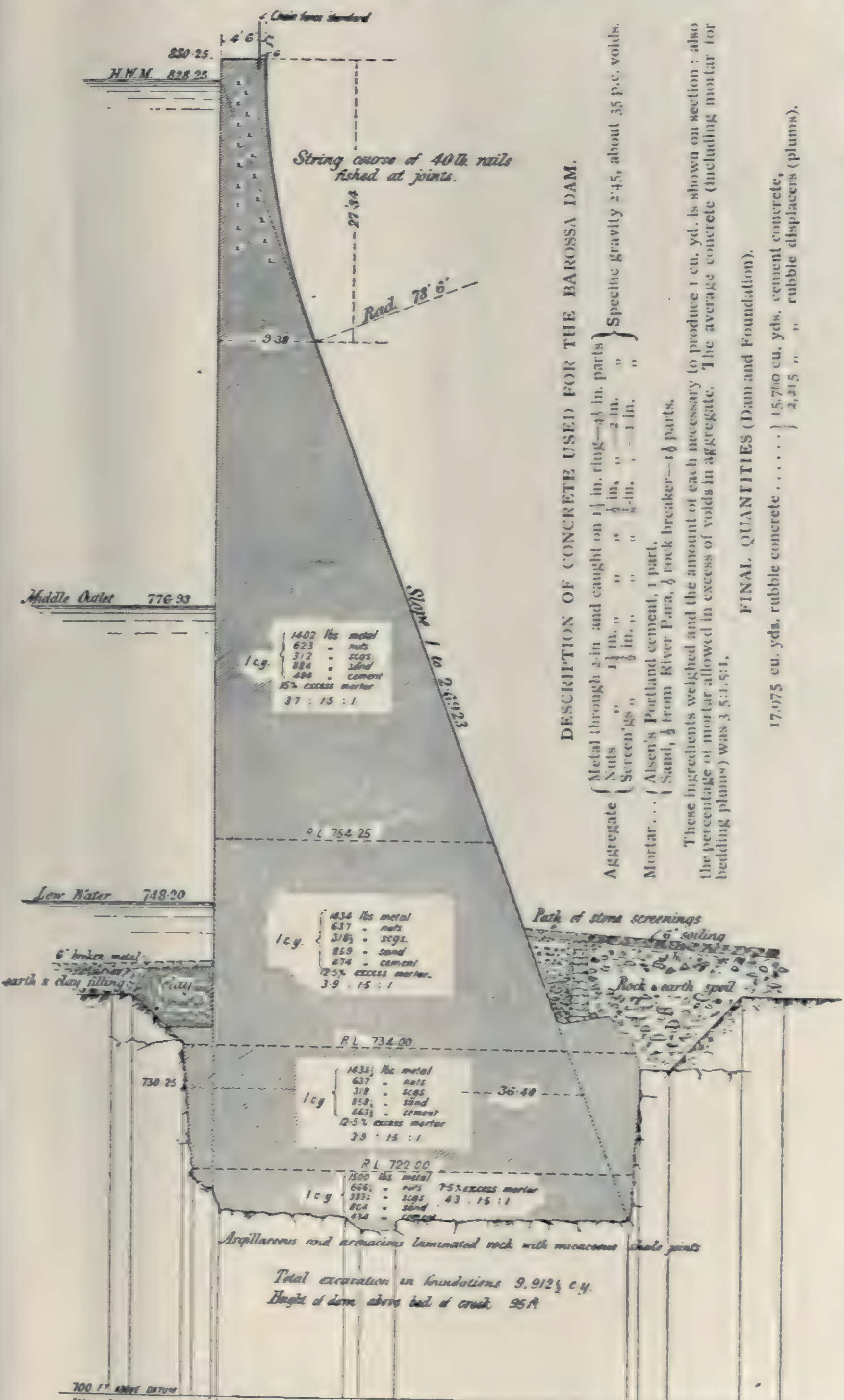


TWO VIEWS OF THE BAROSSA DAM.

Showing the work in process of construction and completed.

solid rock, and the excavation was carefully stepped for the reception of the thrust of the arch into the hill on both sides. The utmost care was taken that the whole of the ingredients should be as uniform as possible, and, to insure this result, they were all dealt with by weight, the appliances used for this purpose being automatic. Numerous tests were made before determining the proportions of the various aggregates and cement to be used in the concrete in order that a watertight dam might be insured. A number of 2-ft. cube concrete blocks were manufactured with varying proportions of ingredients, placed under hydrostatic pressure of 200 ft., and proved impervious before the proportions of the material to be used in the concrete was finally determined. The sand and stone were carefully washed and the cement was aerated for fourteen days before using. The quantity of cement necessary to produce half a cubic yard of concrete was then mixed with the required proportions of sand in two operations and tipped in layers between the various charges of aggregate to assist in thorough incorporation. The combined aggregates, sand and cement, were then passed through a Messent concrete mixer and immediately placed in the work. Rubble displacers or "plums" of gneiss rock were placed in the concrete, the rule observed being that no large stone should be nearer to any other than 6 in.

When the general level of the concrete had risen nearly to the natural surface of the gravel, moulding timbers were introduced, which were hung on bolts built into the wall at every 4 ft. vertical. Previous to insertion, these bolts were covered with paper from the cement casks and tied around with cotton, which formed an effective method of facilitating their removal from the wall, leaving the paper behind. The paper was then scraped out, the holes hosed, and filled with mortar. As the wall grew in height, the moulding timbers were raised to the



CROSS SECTION AT CENTRE OF THE BAROSSA DAM.

DESCRIPTION OF CONCRETE USED FOR THE BAROSSA DAM.

Aggregate { Metal through 2-in. and caught on 1½ in. ring—4½ in. parts; Nuts " 1½ in. " " " ½ in. " —2 in. "; Screen'gs " ½ in. " " " ⅛-in. " —1 in. " } Specific gravity 2·45, about 35 p.c. voids.

Mortar . . . { Alsen's Portland cement, 1 part. Sand, ½ from River Para, ½ rock breaker—1½ parts.

These ingredients weighed and the amount of each necessary to produce 1 cu. yd. is shown on section : also the percentage of mortar allowed in excess of voids in aggregate. The average concrete (including mortar for bedding plums) was 3.5:1.5:1.

FINAL QUANTITIES (Dam and Foundation).

17,975 cu. yds. rubble concrete . . . . . . { 15,760 cu. yds. cement concrete, 2,215 " " rubble displacers (plums).

bolts above, and those on the vertical side were carefully fixed in the correct position at intervals of 10 ft. by sighting with the theodolite. When within 15 ft. of the top of the wall, the use of the large "plums" was discontinued on account of the narrow width, and string courses of iron tramrails were built in horizontally, about 40 tons being so used. The work of concreting was commenced in August, 1900, and completed in September, 1902, or at the rate of about 30 cubic yards of concrete and 5 cubic yards of displacers per diem, which was considered sufficient for uniformity in the setting of the mass.

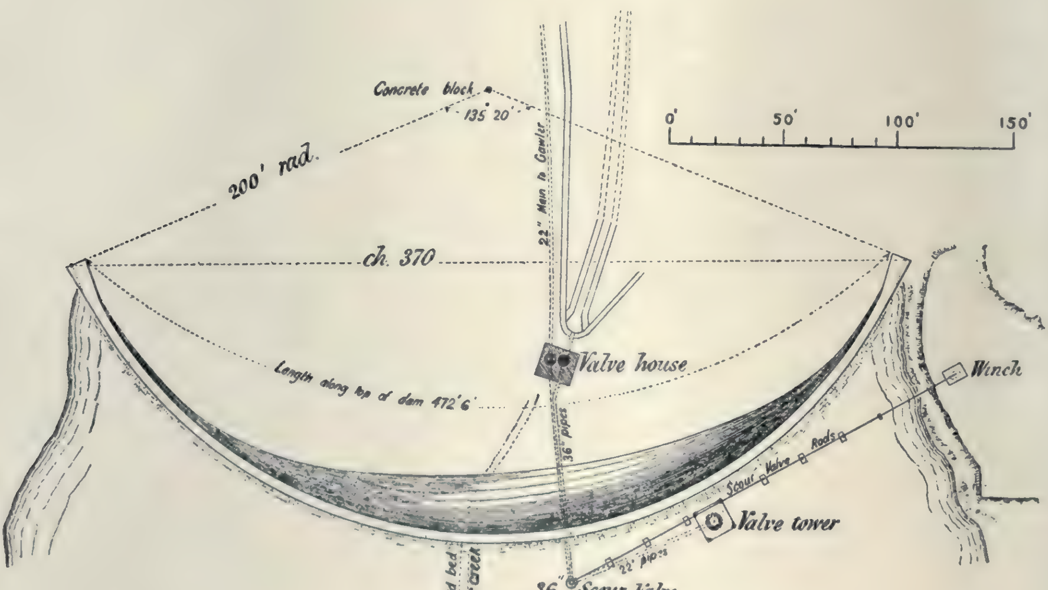
Upon completion, the cubic contents of the work were carefully measured and agreed with the figures arrived at by weighing in. The cost of the rubble concrete was 38s. 9d. per cubic yard.

Instructions were given that the water should be allowed to rise in the basin of the reservoir as the work proceeded, and this was done as far as possible, but the final filling of the reservoir did not take place until September, 1903. The atmospheric temperature during construction of the dam ranged between 30° and 168° F. In frosty weather the concrete was covered with straw mattresses, and a number of small smoking fires in tar drums were burnt at intervals on staging along the top of the wall with beneficial effects.

Since completion, and from observations made during six days upon which equal extremes of temperatures amounting to 50° prevailed, the top of the wall at the crown was found to tilt up-stream to the extent of $\frac{7}{8}$ in., thus showing an expansion of about $1\frac{1}{2}$ in. in the total length.

So far, the principles upon which this dam was constructed have given satisfactory results, and the writer would not hesitate to recommend the adoption of the same principles in carrying out much larger works where the situation was suitable and where proper materials were obtainable. The construction, says Mr. Moncrief, especially of the upper or thinner part of the dam during the winter season, and the insertion of steel bars therein, I look upon as advisable, and am decidedly of the opinion that a properly constructed concrete work, all the materials of which are practically of the same specific gravity, is better than a composite structure consisting partly of masonry and partly of concrete.

For the above details, cross-section and plan we are indebted to the "Engineering News."



PLAN OF THE BAROSSA DAM.

OUR MONTHLY BIOGRAPHIES.

Photo by Elliott & Fry.]

SIR EDWARD HAMER CARBUTT, BART., J.P., D.L.

SIR EDWARD HAMER CARBUTT, J.P., and Deputy Lieutenant for the county of Surrey, was born July 22nd, 1838. At the age of twenty-three he joined the firm of Messrs. Thwaites and Carbutt, Bradford, makers of steam hammers, rolling mills, and machinery for iron and steel works. While exhibiting machinery at the Paris Exhibition he inspected the Roots Blower shown in the American Department, and was convinced that it was a considerable improvement in pressure blast machinery. He arranged to take up its manufacture, and made many thousands of these blowers. After making machinery for most of the large iron and steel works, and for English and foreign Governments, he retired from the firm in 1877 in order to devote himself to public work.

He was elected member of the Leeds Town Council, and in 1878 was made chief magistrate of the town. In 1880 he entered Parliament as member for the borough of Monmouth. While in Parliament he was mainly concerned in looking after engineering interests; he urged the extension of the Indian Railways, and through his action the Government appointed a committee under the chairmanship of Lord George Hamilton. The evidence reported by Sir Edward Carbutt showed strongly the necessity for large extensions, and the committee decided in favour thereof. He laboured for years, with gratifying results, to obtain better remuneration, pension rules, and distribution of honours for the engineers of the Public Works Department, India.

One of the chief subjects taken up by Sir Edward Carbutt was the question of guns. He urged upon the Government the necessity for acquiring a greater supply, of improved design and manufacture. He advised that the large manufacturers should be encouraged to put down expensive plant to make guns and armament, in return for which the Government should promise to give orders which would justify this large expenditure of capital. By this means the Government would obtain large arsenals all over the country, and thus distribute the work in different localities. He advocated the reorganisation of the workshops of the War Department, and in response to his motion on this subject the Government appointed an important committee presided over by Lord Morley. After taking valuable evidence and visiting many large iron and steel works, the committee reported in favour of extensive alterations, and also in favour of encouraging private firms.

When the Government determined to start a National Physical Laboratory, he was elected as their representative by the Institution of Mechanical Engineers, and confirmed by the Royal Society member of the general Council. Upon the conclusion of his appointment for three years, the Royal Society informed the Mechanical Engineers that if they would re-elect him the Royal Society would be glad to re-nominate him.

When the committee now sitting under the presidency of Sir W. B. White was appointed to formulate a scheme of education for engineers, he was selected to represent the Iron and Steel Institute, there being two representatives of the Institution of Civil Engineers and one representative of each other scientific society.

Sir E. H. Carbutt was asked to serve on the recently constituted Departmental Committee of the Royal College of Science and School of Mines, to represent the iron and steel industries.

He has always maintained a keen interest in exhibitions, having taken part in most of the International Exhibitions since 1862. When the Paris Exhibition of 1889 was being organised, the Government did not deem it necessary to render it either financial or diplomatic assistance. Sir Edward seeing the difficulty, arranged a meeting of the different officials, when it was decided to form a committee and appeal for support. The English exhibit was a complete success, and fortunately no call was made upon the guarantors. Sir Edward Hamer Carbutt was a member of the Royal Commission appointed for the last French exhibition. He is a past-President of the Institution of Mechanical Engineers; Member of the Institution of Civil Engineers; and a Member of the Council of the Iron and Steel Institute. He was created a Baronet in 1892, and 1896 he was made High Sheriff.

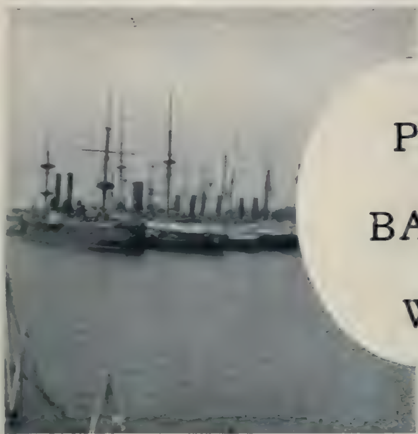
CAPTAIN ALFRED THAYER MAHAN, D.C.L., LL.D.

CAPTAIN A. T. MAHAN

Captain Alfred Thayer Mahan, the famous American naval expert, was born September 27th, 1840, at West Point, New York, being a son of D. H. Mahan, professor of military engineering in the United States Military Academy. He was educated at the United States Naval Academy, and in 1856 entered the American Navy. In 1861 he was a commissioned officer and four years later was promoted to lieutenant-commander. In 1872 he rose to the rank of commander, and in 1885 was appointed captain. He served throughout the Civil War, and subsequently in the Asiatic, South Atlantic, Pacific, and European squadrons. He was elected President of the Naval War College in 1886, while in 1893 he was given command of U.S.S. *Chicago*, a ship belonging to the European Squadron. In 1899 he was sent by the United States of America as their delegate to the Peace Conference at the Hague.

Captain Mahan is best known as a naval historian. His valuable book entitled "The Influence of Sea Power upon Modern History," has won recognition from many leading naval reformers. His other works include "Influence of Sea Power upon French Revolution and Empire," "Life of Nelson; the Embodiment of the Sea Power of Great Britain," "A Short History of the South African War," "Types of Naval Officers," etc.

Captain Mahan was made D.C.L. of Oxford and LL.D. of Cambridge in 1894.



THE

PROTECTION OF BATTLESHIPS BELOW THE WATERLINE

POINTS FROM A NAVAL ESSAY CONTRIBUTED TO THE ROYAL UNITED SERVICE INSTITUTION
BY COMMANDER MURRAY F. SUETER, R.N.

PROTECTION AGAINST SUBMARINES.

IN the course of a valuable essay contributed to the Royal United Service Institution, and recommended to be printed by the referees, Commander Murray F. Sueter calls attention to the submerged microphone, invented by Admiral Makaroff, of the Russian Navy, and supposed to indicate the whereabouts of torpedo craft or submarines. This, he says, is no new idea. Microphones have been used for many years in informing the defence of the approach of attacking boats. Unfortunately, it gives no idea of direction, distance or depth—three rather useful factors. We may say, without much fear of contradiction, that the defending ship would suffer severe nerve tension if the approach of an invisible enemy was known, and that the knowledge hardly contributes to defensive measures.

The hydroscope, by which submerged vessels are to be located by sight, needs scarcely any comment. It is extremely difficult in a submarine running submerged to see more than a few yards even in clear water, and it is unlikely that the instrument will ever be developed sufficiently to be of much value, so as to enable a surface vessel to observe a submarine under water. For the same reason, the proposal to sight submarines from balloons has proved indifferent when experiments have been carried out.

DEFECTS IN EXISTING SUBMARINES.

The chief defects of present submarines as offensive weapons are :—

1. Low speed.
2. Comparatively small radius of action.
3. Limited range of vision.
4. Enervating effect on crews.

We may assume that these defects are not likely to be remedied entirely, but improvements may be expected. The destroyer is the development of the first torpedo-boat, and similarly fast submarines will probably emerge from the embryo type.

Admiral Aube advised that submarines should be carried on board ship, and dropped at the psychological moment. Experience has, however, shown that this was not very successful in the case of torpedo-boats. The *Hecla* was the first depot-ship in our Navy. Built originally for the merchant marine, she carried ten second-class boats in crutches on her superstructure, and was able to hoist them out in a moderate sea-way. After her came the *Vulcan*, which was built in 1889, and is a well armed cruiser with a speed of about 18 knots. She carries six second-class boats 60 ft. long, with a speed of 16 knots, and has powerful hydraulic cranes and derricks. In 1895 the French built the *Foudre*, which is also a well-armed cruiser of 18·5 knots. She carried at first ten aluminium second-class boats, having a speed of 16 knots, but the aluminium hulls of these boats were not a success, and this metal was afterwards replaced by steel. She resembled the "Vulcan" in carrying powerful cranes. Since these types have not been repeated in recent years it may be argued that they have never been considered a very great success. The increased weight of the submarine over the torpedo-boat makes it doubtful if submarines will ever be carried afloat—certainly not until electric storage batteries can be dispensed with and the design made very much lighter than at present.

EXPERIMENTS WITH SPAR TORPEDOES.

These reflections show that there is at present truth in the English view of the submarine as the weapon

The subject of the entire essay, as printed in the Journal of the Institution, was "In the existing State of Development of War-Ships and of Torpedo and Submarine Vessels, in what manner can the Strategical Objects formerly pursued by means of Blockading an Enemy in his own Ports be best Attained?"

FRENCH TORPEDO-BOAT DESTROYER "PIQUE."

Built at Graville, launched 1900. Length, 186 ft.; beam, 19 ft. 6 in.; maximum draught, 10 ft.; displacement, 304 tons; 5,700 i.h.p.; speed, 27 knots; coal capacity, 33 tons. Carries six 3-pounder quick-firing guns, and two 14-in. torpedo tubes.

of feeble Powers. The line, however, between offence and defence is hard to draw, and it is possible that ships may be compelled to come within the sphere of influence of defending submarines. Hence we may ask, What means of protection can be suggested against such a danger? Various proposals have been put forward. It has been said that a submarine can be easily destroyed by a battleship with quick-firing guns. In this case it is assumed that a submarine must always come to the surface to take bearings, and must be exposed to gun fire, if only for a few minutes. But this is unnecessary in the modern type of submarines. The approved antidote to the submarine is a spar with a gun-cotton charge at the end. This is attached to the quarter of a destroyer, which chases the enemy, as soon as the latter is visible. The spar is swung out, and when over the submarine it is detonated. Experiments with the spar torpedo are reported as being quite successful—when the submarine is seen! The Americans placed live animals in a submerged tank, and exploded charges at various distances. The animals were quite unhurt. An experiment, it is reported, was made recently at Cherbourg with a slightly different object. It has been said that a submarine could not fire a torpedo at a short range, because the risk of suffering in the explosion would be too great. Several sheep were placed in the *Naïade*, which was under water, and torpedoes were exploded at different distances. Since the sheep were not hurt, officers took their places, but the explosions had no effect beyond increasing the pressure on the hull.

An admiral recently said: "We want howitzers firing shell at an elevated trajectory, which will explode at a given depth beneath the water." It is as yet impossible, however, to destroy a submarine by an explosion produced under water from gunfire. Up to the present we do not possess a single gun which can send a projectile any distance under water. When a projectile strikes the water its nose is thrown up on impact. The base of the projectile dips in lower, but scarcely more than a foot or two before ricochet occurs. A lucky shot might carry away the periscope and prevent observations, but can do no damage to the boat's power of manœuvring under water. It is often thought that the excess of speed possessed by a battleship or other surface vessel would ensure evasion. This may be so on the assumption that the presence of the enemy was apparent; but what if a fleet came within the meshes of a careful submarine boat plan? We have only to imagine the plight of a single ship within a triangle formed by three submarines with periscopes at most visible. Speed will not be of much avail, and a short time would place the ship out of action for all practical war purposes.

DESTRUCTION OF SUBMARINES—A WAITING GAME.

Good as the torpedo destroyer is, it is doubtful if this type is adapted for the new task of destroying submarines, because: 1. It has a large turning circle. 2. It offers a large target both to the surface and sub-surface vessels. 3. It is easily put out of action by gunfire, and the crew are unprotected. The destruction of submarines must be a waiting game, and they will be caught only when they come to the surface through any of the following causes:—

1. Entanglements by nets or hawsers, or injury from a gun-cotton charge.
2. Exhaustion of electric batteries.
3. Defects to internal mechanism.
4. Defects to external gear of diving rudders, and the like.
5. Bad fumes, producing the collapse, or partial collapse, of the crew.
6. If the periscope is shot away, a porpoise-like rise and dive may be necessary for obtaining a bearing.

The submarine destroyer should therefore possess a high speed to enable her to avoid cruisers. It is thought that she should be designed to offer a small target, as it may be necessary to work in the vicinity of an enemy's fortified port in seeking hostile submarines. A small target is also necessary to enable a destroyer to escape easy detection by submarines. The design of the modern submarine presents a line of thought as to the best form which a submarine destroyer should take. Admiral Henderson recently said in a lecture that the present shape of ships is likely to be stereotyped. But it cannot be doubted that, when the results of sub-surface navigation are better known, the present theories of construction may undergo a change. The following is a suggestion in the present case: The submarine destroyer should be a large surface boat capable of altering her trim by taking in water ballast, so as to lessen the target exposed to the enemy. The upper work should have a turtle-back shape, and armoured, which will cause projectiles to glance off. Navigation should be from a conning tower having an all-round vision, and funnels* should be abaft the conning tower. The conning tower would, of course, have to be armoured. The upper portions of the funnels would be made telescopic, for use when travelling at high rates of speed. A mast would also have to be carried for wireless telegraphy aerial wire to be hoisted to. The construction of submarine boats would be copied in many ways, and the water tanks for lowering trim would also act as water or compressed air protection against a torpedo launched at her from a submarine. Her armament would consist of two 12-pounders and four 18-in. torpedo tubes.

PROTECTION AGAINST THE EXPLOSION OF A TORPEDO.

Such are the methods which may be suggested as best suited for fighting against submarine boats. But it is not to be expected that ships will be able to avoid torpedoes any more than they can avoid being struck by projectiles. In short, we want ships constructed with some protection against torpedo attack. Means must be taken to minimise the damage which may be caused by explosion of a torpedo some ten or twelve feet below the waterline. The writer begs to leave armour, guns, accuracy of gunfire, and similar questions

* Oil motors would dispense with funnels.

to abler hands, but he cannot help remarking that it would seem they receive so much attention from hosts of naval writers and would-be experts, that there is a real and serious danger in neglecting to consider how to minimise the effect of weapons of much more deadly potency than any gun ever constructed.

The modern battleship expends quite 30 per cent. of her displacement in armour to protect her from gun-fire, but the minimum fraction is devoted to defence against torpedoes. A torpedo under present conditions would destroy a very large percentage of ships struck by it, and it would appear that naval architects are not following the teaching of modern science. Perhaps the lessons learnt from the *Belleisle* may have influence. The *Majestic* pounded the *Belleisle* at short range for twelve minutes or so. If a crew had been on board, even during such a severe handling, the actual waterline hits might with some difficulty have been plugged, and little damage have been done to affect the stability. The reason of her settling down on the shoal off Chichester is said to have been due to water coming in from a few water-line hits plus the water pumped into her through all her fire-pumps to guard against fire. There was no outlet for this latter. If we compare this with the damage done by the explosion of a torpedo, the advantage is plainly with the torpedo. The *Belleisle* collapsed under one explosion of the latter; it would appear that the effect outran all anticipations. The difficulty of salvage was certainly unexpected. Although the immediate object of the test was not realised, important data must have been given as to the destructive effect of a torpedo, as, from Press reports, we learn one-sixth of the ship was destroyed, a section of which had been specially strengthened from the bow to the citadel and across to the boiler-room, but the whole portion was so wrecked that divers could not enter.

RANGE OF TORPEDOES.

The extreme accuracy of the modern Whitehead torpedo, fitted with gyroscope, or Obry apparatus, renders a change in construction necessary, and this is shown by the recognition of its increased range. Most critics quote 2,000 yards as the minimum distance for battle squadron actions. The British Navy now has a 3,000-yard torpedo; it is natural to expect that this will be still further increased, and recently there was a report that the Austrian Government is experimenting with a new invention which brings the range of the torpedo up to 3,800 yards. It should be remembered that all nations have adopted the gyroscope for their locomotive torpedoes, and have turned a somewhat erratic weapon into a reliable engine of war, whose influence is more and more attracting notice as the chief and most deadly weapon of modern warfare. This increase of range and of accuracy cannot be too strongly emphasised. Search-lights carried by most ships are of little use outside a 2,000-yards range, and even at this distance the ray can generally be passed through in safety. It is extremely unlikely that a destroyer would be picked up outside this limit and even if she discharged her torpedo as soon as observed, the torpedo would have a fair chance of hitting, particularly if there were several ships in company.

SUGGESTIONS FOR RENDERING A SHIP TORPEDO-PROOF.

The problem is to design a torpedo-proof ship. We have seen the *Dominion* developed from the *Warrior*, the *Libertad* from the *Huascar*, but naval architects have not yet produced a torpedo-protected ship. The only attempt is the crude torpedo bulkhead, as constructed in the Russian battleship *Tsarevitch*, and in some French battleships. Designers in foreign navies have had the idea of armouring the ship below the water-line as a protection, but this plan has been abandoned, and it is known that rigid armour plates, with many butting joints and armour bolts, are no defence against the shattering effect of a torpedo. The ductility of lead has received attention, and lead envelopes in the compartments have been suggested; they might be useful if we did not have a better proposal.

FUTILITY OF CORNPITH CELLULOSE.

It was thought that American cornpith cellulose, if placed behind a plate, would swell on contact with the water, and thus fill up the hole and stop the inrush of water. It is hardly surprising to learn that the cellulose was sent into the air before it had time to get wet. The idea that coal in a bunker would stop the effect of an explosion is equally unsound, because loose coal would suffer the same fate as the cellulose. A hanging net defence is useful for a ship at anchor, and if not very effective against modern net cutters, gives the crew a feeling of security which might be useful in increasing the efficiency of night gun-fire, and in lessening the strain of long watches. Nets are of little use for ships under way, unless they are prepared to steam at very slow speeds.

WATER OR COMPRESSED AIR PROTECTION.

It has long been recognised that a cushion of water or compressed air are the best agents for minimising the explosive effect. It may be said that there are no really reliable methods. Future designs should allow for ships having water or compressed air protection. By a greater system of cellular division, and by increased rapid flooding arrangements, with corresponding pumping facilities, it is thought that injuries from torpedo or ram might be minimised so as not to be so disastrous as in the cases to which we shall refer. All compartments should be flooded, and subjected to a severer water pressure test before launching than that now customary. Each compartment should be tested like a tank to resist a water pressure varying from 40 lb. to 50 lb. on square inch, without undue weeping of rivets. If the design allowed for spaces over the vital parts being filled with water or compressed air when in the vicinity of a coast where danger from submarines or torpedo-boats may be expected, the ship would then suffer the minimum damage by a successful torpedo attack. Ordinarily the compartments would be left empty. The ship would then have a higher freeboard and a higher gun platform for fighting in the open sea. A saving of weight might be obtained by doing away with ammunition passages, water-tight doors and fittings, substituting a tank system of cellular compartments, any one of which could be flooded easily and rapidly, or filled with compressed air by air compressors.

The interior of a ship having such a tank system should be built in the form of an internal ship, quite ten to fifteen feet from the outer skin, so that the inner skin could not more than slightly be pierced by an explosion. The amount of the water cushion or compressed air protection round the sides of a ship would, of course, have to be calculated so as to allow of a maximum space outside the engines and magazine. The diagram of the tank design for battleships will show that a considerable water or compressed air protection could be carried. Private enterprise cannot undertake explosive experiments.

It seems that compressed air would minimise the effect of a torpedo explosion below the water-line more than anything else, as a large volume of air would escape when a fracture occurred and partly counteract the explosive effect. It might be difficult to make the tanks air-tight, and would slightly increase the cost of construction for extra caulking, etc. The air compressors could always be kept going in dangerous waters, and a sufficient pressure maintained in the tanks to be of great service; this would offer no great difficulties, as the ballast tanks of a *Holland* submarine frequently retain air pressure for a considerable time to counteract leaks from a faulty Kingston valve or leaky rivet.

It is also difficult to foretell the value of a cushion of water without exhaustive trials. In this case, if water is present and helping the outer shell, should this plating be shattered, only the particular compartment or the adjoining one damaged, there would be no change in water-line, and if a serious leak did occur other tanks could be pumped out, thus lightening the ship.

The re-arranging of bulkheads and sub-division should make a ship almost unsinkable against a torpedo attack, because whatever damage is done the inrush of water is so much located.

Whatever material might be introduced in the spaces, the most important feature is the sub-division into a tank system with a water or air service, pumping facilities, etc., well developed, and under perfect control.

Battleships and cruisers should be modified and split up into cellular compartments. The centre of gravity of each cellular space can be calculated from the designs, and if several compartments on one side of the ship were injured and filled with water, their opposite compensating compartments would be brought into use, and there would still be an ample margin of buoyancy. If large emergency Kingston doors were fitted so that abundant volumes of water could at once be let into special compartments to compensate, an even keel would be maintained. Experience teaches that it takes some considerable time to bring a submarine from surface running condition to awash condition ready for diving, even when all Kingstons are thrown open to the sea simultaneously. However large an injury were made, an even keel could be kept if the compensating compartments were at once flooded. It is thought that no communication should be allowed from one compartment to another, except through manholes (not doors), which can be closed with great rapidity from below and on deck. If doors cannot be eliminated there should be as few as possible, and nearly all communication should be from the upper deck for every door and hole in a watertight bulkhead is a grave weakness. Fire mains, electric wires, and steam pipes are indiscriminately run through bulkheads and are often not quite watertight. All barbettes and similar parts of the ship should be made more watertight than at present.

ALASKA'S MINERAL WEALTH.

THE INVESTIGATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

MR. ALFRED A. BROOKS has written for the Lake Superior meeting of the American Institute of Mining Engineers an instructive account of the operations of the United States Geological Survey in Alaska. It is shown that prior to 1866, when Russia ceded her North American possessions to the United States for the sum of 7,200,000 dols., little was done to investigate the mineral wealth of Alaska. It was the policy of the Russian American Company to discourage the development of any mining interests owing to a belief that mining would be inimical to the fur-trading interest. For twenty years after Alaska passed under the control of the United States, systematic surveys were limited to its coast line.

But while the Government's interest in this virgin field lay dormant it soon attracted the ever-active American prospector, who found gold on the Stikine even before the purchase of Alaska. Following this came the discovery of auriferous quartz near Sitka in 1879, and of gold in the Juneau placers in 1880. It was the development of the latter which led to the finding of the gold-bearing

MAP OF ALASKA, SHOWING THE DISTRIBUTION OF MINERAL PRODUCTS.

lodes that have made Juneau the foremost mining-camp of Alaska. The restless pioneers, soon finding means to overcome the opposition of the natives to white men penetrating the interior, made their way across the Chilkoot Pass, and while descending the Lewes river came upon more gold. In 1886 the gold-placers of the Fortymile region were discovered, and the discovery of other districts followed rapidly during the succeeding decade.

These Yukon pioneer miners were dependent entirely upon their own resources, formulated and executed their own laws, and were practically ignored by the territorial and federal Governments. It is largely to their perseverance and pluck that the country now owes its millions of revenues from the Alaskan placer-fields. Not until 1895 did Congress awake to the importance of examining into Alaska's mineral wealth.

The author describes the systematic investigations which have since been made, and presents the accompanying map which shows in detail the progress of the topographic and geologic surveys of Alaska during the period 1898 to 1904, and also gives the distribution of the country's mineral products as far as they are at present known.

The developments of the last five years have shown that Alaska, as a field for mining, stands in the first rank among the possessions of the United States. Its annual gold output is now about 8,000,000 dols. It produces silver, copper and coal in commercial quantities, and its recently discovered tin and petroleum promise to become important products. Concurrent with the gradual development of this wealth, the mining public has ceased to regard the territory simply as an arctic province where a few placer-miners struggle with adverse conditions to secure a grub-stake or a modest fortune. Of late years there has been a large influx of capital to investigate its mineral resources, but in its area of nearly 600,000 square miles there still remain large unexploited and little known fields.

THE SOCIETY OF ENGINEERS.

VISIT TO THE WORKS OF MESSRS. YARROW AND CO., AT POPLAR.

A HIGHLY interesting visit was recently made by the President—Mr. D. B. Butler—and members of the Society of Engineers, to the Shipbuilding and Engineering works of Messrs. Yarrow and Co., at Poplar, where they witnessed the building and engineing of light-draught, high-speed craft of all kinds, notably torpedo-boats, destroyers, and light-draught gunboats.

Amongst the smaller craft a very successful type of boat is being built. She is 75 ft. long by 9 ft. 3 in. beam, and with steam up has a draught of 11 in. with a speed of 10 miles an hour. The propeller is carried in a tunnel, and there is a special arrangement by which the efficiency of the propelling machinery is maintained at various loaded draughts, instead of at one designed draught only, as hitherto. There are at the present time about twelve vessels being built on this principle; four of these are protected gunboats for the Brazilian Government, 120 ft. long by 20 ft. beam, carrying two 6-pounders, 5 Maxims, and one howitzer, whilst three others are protected armed launches. The firm have recently built 11 protected gunboats of shallow draught, and have lately delivered two, one for the Japanese Government just before the outbreak of the war, and one for the British Government. These are 160 ft. long by 24 ft. 6 in. beam; they carry mountings for two 6-pounders and six Maxims, and have a draught of water of 2 ft. 2 in. and a speed of 15 miles an hour.

Messrs. Yarrow have also in hand a turbine-driven torpedo-boat 152 ft. long by 15 ft. 3 in. beam. This vessel is launched, and has undergone some very successful experimental trials in which the merits of its special arrangement were clearly proved. This arrangement consists in employing both turbine and reciprocating machinery for propulsion, a set of triple-expansion engines of power sufficient for cruising purposes being fitted, while a turbine engine on each side provides for full-speed power. The advantages of both systems are thus obtained as required, viz., economy of fuel when cruising, and machinery suitable for high speed at full power. This vessel develops over 2,000 i.h.p. and attains a speed of 25 knots. It is designed to carry three 18-in. torpedo tubes and two quick-firing guns.

A large number of destroyers have been built at these works for the Japanese Government, and nine of these have been in very active service during the recent attacks on Port Arthur. Messrs. Yarrow have had highly satisfactory reports from the Japanese Government as to their efficiency and behaviour at sea. It is stated that not one of these vessels has required to go into dock for repairs since the commencement of the war. They are 220 ft. long by 20 ft. 6 in. beam, and carry two torpedo tubes on deck, one 12-pounder quick-firing gun and five 6-pounders. They are built of high tensile steel, which enables the firm to construct vessels so light as to be able to maintain 31 knots, carrying a load of 35 tons, with comparative ease, although completely fitted in all respects for naval service. Their full speed is also obtained with a very low consumption of fuel, viz., 1·9 lb. per i.h.p. and under $1\frac{1}{2}$ in. of air pressure. Within the last four years 30 torpedo-boats of the 152 ft. type were also delivered. These were built for the Japanese, Austrian, Dutch and Chilian Governments.

Long Distance Transmission FROM High Head Water Powers.

BY

E. KILBURN SCOTT, A.M.Inst.C.E., M.I.E.E.

In the following article the author deals practically with the utilisation of high head water powers. These notes should be specially useful to Colonial readers, and also to engineers in South America, South Africa, and the Far East, where the tangential wheel is often the most suitable prime mover that can be employed.—Ed.

STRICTLY speaking, in an electrical transmission from water power there are two separate transmissions, the first being the hydraulic transmission from the service reservoir to the power-house, and the second the electrical transmission by overhead wires (or possibly underground cables) from the power-house to the consumer. It is mainly with these aspects of the transmission of power problem that the author deals. High head water powers are mostly met with abroad, but in the Snowdon Power Plant the fall from Lake Llydaw is 1,150 feet. Information of this, and also of the Burma Ruby Mines, the Raub and the Rezende Mines transmissions are given in the paper.

THE TANGENTIAL WATER WHEEL.

The simplest of all the prime movers which are in use to-day is undoubtedly the Pelton wheel, or, as it should more properly be called, the tangential water wheel.

As compared with the turbine, the first cost of the tangential wheel is very much less, and for high heads running into many hundreds of feet, it can be used where a turbine is impossible. At the same time its cost of maintenance is but a fraction of that of the turbine, for a complete set of new buckets costs very little and can be mounted very quickly by an unskilled man.

A disadvantage of the turbine is that the variation in design is limited by reason of its excessive cost for large diameters, the tangential wheel, on the other hand, permits of very wide and free scope.

VALUE OF HIGH FALLS.

As a rule, travellers are only impressed by falls of moderate height over which the water comes tumbling in masses; they do not appreciate the fact that a mountain streamlet dropping 1,000 ft. or so in a short horizontal distance may be capable of developing much more power at a fraction of the expense. A low fall is generally in the valley where the land has considerable value, and where, if the water is interfered with, there may be legal difficulties with landowners and occupiers.

With low heads a variation of a few feet in the height of the storage reservoir or in the tail race makes quite an appreciable difference in the power, whereas on a high fall a few feet is immaterial. Again, owing to the smaller amount of water required for a given power quite a moderate storage allows of the actual power of the stream being multiplied several times wherever the maximum power is required for *only a part* of the twenty-four hours.

A glacial stream or mountain torrent is better for the purpose of power work than water of a lower altitude, because when the water passes into pipes at a point above the tree line there is so much less risk of trouble from organic matter.

TANGENTIAL WHEEL GOVERNORS.

There are three methods of sensitive governing under high heads. The *first* is by means of stand pipes, into which the flow of water is diverted when shut off from the wheel, relief valves being also provided. The *second*, which is used largely in the States, is to deflect the jet or stream away from the buckets, sudden changes of speed in the centrifugal governor bringing a nozzle deflecting mechanism into action. The *third* is a method introduced by Mr. E. F. Cassel, in which the wheel is divided along the centre line of the buckets into two sections, and the centrifugal force developed in the rotation of the wheel body itself is arranged to cause the two sections to separate slightly. A portion of the water jet is thus allowed to pass between the buckets, instead of impinging directly against them, and being part of the wheel itself, the governing action is instantaneous.

CONSTRUCTION OF STEEL PIPES.

Riveted pipes have the objection that the rivets and joints cause eddies and so loss of head, especially at the high velocities employed for Pelton wheel work. They are also more liable to corrosion, because the preservative coating may become worn or knocked off the rivet heads, etc.

The alternative methods of constructing a steel pipe are either by lap-welding or by the Ferguson locking-bar system. The lap-weld is well-known, and if carried out by a good firm, makes an excellent job; but it is somewhat expensive.

In the Ferguson locking-bar pipe each pipe consists of two plates, the edges of which are up-set in a special machine. The plates are then bent into semi-circles, and the steel locking-bars are squeezed down cold by hydraulic pressure. The Ferguson pipe has the same advantages as a welded pipe, that is to say, there is a minimum of friction owing to the absence of rivets and joints, and at the same time it has the advantage over welded pipes that all the material is made up cold so there is no fear of defects due to burns and incomplete welds. As there are no exposed plate edges, no caulking is necessary, owing to the special system of manufacture.

The highest heads in use are: 2,530 ft. at an installation near Seattle, Washington, 2,250 ft. at the Paunco Mines, Mexico, and 2,100 ft. at Pike's Peak Hydro. Electric Company at Colorado Springs. The difficulties which have been surmounted in carrying out these installations may be gathered from the fact that the pressure at the bottom of the pipe line due to a 2,250 ft. static head of water is no less than 900 lb. per square inch.

EXPANSION OF STEEL PIPE LINES.

A method of taking care of the expansion is by socket or Kimberley joints sealed with lead, each pipe length then takes up its own expansion, and the joints can be caulked or re-made easily. These joints also enable the pipe to follow slight inequalities of the ground.

To ensure efficiency with lead joints, it is best to lay the pipes straight from point to point, and where sharp bends must be made, the points where the angles occur should consist of strong junction boxes secured on rigid foundations. Between these boxes the pipes act as columns in compression, and such columns being in unstable equilibrium the pipe must be held in line by being clamped down to foundation blocks at frequent intervals. In this way the end pressures are received entirely by the junction boxes, and the transverse pressures by the pipe clamps.

OVERHEAD ELECTRIC TRANSMISSION LINES.

The experience in the States regarding route of high tension pole lines is that "Private Rights of Way" are preferable to running the wire alongside the highway. The wires can then be laid in a bee line from point to point, whereas if they follow the highway there may be frequent turns requiring poles closer together and extra guys and insulators, etc. There is always the question, also, of the authorities giving trouble as to limitation of voltage, and the widening and paving of roads, etc.

The Niagara to Buffalo line runs for nearly 25 miles on a private right of way 30 ft. wide. The 80 miles transmission from Rochester to Pelham, N.H. (13,200 volts); the 65 miles from Canon Ferry to Butte (50,000 volts); and the Colgate to Oakland, 142 miles transmission (40,000 volts), are mostly run on private rights of way, varying from 50 ft. to several hundred feet wide.

CONTINUITY OF ELECTRIC SUPPLY.

A point in connection with overhead transmission lines is the question of continuity of supply. One reply to objections on this score is the fact that abroad there are hundreds of towns supplied from overhead transmission lines, and the author has yet to learn that citizens in such towns abroad are less particular as to what they consider their rights than citizens in similar communities in this country. The fact of the matter is, it would not pay any power company to give a discontinuous supply, as if so, they would soon find themselves in financial difficulties. If, therefore, we find that the shares of the large power companies in North Italy and other parts of the Continent are at a substantial premium, and that many power companies in the States are also doing so well, it is only fair to assume that these companies are *carrying out their obligations* properly.

In case a fault does occur on an overhead line, it is much easier to find, and very much easier to repair than if it were underground. Some of the transmission lines abroad have several hundred miles of wire, and yet by means of mounted men the whole system can be inspected in an hour or so, and the bare telephone wires enable them to communicate with power house or sub-stations at once. If such cables were underground it might take days to locate the fault and repair it, and many more men would be required, as there would be trenching to do, whilst the joint itself would take much longer to make.

LIMITATION OF VOLTAGE.

The limitation of voltage on an overhead transmission line is governed by the insulation strength of the insulator and the losses through the air between the conductors.

Regarding the insulator, it is really only a matter of having a good dielectric material to resist puncture, and suitable dimensions to a well-thought-out design. When insulators were not so well made as they are now, they constituted the limiting factor, but the manufacture has been so perfected that in an ordinary dry and pure atmosphere, such as in the States, insulators will easily carry 60,000 volts without appreciable leakage.

HIGH TENSION INSULATORS.

The requisites of an insulator for high voltage work are:—

(1) That its dielectric strength shall be sufficient to prevent the current passing directly through the material.

(2) That its dimensions and surface area shall be sufficient to prevent the passage of current over the outside of the insulator to its support.

(3) That the resistance of both the material and its surface shall be sufficiently high to prevent undue loss of energy.

(4) That it shall be mechanically strong enough to withstand severe stresses in time of bad weather.

(5) That it shall not be subject to deterioration whilst in service, particularly from heat and cold.

(6) That it shall not be so obtrusive as to form a target for the catapult or shot gun.

It was first thought that insulators with cups containing oil would be necessary for reducing the surface leakage, and insulators of this kind were used in the Frankfort-Lauffen 100-mile transmission at 30,000 volts. It has since been found, however, that the ordinary glaze surface is ample insulation. The principal duty of an insulator is to prevent the current passing over the outside surface and *jumping* to the pin or cross-arm, a matter which oil cannot prevent.

Although glass insulators have been much used in the States, they do not appear to have any advantage over vitrified porcelain in the matter of mechanical strength or resistance to piercing. On account of its transparency, glass has, however, the advantage over porcelain in that it does not need an electrical test to pick out a good insulator, whereas porcelain must be carefully tested. Glass insulators are also lighter and less likely to be shot at than porcelain, for when the latter are white they offer a very tempting mark.

A form of insulator which is much used—the composite—consists of porcelain and glass, the porcelain underneath on the insulator pin, and the glass having a wide petticoat cemented to the top of the porcelain.

The best porcelain insulators have a polished fracture when they are broken, and they should be absolutely non-absorbent. The test for this is to place the pieces in a dry stove, weigh them, then immerse in water and weigh again. The weight should be the same in both cases. The test for puncture is made by setting the insulator in salt water and slowly increasing the potential until it is double the working pressure. In case of a composite insulator each portion must be dealt with separately, and the potential should be kept on for one minute. It is interesting to note that insulators will withstand a much higher potential applied instantaneously than they will if applied continuously.

The wet weather test is made by causing a jet of water from a sprinkler nozzle, under pressure of 50 lb., to play on to the insulator at an angle of about 30 deg. from the horizontal. Under these conditions the insulator should not arc over from the wire to the pin at a less potential than that which will exist in service between any two conductors.

It may be mentioned that when working at high pressures and with ordinary insulators, the part around and near the live wire does not retain deposits of moisture or frost, but remains dry, the particles being repelled.

In any case when working, the small amount of power necessary to keep the surfaces dry is insignificant. Of course, in starting up a "cold" line there is danger of breakdown if current is put on suddenly at full value; it should always be raised gradually.

POLES.

Wooden poles are used almost exclusively for overhead transmission lines. The kind of wood depends on the country or district, but fir, spruce, and pine are commonly employed, whilst in the States harder woods, such as chestnut, cedar, and sawn redwood are also used. A good creosoted fir pole will last thirty years.

White ants and other insects are a great nuisance in tropical countries, and jodelite is said to be a preventative against them. Asphaltum is also used. It was mainly on account of the white ants that on the Cauvery Falls line a composite pole was used consisting of 17 ft. of 7-in. Australian jarrah in a steel socket 13 ft. long. The steel is buried 6 ft. in the ground, so that the pole projects 24 ft., the minimum height of wires above ground being about 20 ft. A layer of concrete inside the steel tube prevents the ants climbing up; they never climb outside anything.

A curious accident occurred on the San Bernardino and Pomona line, 30 miles at 15,000 volts, two of the wooden poles being set alight by a defect in the insulators. The poles burned to the ground, leaving the line hanging clear without anyone at the generating station or sub-station being aware of the fact.

Where the soil is soft or the poles have to resist heavy strains, the stability may be much increased by making the hole 2 ft. larger in diameter than the butt, and partly filling in with concrete. In good ground the hole is made as small in diameter as possible.

CROSS ARMS.

Wooden cross-arms are the weakest part of the overhead equipment, as they are so liable to be "wind shaken" or "weather cracked," and so allow moisture and dirt to settle in the cracks, and form a path of low resistance. To prevent it the cross-arms should be specially treated to fill all cracks and fissures, and well crowned to allow water and snow to fall off easily.

In this country cross-arms are usually made of oak, in the States they are of yellow pine, treated with asphaltum or linseed oil.

On the Cauvery Falls line three (No. O. B. and S. gauge) copper wires form an equilateral triangle, one insulator being carried on the top of the poles and the two lower ones by a cross-arm of jarrah wood.

PINS FOR INSULATORS.

It is common practice in the States to mount extra high tension insulators on wooden pins made of eucalyptus, oak, or locust wood, treated with linseed oil, hot asphaltum, or paraffin. The idea is that wooden pins raise the installation of the pole system as a whole, but this is open to doubt.

Iron pins are better than wood, because, in the first place, to secure sufficient strength in the shank, a wooden pin must be of such a large diameter that the size of the cross-arm is considerably increased. Again, where there is a tendency for the line wire to raise or pull the pin out of the cross-arm, as for example, when crossing depressions in the ground, the usual nail driven through the cross-arm into the shank of the pin is not strong enough. With an iron pin on the other hand, a thoroughly firm job can be made.

CROSSING WIDE ESTUARIES OR RIVERS.

It sometimes happens that a wide estuary or river has to be crossed by a transmission line, and in such a case three methods are available :—

(*a*) The overhead line may be continued as a single span between high towers on each bank, or it may cross in several spans, piers being built for the purpose in the water.

(*b*) The overhead line may connect to a submarine cable, the insulation of which will be exposed to the full voltage of the transmission.

(*c*) A submarine cable may be laid down for a moderate voltage, and connected at each bank with step-down and step-up transformers.

The first method has been adopted for the transmission line between Colgate and Oakland, where it crosses the Carquinez Straits by a span of 4,427 ft., the voltage being 40,000. In order to allow ships with the tallest masts to pass under, it was necessary for the lowest part of the conductor to be at least 200 ft. above water level. Two steel towers have been built 4,427 ft. apart, and between these four galvanised steel wire cables are suspended, each having 19 strands, and measuring $\frac{7}{8}$ in. diameter. The breaking strain of each cable is 44 tons, and the electrical conductivity is equal to No. 2 gauge copper wire. The cables pass over steel rollers on the towers, each cable being secured by a series of strain insulators, the total pull of about 12 tons being taken by an anchor.

When crossing a stream or river the wires are spread out horizontally instead of forming the usual equilateral triangle. On the Cauvery Falls line there is a span of 525 ft., and the wires are spaced 10 ft. apart. They are carried on special pole structures of framed wood supported on a triple masonry foundation, and guyed back to the ground by steel cables. For crossing this span the hard drawn copper wire is replaced by silicon bronze, and it may also be mentioned that this material is used when crossing over railways. It is much used on Indian Government telegraph lines.

The second method has been adopted on a transmission line between Portsmouth and Dover, N.M., where an arm of the sea is crossed by a three-phase submarine cable 4,810 ft. long, working at 13,500 volts.

LIMITATIONS TO SIZE OF WIRE.

The size of the wire is limited between 0·4 of an inch diameter as the largest size, and about 0·1 of an inch diameter as the smallest. This is due to the fact that it is extremely difficult to stretch a wire larger than 0·4 inch, and on the other hand it is not mechanically practicable to use wires much smaller than 0·1 inch because of their having to withstand wind pressure, snow and sleet. For small powers it frequently happens that a larger wire has to be used than is really necessary, and this is specially the case for the branch wires at the end of a transmission line.

ALUMINIUM CONDUCTORS.

One advantage of an aluminium line is that for equal conductivity it is only about half the weight of copper, and the span between the poles may, therefore, be greater. On the Colgate and Oakland line, 142 miles transmission, the spacing of the poles is 132 ft. On the original Niagara to Buffalo line with copper wires the spacing of the poles is 75 ft., whilst with the aluminium line which has been added later, the spacing is 112 ft. In one transmission the span is 150 ft.

As it is difficult to solder aluminium, a mechanical joint is generally employed, and when such a joint is made it is necessary that all the parts should be of aluminium, otherwise electrolytic action may take place. The best known joint is the McIntyre, consisting of a double aluminium tube 9 in. long and 1-16th of an inch thick, large enough to snugly enclose two wires. The whole is given several complete twists by clamping tools, and the joint is completed by turning back the projected ends of the wires.

OVERHEAD HIGH TENSION WIRES IN THIS COUNTRY.

There is a growing feeling that if we are to do anything in long distance transmission of power in this country we shall have to employ overhead wires. As a matter of fact the Board of Trade is apparently very reasonable on this question, and several Power Bills have been passed, containing the following or a similar clause :—

" The consent of a rural district council as the local authority to the placing of electric lines above ground . . . . shall not *be unreasonably withheld, and if any question arises whether that consent is unreasonably withheld or not, that question shall be decided by the Board of Trade.*"

The cable manufacturing companies naturally do not care for bare wires ; very few of them draw their own copper wire, and there is not much profit in merchanting bare copper. Their policy hitherto has been to become financially interested in the Power Companies, so as to sell their underground cables. This should be prevented in future, as the great expense of such cables is already a very heavy drag on more than one company.

To show the extent to which overhead lines are used abroad, the United States Government Report for 1902, states that of the 125,000 miles of electric main and feeder cables in use, only 8,124 miles, or barely 6½ per cent., are underground. No less than 75 per cent. of the 3,700 towns with an electric supply have less than 5,000 population, and the bulk of these towns receive their supply through overhead wires.

LIGHTNING ARRESTERS.

Regarding lightning arresters, these have been developed to a really remarkable degree of perfection. The Siemens-Halske flare arrester is too well known to need description. There must be thousands in use all over the world ; it is at once one of the simplest as well as the most perfect pieces of electrical apparatus known.

There is also the ingenious water-jet arrester, which is used at the Vizzola Power Station in North Italy. In this apparatus the minute spaces between the globules of water in the jet effectively prevent the station voltage going to earth, but will readily pass a lightning discharge. The apparatus has the advantage that it is always ready, and there is nothing to burn up.

EFFICIENCIES.

The efficiencies of any given electric transmission from water power to the motor spindle, at the further end of a transmission line, may be roughly estimated as follows :—

	Full Load Efficiency.
Pipe line	.. 96 per cent.
Nozzle of tangential wheel ..	.. 97 ,,
Tangential wheel	.. 82 ,,
Three-phase alternator generating high-tension current ..	.. 94 ,,
Transmission line	.. 90 ,,
Step-down transformer ..	.. 98 ,,
Three-phase motor	.. 92 ,,

Overall efficiency, 58 per cent.

That is to say, of the potential energy of the water, 58 per cent. is turned into useful work on the electric motor spindles. It would have to be a poor installation indeed to fall below 50 per cent.

Of the potential energy of coal only about 7 per cent. reaches the electric motor spindles, and whereas in the burning of coal future generations are deprived of its use, in the case of water the power is inexhaustible. The man who harnesses a water power does much more for humanity than one who exhausts a coalpit, and further, he does the work in a cleanly way, and not by befouling the atmosphere.

Notes from a paper contributed to the Liverpool Engineering Society.

SIR OLIVER LODGE ON THE NATURE OF ELECTRICITY.

SIR OLIVER LODGE has embodied the latest exposition of his views on the nature of electricity in an article contributed to the August number of "Harper's Magazine."

Electricity, he remarks, is not a form of energy any more than water is a form of energy. Water may be a vehicle of energy when at a high level or in motion; so may electricity. Electricity cannot be manufactured as heat can; it can only be moved from place to place, like water; and its energy must be in the form of motion or of strain. Electricity under strain constitutes "charge"; electricity in locomotion constitutes a current and magnetism; electricity in vibration constitutes light. What electricity itself is we do not know, but it may perhaps, be a form or aspect of matter. So have taught for thirty years the disciples of Clerk-Maxwell. Now we can go one step farther and say matter is composed of electricity, and of nothing else—a thesis which I wish to explain and partially justify.

First we must ask what is positive electricity, and the answer is still we do not know. For myself, I do not even guess—beyond supposing it to be a mode of manifestation, or a differentiated portion, of the continuous and all-pervading ether. It seems to exist in lumps the size of the atoms of matter; and no portion of it less in bulk than an atom has ever been isolated, nor appears likely to be isolated.

But concerning negative electricity we know a great deal more. This exists in excessively minute particles, sometimes called electrons and sometimes called corpuscles; these are thrown off the negatively charged terminal in a vacuum tube, and they fly with tremendous speed till they strike something. When they strike they can propel as well as heat the target, and they can likewise make it emit a phosphorescent glow, especially if it be made of glass or precious stones. If the target is a very massive metal like platinum, the sudden stoppage of the flying electrons which encounter it causes the production of the ethereal pulses, known as X-rays. Electrons are not very easy to stop, however, and a fair proportion of them can penetrate not only wood and paper, but sheets of such metals as aluminium, and other moderately thin obstacles. That is because they are extremely small—much smaller than the atoms of matter.

Each electron has a definite charge of electricity, viz., the same charge as is conveyed by each single atom when a current is passed through a chemically conducting liquid. Every electron has also a definite and uniform mass, which is about 1/800 of that of an atom of hydrogen—hitherto the lightest known form of matter.

From every kind of material the same and no other kind of electron can be obtained, and we have reason for asserting that no other kind exists.

Electric currents are always due to the locomotion of these little electric charges; they permeate and make their way through metals, being handed on from one atom to the next, as a fire bucket is passed from hand to hand. This is metallic conduction. Liquid conduction is different; the electrons travel with the atoms in liquids, and hence travel slowly, being jostled by the crown, and being laden with the heavy atom which they convey or propel, as a pony (or a flea—in mass a pony, but in bulk a flea) might drag a heavy wagon through crowded streets, until at the terminal station it is unharnessed and allowed to trot into its stable, which is what happens when the boundary between liquid and metallic conductors is reached. Electrons become still more emancipated, however, in rarefied gases, which act as a cleared racecourse, or like a free range for flight; and then it is possible to find them flying at prodigious speed, even as high as 100,000 miles a second, and sometimes faster still, but never quite so fast as light.

Whenever an electron is suddenly started or stopped or made to turn a corner it disturbs the ether through which it has been quietly moving and excites a ripple in it. These ethereal ripples constitute radiation, and the best-known variety of them we call "light." With this we have been familiar for a long time, because of our happening to possess eyes—instruments for the ready appreciation of ethereal ripples. We used not to know the reason, however, for the production of light. We know now that it is due to the sudden change of motion, either in speed or direction, of an electron, and probably to no other cause.

The charge in an electron is very small, but is extremely concentrated—that is to say, it exists only as a very minute nucleus; and in order to explain the manifestation of the observed mass of 1/800 part of a hydrogen atom by so trifling a quantity of electricity it is necessary to suppose that it is concentrated into a space one-hundred-thousandth of the diameter of a material atom. This is the size which is at present accepted for an electron. It is quite the smallest thing known.

Matter, then, appears to be composed of positive and negative electricity, and nothing else. All its newly discovered, as well as all its long-known properties, can thus be explained—even the long-standing puzzle of "cohesion" shows signs of giving way. The only outstanding still-intractable physical property is "gravitation," and no satisfactory theory of the nature of gravitation has been so far forthcoming. I doubt, however, if it is far away. It would seem to be a slight but quite uniform secondary or residual effect due to the immersion of a negative electron in a positive atmosphere.

A CONTINUOUS WEIGHING MACHINE.

THE Blake-Denison Continuous Weigher, which we illustrate by the courtesy of Messrs. Samuel Denison and Son, of Leeds, disposes of many of the difficulties encountered in the use of hopper machines. This appliance weighs coal and other material upon a conveyor during transit, and will take pieces of any size.

The principle upon which the machine is constructed is that of weighing a given length of the conveyor at intervals of time corresponding to the travel of such length, and automatically recording the weight. Its chief features are :—

1. A steelyard balanced to suit the unloaded conveyor, and arranged to rise accurately in proportion to the load.

2. A gripping device to hold the steelyard fast at suitable intervals.

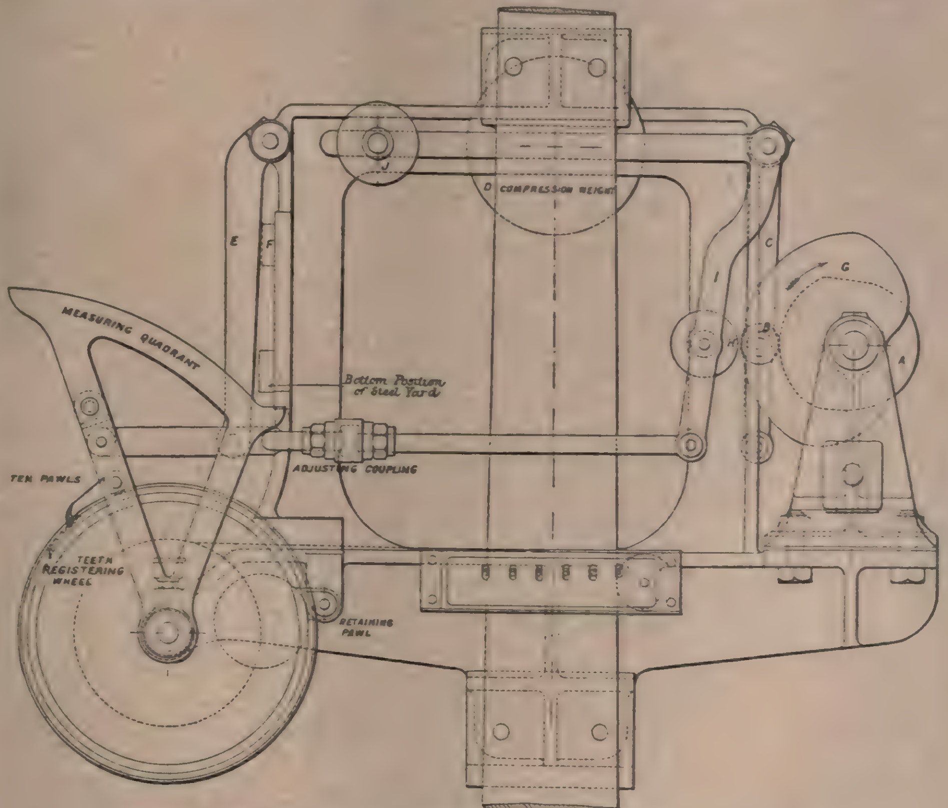
3. A measuring gauge or quadrant to ascertain the weight indicated by the steelyard when so held.

4. A recording mechanism to exhibit the result.

The resistance of the steelyard to the load is provided by a hollow plunger suspended in a bath of mercury in such a way that it forms a dash pot or drag against undue oscillation, and ensures the steelyard being always in a position exactly indicative of the load. There are no weights.

The gripping and measuring actions are produced by two cams upon a shaft operated directly by toothed gears from a drum which is revolved by the conveyor itself.

In the machines already made, the cycle recurs every five seconds, and is as follows :—The steelyard is free for about three seconds, during which time it assumes a position proportional to the load upon that portion of the conveyor which is supported by the weighing machine. It is then gripped by the action of the first cam A, which forces the gripping lever E against the steelyard F. The rotation of the second cam G then allows the lever I to fall to the right. The lever I is attached to the pin on the measuring quadrant. This measuring quadrant therefore, also falls to the right until it touches the gripped steelyard. As the quadrant so moves to the right it takes with it a number of steel pawls, which slip over the cogs of the registering wheel—the registering wheel being held firmly in position by a set of retaining pawls. Then, as the cam G continues to rotate, the lever I is pushed back to the left to its normal position, carrying the quadrant with it. As the quadrant goes over to the left to its normal position, the pawls engage in the cogs of the registering wheel, and so it will be seen that at each weighing operation the registering wheel is moved round the number of cogs or teeth that is exactly proportionate to the height of the steelyard. Then as the cams continue to rotate, the gripping lever E rises, the steelyard is set free, it again assumes a position exactly indicative of the load, and (assuming the length of suspended conveyor is 6 ft.) the steelyard is again gripped at that exact moment of time when the conveyor has travelled 6 ft. from the time when the steelyard was last gripped. The recording mechanism is again set in motion, and every successive 6 ft. length of the conveyor is weighed and the net total result shown on the indicator.



END ELEVATION OF THE BLAKE-DENISON WEIGHING MACHINE.

British Standards
. . FOR . .
Electrical Machinery.

SINCE the appearance of our last issue the Engineering Standards Committee has issued its interim report with reference to British Standards for Electrical Machinery. In view of its importance, we reproduce the report in *extenso* :—

CHAIRMAN'S STATEMENT.

In publishing the interim report of the sub-committee on generators, motors and transformers it will be as well to draw attention to some of the important points which have arisen in carrying out the work entrusted to the sub-committee by the electrical plant committee.

The sub-committee on generators, motors and transformers was appointed at a meeting of the electrical plant committee on December 18th, 1902, and confirmed by the main committee on February 13th, 1903.

This interim report was approved by the main committee at their meeting on July 26th, 1904.

At the earlier meetings it was decided that no attempt should be made to prescribe standard dimensions or shapes which might hamper future development in design, but to confine the recommendations of the sub-committee to such points as would ensure uniformity in nomenclature, outputs and test conditions.

The recommendations which the committee have arrived at with reference to standard pressures, frequencies, outputs and speeds were prepared after the views of both users and manufacturers had been very carefully considered.

Before standard test conditions can be laid down, the safe limit of temperature at which electrical machinery can be allowed to work for lengthened periods of time has, of course, to be determined. A sub-committee, under the chairmanship of Dr. Glazebrook was, therefore, formed to experimentally investigate this matter at the National Physical Laboratory, supplemented by tests at the works of those manufacturers who were willing to assist.

The points to be investigated were the following :—

1. The maximum temperature to which the insulating materials at present used in the manufacture of electrical apparatus could be exposed for lengthened periods of time without electrical or mechanical deterioration.

2. The permissible rise in temperature deduced from these experiments.

3. The relation between the mean temperature of any coil obtained by measurement of rise in resistance and the maximum temperature at the hottest portion of the same coil.

In addition to these experiments, some of the coils which were tested singly at the National Physical Laboratory were subjected to a second series of tests when mounted on the machines for which they were intended, at the maker's works.

The reports of this experimental work are likely to be of very great interest and value to the electrical industry at large, and the committee hope to publish them in full, at an early date.

It will be of interest to designers to note that the experimental work has made sufficient progress to indicate, with considerable certainty, that the temperature limits ultimately to be recommended by this sub-committee are likely to be more liberal than those laid down by either the American or German Electrical Standardisation committees. The experiments have also demonstrated that the temperature of the hottest part of the coils, taken by thermo junction, is no more than 25 deg. C. in excess of the mean temperature of the coil, taken by rise in resistance.

The question of settling the standard electrical pressures did not meet with as much difficulty as was anticipated. Care was taken to select those standard pressures which, with the allowable variation of 10 per cent. on either side, would enable nearly all the pressures at present existing to be served by the proposed standard machines. These standard pressures have now been fixed, and it is hoped that *in all future work* they will be universally adopted by Engineers who are advising Power Companies, Corporations, Supply Companies, and others engaged in the distribution of electrical energy, so that in these cases the permissible variations will gradually cease to be necessary.

The standard frequencies proved to be a debatable matter, and after several circular letters had been addressed to, and replies received from, both users and makers, it was deemed advisable to convene a conference, so that the matter might be thoroughly discussed. This conference was held early in January, and the advisability of adopting two or three standard frequencies was fully considered, especially from the point of view of the future developments in power schemes. Strong evidence was brought forward in favour of standardising one frequency only, and the sub-committee, after due consideration, decided to recommend 50 periods per second as the standard frequency, placing 25 periods per second in a secondary category.

The question of recommending standard lists of motor speeds, which appeared so desirable from the users' point of view, was found to be an extremely difficult one. The sub-committee felt that they could not materially assist manufacturers in reducing the number of patterns kept in stock, if a greater number of speeds were retained than those recommended in the standard lists. Happily, one list of speeds, namely that from Prime movers, was practically fixed for the Committee by the conditions of the frequency and the number of the poles in the alternators, so that the committee decided to put forward this one list of speeds for the whole of the direct coupled machinery of both classes.

The sub-committee on generators, motors and transformers are indebted to the transformer sub-committee for the recommendations with reference to alternating current generators.

They have still under consideration the very important subjects of the standardisation of transformers, test conditions, and permissible variations from the adopted standards, and the complete report cannot be published until such time as these investigations are concluded.

The committee, however, feel that the interests of the electrical profession will best be served by the early publication of a portion of the information which will ultimately be embodied in the Report when complete.

R. E. B. Crompton,
Chairman of Sub-Committee on Generators, Motors and Transformers.

The following is a list of the members of the sub-committees, by whom the standards for generators, motors and transformers are being drawn up :—

Sub-Committee on Generators, Motors and Transformers.—Colonel R. E. B. Crompton, C.B. (Chairman); Commander H. W. Richmond, R.N., Messrs. C. H. Wordingham and L. J. Steele (representing the Admiralty); Colonel H. C. L. Holden, R.A., and Captain A. H. Dumaresq, R.E. (representing the War Office); Mr. Llewellyn Preece (representing the Crown Agents for the Colonies); Dr. R. T. Glazebrook (representing the National Physical Laboratory); Messrs. B. H. Antill and W. B. Esson (nominated by the Electrical Engineering Plant Manufacturers' Association); Captain H. R. Sankey (retired), Messrs. A. C. Eborall, S. Z. de Ferranti, Robert Hammond, W. H. Patchell, and Charles P. Sparks.

Sub-Committee on Transformers.—Mr. Charles P. Sparks (Chairman); Colonel R. E. B. Crompton, C.B. (ex-officio); Messrs. A. F. Berry, A. C. Eborall, W. B. Esson, W. M. McConahey and H. S. Meyer; Mr. Leslie S. Robertson, M.Inst.C.E. (Secretary); Mr. C. le Maistre, A.M.Inst.C.E. (Electrical Assistant Secretary).

PRESSURES AND FREQUENCIES.

The following are the resolutions with reference to British Standard Pressures and Frequencies :—

1. Resolved that the standard low pressures for direct and alternating current work, measured at the terminals of the consumer, be :—

110, 220, 440, 500, volts.

Though not included in the above standard pressures, 380 volts shall be considered as the recognised pressure to be maintained between the principal conductors in a three-phase system with neutral wire, the pressure then being 220 volts between the three conductors and the neutral.

2. Resolved that the standard high pressures for alternating current work, measured at the terminals of the generator, be :—

2,200, 3,300, 6,600, 11,000, volts.

3. Resolved that the standard primary pressures for alternating current transformer work, measured at the primary terminals of the transformer, be :—

2,000, 3,000, 6,000, 10,000, volts.

4. Resolved that the standard secondary pressures for alternating current transformer work, measured at the secondary terminals of the transformer, be :—

115, 230, 460, 525, volts at no load.

5. Resolved that the standard direct current pressure for tramway work, measured at the terminals of the motor, be :—

500 volts.

6. Resolved that the standard frequency for alternating current work be :—

50 periods per second.

But where the circumstances of the case demand a lower frequency, a standard of 25 periods per second shall be adopted.

N.B.—The above standard pressures are subject to a permissible variation of 10 per cent. on either side, as explained in the introduction.

RATING OF GENERATORS AND MOTORS.

(*Except for traction motors.*)

1. Two ratings shall be recognised by the British Engineering Standards Committee—

(A) Continuous working.
(B) Intermittent working.

(A) The output of generators and motors for continuous working shall be defined as the output at which they can work continuously for *six hours* and conform to the prescribed tests.

(B) The output of motors for intermittent working shall be defined as the output at which they can work for one hour and conform to the prescribed tests.

N.B.—The duration of test for machines above 250 kilowatts is still under consideration.

2. Every generator and motor shall carry, in a conspicuous position, a name plate giving the output and other particulars enumerated below.

In the absence of any statement to the contrary, the output given shall always be understood to mean the output for continuous working under Rating (A).

Name plates for machines under Class (B) shall bear the word "Intermittent."

3. The output and full load speed marked on the name plate shall be those taken when the machine is at its normal working temperature, as determined at the close of the test run referred to above.

4. All generators shall have their outputs stated in kilowatts (k.w.).

All motors shall have their outputs stated in b.h.p.

5. The following information shall be given on the name plates :—

Generators.	Direct Current.	K.W.	Volts.	Amps.	R.p.m.	
	Alternating Current.	K.W.	Volts.	Amps.	Power Factor	
		Full Load. Excitation.	Volts. Amps.	Frequency.	R.p.m.	
Motors	D.C. (Continuous working)	B.H.P.	Volts.	R.p.m.		
	D.C. (Intermittent working)	B.H.P. (Intermittent)	Volts.	R.p.m.		
	A.C. (Continuous working)	B.H.P.	Volts. Frequency.	R.p.m. Power Factor.		
	A.C. (Intermittent working)	B.H.P. (Intermittent)	Volts. Frequency.	R.p.m. Power Factor.		

The above applies to combined machines, such as motor generators, boosters, rotary converters, which shall have name plates giving information applying both to input and output.

DIRECT CURRENT GENERATORS.

6. The List Nos. represent the kilowatts which the machine can work at when continuously as a generator.

List Nos. and speeds of direct current generators (up to 100 kilowatts) :—

List No.	Standard Motor Carcase.	R. p. m.	List No.	Standard Motor Carcase.	R. p. m.
6	7½	1075	32	40	750
8	10	1000	40	50	675
12	15	900	60	75	625
16	20	850	80	100	575
24	30	800	100	–	500

KW.	Revolutions per Minute.		
	Slow.	Medium.	High.
100	*	250	500
150	*	250	428
200	*	250	375
250	*	250	375
300	94	214	375
400	94	214	375
500	83	214	300
750	83	188	250
1000	83	188	250

N.B.—The "Slow" speeds in the above table are tentative.

British Standard Generators of 100 kilowatts and above, whether for direct or alternating current work, shall conform to the above list of sizes and speeds recommended for generators to be directly coupled to steam or gas engines.

ALTERNATING CURRENT GENERATORS.

7. British Standard alternators of any type, in addition to the requirements laid down in previous clauses, in so far as the latter apply, shall conform to the following regulations :—

(*a*) They shall give an E.M.F. curve which, under all working conditions, shall be as nearly as possible a sine wave.

(*b*) For exciting the field magnets the standard pressures shall be :—

65, 110 or 220 volts.

(*c*) The term "Alternator" shall not include an "Exciter." The latter, when necessary, shall be separately specified and subject to the regulations for standard direct current generators.

(*d*) The regulation of an alternator shall be defined as the difference between the rated full load pressure and the no load pressure with the same speed and excitation. This difference expressed as a percentage of the rated full load pressure shall be termed the percentage "pressure rise" of the alternator.

(*e*) They shall not have a greater percentage pressure rise than six per cent. (6%) on a non-inductive load and twenty per cent (20%) on an inductive load, the latter being here considered as one having a power factor of 0·8.

This pressure rise may be tested on a non-inductive or inductive load according to the requirements of the specification.

The figures in (B) and (D) shall not apply to compounded alternators.

MOTORS.

8. All motors for the purposes of tests shall be rated under the following classes :—

(1) Open.
(2) Protected.
(3) Ventilated.
(4) Totally closed.

(1) and (4) require no definition.

(2) A *protected* motor is defined as a motor, in which the armature, field coils and other live parts are protected mechanically from accidental or careless contact, so as not to materially interfere with ventilation.

(3) A *ventilated* motor is defined as a motor in which, while ventilation is provided for, access to the armature, field coils and other live parts is only to be obtained by opening a door in, or removing a portion of, the enclosing case.

N.B.—An alternating current motor, Class (3), in which the slip rings are outside the protection, shall be considered as coming under Class (2).

LISTS OF MOTORS.

9. The list Nos. represent the b.h.p. which the machine can work at when running continuously as a motor, at the standard pressure of 220 volts up to and including two (2) b.h.p., and above that size, at the standard pressure of 440 volts.

10. The following are the list Nos. of British Standard Sizes of motors :—

List Nos. (direct current).

¼, ½, 1, 2, 3, 5, 7½, 10, 15, 20, 30, 40, 50, 75, 100,

List Nos. (single phase) 50 ∼

1, 2, 3, 5, 7½, 7½A, 10, 10A, 15, 20, 25.

List Nos. (two- and three-phase) 50 ∼

1, 2, 3, 5, 7½, 7½A, 10, 10A, 15, 20, 25, 30, 40, 50, 50A, 75, 100.

11. List Nos. and speeds of motors (up to b.h.p.).

DIRECT CURRENT MOTORS.

List No.	R.p.m. at Full Load.	List No.	R.p.m. at Full Load.	List No.	R.p.m. at Full Load.
¼	1600	5	1000	30	750
½	1400	7½	1000	40	700
1	1400	10	900	50	650
2	1100	15	850	75	600
3	1100	20	800	100	550

ALTERNATING CURRENT INDUCTION MOTORS.

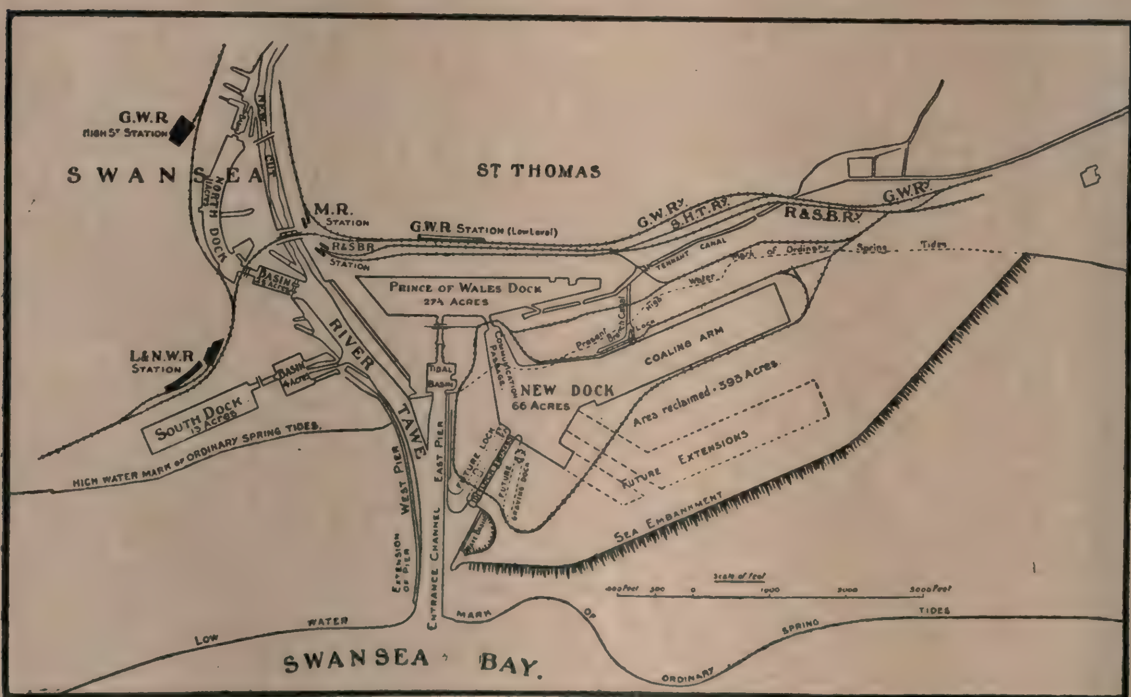
Single phase, 50 ∼

List No.	R.p.m. at No Load.	List No.	R.p.m. at No Load.	List No.	R.p.m. at No Load.
1	1500	7½	1500	15	1000
2	1500	7½A	1000	20	1000
3	1500	10	1500	25	750
5	1500	10A	1000		

ALTERNATING CURRENT INDUCTION MOTORS.—Two and Three Phase, 50 ~

List No.	R.p.m. at No Load.	List No.	R.p.m. at No Load.	List No.	R.p.m. at No Load.
1	1500	10	1500	40	750
2	1500	10A	1000	50	750
3	1500	15	1000	50A	600
5	1500	20	1000	75	600
$7\frac{1}{2}$	1500	25	750	100	500
$7\frac{1}{2}$A	1000	30	750		

The figures referring to a.c. motors give the no load or synchronous speeds, allowance should, therefore, be made for a reduction in speed at full load of, from about seven-a-half per cent. ($7\frac{1}{2}$%) in the smallest motors to two-and-a-half per cent. ($2\frac{1}{2}$%) in the largest motors.



PLAN OF THE NEW DOCK AT SWANSEA.

Details of this important development, which was inaugurated by His Majesty the King last month, will be found in our notes on Civil Engineering.

The Irrigation Problems of the Nile.

A Summary of the Schemes recommended by Sir William Garstin, G.C.M.G., for the control of the river throughout its entire length.

ONE of the most important documents hitherto issued concerning Egypt and the Soudan is the report which has been drawn up by Sir William Garstin, G.C.M.G., Under-Secretary of State for Public Works in Egypt, upon the Basin of the Upper Nile. After the most careful investigation, he discusses the works which he considers necessary in order to conserve the waters of the Nile and to control the entire river. Incidentally, he advises the formation of a properly organised Irrigation Service of the Soudan. It is laid down very clearly that the flow of the Nile must remain always and absolutely in the hands of one authority. The proposed Irrigation Service should be entirely controlled by the Ministry of Public Works in Egypt, and should, in fact, form a branch of that department.

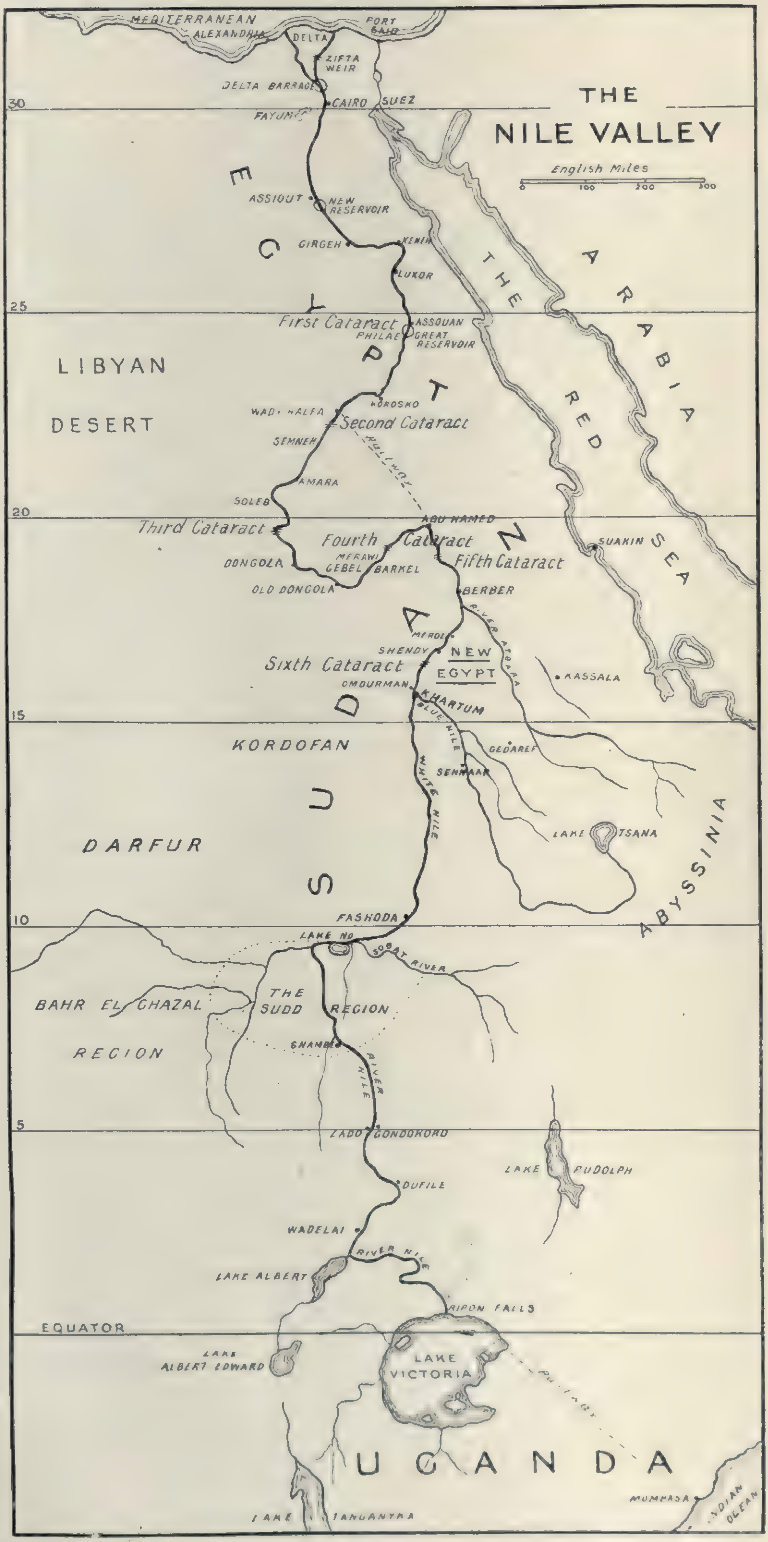
Sir William Garstin is nothing if not thorough. Consequently, he first takes us to the region of the great lakes, and in the course of a general description we learn all that has been ascertained within recent years as to the source of the Nile. In the first part of his report, he gives detailed descriptions of the Victoria Nyanza, the country between the Victoria and the Albert Edward Lakes, comprising the districts of Buddu and Ankoli, Lake Albert Edward, the country between the Albert Edward and Albert Lakes in the districts of Toru and Ungoro, the Semliki River, the Victoria Nile, the Lake Albert Nyanza, the Upper Nile, or Bahr-el-Gebel, the White Nile, or Bahr-el-Abyad, Lake No, the Bahr-el-Ghazal, and the Blue Nile.

THE POPULATION OF THE SOUDAN.

In the Report upon the Upper Nile, published in 1901, the following remarks were made :—

"The Soudan is scarcely ready yet for the introduction of irrigation works upon a large scale. Were an increased supply of water to be granted at this moment, the country is not in a position to make effective use of the boon. Its chief want, for many years to come, must be population."

SIR WILLIAM GARSTIN, G.C.M.G.,
Under-Secretary of State for Public Works in Egypt.



These words are almost as applicable to the situation to-day as they were three years ago. It may well be that the actual total of the population is considerably larger than was at first supposed, but, even at the most favourable estimate, it must be very small as compared to the immense areas to be dealt with. It must, moreover, be extremely scattered. Further, with certain exceptions, the bulk of the population can hardly be classed as an agricultural one. It is difficult, then, to see how, unless labour is imported into the Soudan, full advantage can be taken, in any short period of time, of improved facilities for irrigation upon an extended scale.

At the same time, Sir William Garstin does not wish it to be supposed that his remarks are intended to advocate a policy of doing nothing towards improving irrigation in that country. The contrary is the case. If nothing is done no progress is possible, and, until a commencement has been made, no real amelioration in the state of agriculture can be looked for.

SCHEMES FOR THE FURTHER UTILISATION OF THE NILE SUPPLY.

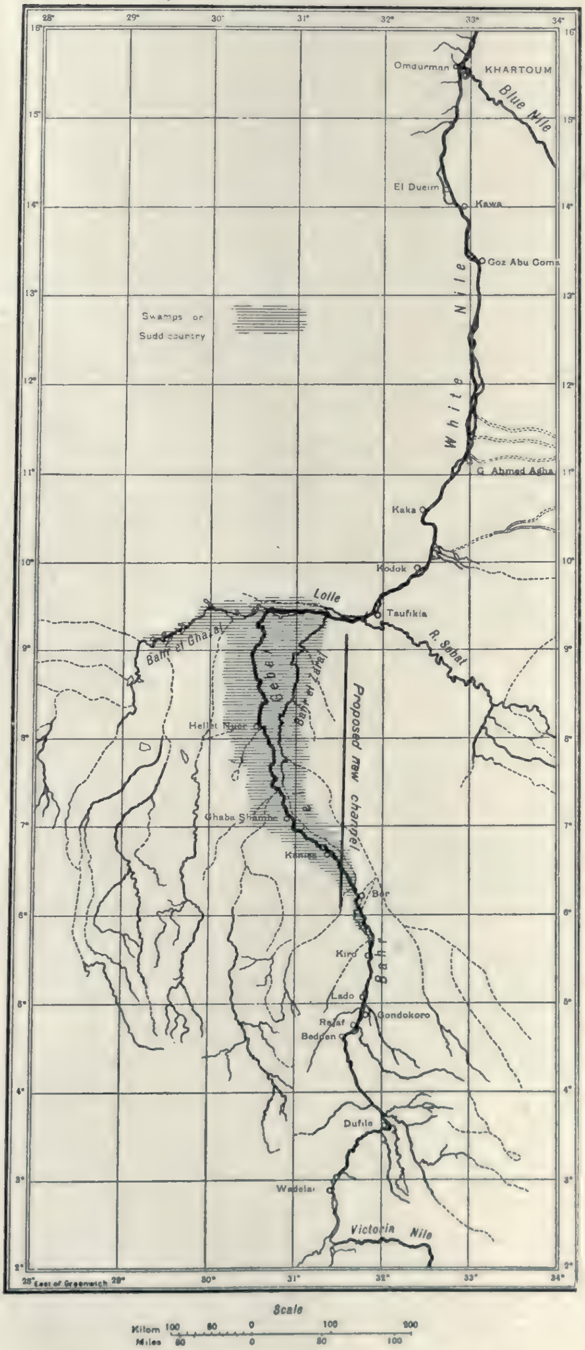
The problems investigated in the second portion of the report have two main objects, namely, that of increasing the water supply of Egypt in the summer, and that of securing similar advantages to the Soudan during the same period. Both of

CHARACTERISTIC NILE SCENERY.

(1) Papyrus on the Bahr-el-Gebel. (2) The White Nile at Taufikia.

these ends are of equal importance, although the former is perhaps the more likely to bring in an early return for the expenditure to be incurred.

The schemes in connection with the White Nile are considered first. They are two in number; firstly, the regulation of the great lakes which feed it, and, secondly, the prevention of the waste of water caused by the vast swamps through which it passes in the upper portion of its course.



MAP SHOWING PROPOSED NEW CHANNEL FOR BAHR-EL-GEBEL.

REGULATING THE GREAT LAKES.

Sir William Willcocks, in a recent work, has suggested lowering the crest of the Ripon Falls and, instead of attempting to raise the lake surface, drawing upon the immense amount of water annually stored in Lake Victoria. This suggestion is a sound one, and, should regulation of the Victoria Lake outfall ever be undertaken, the necessary works should be carried out upon these lines. No object would be attained by raising the water-level of Lake Victoria, even were it possible to do so. This, taking into account the area of the water surface and the annual loss by evaporation, is extremely doubtful. On the other hand, there is an immense volume of water annually available upon which to draw. This volume, even after deducting the loss due to evaporation, is far more than sufficient to meet the wants both of Egypt and the Soudan.

Should, however, such a work ever be undertaken, it would almost certainly be necessary to embank the 80 kilometres of its course through Lake Choga. If this were not done, the only result of an increased discharge at the outlet of the river would be an increase of the area of this lake, and a corresponding increase in the loss caused by evaporation.

Beyond the difficulties due to the remoteness of the locality, the scarcity of trained labour, and the cost of transport and supplies, it may be stated with confidence that there would be no special difficulties involved in the construction of a regulating work at the outlet of the Victoria Nile. Such a work would in all probability be far easier to construct than was either the dam at Assouan or the barrage at Assout.

Turning to the Albert Lake, the best site for a regulator would undoubtedly be at the 15th kilometre downstream of the outlet, at the point where the high land borders the river channel upon either side. Any other point between Magungo and Dufilé would necessitate the construction of very heavy embankments for a considerable length. Here, again, no very special difficulties of construction would appear likely to arise.

The objection to any proposals for augmenting the discharge from the equatorial lakes is that under present conditions the increased volume would never reach the White Nile, but would be entirely wasted in the marshes through which the Bahr-el-Gebel passes. It will be understood that barely 50 per cent. of the water which now leaves the Albert Lake in summer ever arrives at the White Nile, while in the flood the proportion of loss is very much greater. In other words, the greater the amount of water in the Bahr-el-Gebel, the larger is the proportion of loss; while the discharge entering the White Nile is constant throughout the year. Until, then, some means have been found whereby the water passing Lado during the dry season of the year can be brought down to Khartoum in undiminished volume, it is needless to consider the question of any regulation of the Albert and the Victoria Lakes. These projects may, therefore, be postponed to a possible future, when the existing supply in the Bahr-el-Gebel shall have been made full use of, and when this shall have been found to be insufficient for the requirements of Egypt and the Soudan.

Sir William Garstin also says it would seem possible without any very heavy expenditure, to so train the Upper Nile that during the dry season its waters should be delivered at the head of the Bahr-el-Zaraf, without any serious reduction of the volume passing Lado, while during the flood they would fill the reservoir, up stream of Ghaba Shambé, to the same extent as they do under present conditions.

SUMMARY OF SIR WM. GARSTIN'S PROPOSALS.

He summarises his various proposals as follows :—

(*a*) To prevent waste in summer by closing of all spills and barring all branch channels, the latter by earthen dams or small masonry regulators, between Gondokoro and Ghaba Shambé. Also to try the experiment of planting ambatch as a means of closing these channels. The summer water would then be confined to one single stream, while the floods would rise over the valley and form a great basin, as at present.

(*b*) To study the possibility of excavating a completely new channel for the summer water of the Upper Nile, on an alignment running nearly due north and south from Bor to the Sobat junction with the White Nile. If the levels permit of it, this project should be carried out in preference to any other. The channel should be designed to eventually carry 1,000 metres cube per second. A regulator and lock would be built at the head, and another regulator across the Nile downstream of the new outlet.

With regard to proposal (*b*) we quote the following from the report in *extenso* :—

The next point to be considered is how best to pass on the summer water through the great marshes north of Bor, and deliver it into the channel of the White Nile without any serious diminution of the discharge.

The most natural way to effect this would appear to be to select one of the two main branches, namely, the Bahr-el-Gebel or the Bahr-el-Zaraf, and to improve its section so as to render it capable of carrying a discharge of from 600 to 700 metres cube per second. This, as has been said, appears to be the most natural method to adopt, and would most probably be the cheapest. There is, however, another plan, which, if it should prove, upon examination, to be feasible, would undoubtedly improve the river to an extent far beyond any result that could be attained by merely remodelling one or other of the existing channels.

DETAILS OF PROPOSED NEW CHANNEL.

In order to understand this scheme it will be necessary to refer to the accompanying small-scale map of the river.

It will be seen that a line drawn through Bor, on the Upper Bahr-el-Gebel, and running due north and south, would cut the White Nile at or near the point where the Sobat joins this river. The distance between these two points in a straight line is approximately 340 kilometres. Were it possible to excavate an entirely new channel for the river, following this line, and to bring down its waters by this means from the Upper Nile at Bor, direct to the White Nile, at the Sobat junction, the advantages that would be secured are so great and so obvious as to outweigh almost every objection that could be made to the proposal, short of the fact that further knowledge might prove that its execution was a sheer impossibility—owing to the levels or to the conformation of the intervening country.

These advantages may be briefly recounted :—

The entire swamp region would be avoided altogether—the floods in the river might cover these marshes unchecked, as at present, and the channels might be allowed to be blocked by "sudd" without exercising the slightest effect upon the discharge in the new channel—the distance to be travelled by the water would be largely reduced, and navigation would be immensely facilitated by following a direct and straight line—the training works upon the Upper Nile would stop short at Bor, and a distance of some 200 kilometres of such work would be thus economised. As the high land touches the Nile on the east at Bor, the new channel would take off in excavation and much banking would be avoided.

Lastly, the discharge of the new branch would be under complete control, as a regulating head, with a lock, would be built at the point where it left the main river. Another and larger regulator would be built across the Nile at Bor, connected with the western high land by an embankment. With these two works the control of the discharge at all seasons would be complete.

Were a channel to be constructed of this capacity it would then be most advisable to carry out the proposed schemes for the control of the equatorial lakes by constructing regulators at the Ripon Falls, and downstream of the outlet of the Bahr-el-Gebel from the Albert Lake. In fact, the one project would be a complement of the other.

This proposal, may, perhaps, seem to be so drastic a remedy for the present loss of water as to be unacceptable to some. In reality, it is nct so drastic as at first sight it may appear to be. The real reason which, given that other conditions are favourable, would render its execution possible, is the power of escape supplied by the Gebel marshes. There is no question of turning the entire Nile flood down an artificial channel. What is proposed amounts to nothing more than the construction of an entirely new channel (not much larger than one of the great canals of Egypt), which would afford a means of delivering the summer water by the shortest and most direct route to the point where it was required, and, by avoiding the great swamps, reducing the difficulties of maintenance and the loss of water which is caused by their presence. At the same time these swamps would act as an effective regulating force to the flood-water, and would supplement the supply in the winter in the same proportion as they do at present.

The following is a comparison of the length of the proposed new channel with those of the Bahr-el-Gebel and Bahr-el-Zaraf, including the White Nile upstream of the Sobat junction:

	Kilometres.
I.—New channel from Bor to the Sobat, as scaled from the map	340
II.—From Bor to the Sobat junction *via* the Bahr-el-Gebel, Lake No, and the White Nile (approximately) ..	710
III.—From Bor to the Sobat *via* the Bahr-el-Zaraf and the White Nile (approximately)	650

The question will naturally arise whether, with such a reduction in the distance traversed by the water, the increase in slope in the new channel would not be so great as to render navigation impossible. This cannot be solved until the difference of level between the two points has been ascertained.

ALTERNATIVE PROPOSALS FOR CONSERVING THE WATERS OF THE WHITE NILE.

(*c*) If proposal (*b*) should turn out to be impracticable, then, but then only, measures should be taken to improve the Bahr-el-Gebel through that portion of it which traverses the great marshes, *i.e.*, from Ghaba Shambé to Lake No, by cutting off the worst of the existing bends, and by closing the connections between the river channel and the great lagoons. It is indispensable, under such circumstances, that this river shall be kept free from all blocking by "sudd," not only because it would have always to remain the navigation channel between the White Nile and Gondokoro, but also because it would be imperative to prevent any tendency of the flood-water to burst out in the direction of the Bahr-el-Zaraf.

The Bahr-el-Gebel would thus, as it does as present, convey about half of the summer discharge at Lado to the White Nile, and even when the river was at its maximum this discharge would remain constant.

(*d*) Again, if (*b*) is found to be not feasible, then the best project will be to widen, deepen, and embark the Bahr-el-Zaraf throughout its length by means of powerful dredging plant, thus rendering it capable of carrying the balance of the summer water passing Gondokoro and discharging it into the White Nile at the present junction of the two rivers. By this means, the waste which at present occurs at Lake No would be avoided, and the water would be brought down from the south to the north with comparative little loss. Another great advantage of this scheme would be that, supposing that the Bahr-el-Gebel did get temporarily blocked by "sudd" during summer, an alternative channel would exist capable of carrying a considerable, probably the greater, portion of the summer supply. A regulating head would be built for this river at the point where it leaves the Upper Nile, which during flood would be closed entirely. At this period of the year, the Bahr-el-Zaraf would remain dry, except for the drainage water which would enter it, controlled by inlets in the banks from the right and from the left. If it were found unadvisable, owing to the difficulties caused by the marshes, to construct this head at the point where Bahr-el-Zaraf takes off from the Upper Nile, it might be possible to utilise the channel named by Mr. Grogan the Gertrude Nile, and continue the remodelled Zaraf up to the high land at Bor, where a head could without difficulty be constructed.

(*e*) Once the channel for the summer water had been satisfactorily completed, the schemes for regulating on the outlets of the Victoria and Albert Lakes should be put in hand in order that a constant discharge of 1,000 metres cube per second should be poured into the White Nile during the season of lowest supply.

REQUIRED—A FLEET OF POWERFUL HYDRAULIC DREDGERS.

Before leaving the subject of the White Nile a few words are necessary as to the method in which the main works should be carried out. These works apply to the proposed new channel from Bor, equally to the work on the Bahr-el-Zaraf, should the former scheme be rejected. There is no question that the only practical way would be by the assistance of a fleet of powerful hydraulic dredgers or excavators, specially designed

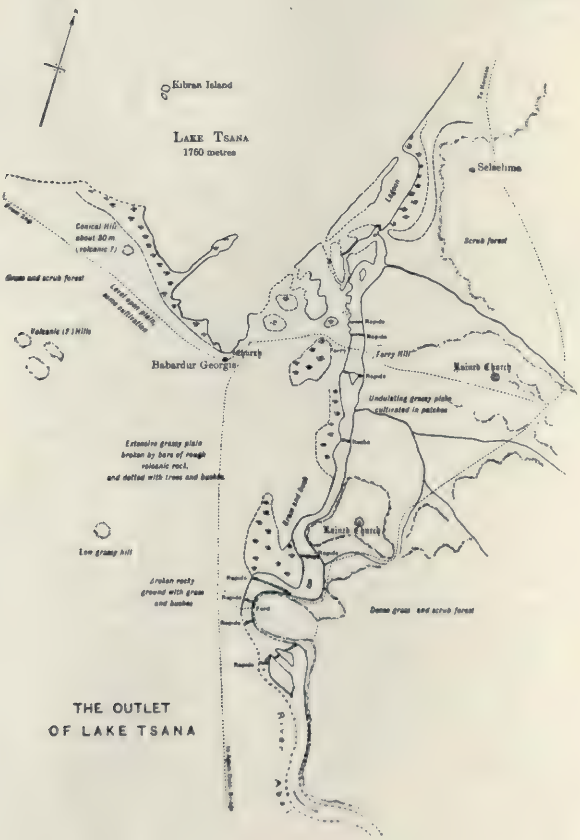
ON THE BAHR-EL-GEBEL.
(1) At Kiro. (2) Mongalla.

to meet the various necessities of the case. Several different types would almost to a certainty be required before the work was completed. It would consequently be advisable to commence with a small number, say with two or three, adding to these and altering the type according to the knowledge gained by the experience of the earlier work. To carry out such an undertaking by hand labour would be practically impossible, and would almost to a certainty result in failure. The conditions under which the works would have in this region to be carried out constitute the chief difficulty. The local tribes can never be counted upon to provide labour; all supplies would have to be brought from Khartoum, which is more than 950 kilometres from the *nearest* point of the work; fuel for the dredgers and steamers is a difficulty of yearly increasing magnitude; malaria is at all seasons prevalent in these marshes; the temperature even in winter is high, and the dampness of the atmosphere must be felt to be appreciated. For some months annually, *i.e.*, from June to September, the rainfall is so heavy that continuous work would be well-nigh impossible. Lastly, the mosquitoes of this region are probably more numerous and more ferocious than in any other part of the world. These difficulties constitute a formidable list, and it must be admitted that the task is a heavy one. Still it is not impossible. It is merely a question of money and time, and possibly of certain loss of life—the toll levied upon the workers by the climate.

The advantages that would accrue to Egypt, and to the Soudan north of Khartoum, could an increased discharge of from 600 to 700 metres cube per second be added to the volume of the river at the period when water is most required, are so great and so obvious as to warrant an attempt to secure them even more difficult and more costly than that proposed in these pages.

In any such project the unknown point must, of course, always be as to how much of this extra water would actually reach Assouan, supposing that the wastage through the "Sudd" region could be successfully arrested. The White Nile swamps would doubtless absorb a certain quantity, and evaporation between the Bahr-el-Zaraf and the first cataract would still further reduce the volume. Allowing that this loss was as much as one-third, which is a high estimate—even so, the balance would form a most important addition to the summer supply of Egypt, and one well worth spending a large sum of money to secure.

PLAN XI



THE OUTLET OF LAKE TSANA

THE UTILISATION OF THE BLUE NILE.

It is now necessary to consider the second of the great questions connected with the control of the Nile, viz., the possible utilisation of the Blue Nile as a means of increasing the water supply in summer. Any works undertaken upon this river should be designed and carried out in the interests of the Soudan rather than of Egypt—the latter country deriving its increased discharge from the waters of the White Nile.

The best and the most complete project in connection with the Blue Nile is beyond all question that of constructing a regulator at the outlet of the river at Lake Tsana, whereby this lake may be converted into a storage reservoir of large size. Were it not for the fact that it lies outside of the Soudan Frontier, and that its construction might cause political difficulties, it would be unnecessary to look beyond this scheme for a means of satisfactorily increasing the volume of the Blue Nile discharge in summer. A reservoir that would store, at a comparatively small cost, 3,000 millions of cubic metres of water would amply suffice for the wants of the Ghezireh and of the eastern Soudan. Unfortunately, the questions involved by its position are so many and so difficult of adjustment, that the abandonment of this project for an indefinite future appears to be a matter of certainty. This being so, it is necessary to search for a project, or projects, involving the construction of works within the territories of the Soudan. The following list gives the different projects requiring study in this direction in the order of their importance:—

1. The selection of a site for an open barrage in the vicinity of Wad Medani. Such a study would involve that of the projects for the main canals east and west of the river.

2. The possibility of making a storage reservoir of limited capacity within Soudan territory by means of a dam constructed at or south of the Rosaires Rapids. This reservoir would be filled during the months of October and November, and would be made use of for augmenting the river supply during the months of December, January, and February.

3. The project for improving the irrigation of the river Gash by means of a basin for controlling the floods with its subsidiary canals.

4. The study of the project for constructing a dam and storage reservoir in the Atbara River, near Kashim-el-Girba.

5. An examination of the Rivers Dinder and Rahad with a view to ascertaining whether the construction of storage reservoirs at any points of their course is practicablly possible.

6. An examination of the upper valley of the Atbara with the same end in view.

As regards the river valley to the north of Khartoum, and between that place and Berber, the conditions are entirely different from those of the Blue Nile, and more nearly resemble those of Upper Egypt and of the Dongola Province. The rainfall is irregular, being limited, even south of Shendy, to heavy but local storms. The strip of good land on either side of the river bounded by the desert is not very wide. In this region the best plan to follow for improving these lands is undoubtedly the erection of large pumping stations capable of irrigating a large area of country. In addition certain selected tracks might advantageously be turned into basins, but the expenditure would be heavy in proportion to the result to be obtained. The general conditions prevailing in Egypt, between Assouan and Assout would thus be reproduced, and the fact that this area throughout its entire length is traversed by a line of railway would greatly facilitate its agricultural development.

THE PROPOSED IRRIGATION SERVICE.

With regard to the proposed Irrigation Service for the Soudan, Sir William Garstin outlines its constitution as follows: An Inspector-General of Irrigation should be appointed having his headquarters at Khartoum. He would supervise and control the service as a whole. His chief assistants should consist of two inspectors, one for the White and the other for the Blue Nile. It would be advisable to appoint a third and junior officer, who would act as a reserve man, and who could be usefully employed upon special works and studies. There should also be appointed a large staff of native engineers and levellers, together with the requisite office establishment. Two steamers would be required for inspection work, one for the White Nile and another, of very shallow draught, specially designed for work on the Blue Nile.

If the decision of the Egyptian Government is favourable to the proposal, and there can be little doubt that such a decision would be a wise one, then as little time as possible should be lost, and the new service should be started by the commencement of the next winter, so as to enable full advantage to be taken of the cool season of the year.

It is not to be expected that projects of any magnitude will be immediately presented for consideration, neither is this to be desired. The fullest study must be given and the closest observations made of the different schemes in all their details. This will take time, but it will not be time lost, and it will be far more economical in the end if a delay due to study occurs *before* a project is presented than if this occurs *after*, and *after the works have been started*.

Should it be decided to form an Irrigation Service in the Soudan, it is absolutely necessary that it should be entirely controlled by the Ministry of Public Works in Egypt, and that it should in fact form a branch of that department.

RELATIVE URGENCY OF THE SCHEMES.

Among the many schemes outlined in this important note, four are recommended as being the most suitable for early examination:—

Blue Nile.—Controlling the River Gash.
Barrage upon the Blue Nile.

White Nile.—Proposed new channel between Bor and the Sobat junction.
(Alternatively)—The remodelling of the Bahr-el-Zaraf so as to enable it to carry the required discharge.

Once it has been secured by one or other of these methods that the summer discharge of the Bahr-el-Gebel shall reach the White Nile in undiminished volume, then the work of regulating the Victoria and Albert Lakes at their outlets should be proceeded with.

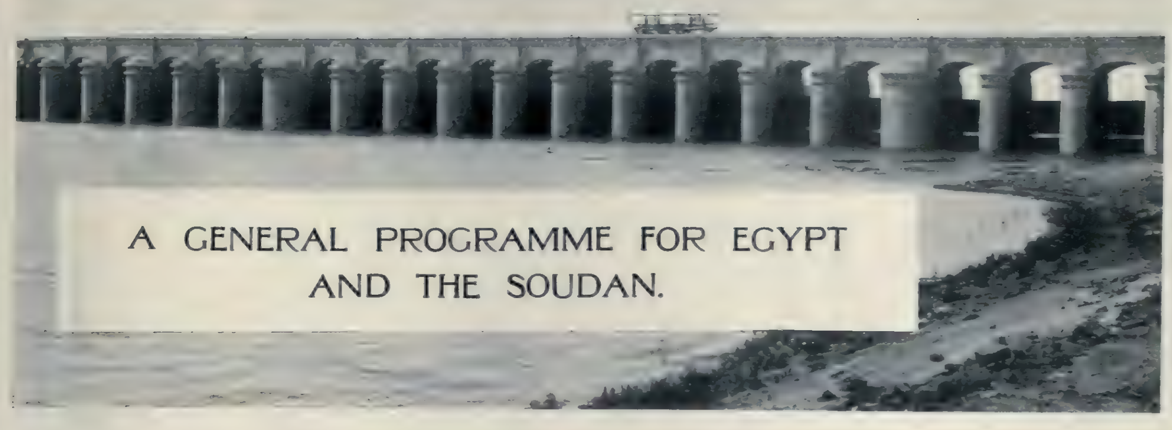
The more important of the projects demanding immediate attention in the Soudan have been indicated in the above brief summary. It will be understood that their execution will entail the expenditure of large sums of money. If to this is added the cost of the large irrigation works required simultaneously in Egypt this expenditure will reach a very large figure indeed.

A GREAT QUESTION.

It is for those who control the finances of Egypt to decide whether such expenditure is desirable, or whether, even with every prospect of a large increase to the annual revenue as a result of these undertakings, it is not advisable to proceed slowly, and to apply a portion of the surplus available to the many other necessary reforms alluded to by Lord Cromer in his yearly report upon Egyptian Administration. The present high selling and rental value of land in Egypt has engendered a hunger for its acquisition in all classes of the community, and this hunger seems likely to extend to the Soudan. Whether these prices will be maintained, or whether a largely-increased production will not one day cause a serious fall in the value of all agricultural products, is a question regarding which various opinions are held. Whatever the future may hold, this much is certain, that at present land is being urgently sought for everywhere, and that schemes for increasing the cultivated area are being urged upon the Egyptian Government. Fortunately, in the Soudan, equally as in Egypt, there can be no doubt of the eventual return to be obtained from any well-considered and sound irrigation project. Given a sufficient population, the combination of the sun, the soil, and the water renders its success a certainty.

Should all, or even a portion of these schemes ever become accomplished facts, it is difficult to estimate the extent of the benefits that will have been secured to a not inconsiderable portion of the continent of Africa. The limits of cultivation in Egypt are far from having been as yet reached. With a Nile under control throughout its entire length, and with the power of adding to its volume by drawing upon the almost inexhaustible resources of the natural reservoirs which supply it, the agricultural wealth of that country should increase to an extent beyond the dreams of the most sanguine reformer. The Soudan, it is true, represents an unknown quantity, and its future is one about which it would be at present rash to prophesy. That progress in that country must be slow is, unfortunately, certain, but there appears to be no reason why it should not be sure. What has once been may again be, and there are good grounds for anticipating an eventual return to prosperity—a prosperity, perhaps, even greater than that which excited the astonishment of Nero's envoys nearly nineteen centuries ago.

Those to whom the privilege shall be granted of assisting towards this consummation will have a chance given to them such as seldom falls to the lot of man. To rescue the Upper Nile from the marshes in which it has lost more than half its volume; to control and regulate the great Equatorial lakes, making them add to the flow of the river at will; to cause the waters of the Blue Nile to rise and irrigate the fertile tracts through which they pass; to secure to Egypt a constant and sufficient supply for the entire area between the cataracts and the Mediterranean; to free that country from the ever-present danger of a disastrous flood—these are tasks worthy of comparison with any previously recorded in the world's history, and which, if successfully accomplished, will leave behind them a monument that will probably endure long after all evidence of those erected by an earlier civilisation shall have passed away.



A GENERAL PROGRAMME FOR EGYPT AND THE SOUDAN.

In an appendix to the report dealt with in the foregoing pages, Sir William Garstin draws up a general programme of the main irrigation projects in Egypt as well as in the Soudan. In doing so, he emphasises the fact that with the single exception of the provision of escape power for the Nile during an exceptional flood, the large works outlined are not matters of extreme urgency, Egypt being already practically assured against agricultural disaster. In the Soudan, matters are different, for until irrigation works are commenced there, no hope of any real improvement in the country's annual heavy deficit can be entertained.

THE PROPOSALS OF SIR WILLIAM WILLCOCKS.

No examination of the different measures possible for improving the water-supply of Egypt can be complete without taking into consideration those schemes proposed for this purpose by Sir William Willcocks. These are of such importance that Sir William Garstin gives them precedence over all others.

They are three in number :—

(i.) The raising of the Assouan dam, thereby increasing the storage capacity of the Nile reservoir.

(ii.) The utilisation of the depression known as the Wady Rayan, for a secondary reservoir, to augment the summer supply of northern Egypt.

(iii.) The remodelling of the Rosetta branch of the Nile, so as to render it capable of serving as a flood escape for the river.

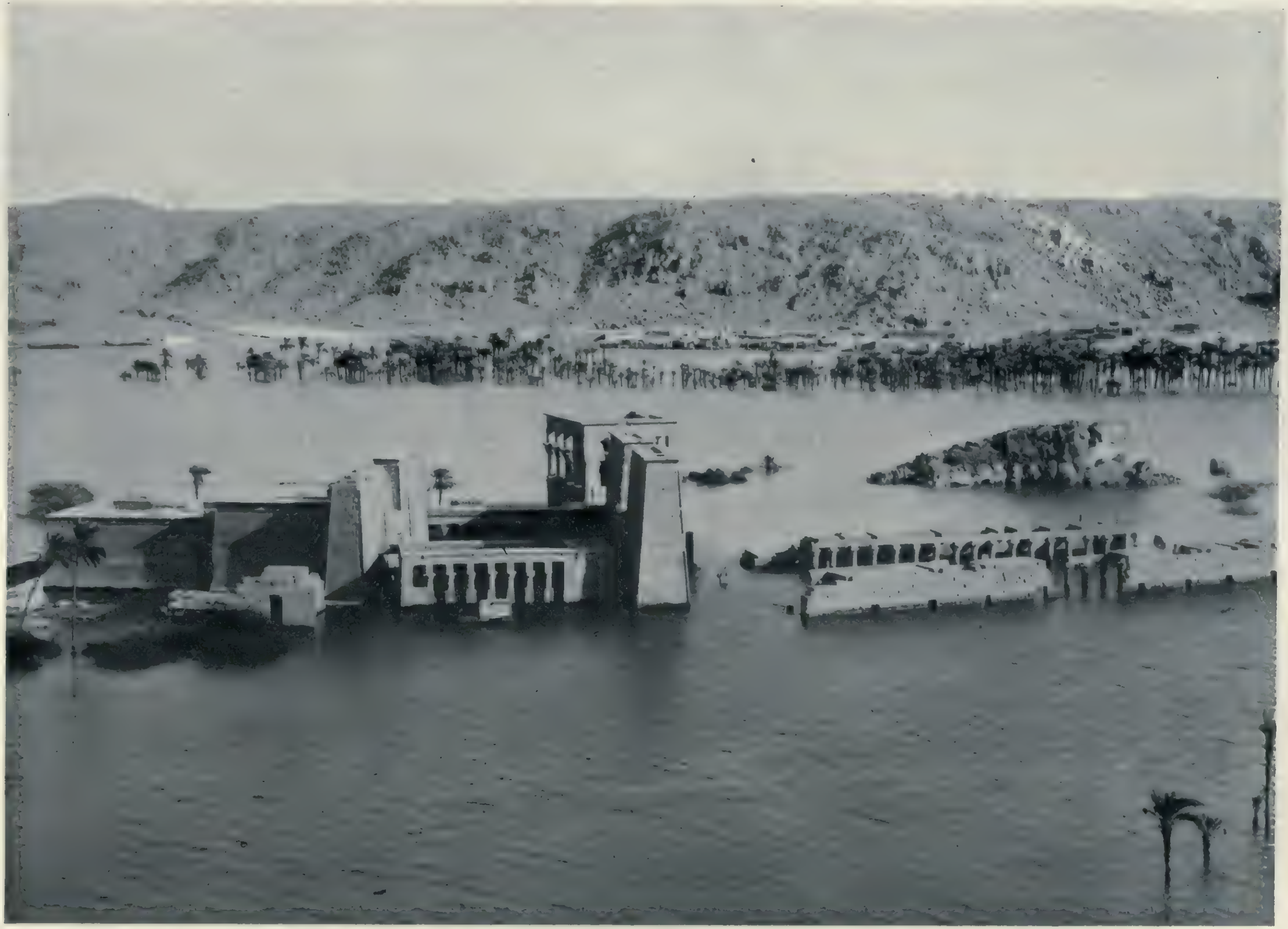
As regards numbers (i.) and (ii.), neither of these proposals, as it stands, can be said to be absolutely novel. A dam, at Assouan, raised to a height greater than that now suggested, was proposed by Sir W. Willcocks himself, in his original report upon the storage of Nile water. Again, the idea of making use of the Wady Rayan as a reservoir is due to Mr. Cope Whitehouse, who, for years, urged this project upon the Government. The combination of the two schemes, making the one the complement of the other, as now proposed, is, however, an entirely novel idea.

THE RAISING OF THE DAM AT ASSOUAN.

With regard to the proposed raising of the Assouan dam by six metres, doubling the storage capacity of the reservoir, Sir William Garstin no longer opposes the immediate execution of this work, provided that it is executed in conjunction with two other schemes, viz., (1) the improvement of the Upper Nile, so that an increased summer supply may be brought down, and (2) the provision of sufficient escape power for the river when in flood. He further says that he considers the project one which will undoubtedly render service to Egypt, and while the scheme is one from which the earliest returns can be anticipated, the cost of construction cannot be considered prohibitive.

THE SUBMERGED TEMPLES AT PHILÆ.

Sir William Garstin discusses the grounds of his having opposed the raising of the dam, the last of which was the question of the Philæ monuments. He concludes from the available evidence, with some confidence, that the



THE SUBMERGED TEMPLES AT PHILÆ.

Which call for special consideration in connection with the proposed raising of the Assouan dam.

stability of these temples has not up to the present suffered from their submersion.

There is, however, another question to be considered, namely, the effect of the water upon the surface of the stonework. Throughout the structures, above the water-line, there is a band of apparently saturated stone, from 0·60 to 0·80 metres in height. The saturation is due to capillary attraction, and in this band salts deleterious to the masonry have made their appearance. This is more particularly noticeable round and on those portions where cement was made use of in repairing the stonework. As regards the remedy for this evil the general opinion appears to be that the only one possible is to wash the stonework thoroughly and carefully as soon as the water has subsided, thus getting rid of the salts. These are reported as coming away easily. Whether this will effectually preserve the stone from decay it is impossible to say. Monsieur Maspero considers that it will not be possible to decide this point in a less period of time than from four to five years.

The submersion of the temples to a further height of six metres will undoubtedly destroy much of their picturesqueness, and much of the beauty of the present landscape will be spoiled. No one can pretend that this will be otherwise, and, unfortunately, this effect will be produced during the time when Philæ is visited by many tourists. That this should be so must always be a matter for deep regret, but even such a consideration should not be allowed to weigh against the benefits that would result to the Fellahin of Egypt from so large an increase in the storage capacity of the Assouan reservoir.

THE WADY RAYAN.

As to this project, Sir William Garstin quotes Sir William Willcocks on his scheme, as follows :

When the Assouan dam will have been raised, we shall be standing on the threshold of what it will be able to do. The projected Wady Rayan reservoir, or the modern Lake Mœris, will be well able to supply the two remaining milliards of cubic metres of water when working in conjunction with the Assouan reservoir. The great weakness of this projected lake has lain in the fact that *by itself* it can give a plentiful discharge in April and May, less in June, and very little in July, and it was for this reason that in my report of 1894 to the Egyptian Government I had reluctantly to recommend that it be not carried out. But when the Assouan reservoir is capable of supplying two milliards of cubic metres of water it will be possible to utilise the Mœris lake to its utmost capacity. The Assouan reservoir, being high above the level of the Nile, can give its supply at the beginning or end of the summer ; it can give it slowly or with a rush ; while the projected Lake Mœris, being directly in communication with the Nile, and only slightly above low Nile level, its discharge would depend entirely on the difference of level between it and the Nile, and consequently as the summer advanced, it would gradually fall and would not be able to give at the end of the summer a quarter of the discharge it would give at the beginning.

But let us imagine that the reservoir and the lake are both completed and full of water, and that it is the 1st of April. Lake Mœris will be opened on to the Nile and give all the water needed in that month, while the Assouan reservoir will be maintained at its full level. In May, Lake Mœris will give nearly the whole supply and the reservoir will give a little. In June, the lake will give little and the reservoir much ; while in July the lake will give practically nothing and the reservoir the whole supply. Working together in this harmonious manner, the reservoir and the lake, which are the true complements of each other, will easily provide the whole of the water needed for Egypt.

Sir William Garstin, on this, has " no hesitation in saying that the scheme as thus presented is a most attractive one, and one that, if feasible, appears to solve the problem of the best method of increasing the water supply of Egypt."

Further consideration has convinced him, however, that the question is not quite so simple as at first sight it may seem to be. The amount of water available in the river during winter would be lessened by Sir William Garstin's proposal to withdraw 200 metres cube per second for the irrigation of eastern Soudan, and Mr. A. L. Webb, C.M.G., Inspector-General of Irrigation in Upper Egypt, has shown that :—

As regards Sir William Willcock's smaller project,* *if the deduction be made for the Soudan* the Rayan reservoir could not be filled by means of the Bahr Yusuf during the winter months in a year of minimum supply. He also shows that even in a mean year this would be very difficult, and would seriously affect navigation in the Nile during the period of filling. Moreover, he points out that in order to supply the Yusuf Canal it would be necessary to put a head of 4·5 metres upon the Assout barrage. This would entail the construction of a subsidiary weir downstream of the work, similar to those recently constructed at the Delta barrage. It would further necessitate considerable remodelling in both the Bahr Yussuf and the upper reach of the Ibrahimieh Canal in order to permit of the necessary supply being passed down in a bad year. In order, then, to render the smaller project feasible, it would be necessary either to increase the supply passing Assouan during the winter or to abandon altogether the idea of benefiting the Blue Nile provinces.

As regards the second, or larger, project,† Mr. Webb proves that the scheme is a possible one, as the reservoir

* This project is for a reservoir to hold two milliards of cubic metres of water, with a single canal for filling and discharging. It is to be supplied during the winter months from the Yusufi Canal. The estimated cost of this project is £E.2,000,000.

† This is for a reservoir capable of storing three milliards of cubic metres of water, with separate inlet and outlet canals, to be filled direct from the Nile. This project is estimated to cost £E.6,600,000.

could be filled yearly by the flood water. Even in very low floods like those of 1899 and 1902 this would have been possible, *provided that the inlet canal were made of sufficiently large section.*

This last is the important point, and unless the feeder canal be made of sufficient dimensions it would be impossible to fill the reservoir to the required height in flood in years of low level. It is here that the main difference of opinion lies between Sir William Willcocks, on the one hand, and Messrs. Webb and Verschoyle on the other.

There remains one other point for consideration which is perhaps the most important of all, viz., the uncertainty which must prevail as to whether, when the reservoir is full, the high water-level maintained in the lake will not gradually cause infiltration through the ridge which separates the Wady Rayan from the Fayoum and cause serious damage to the cultivated land of the latter province.

Taking everything into consideration, says Sir William Garstin, all points to the conclusion that a thorough geological examination of the locality, with perhaps a line of shafts sunk through the strata, will be necessary in addition to a detailed study of the dimensions to be given to the inlet and outlet canals. Until fuller information is available, it is advisable to reserve judgment upon this scheme. Meanwhile I consider that, under any circumstances, the project for improving the Bahr-el-Gebel should be given preference over that of the Wady Rayan, as I maintain that if the Assouan dam is to be raised measures must be taken to increase the water supply passing Assouan. If this is admitted, it will, to my mind, be wiser and more advantageous in the end to undertake the work upon a scale sufficiently large to secure, not only for Egypt, but for the entire Nile valley north of Khartoum, the benefits which such an increased water supply would give.

Even allowing that the cost of the improvement of the Upper Nile will be greater than that of the Rayan scheme, I should still recommend the former in preference to the latter. First, because it will render service to a much greater area than will the Wady Rayan. Secondly, because it is necessary in every case, if the Assouan dam is to be raised, to take measures to increase the river supply to a certain extent. Thirdly and lastly, because there is no risk or uncertainty attendant upon it when completed.

The Wady Rayan scheme may then, I think, be given a place secondary to this other. When at some future time the question of reclaiming the lakes in the northern delta shall, as it surely will, become a pressing one—then the Rayan project will probably prove to be the best means of securing the increased supply.

THE ROSETTA BRANCH OF THE NILE.

Sir William Willcocks, in his recent paper, urges that both branches of the river should be put into such order that the danger from a flood passing down would be largely diminished. He further proposes that the section of the Rosetta branch shall be brought to a uniform width, by means of spurs, and the banks thrown back, where necessary, so that this channel shall be able to carry a much larger discharge, without danger to the country, than is at present possible. He would then, in flood, regulate upon the Damietta barrage, treating this branch as he says, like a large canal, and turning the surplus water down the improved Rosetta branch.

As regards the Rosetta branch, says Sir William Garstin, if it is to act as a flood escape, and I agree with Sir William Willcocks in advising that it should be made to do so, then, as he says, it must be put in thorough order and remodelled throughout its length.

COST.

While recommending the raising of the dam at Assouan, the improvement of the Rosetta branch, and that of the Bahr-el-Gebel, Sir William Garstin makes it quite clear that these works by no means comprise the whole of the programme.

An increased water supply sufficient for the entire wants of Egypt will entail the construction of an extensive system of supplementary works, in the hape of canals and drains, in order that the benefits to be derived from the extra water may be fully secured. Such works will necessitate a very heavy expenditure. This need not be immediate, but may be distributed over a series of years. It must, however, sooner or later be faced, as until these works are completed the full results to be anticipated cannot be realised. It is as well, therefore, that the Egyptian Government should understand that by taking the first step, *i.e.*, by raising the Assouan dam, it is committing itself to a programme which will eventually entail the expenditure of a considerable capital.

An approximate idea of cost is arrived at as follows :—

The total expenditure in the Soudan would amount to the following, according to which estimates for the Bahr-el-Gebel were made use of :—

	Estimate No. 1. £E.	Estimate No. 2. £E.
Bahr-el-Gebel	5,500,000	3,400,000
Reservoir at Rosaires, say	2,000,000	2,000,000
Barrage in Blue Nile	1,000,000	1,000,000
Ghezireh canal system	2,000,000	2,000,000
Gash project	500,000	500,000
Regulation of lakes	2,000,000	2,000,000
Totals	13,000,000	10,900,000

If to the above be added the expenditure estimated for Egypt, viz.:

	£E.
Raising the Assouan dam	500,000
Remodelling the Rosetta and Damietta branches	900,000
Conversion of Upper Egypt basins	5,000,000
Two barrages between Assout and Kena ..	2,000,000
Total	8,400,000

The totals thus become :—

	Estimate No. 1. £E.	Estimate No. 2. £E.
Soudan	13,000,000 ..	10,900,000
Egypt	8,400,000 ..	8,400,000
Total ..	21,400,000 ..	19,300,000

Both of these are very large figures indeed. There could, of course, be no question of carrying out such a programme in any very short space of time. In fact, even if the money were available, it is scarcely possible that these works could be executed under a period of 10 to 15 years under the most favourable circumstances.

The time is not ready for many of them either, says Sir William Garstin. If I were asked to point out those which I consider the most urgent, and which could probably be carried out in a comparatively short period, I should select the following :—

	£E.
1. The raising of the Asouan dam	500,000
2. The remodelling of the Rosetta and Damietta branches	900,000
3. The remodelling of the Bahr-el-Gebel ..	5,500,000
4. A portion of the Lower Egypt canal system	500,000
5. A portion of the Upper Egypt canal system	2,500,000
6. One weir in the Nile between Assout and Kena	1,000,000
7. A weir in the Blue Nile	1,000,000
8. A portion of the Ghezireh canal system ..	500,000
9. The Gash project	500,000
Total	12,900,000

If in No. 3 the smaller project was to be selected, this estimate would be reduced by £E.2,100,000, and would amount to £E.10,800,000.

The remaining works in the list, amounting to a figure of £E.8,500,000, could be carried out after the completion of the first portion of the programme.

LORD CROMER ON THE SCHEMES.

The following notes are from Lord Cromer's despatch to the Marquess of Lansdowne, covering Sir William Garstin's report :—

It must be borne in mind that in each of the cases mentioned by Sir William Garstin, the financial, and in most cases the engineering, features of the particular proposals require further study.

I have no hesitation in saying that Sir William Garstin's programme may safely be adopted in the following sense—that the aim of the Egyptian Government should be to work gradually up to the execution of the schemes which he proposes. The main question to be decided is, what portions of the general plan require relatively early treatment, and what portions, on the other hand, can be left for future consideration.

Broadly speaking, the whole plan is based on the principle of utilising the waters of the White Nile for the benefit of Egypt, and of the Blue Nile for the Soudan.

Your lordship will observe that Sir William Garstin proposes to employ an additional staff in order to study the various projects to which he alludes. This is the only point which requires an early decision. The cost will be £E.24,000 for the first year. The money will be granted. A more difficult question is to find the right men for the work. This matter will be left in Sir William Garstin's hands.

Sir William Garstin estimates that when the whole of his Egyptian project is carried out, 750,000 acres of land will be converted from basin into perennial irrigation; 100,000 acres will be made capable of being irrigated by pumps; 800,000 additional acres will be brought under cultivation, and that at very moderate rates the increased revenue to be derived from taxation will be £E.1,205,000 a year.

Your lordship will observe that Sir William Garstin estimates that, when the whole of his scheme is completed 1,000,000 acres in the Soudan will be brought under cultivation, and that the direct return in the shape of land tax, at £T. 50 an acre, would be £E.500,000 a year. The whole, or at all events the greater part, of this money would, of course, be utilised to diminish the Egyptian contribution now paid annually to the Soudan Government. In fact, the only hope of rendering the Soudan ultimately self-supporting lies in judicious expenditure on railways and irrigation.

All that it is proposed to do for the moment is to spend £E.24,000 a year on the employment of a competent staff to examine more closely into some of the projects to which Sir William Garstin has directed attention.

Subject to any changes which the result of further inquiry may necessitate, an attempt will be made in the relatively near future to carry out an Egyptian railway and irrigation programme, involving a capital expenditure of £E.5,400,000. This programme will involve raising the Assouan dam and remodelling the Rosetta and Damietta branches of the Nile.

In the Soudan, subject to the same conditions as in the case of Egypt, an attempt will be made to undertake the Gash project, and in due time—that is to say, when the Suakim-Berber Railway is completed—to still further improve the railway communication.

This general programme is quite sufficiently ambitious for the present. It will by itself take some time to execute. As events develop, and as further information—both technical and financial—is obtained, it will be capable of modification and possibly of extension.

I cannot close this despatch without recording my opinion that all interested in Egyptian affairs owe a deep debt of gratitude to Sir William Garstin for the care and the conspicuous talent with which he has treated this very important question.

THE CHAMPION COAL-CUTTER.

DISCUSSION BY THE MEMBERS OF THE MINING INSTITUTE OF SCOTLAND.

THE members of the Mining Institute of Scotland recently had an opportunity of examining the Champion coal-cutter in operation at the Wishaw Coal Company's Dalzell Colliery, Motherwell.

This machine is of the percussive type, and consists of five essential parts, viz.: (1) Supporting Column, with clamp. Weight according to length. (A 5 ft. column weighs 200 lb.) (2) Segment, 110 lb. (3) Drill, largest size, 239 lb. (4) Extension Rods (five), 20, 40, 60, 80, and 100 in. long respectively, for cutting to a depth of 7 ft. Average total weight, 80 lb. (5) Cutting Bit.

In the course of the ensuing discussion, Mr. R. W. Dron said that the Wishaw Coal Company, Ltd., had used the Champion coal-cutting machine for the past three or four months. One machine was introduced experimentally, and they were so satisfied with the results that they were erecting plant with the intention of installing more. The practical results of the machine were satisfactory, although they did not come up to the estimates given by Dr. Simon in his paper.* They found, so far as they had gone, that a machine could deal with two places per day. These places were 11 ft. wide, and the coal was undercut to a maximum depth of 5 ft., giving an undercutting, altogether, of 110 square feet; and in addition the machine also put in two shot-holes. The work of a shift of two men, who were controlling the machine, was represented by an undercut in two places, charging the shot-holes, firing them, and leaving the coal on the pavement. The coal was cut in a seam 4 ft. 9 in. to 5 ft. thick, and the amount produced was about 13 tons. He calculated that the cost of a ton of coal put on the pavement was 1s. 4½d., the actual cutting cost was 1s. 1d. per ton, 2d. per ton was allowed for powder, while the upkeep of the machine and fuel were reckoned at 1½d. per ton. The machine was employed in hard coal, nevertheless, he was satisfied that the work was being done, as compared with ordinary pick-labour, at a reduction in cost of from 20 to 25 per cent. As to the time occupied, he (Mr. Dron) found that at Dalzell Colliery, with two men on the machine, it took 3 hours and 20 minutes to cut a place 11 ft. wide and 5 ft. deep, and to bore two holes.

Dr. Simon had expressed the opinion that a man and a boy could efficiently control the machine, but it had been his (Mr. Dron's) experience that this type of boy was not to be found in Scotland. It was necessary to explain, however, that of the 3 hours 20 minutes referred to, the actual time spent in cutting was 1 hour 50 minutes; and the balance of the time was spent in lifting the machine into position; and included stoppages, slight breakdowns, and so on. He (Mr. Dron) had given a fair average of what the machine could do, and what they had

* "Trans. Inst. M.E., 1903," vol. xxvi., page 322.

CHAMPION COAL CUTTER SET FOR HOLING OR UNDERCUTTING. READY TO START.

ILLUSTRATION SHOWING SHEAR AND UNDERCUT FINISHED.

been able to get out of the men in a shift of eight hours from bank to bank; and he hoped to get better results out of these machines when they commenced working in more regular places. In the meantime, the machines were being applied to "deficient places," where the coal was more costly and more difficult to work than in ordinary places. The machines had proved very useful in cutting through hitches and stonework of that kind, while they had proved advantageous in driving stone-mines. In the softer rock the machine was not very beneficially employed, but in hard rock it was certainly profitable to use the machine.

The coal-cutter had also been employed in a seam, 2 ft. 4 in. thick, for the purpose of driving a dook, 30 ft. wide. They found that two men took 8 hours to make that undercut, without being able to bore the holes. The principal difficulty was that the place was very wet, and the holing-dirt became clogged in the undercut. Even in this case, the machine was cheaper than pick labour.

A good feature of the Champion machine, to his mind, was that the expenditure on repairs was very small. Then again, a workman of ordinary intelligence could learn to operate the machine successfully in the course of a week. The trials at Dalzell Colliery had all been made in hard coal, which could not be worked by manual labour at a profitable rate per ton. A Morgan-Gardner electric heading-machine, weighing about 30 cwt., had been introduced for the purpose of cutting through this hard coal, but they found that the cost was about 6d. per ton more than with hand-labour, chiefly because the machine was unwieldy; and from 2 to 2½ hours were required to shift the machine from one place to another. People who were satisfied with a moderate result would be quite pleased with the Champion machine, as it enabled them to work fairly hard coal at miners' ordinary rates.

Dr. A. Simon said that the Champion machine had been tried at the Cannock and Rugeley Collieries, in ordinary strata, with good results. The rock was of moderate texture—not very hard. Some of the men had tendered to drive a place through a fault at the rate of £2 per unit; but one of the men, who appeared to know how the machine should be handled, tendered for the work at £1 per unit. He got the contract and did excellent work, making more than his ordinary wages. Generally speaking, the machine had not, so far, proved successful in its operations in oil, shale. At Aldridge Colliery, near Walsall, the Champion machine had cut, in consecutive shifts of 8 hours 360, 340, and 350 square feet in a fire-clay found on the top of the coal. In other cases, where the fire-clay was located underneath the coal, the rate of speed was in excess of cutting in the coal; but, on the other hand, it sometimes happened that the reverse was the case. Generally speaking, reasonable and good results could be got from the use of the machine in fire-clay, if no clogging occurred. To overcome any eventual clogging a special device had been adopted by which a jet of water was made to play intermittently from the centre of the cutting-bit.

Mr. Henry King (Lanemark) said that the Champion machine had been in use at his colliery for about two months. It was first tried in the 8-ft. seam, comprising a bottom coal about 3 ft. thick, then about 2 ft. of dirt, and finally the top coal. The machine was set for holing in the dirt immediately on the top of the bottom coal; when going uphill and driving ahead, it was found that the men were kept busily employed in redding up the dirt. After a week's trial, the machine was removed to another seam, consisting of 4¼ ft. to 4½ ft. of ordinary house-coal, with 9 in. of cannel coal. The holing in that seam (and the seam was still being worked) was on the top of the house-coal, lying immediately underneath the cannel-coal. The place was being worked by stoop-and-room, and the men were holing two places in each eight hours' shift. Each place was about 9 ft. wide, and the men were holing to a depth of 6 ft. to 8 ft. Two men could easily move the machine about, when it was in a level-course working; but in steep workings assistance was required. There was more difficulty, to his mind, in shearing than holing with the Champion machine, because so much more dust was produced. There was another difficulty in connection with shearing, namely, that when the drill missed the coal or stone and struck into empty space, it flew out and stuck. Attempts had been made to square the corners of the cuts, but they were never squared in the true sense of squaring.

Mr. Thomas Thomson (Hamilton) said that when he saw the Champion machine working some time ago, it certainly cut to an equal depth all round. The manager, Mr. McBride, said that if the machine could be allowed to run without squaring the corners, it would do one-half more work. He (Mr. Thomson) was of opinion that there was no advantage in squaring the corners, because the coal could be blasted off in a semicircle as well as if the face were kept straight; but, in the case of a coal with good backs, etc., the results might be different. He was also of opinion that when the coal was holed, the machine did not require to be removed, and could bore holes straight forward and into the sides as required, which he thought would do as well as shifting the machine from side to side.

Mr. R. W. Dron said that the Wishaw Coal Company started to drive a mine by using the machine for channelling; they found that this system was not economical, being no cheaper than hand-labour, so they took it out again. When, however, they came into the hard rock the machine was put back into the mine; and when they had passed through the hard rock, the machine was once more withdrawn.

Mr. W. Smith (Dalmellington) said that in the Wishaw Coal Company's pit that day the Champion machine ran for 30 minutes. The holing was 2 ft. 3 in. under in the centre; at 1½ ft. from the centre, it was 1 ft. 6 in.; and it was only 9 in. deep at the corners. The length of the work was 8½ ft.

Mr. James Barrowman said that there had been no attempt to cut out the corners in the course of the tests made that day.

The President (Mr. R. T. Moore) remarked that a miner in his ordinary working of a place did not square the corners every time.

Mr. Henry King said that very little attempt was made to square the corners at his colliery.

Dr. A. Simon said that the squarings of the corners had been a difficulty with several users of the Champion machine. Mr. Smith had mentioned that, in connection with the operations at Motherwell that day, the holing was 2 ft. 3 in. deep in the middle, and only 9 in. at the sides. The members were aware, however, that the longer the rod with which the cutting was made, the flatter would be the arc. Anyhow he could assure the members that there was no difficulty in squaring out the corners, if only the operators would take the trouble to think a little of what they were doing. Mr. H. King stated that one drawback to the machine was the tendency which it showed for sticking or stopping in front when missing the solid coal-face in striking. He, however, could provide Mr. King with a machine which did not stick in front, but it would not cut the same amount of square feet per day as the other; a novice preferred a machine which did not stop, though the skilled operator gave his preference to the machine which did most work and he could handle the machine so that it did not stop. Mr. King had also remarked that the Champion machine did not work so fast at shearing as at holing. That day, on their visit to the colliery at Motherwell, the members had seen the reverse: the holing took 35 minutes, and the shearing to a slightly greater depth, 3 ft. 6 in. in a 5½-ft. seam, only occupied some 18 or 19 minutes.

Mr. R. W. Dron said that, in order to avoid a false impression getting abroad, it would be as well to add that the shearing had been made in a very soft coal and the holing in a hard coal.

Dr. A. Simon, continuing, said that the holing was made in what was described as hard coal, close to the burnt coal; whereas the shearing had been performed through all the layers of the seam. In other mines, where soft layers alternated with hard, he found that the shearing required more skill and time than the holing. Many of the so-called drawbacks pointed out in the course of the discussion, were attributable to the fact that the men in charge of the machine had not yet acquired a sufficient acquaintance with it; and usually most of the above-mentioned drawbacks vanished as soon as a rate for piece-work could be arranged.

At the close of the discussion a vote of thanks was awarded to the Wishaw Coal Company, Ltd., and to Dr. Simon. For the accompanying illustrations we are indebted to the Champion Channelling Machines, Ltd.

NEW BRIDGE CARRYING THE LONDON, TILBURY AND SOUTHEND RAILWAY OVER THE MAIN LINE, SIDINGS, AND SHOPS OF THE NORTH LONDON RAILWAY COMPANY AT BOW.
Showing trestles for temporary timber staging.

Alterations on the London, Tilbury and Southend Railway.

HOW SUSPENSION OF TRAFFIC IS AVOIDED.

THE London, Tilbury and Southend Railway is providing for its largely increased traffic by doubling its rail capacity from Bromley to Barking ; thus between these points in future there will be four pairs of rails. At the same time the opportunity has been taken of carrying out structural alterations and renewing some of the bridges, which have borne the brunt of the traffic since the opening of the railway in 1854.

The New Bridge at Bow.

Among the latter was a bowstring bridge carrying the London, Tilbury and Southend Railway over the main line sidings and shops of the North London Railway Company at Bow. The new bridge, of 160-ft. span, destined to replace this, has been built on a heavy timber staging alongside, and its transfer to the proper abutments during the small hours of a Sunday morning, was a feat of which the engineers and contractors may feel justifiably proud. In June, 1902, a short line was opened between Whitechapel and Bow, connecting up the Metropolitan District Railway with the London, Tilbury and Southend line. This branch, which has been largely responsible for the augmented traffic, joins the main line near the London side of the new bridge, the necessary interference with the points at this junction adding considerably to the difficulty of getting the permanent way in order when the bridge was brought into place.

Placing the Bridge in Position.

The contour of the bridge and its leading characteristics and dimensions will be seen from the accompanying drawing and photos. It was erected complete with railway track, on the temporary staging, by Saturday, the 9th July, the whole mass weighing 420 tons.

The old bridge had, in the meantime, been gradually dismantled until only the flooring, supported by heavy timbering, remained. The actual work to be done, therefore, was the removal of the permanent way and the immense mass of wood which had served to carry the line pending the completion of the new bridge and the hauling of the latter into position.

A large force of workmen foregathered at the spot on the Saturday evening, giving the place the appearance of a hive of industry, and at 12.40 a.m. on Sunday, immediately after the passage of the last train, the removal of the timbering commenced, the process being rendered more difficult owing to the fact that no dumping ground was available anywhere near the scene of operations. On the completion of this clearance, which was effected by 4 a.m., the new bridge was gradually carried over upon trollies running on the abutments to its final position—a distance of 30 ft. This operation, carried out by means of hand winches and tackle, was finished at 6.10 a.m., and two hours later the bridge had been lowered by means of powerful hydraulic jacks into its final position.

The permanent way at each end was put in order

THE NEW RAILWAY BRIDGE AT BOW, AS VIEWED FROM THE LONDON, TILBURY AND SOUTHEND LINE.

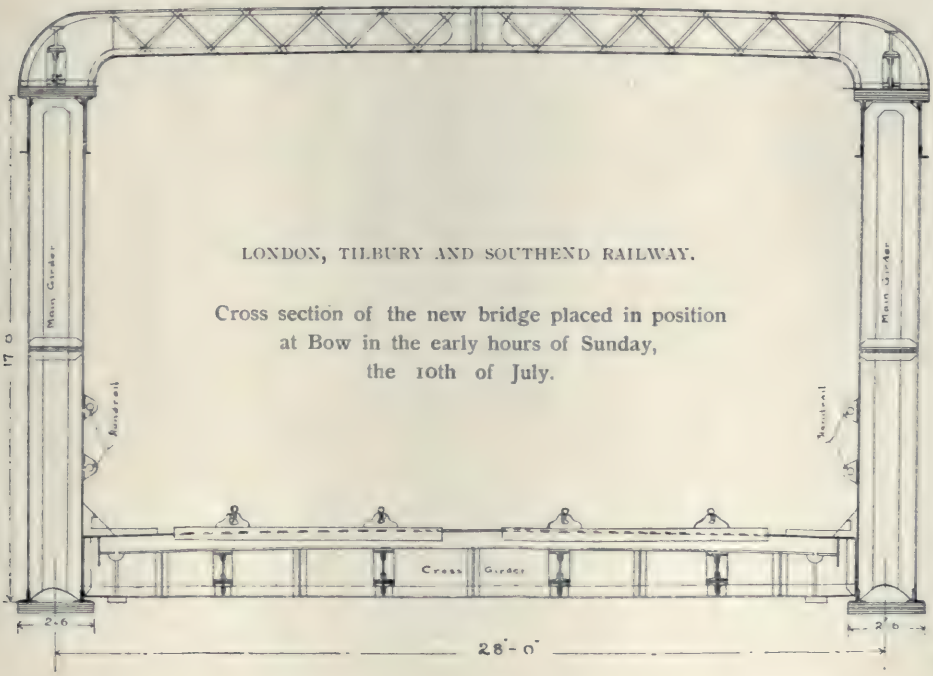
by 10.30 a.m. on Sunday, and at 11.20 a.m. the first passenger train crossed the new bridge. The accompanying photo shows the bridge in position as viewed from the North London Railway, (A similar bridge to carry the additional rails for the widening is now being built practically *in situ*, on the spot vacated.)

The contractors for the bridge, Messrs. Head, Wrightson, and Co., of Stockton-on-Tees, were represented by Mr. Septimus Young, their London manager, and by Mr. W. Clark, works manager. The bridge was designed by Mr. James R. Robertson, M.Inst.C.E., the railway company's chief engineer. It has been carried out under the supervision of Mr. Sydney H. Ellis, A.M.Inst.C.E., resident engineer, who courteously showed our representative over the works.

Further Alterations in Progress.

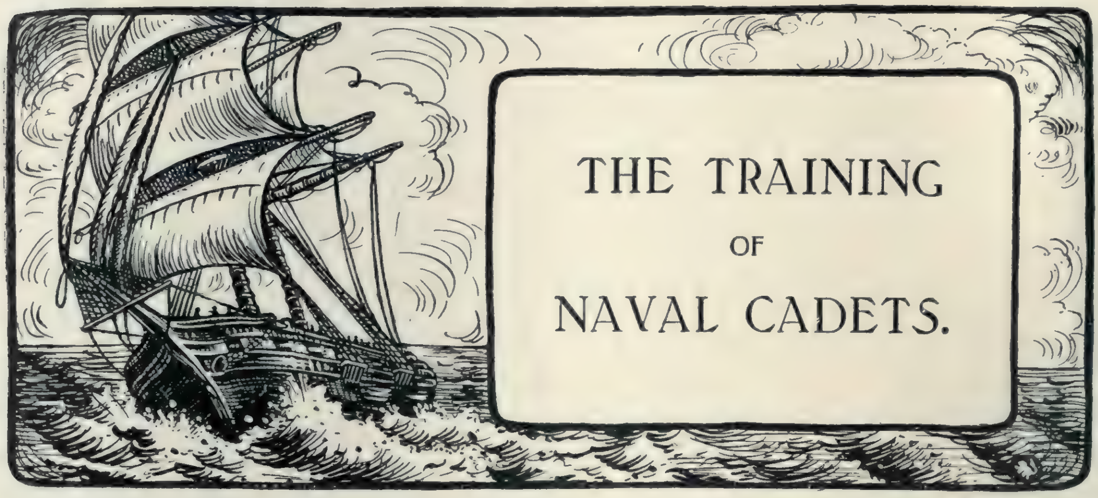
The three-quarters of a mile of main line under the supervision of Mr. Ellis, presents alterations in progress at almost every turn, more than half a dozen bridges being under reconstruction. A new platform is being erected at Bromley Station, at one end of which preparations are in an advanced stage, to carry the additional rails over Devons Road, while at the other end of the platform the bridge carrying St. Leonard Street over the line is being widened in order to meet the requirements of the L.C.C.

A short distance down the line the largest of the bridges now under construction is in course of erection, and will carry the additional pair of rails over the River Lea and Bow Creek. It will consist of two spans each of 200 ft., and will be carried on six cast iron piers, resting on the London clay and filled with concrete and brickwork. The contractors for this work are Messrs. T. Docwra and Sons, of Balls Pond Road, N. At the time of our visit one of these piers was being tested with a load of 760 tons of steel rails. The piers under this treatment have been found to sink evenly about ⅜ in., which was approximately the margin allowed by Mr. Ellis. The lattice girder bridge, which carries the existing rails at this spot, is only fifteen years old, and does not need renewal. The accompanying photographs were taken specially for PAGE'S MAGAZINE by Messrs. Booker and Sullivan.



LONDON, TILBURY AND SOUTHEND RAILWAY.

Cross section of the new bridge placed in position at Bow in the early hours of Sunday, the 10th of July.



THE TRAINING OF NAVAL CADETS.

COMMANDER STATHAM'S appreciative story of the *Britannia* comes at an opportune moment, for the old vessel's days—as a training ship at all events—are now practically numbered. Before long the familiar twin hulls, with the connecting bridge and the flotilla of steam and sailing boats clustered about them, will have disappeared, and the naval cadets will be installed in the imposing college now under construction at Dartmouth. Students of naval engineering will read with interest the account of the many vicissitudes through which the complex problem of training the young naval officer had to pass before the present system was evolved. The author takes us back to the eighteenth century, when the system in vogue was in a very nebulous condition. As a rule the aspirant to the Service entered as a "Captain's Servant," or "King's Letter Boy"; there was no qualifying examination to be undergone, and the education and equipment of the youngsters depended to a great extent upon their individual observant faculties. There was no age limit and many absurd incongruities were prevalent.

In 1733 the Royal Naval Academy was opened in Portsmouth. In 1807, the whole curriculum was re-organised and the institution was termed the Royal Naval College. This establishment was closed in 1837, and for about twenty years there was again a total absence of any organised method. At the end of this period, Captain Harris was authorised to open up a new epoch in the history of naval education. The fourth *Britannia*, the one in which Captain Harris began his celebrated work, was at Sebastopol. In 1862 she was brought to Portland, and was eventually stationed at Dartmouth. Seven years later she was superseded by the fifth and present vessel. This year saw the introduction of a competitive entry examination. The subsequent history of the *Britannia* is a recital of continual changes and tentative methods formed as attempts to constitute a thoroughly practicable system of naval training.

Commander Statham claims that whatever may be the views held by various officers and experts as to the advisability of using a stationary ship in preference to a college, there can be no doubt as to the high state of perfection which has been attained in the *Britannia*, whether from a sanitary, a disciplinary, or an educational point of view. The present instructional staff consists of the chief naval instructor, eight naval instructors, two French masters, two drawing masters, an English master, and one natural science master. The course of studies and seamanship at present pursued is detailed in the appendix, and it will be observed that instructions as to working sails and masts, manœuvring a ship under sail, etc., are now dispensed with. All fitting of rigging is also abolished, and only such bends, hitches, knots, and splices are retained as may be occasionally useful. It is interesting to note that of 1,770 cadets who were examined during the last ten years, only 27 failed, and the last five examinations up to August, 1903, have been free from failures.

The new regulations are of a revolutionary character. The principal points are as follows: The average age of entry is between 12 and 13; all candidates are admitted by the nomination of the Admiralty; all are liable, at the expiration of their training, to be placed on the strength as sub-lieutenants, engineer sub-lieutenants, or subalterns of marines; but the wishes of each officer will be consulted as far as is compatible with the needs of the Service. In giving nominations, preference will be given, other things being equal, to those applicants whose parents or guardians declare for them that they are prepared to enter any of the three branches.

Proceeding to describe the arrangements which are to supplant the old course, Commander Statham writes: Instruction will comprise an extension of the present *Britannia* course, and a thorough elementary instruction in physics, marine engineering, etc.,

* "The Story of the *Britannia*," the Training Ship for Naval Cadets, with some account of previous methods of naval education and of the new scheme of 1903. By Commander E. P. Statham, R.N. Cassell and Co., Ltd. 12s. 6d.

From "The Story of the Britannia."

THE NEW COLLEGE, DARTMOUTH.
From the design by Aston Webb R.A.

including the use of tools and machines. Instruction will be carried out in small vessels attached to the establishment.

Examinations will be held during the second and fourth year of training. Cadets who fail to pass will be withdrawn. Parents or guardians are required to sign a declaration on the admission of a cadet to the training establishment to the effect that he shall be immediately withdrawn on the receipt of an official intimation of his being considered unfit for the Navy.

After leaving the training establishment cadets will go to sea, and will then be instructed in seamanship, navigation, pilotage, gunnery, mechanics, and engineering by the specialised officers of the ship.

After three years, each midshipman who has passed the qualifying examinations will become an acting sub-lieutenant. Acting sub-lieutenants go to Greenwich Royal Naval College and to Portsmouth for final instruction in the subjects they studied while midshipmen at sea. On conclusion of their examination in these subjects, having reached the age of 19 or 20, sub-lieutenants will be distributed between the executive and engineer branches of the Navy and Royal Marines. No sub-lieutenant will be required to join any branch for which he did not enter as a boy when applying for a nomination.

The training establishments alluded to consist of the college at Dartmouth, and Osborne (which was dealt with in PAGE'S MAGAZINE for October, 1903), with such steam vessels as may be necessary for instruction afloat. Our illustration, reproduced by permission of Mr. Aston Webb, R.A., the architect, gives a comprehensive idea of the future appearance of the new college.

A Modern Optical Laboratory.

NO industry has felt the keenness of foreign competition, or is making more energetic efforts to meet this, than the British optical trade, in which, at the present moment, we have a splendid illustration of an industry waking up from a period of lethargy and endeavouring to recover lost ground.

Up to the middle of last century, the users of optical and scientific instruments all the world over came to the English optician for their requirements. Jesse Ramsden and others of the industry had achieved a world-wide reputation for the accuracy of their work, and examples of their dividing and screw cutting are in existence that could scarcely be beaten to-day.

The invention of the achromatic lens and the technical manipulation of optical glass was brought to perfection as the result of the work of the English optician. The available glasses, however, were then few, and it was soon seen by both opticians and scientists that any further advancements could only be made by the introduction of new substances into optical glass making. Many efforts were made in this country by private individuals to achieve this end, notably by the Rev. Mr. Harcourt, but a series of experiments necessary for the commercial production on any scale were of such a costly character as to place them outside the scope of private enterprise. Rewards were offered by several institutions, both at home and abroad (mostly abroad), for the production of these glasses, but it was left to the enterprising German scientists to bring about the desired results.

A considerable sum of money was placed in the hands of Professors Abbe and Schott by the Prussian Diet and Board of Education, which resulted in a series of glasses possessing the necessary greater difference in the ratio of dispersion and refraction being placed upon the market, and the foundation of the celebrated Jena Glass Works was the direct result.

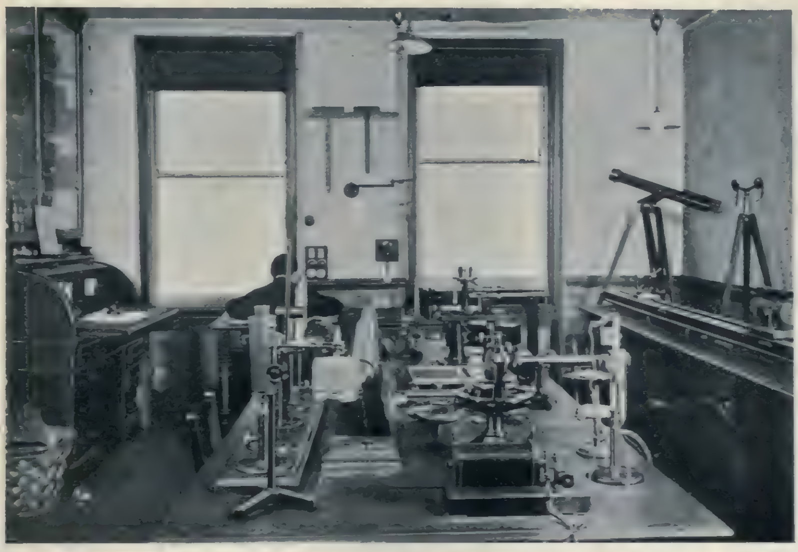
The German optician was not slow to avail himself of the work of his scientists, and the industry in Germany has since made rapid strides, whilst many attempts made by the English optician to retain and get back some of this optical business have resulted in failure.

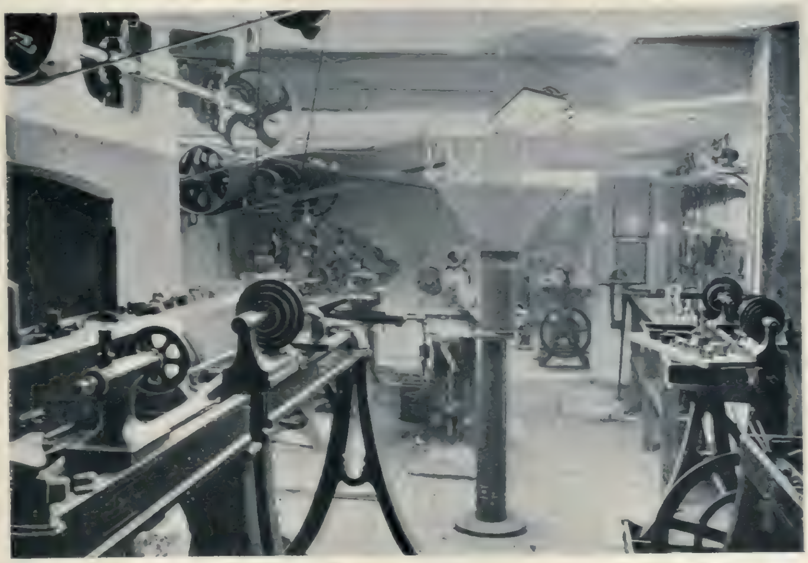
One of the branches of the industry in which the foreigners obtained almost a monopoly was that of field-glass making, and within the last few years several new and improved types of glasses have been introduced by German makers, notably the type known as prism binoculars. These glasses, when carefully produced, possess many advantages over the old forms of binoculars, and just as long as there was no competition in the English market they were sold at high prices by the German makers.

It was principally through the enterprise of Mr. James Aitchison, the well-known optician of 428, Strand, and numerous branches, that this state of affairs has been remedied and that it is now possible to buy English-made field-glasses of equal and better quality than the German, at lower prices. After a careful investigation of the economic condition of the optical industry both on the Continent and at home, Mr. Aitchison was impressed with the value of scientific method as a commercial factor, and the first step towards the accomplishment of his purpose was the equipment of an optical laboratory for utilitarian optical research, illustrations of which appear on the opposite page. Here, needless to say, nothing is left to chance, and no optical work of an experimental character is attempted in the workshop before careful design and mathematical calculation in the laboratory has proved its practicability.

The difference in the value of Continental and English labour and the absence of any available body of well-trained men in the English optical trade was a factor which had to be considered in the settlement of the methods of production. Nothing but the most perfect workmanship was admissible, and at the same time economic production in considerable quantity was absolutely necessary in order to successfully meet competition. The Continental makers had already such a hold upon the English market that it was clear an advantage both in quality and in price would have to be given to purchasers in order to keep up sales with the rate of production.

Messrs. Aitchison and Co. began their operations by settling upon the smallest unit of output that could be turned out to fulfil these conditions. It was found that an output necessitating the division





INTERIOR VIEWS OF MESSRS. AITCHISON AND COMPANY'S OPTICAL LABORATORY.

of work among twenty hands was the smallest quantity that could be made economically, and it was only by the continuous production of their unit of output in their unit of time that economic production became at all possible.

Accurate standards of operation have also been great factors promoting the desired end. Messrs. Aitchison and Co.'s method of standardising lens curvatures and proving truth of the surfaces is very interesting, and the utilisation of the phenomena known as the Newton Rings, or the colours of interference fringes, enables them to make a wave length of light their unit of measurement and deal with a thousandth part of a millimetre as easily as the engineer will deal with an inch. An absolutely true test-plane having been carefully made from transparent material in the first place, the surfaces to be checked are placed in contact with this. If the surface is equally true with the test-plane, the air film between the two surfaces will be so immeasurably thin that the light passing through is split into the chromatic colours of the spectrum, according to the thickness and wave length. It is possible by this method to work surfaces nine inches in diameter that do not vary a fraction of a wave length in any part. The same method is used for standardising curves; a standard curve of exact radius is worked as a test plate, and the lens surfaces have to be so exact that they only show one colour ring over the whole of the surface when in contact with the test plate.

Messrs. Aitchison and Co., in their determination that their methods should be original and in no sense a copy of Continental methods, instituted a careful series of experiments with all the different abrasive and polishing processes for optical work, the only aim being economical production, and the only arbitrator, the cost book. The result was a demonstration that the law of the survival of the fittest applies to workshop processes much the same as in other affairs. It was established that some of the older and simpler methods, depending in a great measure upon the intelligence of the workman, are the most economical where perfect work is required.

It was found impossible to devise a purely mechanical process for the production of perfect optical surfaces without the supervision of a more or less intelligent workman, and many of the machines that have been devised for this purpose were found less economical and of little value unmixed with the brains controlling them. The necessity of introducing a more intelligent type of workman into the optical workshop was so apparent that, as an encouragement to this end, Mr. Aitchison founded a scholarship at the Northampton Institute, which by the way is the centre of technical optical instruction in London. This scholarship is open for public competition and is tenable for two years.

Another economic factor of extreme importance is shown by the careful arrangement of the lighting of the machine shops. These are situated in the basement of the building, and are consequently dependent upon artificial light. It was found that the introduction of inverted arc lamps as a source of lighting was accompanied by a distinct improvement in the output, which more than made up for the extra cost and maintenance.

The value of international competition is well demonstrated by the success of Mr. Aitchison's efforts The German makers have been compelled to drop their prices, and therefore, through the unaided efforts of a single firm, many thousand pounds annually have been prevented from going from this country into the pockets of the State-aided German manufacturers.

THE CHIEF ENGINEER OF THE PANAMA CANAL.

Mr. John Findley Wallace, who has been appointed by President Roosevelt, chief engineer of the Panama Canal, will receive a salary of $25,000 a year. Mr. Wallace obtained his education for the engineering profession at Monmouth College, Illinois. Starting as rodman in the service of the Carthage and Quincy Railroad, he successively filled the posts of assistant-engineer in the United States Engineering Corps at Rock Island, Illinois; engineer-in-chief of the Peoria and Farmington Railway and of the Iowa Central Railway. The latter undertaking may be said to have made his reputation as a bridge builder.

In 1886 he undertook a series of surveys for the Union Pacific Railway, subsequently acting as resident engineer to the Santa Fe Railway. For the past three years he has been general manager of the Illinois Central Railroad. He has been president of the American Society of Civil Engineers and of other important societies.

At Panama he is likely to add fresh laurels to his career, though the position is anything but a sinecure, and Mr. Wallace is probably as much alive to this fact as anyone in America. He has summarised the task which lies before him as follows:—

"The construction of the Panama Canal involves problems covering the entire field of civil engineering. There are two big harbours to construct at Colon and Panama; extensive surveys to be made to determine which of the five plans proposed is the most economical and commercially advantageous; and extensive borings to determine the cost of locks and dams. Great works must be constructed with a view to controlling the Chagres river, which rises from twenty to sixty feet sometimes in the course of twenty-four hours, and which follows the route of the canal for twenty miles. Immense reservoirs must be constructed in the mountains to provide water supply for the upper reaches of the canal, to furnish power for lighting it with electricity throughout its length, and supply water to the large cities. There are many other problems of almost equal magnitude."

A 50-Ton Electric Crane

FOR THE

L. & S. W. Ry.

THIS crane was designed and constructed by Messrs. Stothert and Pitt, Ltd., of Bath, to the order of the London and South-Western Railway Company, for use at their new graving dock at Southampton. The electrical equipment was supplied by the Allgemeine Elektricitäts-Gesellschaft, of Berlin. The crane was built under the supervision of Mr. D. Drummond, the railway company's engineer, and the electrical gear was inspected by Mr. J. G. W. Aldridge, of 9, Victoria Street, S.W. The crane is electrically driven throughout by separate motors for each motion.

The maximum radius of the crane for 50-ton loads is 87 ft., at which radius the jib lies at an angle of 22 degrees from the horizontal; the proof load at this radius is 70 tons. The derricking gear enables the gear to be raised—with the maximum load suspended—to a minimum radius of 47 ft., at which radius the jib stands at an angle of 15 degrees from the vertical.

The principal dimensions of the crane are as follow: gauge, rail centres, 25 ft. 6 in.; clear height under truck cross girders, 15 ft.; diameter of roller path, 25 ft. 6 in. centres; wheel base, 30 ft.; length of jib, 85 ft.; height of the jib head at maximum radius, 60 ft.; height of the jib head at the maximum radius, 103 ft.; radius to centre of tail ballast, 32 ft.; height from rails to circular rack, 23 ft.; height from rails to top of king post, 56 ft.

The crane runs on twenty central flanged steel-tyred wheels arranged for a twin rail track. Each axle bearing has four volute steel springs on either side of the running wheels, making 106 springs in all. The travelling gear at the running wheels is of special construction on account of the play of the springs.

The jib is of the double boom, lattice braced type composed of four main angles to each boom, and cross-braced at ends and middle. The derricking ropes are 12 part, 5½ in. circumference, reeved double, two parts leading from the barrel, which is grooved right and left hand.

The lifting ropes are 4½ in. circumference, reeved double, two parts off the barrel, which is also grooved right and left hand. These ropes have a factor of safety of eight times when dealing with the maximum load.

The back part of the house encloses the lifting and derricking crabs, the centre part contains the slewing and travelling motors and gearing, and the front part contains the controllers and resistances. On the upper part of the front of the house is built an elevated cabin for the driver, to which are brought all the operating levers. This arrangement gives a very extensive outlook for the driver in all directions, the cabin having windows on all four sides.

The current is taken from the company's ground boxes by a length of cable to the junction box fixed to the inside of the crane truck, from whence it is carried by cables up through the centre pin, on the top of which is a double ring collector. The distribution is made from the switchboard in the driver's cabin to each controller and motor separately.

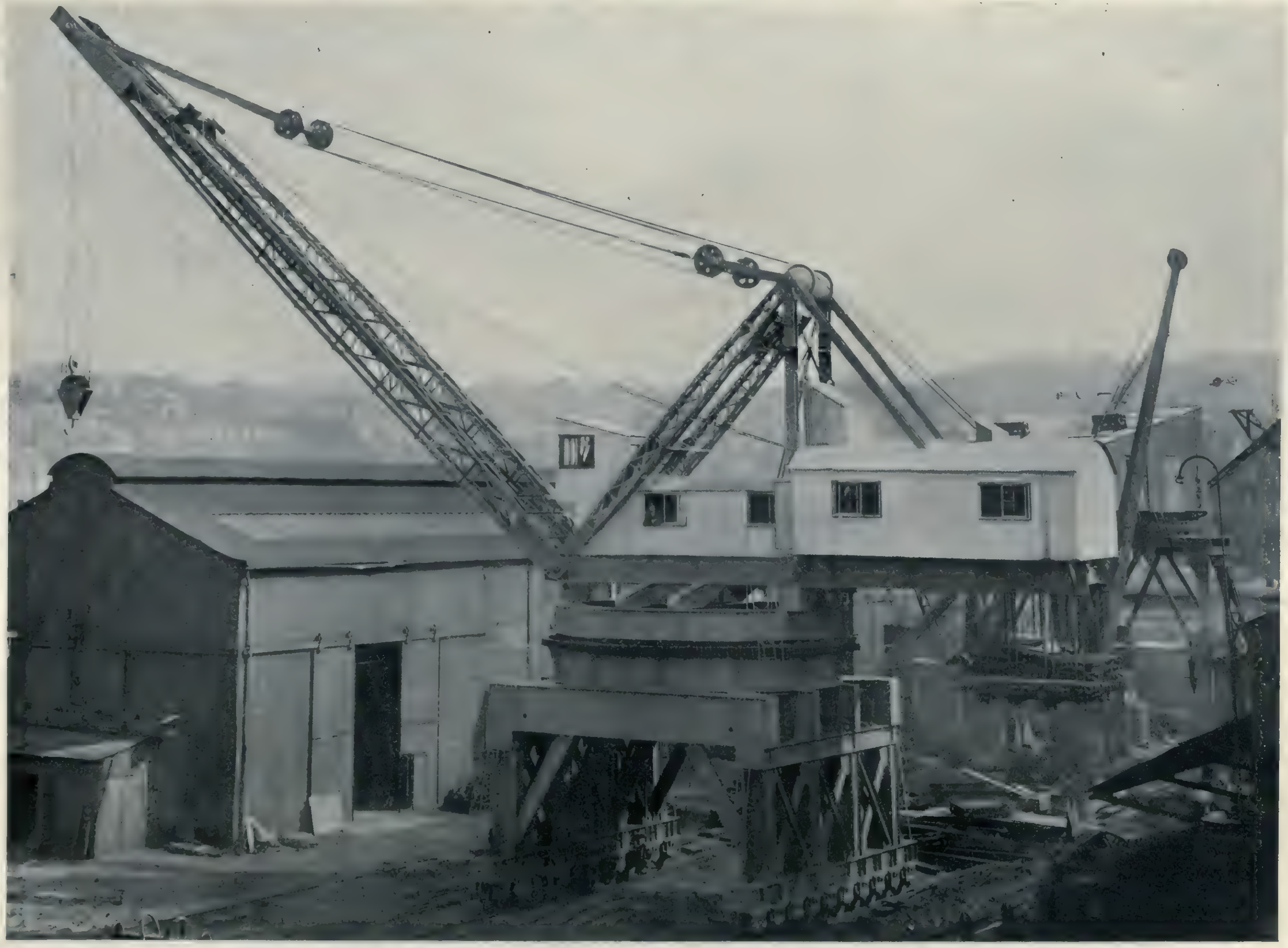
The motor equipment is as follows: two 50 b.h.p. lifting motors arranged with series parallel control; one 80 b.h.p. derricking motor; one 50 b.h.p. travelling motor, and one 25 b.h.p. slewing motor. All the motors are of the enclosed type, series wound for 480 volts continuous current.

The first and second gear reductions are all machine-cut spur gear, except the first reduction of the derrick motion, for which a worm and worm wheel running in an oil bath are used.

There are magnetic brakes to the lifting and derricking gears, arranged in series with the motors, and connected up to the first notches of the controllers. In addition to these are provided a mechanical foot brake for lowering out loads, and a slewing brake. The derrick gear is provided with a special mechanical frictional resistance which comes into action when lowering out the jib. It is fitted on the end of the worm spindle, and is of the ratchet and pawl type, so arranged as to be automatically thrown out of gear when raising the jib, and *vice versa*.

The whole of the first reduction gears are enclosed and run in oil. The undercarriage of the crane is constructed upon the lines of the maker's well-known Titan practice, and is strongly braced in all directions.

The net weight of the crane is about 250 tons; ballast in concrete blocks 70 tons; making the weight of the crane in running order with load on about 375 tons.



50-TON ELECTRIC CRANE CONSTRUCTED BY MESSRS. STOTHERT AND PITT, LTD., FOR THE LONDON AND SOUTH-WESTERN RAILWAY COMPANY.

THE HON.

CHARLES A. PARSONS.

A LECTURE AND A PRESENTATION.

At the recent meeting of the British Association the Hon. Charles A. Parsons, President of the Engineering Section, devoted his address to the subject of invention, and pointed out the need of a revision of the patent laws. What a waste of time, expense, and disappointment would be avoided if in England the patentee were helped to find out easily what had been done previously, on the lines adopted by the United States and German Patent Offices, which advised the patentee after the receipt of his provisional specification of the chief anticipatory patents, dead or alive! Ought we in England to rest content to see our patentees awaiting the report of the United States and German Patent Offices on their foreign equivalent specifications before filing their English patent claims? Ought not our Patent Office to give more facilities and assistance to the patentee? It might be said that the United States and German Patent Offices reports ought to suffice to warn the English patentee. His own experience had been that such protection was not entirely satisfactory.

There were many problems of the highest importance in physics, engineering, chemistry, geology, and the arts, of which the investigation might probably prove of great benefit to the human race, but would involve considerable, sometimes very great, monetary cost. In many cases no patents would give adequate protection; in some there was no subject-matter of novelty and importance involved. In others the probable duration of the investigation was so long that any initial patents would have expired before a commercial result could be reached. In any of these circumstances there would be no inducement to business men or financiers to undertake the risk. As an illustration of his meaning he took two investigations, one being the problem of aerial navigation, and the other the exploration of the lower depths of the earth. Incidentally the following estimate was given for the sinking of a twelve mile shaft, with air locks at each second or third mile, and a special cooling process in advance of the sinkers, similar to the Belgian freezing system of M. Poesche;—

Depth.	Cost. £	Time in Years.	Temperature of Rock.
2 miles ...	... 500,000 ...	10 ...	122°F.
4 miles ...	... 1,100,000 ...	25 ...	152°
6 miles ...	... 1,800,000 ...	40 ...	182°
8 miles ...	... 2,700,000 ...	55 ...	212°
10 miles ...	... 3,700,000 ...	70 ...	242°
12 miles ..	... 5,000,000 ...	85 ...	272°

Discussing the changes in the laws which would place great pioneer research works on a sound financial basis, Mr. Parsons said that a Government grant, except for very special purposes, seemed out of the question, seeing that the benefits to be derived were generally not confined to any one country. An extension to the life of patents, now from fourteen to sixteen years in different countries, would be undoubtedly a step in the right direction. It would be of great benefit generally if some scale of duration of patents could be fixed internationally, the scale being fixed according to the subject-matter, the difficulty of the attack, and the past history of the subject, but more especially in view of the utility of the invention. One of the chief objections raised by the Privy Council against the extension of patents in this country had rightly been that undue prolongation was unfair to the British public, seeing that abroad no prolongations were granted. Therefore, if the duration of patents for important matters was to be extended at home, it must also be extended abroad. One possible solution of this difficult question would be to place such matters under the jurisdiction of a central international committee, which would have the apportionment of the life and privileges of patents and of the extension or curtailment of their duration, according to their handling by the owners. A patent, to be fair to the patentee, ought in many cases to be analogous to an Act of Parliament or a provisional order. Would it not place matters in a fairer position, especially in the case of expensive and lengthy researches, to grant to those who pledged themselves to spend a suitable and *minimum* sum within a stated period on the research, a reasonable and fair monopoly, so that such person or syndicate might, in the event of success, be in the position to reap a reasonable return for their expenditure and risk? Some such measure would unquestionably give an immense stimulus to research and invention, by enabling capital to be raised and works started on commercial lines in fields of great promise at present almost untouched.

Mr. Balfour, in moving a vote of thanks to the lecturer, said he was glad that among the unfortunates in the world of invention they need not count the president of the section. The value of his great invention was recognised throughout civilised nations. Mr. Parsons had not laboured in vain, for he had seen the success and result of his labours. In Germany the value of his inventions had been so fully recognised that the German Society of Civil Engineers had awarded him their gold medal, which Dr. Schröter had been deputed to present.

Dr. Schröter, in seconding the vote of thanks, said no one was more entitled to speak on inventions than the president of the section, whose work had done so much for the advancement of engineering. He was proud to think that the German Society of Civil Engineers—which was the largest engineering society, numbering 19,000 members—was the first publicly to acknowledge the great merit of the steam turbine. At their last meeting at Frankfurt they had decided to award the gold medal to Mr. Parsons, accompanied by the diploma of the Society. Dr. Schröter then presented the medal and diploma to Mr. Parsons.

Mr. Parsons, in returning thanks, said he had not intended to speak of the steam turbine, but he would point out that it was an instance of the manner in which many minds worked on a single subject. After he had taken the matter up he found that at least 100 patents had been taken out for steam turbines, many of them of a similar nature.

The vote of thanks was carried unanimously.

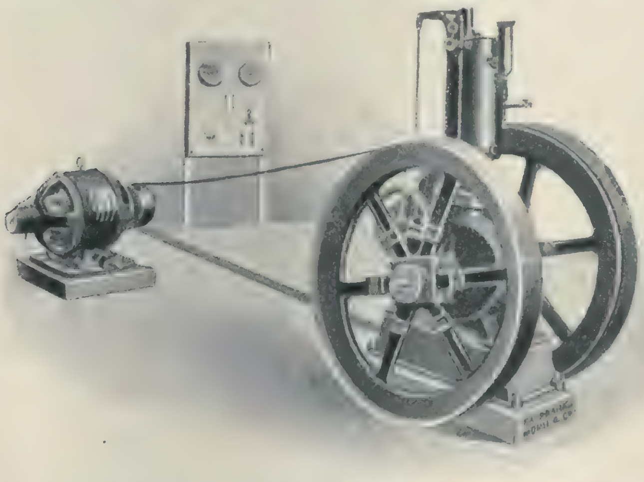
"P.M." MONTHLY ILLUSTRATED NOTES.

Properties of British Standard Sections.

THOSE who have been inquiring for No. 6. of the Engineering Standards Committee Publications will be glad to hear that this is now available and can be obtained from Mr. Leslie S. Robertson, M.Inst.C.E., secretary, from the publishers, Messrs. Crosby, Lockwood and Son, or through the booksellers. It includes preface, definitions and formulæ, and lists of the three committees engaged respectively upon sections used in shipbuilding, bridges and building construction, and railway rolling stock underframes. The British standard sections contained in this volume are as follows: List 1, equal angles; 2, unequal angles; 3, bulb angles; 4, bulb tees; 5, bulb plates; 6, Z bars; 7, channels; 8, beams; 9, T bars. It will be readily understood that the preparation of this work has entailed a vast amount of labour, and we are pleased to receive it in the form of a volume that is made to wear and can be easily consulted. The mathematical preface contains useful information on moments of inertia, ellipse of inertia, moments of resistance, etc. The volume is issued at 5s. net.

Millwall Dock Company.

At the half-yearly meeting of the Millwall Dock Company, it was shown that during the first half of the present year, the tonnage of vessels entering the dock, as compared with the figures for the corresponding period of 1903, had risen from 437,108 to 565,097 tons. This is the best first half-year and the largest tonnage the Company has ever accommodated from January to July in the history of the dock.



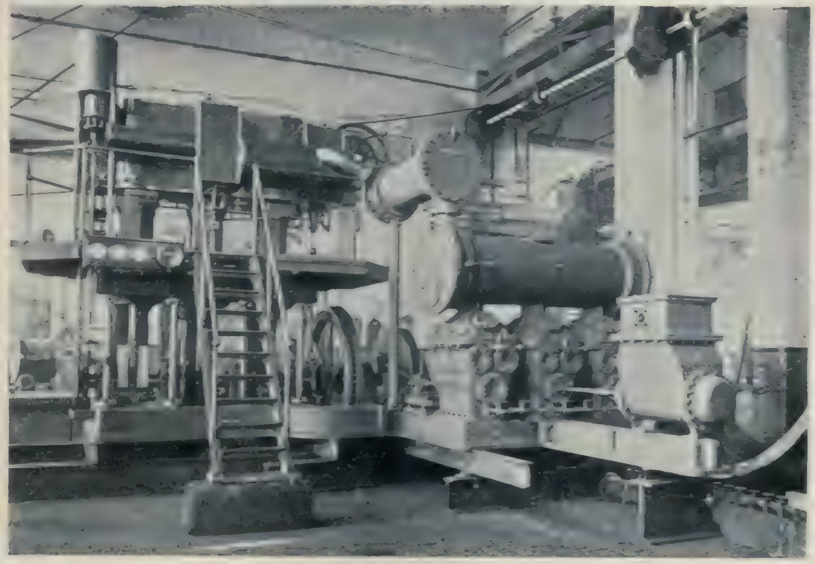
A SMALL LIGHTING PLANT FOR COUNTRY HOUSES.

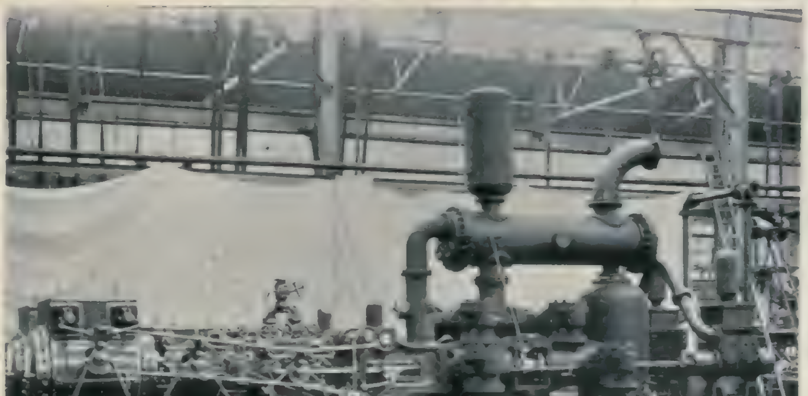
Electric Light in Country Houses.

The annexed illustration shows an example of a small lighting plant such as is often inquired for by those who live in the country or at a prohibitive distance from the nearest power station. The small dynamo is driven by one of Messrs. Fairbanks, Morse and Co.'s gasoline engines fitted with extra heavy fly-wheels. These outfits include engines of from two to six h.p., and are capable of lighting from 20 to 60 sixteen-candle power lamps. The apparatus is also useful for charging storage batteries for automobiles, or electric launches. During the day the engine is available for driving a pump for water supply, etc.

Civil and Mechanical Engineers' Society.

On the 12th ult the members of the above society paid an instructive visit to the Hydraulic Works of Messrs. James Simpson and Co., Ltd., at 101, Grosvenor Road, S.W. By the courtesy of the firm we reproduce on the opposite page photos of two of the latest engines manufactured at these works. The lower photo shows a horizontal triple-expansion surface-condensing, high-duty Worthington pumping engine for Kimberley Waterworks, to pump 1,042 gallons per minute, or 1,500,000 gallons per 24 hours, against a total head, including friction, of 632 ft. The other view shows a triple expansion inverted vertical engine for Kolar Water Works, driving direct triplex double-acting pumps, to pump 695 gallons per minute, or 1,000,000 gallons per 24 hours, against a total head of 500 ft.





VISIT OF THE CIVIL AND MECHANICAL ENGINEERS TO THE WORKS OF MESSRS JAMES SIMPSON AND CO., LTD. TWO OF THE FIRM'S LATEST PRODUCTIONS.

(For descriptions, see opposite page.)

A $\frac{3}{4}$-COUPLED TENDER GOODS LOCOMOTIVE,

BY

The Humboldt Engineering Works Company, Kalk, near Cologne.

This is one of the standard goods locomotives supplied to the Prussian State Railways. The Prussian State gives out orders for a few hundred locomotives of various descriptions yearly, which orders are divided amongst the principal German firms.

Diameter of Cylinder	$17\frac{3}{4}$ in.	Total Fire Heating Surface	1,198 sq. ft.
Stroke of Piston	$24\frac{3}{4}$ in.	Total Water Heating Surface	1,444 sq. ft.
Diameter of Driving Wheels	4 ft. $5\frac{1}{8}$ in.	Grate Surface...	$21\frac{1}{2}$ sq. ft.
Diameter of Trailing Wheels	3 ft. $3\frac{3}{8}$ in.	Contents of Water Tank	247 cu. ft.
Length of Wheel Base	19 ft. 8 in.	Space for Coals	2 tons
Steam Pressure	180 lb. sq. in.	Weight, Empty	47 tons.
Fire Heating Surface of Tubes	1,113 sq. ft.	Running Weight, Full	60 tons.
Fire Heating Surface of Fire Box... ...	85 sq. ft.		

BUSINESS AND PROFESSIONAL.

Messrs. John Brown and Co., of Clydebank, N.B., have placed an order with the Power-Gas Corporation Ltd., for a complete Mond Gas Plant of 4,000 h.p. for generating electricity for general use in their shops.

The Admiralty have recently placed orders with Messrs. Edward G. Herbert, Ltd., for a number of eccentric sawing machines, and the firm have at the present time machines in hand for the Royal dockyards at Chatham, Devonport, Sheerness, Portsmouth, Pembroke, Haulbowline, Gibraltar and Malta.

The Windsor Royal Gaslight Company have placed a repeat order with Messrs. Ashmore, Benson, Pease and Co., Ltd., of Stockton-on-Tees, for retort bench ironwork. The Brackley Gas Company have placed an order with the Company for two purifiers.

Messrs. Holden and Brooks, Ltd., of Manchester, have received a repeat order from their South African representatives, Messrs. Hannam, Hill and Co., for two large oil separators for the Witwatersrand Gold Mining Company, Johannesburg. One of these is to be capable of dealing with 7,200 lb. of exhaust steam per hour, and the other will deal with 24,000 lb. For discharging the oil, etc., separated from the exhaust steam, each of the separators will be fitted with Brooke's Patent Automatic Discharger or Vacuum Trap.

In connection with the article written by Mr. E. O. Mawson, Executive Engineer, Public Works Department, Bombay, which appeared in our issue for August, it should be noted that these automatic sluice gates have been patented in the United Kingdom, India, and the Colonies, and in nearly all countries where irrigation is practised on a large scale. The patents are controlled by Mr. E. R. Calthrop, M.Inst.C.E., 3, Crosby Square, London, E.C.

PAGE'S MAGAZINE

An Illustrated Technical Monthly, dealing with the Engineering, Electrical, Shipbuilding, Iron and Steel Mining and Allied Industries.

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Correspondence *is invited from any person upon subjects of interest to the engineering community. In all cases this must be accompanied by full name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

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Alterations, &c., should reach us **not later than the morning of the 4th of the month preceding** that in which such changes and alterations are required to be made, otherwise, while we will do all in our power to make any changes or alterations, we cannot guarantee them.

OUR MONTHLY SUMMARY.

LONDON, August 20th, 1904.

Final Report of the Boiler Committee.

The tenth and final report of the Boiler Committee appointed by the Admiralty in September, 1900, states that the report of May, 1902, was intended to be final as regards the Belleville boiler, and the committee have since seen no reason to modify the opinion then expressed, that it is "undesirable to fit any more of this type in His Majesty's Navy."

In the report of May, 1902, it was stated that experience had confirmed the committee in the opinion that the advantages of water-tube boilers for naval purposes were so great, chiefly from a military point of view, that, provided a satisfactory type of water-tube boiler were adopted, it would be more suitable for use in the Navy than the cylindrical type of boiler.

With reference to their already expressed view that the four types of boiler, Babcock and Wilcox, Niclausse, Dürr, and the Yarrow large tube, were sufficiently promising to justify their use in the Navy in combination with cylindrical boilers, the committee are now satisfied that two of these four types, viz., the Babcock and Wilcox, similar to that tried in the *Hermes*, and the Yarrow large tube, similar to that tried in the *Medea*, are satisfactory, and are suitable for use in battleships and cruisers without cylindrical boilers. Each type has its particular advantages, and only long experience on general service can show which is on the whole the better boiler. For the present the committee unanimously recommend both types as suitable for naval requirements.

Although the committee have no knowledge of any type of water-tube boiler which is likely to prove more suitable for His Majesty's ships than the two recommended, there are other types which may be considered worthy of trial later on. If any type of boiler is considered in future to be of sufficient merit to justify its trial in the Navy, it is recommended that it be fitted in a new vessel not smaller than a second-class cruiser.

The report has entailed a vast amount of investigation, the principal comparative results obtained dealing with the thermal efficiency, wetness of steam, loss of water, examination and cleaning of interiors of tubes, external cleaning of tubes, bending of tubes, corrosion of tubes and wear of casings and uptakes, liability to damage from being forced, skilled firing required, superheated steam, feeding of the boilers, salt water, and relative weights.

Sir Compton Domvile, president of the committee, in his covering letter to the Admiralty, has felt compelled to say that his experience with the Belleville boilers on the Mediterranean station has been very favourable to them as a steam generator, and it is clear to him that the earlier boilers of this description were badly constructed and badly used. He adds: "We have had no serious boiler defects in any of the ships out here, and the fact that two ships are about to be recommissioned with only the ordinary annual repairs being undertaken shows that their life is not so short as I originally supposed. However, the second commission of these ships will be a very good test of the staying capabilities of their boilers."

Special mention is made in the report of the services of Captain Browning, R.N., who acted as joint secretary until his appointment to the *Ariadne* in 1902, Engineer-Lieut. W. H. Wood, Mr. C. J. Wilson, F.C.S. (who has, during the four years of their work, given his valuable personal attention to the analysis of funnel gases and of coal samples without any remuneration), Messrs. Thomas Wilson, Sons, and Co. (who arranged for the committee to examine the boilers of the steamship *Martello*), and Mr. W. S. Hide, the superintending engineer of that company.

The Management of the Belleville Boiler.

Oddly enough, the next document that comes to hand is a paper on "The Management of Belleville Boilers at Sea," read by Engineer-Lieut. E. F. Baker, R.N., before the North-East Coast Institution of Engineers and Shipbuilders. This, in the words of the author, goes to prove that even the much-maligned Belleville boiler may by suitable treatment be not only tamed, but made as tractable, economical, and orderly as any of its more distant relatives. It records the experience gained with these boilers in H.M.S. *Good Hope*, which has forty-three Belleville boilers fitted with economisers. It is shown that when the ship was first commissioned the maintenance of steam and the details as to cleaning fires were in a large measure left to the chief and leading stokers, who received their orders from the officer of the watch as to the pressure to be kept, the thickness of the fires, and the number of fires to be cleaned each watch. As the ship is not fitted with reducing valves (like some of the earlier Belleville ships), this arrangement proved most unsatisfactory. Most of the men, having just come out of ships fitted with cylindrical boilers, treated the Belleville boilers as they were accustomed to treat the former.

The author proceeds to show the necessity for more system and regularity in the treatment of the Belleville boiler, which is only possible with a thorough control of the firing and cleaning.

The British Science Guild.

Still another Guild has arrived, and one which, I trust, will accomplish useful work. The suggestion which Sir Norman Lockyer made in his address last year, as President of the British Association, has developed into an association with the following objects :—

1. To bring together as members of the guild all those throughout the Empire interested in science and scientific method in order, by joint action, to convince the people, by means of publications and meetings, of the necessity of applying the methods of science to all branches of human endeavour, and thus to further the progress and increase the welfare of the Empire.
2. To bring before the Government the scientific aspects of all matters affecting the national welfare.
3. To promote and extend the application of scientific principles to industrial and general purposes.
4. To promote scientific education by encouraging the support of Universities and other institutions where the bounds of science are extended or where new applications of science are devised.

These objects are to be attained by (*a*) Publications. (*b*) Meetings. (*c*) Conferences and lectures. (*d*) Deputations.

All British subjects, both men and women, are eligible for membership of the guild. It is expected, however, that its members will be recruited principally from the following: The House of Lords, the House of Commons, Colonial Legislatures, county, district, borough, and parish councils, municipalities, educational committees, scientific and literary societies and organisations, commercial and industrial chambers and organisations, the learned professions, Universities, colleges, educational bodies and graduates of all British Universities, representatives of labour. I give these in the order in which they are officially stated.

At a meeting of the promoters some time ago, it was decided that the steps preliminary to the formation of the guild should be taken by an organising committee, of which the following were appointed members, with power to add to their number: Lord Avebury, F.R.S., Professor W. E. Ayrton, F.R.S., Sir George Sydenham Clarke, F.R.S., Captain E. W. Creak, R.N., C.B., F.R.S., Mr. Clive Cuthbertson, Dr. William Garnett, Mr. Sidney Lee, Sir Norman Lockyer, F.R.S., Lady Lockyer, Mr. N. Maccoll, Professor Raphael Meldola, F.R.S., Professor J. Perry, F.R.S., Sir Gilbert Parker, M.P., Sir William Ramsay, F.R.S., Dr. W. N. Shaw, F.R.S., Professor S. P. Thompson, F.R.S., Dr Augustus Waller, F.R.S., Sir Henry Trueman Wood.

The organising committee has elected Sir Norman Lockyer president, Lord Avebury honorary treasurer, Lady Lockyer honorary assistant-treasurer, and Mr. C. Cuthbertson honorary secretary. The committee is at present engaged in communicating with prospective supporters, and will hold a meeting to establish a general committee when this preliminary is complete.

The Upper Nile Basin.

The report on the Basin of the Upper Nile, by Sir William Garstin, G.C.M.G., while it embodies the results of five consecutive years' observations on the Bahr-el-Gebel, has been written mainly with the object of describing Sir William's recent visit to the Equatorial lakes. The chapter upon river discharges has fuller information than has ever before been published, and the observations which have been made have resulted in a considerable modification of the schemes proposed in 1901, for the improvement of the Upper Nile. The report contains so much of interest and value that it might fittingly take a less ephemeral form than that of a Blue-book. As it is dealt with elsewhere in this issue, I need not call attention to its essential features, in detail. It may be mentioned, however, that many pages are devoted to descriptive matter, in which Sir William Garstin gives some vivid pictures of little known regions of the Nile. He is of opinion that in the fulness of time, the Albert and Albert Edward Lakes will disappear, but that long after this the Victoria Lake will remain the great reservoir for and the true source of the waters of the White Nile.

At the Source of the Nile.

The outlet at Ripon Falls is not likely to offer much difficulty to the engineers when it is decided to construct a regulating work at this important spot, the rock being a hard and compact diorite. At Ripon Falls the river glides down to the barrier in a glassy expanse until it thunders over the fall in three separate channels, parted by rocky ridges, and breaks, below the leap, into a white and foaming expanse of raging and seething water. The whole scene is of singular beauty and wild to an extreme degree.

In the event of the river being barred across at Ripon Falls it could be turned through one of the openings, while the masonry in the others was in progress. When this portion of the work was completed the river could be passed through the sluices, and the remaining opening similarly closed. To lower the reef would be rather more difficult, as it would not be so easy to manage the diversion of the stream, and a considerable amount of blasting would be necessary in the channel below to ensure a clear outfall for the water. Still, even to this proceeding there would be no insuperable difficulties.

The vast swamps in the region north of Bor, where an enormous quantity of water is lost by evaporation and the superabundant vegetation of the sudd, are not the least inconsiderable difficulties to be met with in obtaining the control of the Nile. How Sir William Garstin proposes to cut out the most troublesome district by means of an entirely new channel will be seen on reference to page 226. To show what is being done to counteract the sudd I must again quote from the report.

How the Nile is Blocked by Sudd.

The Bahr-el-Gebel traverses the marshes between Shambé and Lake No for some 400 kilometres of its course. South of Shambé the river has never been known to be blocked. On either side of the channel in these immense swamps extend large shallow lagoons, some of them covering several square kilometres of area. These lagoons are surrounded on every side by luxuriant growth of aquatic plants, consisting chiefly of the papyrus and the reeds known to the Arabs as the *Um-soof* and the *Bus*. All these plants grow in water, but not in any great depth. The *Um-soof* and *Bus* again will not stand such a depth of water as will the papyrus. This last attains a height of from 5 to 6 metres, with fibrous roots which strike deep into the ground. The *Um-soof* rarely exceeds 1·5 metres in height, and its roots do not extend so deeply as do those of the papyrus. They are, however, very tough and difficult to break or cut through. These roots are bedded in the soil below the water, but the strong gales which blow in these regions loosen their hold to a large extent. The continuous gales which prevail set hundreds of acres of these floating masses of plants moving in one direction. Eventually, they reach a point on the river where they are forced into a channel. Once there, the current speedily carries them down stream. Ere long their course is arrested by a projection on the edge of the channel or by a sharp bend. It may happen that an area of reed several acres in extent bursts into the river in a large sheet, and in such a case it must necessarily be arrested at the first point where the section is contracted. The result is that the channel is quickly blocked, though perhaps not at first to any great depth. Masses of weed, however, follow one another in succession, brought down by the stream. The section of the channel being reduced by the first obstruction the velocity of the water rapidly increases, and these masses, following the easiest course, pass under the obstacle thus created. Each fresh mass arriving is sucked underneath those originally arrested, until at last the whole becomes wedged into one solid block composed partly of earth and partly of stalks and roots of papyrus and reed broken up by the extreme compression into an inextricable tangle. So great is the pressure applied by the water that the surface of the block is often forced several metres above the water-level, and is seamed by alternate ridges and furrows.

Nitro-glycerine as a Remedy.

Major Peake has fully described his "sudd" cutting operations in a report to the Intelligence Department of the Egyptian War Office. His party worked with five gun-boats and a gang of 800 Dervish prisoners guarded by 100 Soudanese. With them were five English and several Egyptian officers; also some English non-commissioned officers. The total cube removed was some 11,850 cubic metres, but this does not include the large amount of stuff that came away by itself. How great this must have been may be judged by the fact that in one instance when a block burst the floating weed took thirty-six hours to pass a given point. Lieutenant Drury endeavoured to break up the mass of Block No. 19 by means of explosives. The nitro-glycerine, however, was of little use, merely making deep holes, and having no further effect. The "sudd" although compact, is very elastic, and has not sufficient resistance to permit of the full force of the charge being felt. There is little doubt, says Sir William Garstin, that the most effectual way of removing the "sudd" is that practised by Major Peake, viz., cutting the surface into rectangular blocks, hauling these out by steamers, and then letting them float down stream. There now remains only one block in the whole length of the river, viz., No. 15.

Since 1901 there have been no traces whatever of the blocks removed by Major Peake. The work was well and thoroughly done, and if continual supervision be given, more especially during the stormy season of the year, Sir William sees no reason why the Bahr-el-Gebel should not be kept permanently open.

Below the Fola Rapids.

Confining myself still to the descriptive section of this remarkable report, I must find space for one more paragraph, in which Sir William Garstin deals with the Fola Rapids:—

"These rapids constitute the most formidable obstacle to the flow of the Nile in the whole of its course between the Albert Nyanza and Khartoum. It is doubtful whether in the cataracts between Shabluka and Assouan any such demonstration of the force and power of water is to be seen. Below the falls the stream rushes down an extremely narrow gorge with a very heavy slope, enclosed between vertical walls of rock. This can best be compared to a gigantic mill-race or water-slide 100 metres in length. The water tears through this channel in a glassy, green sheet with an incredible velocity. The width of this "gut" is nowhere more than 16 metres across, and in places it is less! What the depth of the water may be it is impossible to say. At the foot of this race the river leaps into a deep cauldron or pot, which it fills with an apparently boiling mass of white water, lashed into foam, and affording a remarkable example of the rage with which water attacks any serious obstacle to its course. The length of this cauldron is only 50 metres, but its width is not more than 12 metres across! Immediately below this the channel widens out to some 30 metres, and eventually more, while the river thunders down, in a series of rapids, for a considerable distance. On either side of the channel are vertical walls of rock from 7 to 10 metres above the water. These rocks are polished live black marble, and stand up in vertical ribs, indicating how severe must have been the discolation of the strata at the time when they were originally forced to the surface. In many places they are hidden by masses of vegetation, and creepers hang down in graceful festoons, forming a curtain resembling green velvet. The island and river banks are covered with a thick growth of mimosa trees. The inky blackness of the rocks and the variegated greens of the foliage, contrast vividly with the seething mass of white water, above which the spray is tossed high in the air in a misty cloud. Above all a deep blue sky and a brilliantly clear atmosphere add to the effect of an exceptionally lovely scene. In the distance, but a long way down stream, the pointed peaks of the Kuku Mountains form an effective background to this enchanting picture."

The Earl of Selborne on Naval Expenditure.

Earl Selborne, referring recently to criticisms in the House of Lords on the Naval Estimates, said the great expenditure on naval works was due to the fact that the question had been neglected for nearly two generations in this country, and it had been necessary during the past ten years to overtake arrears. The lessons which he thought were to be learnt from the war in the East were the importance of the *personnel*, the necessity of having a margin of strength, and the fact that, without the battleship, no Power could either hold or win the command of the sea. Nothing, he believed, was further from the truth than to say that the mine and the torpedo had relegated the battleship from the place which it had hitherto held.

Electro Motors in Factories.

The following rules, applicable to electro motors in factories, have been issued by the associated fire offices :

1. Motors, when not in an engine-room or in a separate compartment expressly set apart for their use and built of or lined with incombustible material, must be completely enclosed in an efficient metal case forming part of the designed construction thereof. Ventilation by direct communication with the outer air or by openings in the vertical portion of the metal case protected by two thicknesses of approved wire gauze is allowed. Induction motors may have unprotected ventilation openings in their metal cases, the superficial area of each opening not exceeding ¼ in. and the openings being at least ¼ in. apart. Slip rings and brushes, or any other sliding contacts, must be completely enclosed in metal cases. Inspection holes fitted with plate glass are allowed.

2. No unprotected woodwork or combustible material must be within 18 in. of any motor, and wood flooring beneath any motor must be protected by a sheet of metal.

3. The motor-pulley—or other mechanical device for transmitting power from the motor—must be external to the metal case enclosing the motor. Only the shaft and the connecting conductors may be carried through into the metal case or through the wall of the compartment. No belts, ropes, or other corresponding gear may be so carried. Note.—Holes in the case to admit connecting conductors must have proper bushings, and exposed terminals must have proper protecting caps fitted, to prevent short-circuiting. Each connecting conductor must be provided with a proper switch and proper cut-out.

4. Dynamos must be treated as motors.

5. Resistances and starting transformers must be similarly situated and must be enclosed as required for motors.

6. All metal cases, tubes, etc., must be efficiently connected to earth.

7. Motors must not be supplied with current from dynamos or conductors having an earth return.

The Royal Agricultural Society and its future Shows.

The Royal Agricultural Society has performed such excellent services for the country that widespread regret will be felt at the failure (financially speaking) of the recent show at Park Royal. In spite of the saving of about £5,000 in expenses, the loss amounted to about £8,500, the total attendance being less than 53,000. When the Society acquired the excellent show grounds at Park Royal, no one could reasonably have expected diminished gates; in fact, the permanent show ground has features which in some respects are eminently desirable. One would be sorry, even now, to arrive at the conclusion that the ground is unsuitable, and it would certainly be rash to do so in view of the fact that on six of the shows held in the country by the Society, there was a loss of £21,476, as compared with a gain of £15,984 on eight other shows in the provinces—a net loss of £5,492. On the other hand, it is pointed out that all past experience has been against the metropolis as a venue for the Show.

It is obviously time for the Society to seriously reconsider the question of the show ground, and should it be decided to continue at Park Royal, we would suggest some more attractive method of interesting the attendance of the *general* public, as distinct from agriculturists. The introduction of sports, fireworks, balloon ascents, etc., might involve a departure from tradition, but as auxiliaries to the more serious business of the Show, they might help to swell the coffers of the Society. After all, the average Londoner is apt to view agricultural live stock with languid interest, which is not to be wondered at, while in Queen Victoria Street he can see all sorts and conditions of machinery.

Meeting of the Council.

At the last monthly meeting of the Council, the president (Lord Middleton) explained that the show of 1904 would only be £1,000 less costly to the Society than that of 1903, when there was a deficit of £9,680, and it had only been possible to finance the loss caused by the Show of 1903 by pledging to the bankers the Society's holding of £13,100 in the Harewood House debenture stock, while the heavy loss on the Show of 1904 imposed upon the Council the necessity of applying to the bank for still further advances of large amounts to meet obligations in the matter of prizes, administration expenses, etc. It was estimated that £10,000 would be required before the recess, and £5,000 during the coming autumn and winter. Six of the trustees had guaranteed to the bank sums equal in the aggregate to the total required; but it would obviously be necessary for the Society, unless other means could be found of putting it into funds, to realise eventually one or more of their assets to repay the bank or the guarantors. On the recommendation of the trustees, it has been decided to draw up a statement showing the work of each department of the Society and its cost, and to arrange conferences with the implement and live stock exhibitors, and the various breed societies, with the view of ascertaining the measure of financial support they will give to the Show. A circular will be subsequently issued to the members, pointing out the necessity of increased financial support, and seeking their views on various points. This will be followed by a special general meeting of the Society in November.

The Electrification of the Metropolitan Railway.

At the half-yearly general meeting of the Metropolitan Railway Company, Sir C. McLaren, M.P. (presiding), remarked that one of the most interesting points for their consideration was the progress which was being made in the electrification of the railway. With the very best intentions, contractors, manufacturers, and others had not been able to supply the company with materials and machinery so quickly as they had been given to understand would be the case. This often occurred with engineering work of a known and tried description, but they and the District Company were carrying out a change from steam traction to electric traction on a larger portion of railway and with a heavier train service than he thought had ever been undertaken in any other part of the world. They had built and completed their generating station. The cables and the conductor rails had been laid, and the general equipment of the permanent way had been completed from Baker Street to Uxbridge. Similar work was now being prosecuted each night upon the Inner Circle section, and it would soon be completed. It was intended to adopt corridor cars for the electrical working, and they had had built in England a first consignment of seventy cars, all of which had been delivered at the Company's works at Neasden. A certain number of these were what were called "motor-cars." They had tried some of them in running, with satisfactory results, and they had placed orders for further cars at Birmingham and Manchester. With one or two of the principal officers, he intended to pay a visit to America before the end of the year to look very carefully into the methods of the working of some of the electric railways there, with a view to getting some hints which would be of service to the company when they commenced to work by electric power themselves.

The Metropolitan District Railway.

At the eightieth half-yearly meeting of the Metropolitan District Railway Company, Mr. Perks, M.P., had some interesting things to say about the electrification of the line. He mentioned that 1,000 people were being employed every night upon it. At the Mansion House, the sub-station was ready for roofing in and the machinery would be placed there next month. At Charing Cross there had been a good deal of heavy work, but the sub-stations there were to be finished in about six weeks. They would have to instal electricity alongside the steam trains during the period of conversion; but the board hoped, and fully expected, that by January 1st next, a considerable portion of the railway would be worked by electric motive-power, and that very early in the coming year the shareholders would see the District line completely transformed. It was anticipated that the effect of this conversion would be to increase the traffic enormously.

280 Foreign Cars to carry Londoners.

Mr. Perks was asked if it were correct that a substantial part of the order for the cars had been placed abroad. "In answer to that question, he had to say that 280 out of their 420 cars were being built on the Continent, the reason being that the tenders of the English builders were at least 30 to 40 per cent. above the prices quoted by Continental firms on exactly the same specification and for identically the same article. The Underground Electric Railways Company, by whom the orders were placed, used their utmost endeavours, but in vain, to persuade the English car builders to reduce their prices, and, consequently, an order for 40 trains was given to the Continental builders. No sooner had this been done than the English car builders reduced their figures to the same level as that of their Continental competitors, and the remaining trains, 20 in number, or 140 cars, were taken by them at practically the same price as the foreign car builders had quoted. He did not know whether the shareholders would have wished the Underground Company to have spent in the purchase of the cars £120,000 more, partly for what was called patriotism. At any rate, they had not considered it to be their duty to do so, though the Underground Company would have been delighted to give a small sum in excess of that charged by the Continental car builders if, by doing so, the work could have been kept in this country."

Zone Fares.

An important matter, more grateful than the above to English ears, was that relating to uniform fares. The chairman mentioned that by the company's Bill of this session, which had now received the Royal Assent, they had taken power to charge zone or uniform rates over certain sections of the railway. The rate from Hammersmith to Aldgate East, or between any station upon that section, would be 2d. Anyone travelling past Hammersmith—from Hammersmith to Hounslow or from Hammersmith to Ealing—would pay an extra 2d. They would have a rate from Ealing to the City of 3d., and from Putney to the City of 3d. These were important reductions, but by the new Act they had got rid of the embarrassing obligations imposed upon them by their old Act of carrying passengers short distances at the low rates of 1d. and 1½d., which would have prevented their instituting a uniform rate over the whole line or sections of the line. He was personally in favour of a uniform rate of 2d. to any station on the railway, but it was thought better, as a first step, to have a system of zone rates for specified distances.

Mr. Perks and the L.C.C.

In carrying out his schemes, Mr. Perks has discovered the existence of a body known as the L.C.C., and he is strongly of opinion that "gentlemen who are embarking from £10,000,000 to £15,000,000 in the construction of railways for carrying the people of London," should have met with "sympathetic support" from the governing municipal body, rather than the "constant opposition" which he alleges against every department of the Council, except the engineering department. One does not know whether to be more impressed with the philanthropy of the gentlemen behind the £10,000,000, or the wickedness of the London County Council. But as the "zone fares" are not to be handed over to the hospitals, and as the London County Council is responsible to the people of London for the safeguarding of public interests, doubtless many will look upon their action from an entirely different point of view.

ELECTRICAL AFFAIRS.

BY

E. KILBURN SCOTT, M.I.E.E., A.M.INST.C.E.

Aluminium for Transmission Lines.

The use of aluminium for electric transmission lines has developed in a most remarkable manner, and has got such a hold on the market that it is probable that, even if copper fell to its old price, aluminium would still be used. As will be seen by the following table, when copper is taken at 10¼d. and aluminium at 15d. a lb., aluminium shows a 28 per cent. saving over copper, and even when bought in small quantities at 18d. a lb., aluminium is still 14 per cent. cheaper. It should be remembered that there are also various contingent savings, such as reduced number of poles and insulators, etc., for, as will be seen, the weight of one mile of wire for equal conductivity is less than half that of copper.

	Relative conductivity.	Relative area for equal conductivity.	Relative diameter for equal conductivity.	Relative weight for equal conductivity.	Relative tensile strength for equal conductivity.	Weight of one mile of wire in lb. for equal conductivity.	Present price per lb.	Total price of one mile of wire to give equal conductivity.
Copper	100	100	100	100	100	1 in. dia., 163·2.	10¼d.	£6·93
Aluminium ..	61	164	128	48·5	75	0 128 in dia., 79·5.	15d.	£4·97 (28 per cent. saving).

Comparison of American and British Electrical Development.

The last Report of the United States Government Department of Commerce and Labour is exceedingly interesting, as showing the extent to which electrical development can go when free from restrictive influences. Up to the year 1902, no less than 1,960 towns, each with less than 2,500 inhabitants, had an electricity supply, and 75 per cent. of the electric supply areas in the States are in towns of less than 5,000 inhabitants. In this country, it is doubtful whether one could point to a dozen towns of less than 5,000 inhabitants which have an electric supply.

With us the number of gas plants and the money invested in them is larger than in electric light works. In the States, on the other hand, it is just the reverse, only 877 gas plants are in operation, and the value of these is eight million pounds sterling less than the total of the electric light plants.

A most significant item in the Report is, that of the 125,000 miles of main and feeder cables in the States, only 8,124 miles, or 6½ per cent., are underground. In this country, it is doubtful whether there is so much as 6½ per cent. *above* ground.

Of the total horse-power in central stations, 78 per cent. are steam and gas engines, and 22 per cent. water wheels, etc. The main steam engines total 1,379,940 h.p., the gas engines 12,180 h.p., and auxiliary steam engines 14,450 h.p. The water wheels total up to 438,470 h.p., and eight per cent. of the wheels have a capacity of over 1,000 h.p., and this eight per cent. represents 47 per cent. of the total water wheel horse-power. It will thus be seen what a large part water power plays in the States, and it must be remembered that such power goes on for ever, whereas in burning coal we are gradually but surely exhausting our resources.

Payment to Electrical Employees.

The wages paid in the States to electrical station assistants are, it need hardly be said, higher than in this country. Thus, of the total engineers employed, over 50 per cent. earn more than 6s. 3d. a day. The great majority of the dynamo and switchboard attendants earn from 4s. 2d. to 11s. 3d. a day, and more than half the foremen earn from 6s. 3d. to 10s. a day.

The following gives the percentage that each item of expense bears to the total in average, private and in municipal stations for 1902:—

	Private Stations.	Municipal Stations.
Salaries and wages ..	29.9 per cent.	35·8 per cent.
Supplies, materials, and fuel	32·6 ,,	46·2 ,,
Rent, taxes, insurance, and miscellaneous ..	18·2 ,,	8·4 ,,
Interest on capital ..	19·3 ,,	9·6 ,,

Over 56 per cent. of all wage earners in private stations receive 8s. 4d., or over, per day, compared with 41 per cent. in municipal stations. Also, 15 per cent. of private station employees earn 10s. 6d. to 12s. 6d. per day. In this country, far too many of the electrical stations are sweating shops of the worst type. They are constantly fed with young men from technical institutions, and as the supply is greater than the demand, many of these unfortunate young men do not hold out for a decent salary, or they are kept at pointer dodging on a switchboard.

Hammer Type Wharf Cranes.

A type of wharf crane which is likely to come into considerable use for the loading and unloading of ships is that known as the "Hammer Crane." It consists of a horizontal jib, having arms of unequal length, the longer carrying a travelling crab, and the shorter a counter-weight. The jib is supported at a considerable height from the ground on a revolving post, built up in a trilateral pyramid steel framing, the whole somewhat resembling the shape of a hammer, hence the name. The Germania shipyard of Messrs. Krupp, near Kiel, has one of these cranes of a carrying capacity of 150 tons, and at Messrs. Beardmore's Shipbuilding Yard on the Clyde there is also another of this type. It has the great advantage over the old sheer legs or jib cranes in that the radial movement of the load, as well as the lifting, is effected in a very quick and easy manner, and with a minimum of gearing. The trilateral framing may span several lines of railway, and thus admit of rolling stock passing under it.

The interesting point with regard to these cranes, from the electrical engineer's point of view, is the fact that they are particularly fitted for equipment by electrical power; in fact, it is difficult to see how such a crane could be worked by steam or hydraulic power. The usual plan is to fit the crab with two motors, one for lifting and the other for travelling, in much the same way as the crab of an overhead travelling crane in a power station, whilst another motor, placed at about the centre of the double armed jib, is used for rotating same. Current for these various motors is picked up from trolley wires by means of sliding contacts in the same way as for an overhead crane.

NAVAL NOTES.

MONTHLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

By N. I. D.

GREAT BRITAIN.

THE return just issued specifying the various amounts required for naval works is given below:—

Works.	Total Estimated Cost. 1903-4	Estimated Expenditure, 1904-5.	Expected Date of Completion.
(a) Enclosure and Defence of Harbours.	£	£	
Gibraltar	1,23[illegible],000	53,477	1904-5
Gibraltar, Commercial Mole	[illegible]	142,212	1904-5
Portland	[illegible]	52,814	1904-5
Dover	3,500,000	335,174	1907-8
Malta Breakwater	1,000,000	150,177	1909-10
(b) Adapting Naval Ports to present needs of Fleet.			
Deepening harbours and approaches	1,300,000	105,269	—
Keyham Dockyard extension ...	4,175,000	450,121	1906-7
Gibraltar Dockyard extension ...	2,[illegible],000	260,200	1905-6
Hong-Kong Dockyard extension ...	1,245,500	307,242	1905-6
Malta Dockyard extension	1,250,000	331,750	1907-8
Bermuda Dockyard extension ...	[illegible]	[illegible]	1907-8
Simon's Bay Dockyard extension, etc.	2,500,000	[illegible]	1907-8
Coaling facilities and fuel storage ...	1,280,000	3[illegible]3,193	1906-7
(c) Naval Barracks, etc.			
Chatham Naval Barracks	515,000	39,473	1905-6
Portsmouth Naval Barracks	[illegible]	113,726	1905-6
Magazines	1,335,000	332,595	1906-7
Electric light and power in Naval Establishments	1,500,000	454,030	1908-9
(d) Superintendence and Miscellaneous charges	1,420,303	130,584	—

Official particulars of the new battleships of the *Lord Nelson* class, have been made public and have excited world-wide interest. The displacement is to be 16,500 tons, which is 150 tons more than the *King Edwards*, and the cost is not very much more. But the improvement is very great. Space and weight have been saved in machinery, the horse power being reduced from 18,000 in the *King Edwards* to 16,500 in the *Lord Nelsons*, these latter vessels having a speed of 18 knots. The armour protection of the new vessels, moreover has been improved. In the *King Edward* class the plating amidships is only 9 in. in thickness. In the *Lord Nelsons* it will be 12 in. with 8-in. plates above. If these details are correct, the new arrangement should make the vessels impervious to any artillery smaller than 9·2 in. The belt will be a complete one, thinned fore and aft. But it is in the armament that the greatest development is noticeable. Her principal armament is to consist of four 12-in. guns of forty-five calibres with a secondary battery of ten 9·2 in. guns of fifty calibres. The 12-in. guns are five calibres longer than any other gun of their weight at present mounted in battleships and throw a shell of 850 lb., which is heavier than the shell thrown by any other similar guns, except the *Kansas* of the United States Navy.

Tenders for the first two vessels of the class, the *Lord Nelson* and the *Agamemnon* have been called for, and are to be sent in by September 20th.

Rumour is already busy with regard to the destination of the *King Edward VII.* and *Commonwealth*, when they are put into commission. The policy of the Admiralty latterly has been to send all our best ships to the Mediterranean, and it is most likely that this precedent will be followed in the case of these new vessels.

Messrs. Cammel, Laird, and Co., have launched the *Pathfinder*, scout, this being the second of these vessels to take the water. The ceremony took place on July 16th. The discussion on the merits or otherwise of these boats was dealt with in the last issue of the Magazine.

The destroyers *Ribble* and *Wellend* have been completed and passed into service, and torpedo-boat No. 115 has also been delivered from the contractors, Messrs. J. S. White and Co.

FRANCE.

The Naval Estimates for the current year, to which passing reference has already been made, total £12,722,752, showing an increase over the sum voted for the previous financial year of £209,607. The sums to be devoted to new construction in the public and private yards are £2,587,735 and £1,949,600, respectively. The first-named sum is inclusive of wages and miscellaneous expenses, the sum actually devoted to material being £1,576,000.

The *personnel* of the Fleet is to number 15 vice-admirals, 30 rear-admirals, 125 captains, 215 commanders, 754 lieutenants, 420 sub-lieutenants, 170 midshipmen, and 67 cadets.

The composition and distribution of the French fleet during the year is to be as follows:—

The Mediterranean squadron, nine battleships (six in active commission, three in reserve), three armoured cruisers, with attendant small craft.

The Northern squadron, three battleships, three coast defence ships, six armoured cruisers (three in active commission, three in reserve), with attendant small craft.

In the Far East, three armoured cruisers, three protected cruisers and a flotilla of six destroyers.

Dealing with the vote for new construction, M. Pelletan, in his explanatory statement, says there is an increase of £100,000, and even this is hardly sufficient. The battleships of the 1901 programme are still uncompleted and absorb £1,640,000 of the total asked for, for new construction. The armoured cruisers of the *Gambetta* class take another £1,000,000. These sums are nearly similar to those asked for in the previous Estimates, the increase being solely on account of torpedo-craft on which M. Pelletan places great reliance.

It is announced that the battleship *Democratie* is to be fitted with Belleville boilers.

The armoured cruiser, *Jules Ferry*, is being hastened forward as rapidly as possible, and it is hoped to get her ready for her trials in about a year's time, 1,400 men are employed on her at Cherbourg.

Another submarine of the *Naiade* class has been launched at Rochefort, and has received the name of *Meduse*.

GERMANY.

The formation of the new naval station at Sonderburg on Alsen Island in the Baltic was a natural sequence to the growth of the German Fleet and its continual presence in the somewhat confined waters at Kiel. The new station is to be used mainly as a gunnery school depôt, and it is hoped that many of the inconveniences which have hitherto cramped the work of these establishments at Wilhelmshaven and Kiel will now be overcome.

The new battleship *Schwaben*, while running a trial trip off the coast of the island of Fehmern, near Lübeck, early in July, struck a rock and sustained damage which will, it is expected, take some weeks to make good. The rock was an uncharted one, and is probably one of the so-called erratic blocks which have in recent years caused similar damage to several vessels of the German navy.

Progress with the battleships of the *Braunschweig* class has been well maintained during the last two months, and it is now considered most probable that the two first vessels of the class, the *Braunschweig* and the *Elsass* will be under the pennant by the end of this year. The *Hessen* and *Preussen* launched in August and October of last year, respectively, are being pushed forward with all convenient dispatch, while the *Lothringen*, which took the water in May last, is in an advanced stage. Of the new class, slightly improved *Braunschweigs*, "N" was laid down on March 31st, 1903, and "P" has been laid down at the Royal dockyard, Wilhelmshaven.

ITALY.

The battleship *Vittorio Emanuele*, sister to the *Regina Elena*, the launch of which was noted in the July issue of the Magazine, is expected to be launched at the end of August.

The programme of construction for the year 1904–5 provides for the completion and commissioning of the battleships *Regina Margherita* and *Benedetto Brin*, the armoured cruiser *Francesco Ferrucio*, and three submarines, while work is to be continued on the *Vittorio Emanuele*, *Regina Elena*, *Napoli*, and *Roma*. Of these, two are already in the water, and the other two are to be off the stocks very shortly. Two torpedo-boat destroyers, the *Teffiro*, launched on May 14th, and the *Espero*, are both to be completed by Pattison, of Naples.

At Castellamare, it is hoped, during the current year to commence work on a new battleship, No. 5, of the *Vittorio Emanuele* class, and an armoured cruiser whose design is not yet made public. In addition two sub-marines, C. and D, and fourteen torpedo-boats are to be commenced. The torpedo-boats will be built, four by Odero of Sestri Ponente, four by Pattison, of Naples, and six in the public yards.

The *Regina Margherita*, on her natural draught trials, developed 17,600 h.p., giving a speed of 18·5 knots. A preliminary full-speed trial gave a speed of 19·3 knots, which was subsequently bettered when an average of 20,000 h.p. (maximum 23,000) was maintained, to give an average speed of 20·2 knots. Her Niclausse boilers worked without any trouble.

The armoured cruiser *Francesco Ferrucio* at her stationary machinery trials gave considerable satisfaction. She is shortly to undergo deep sea trials.

RUSSIA.

The ineptitude and want of decision which has marked the command of the Russian Fleet in the Far East from the very beginning of the war has ended, as was only to be expected it would, in the complete defeat of both sections of the Fleet in an attempt to effect a junction.

Early on the morning of August 10th, Admiral Togo's scouts reported to him that the Russian squadron in Port Arthur was beginning another sortie, driven confessedly from its sanctuary by the fire of the Japanese guns mounted on Wolf Hill and commanding an extensive sweep of the dockyards. Togo was thus enabled to lie once more in wait for his adversary, and although the Russians made a gallant and determined effort to break through, they were only successful in isolated instances and that at great cost. The main body of the squadron was driven back to Port Arthur, probably much more severely damaged than when it came out, and with little prospect of effecting any repairs. According to Admiral Togo's reports, which are even more laconic than before, the battleship *Cesarevitch*, the cruisers *Novik* and *Askold*, and some of the torpedo flotilla were the only vessels that escaped. The *Cesarevitch* reached the German port of Tsingtau, steaming at four knots only, and in such a crippled condition that it would take months to make her seaworthy. Her Admiral, Vithoft, was literally blown to pieces and the second-in-command severely wounded. The *Novik* also went to Tsingtau, but only remained the twenty-four hours permitted by international law. The *Askold* reached Shanghai with over two hundred shell holes in her, eighty of which are stated to be below the water-line.

The Vladivostok squadron left its port in the north early in the same week, evidently with a view to joining forces with Vithoft, and awaiting the arrival of the Baltic Fleet. But Kamimura, who in his chase after the Vladivostok ships has been dogged by persistent ill-luck, at least succeeded in bringing the raiders to book, and on August 14th, at five in the morning, engaged the armoured cruisers *Rossia*, *Gromoboi*, and *Rurik*, with his small squadron of protected cruisers. The fight lasted five hours, and resulted in the complete defeat of the Russians, the *Rurik* being sunk with about two hundred and fifty of her crew, and the *Gromoboi* and *Rossia* driven back to the north. These, all but simultaneous defeats of the remnants of the Russian fleets in the Far East give the command of the sea indisputably into the hands of the Japanese. The reports to hand at the time of writing are too vague to allow of any but the broadest conclusions being deduced from these engagements, but it must now be plain, even to the St. Petersburg Government, that the despatch of the Baltic Fleet cannot in any way alter the state of affairs in the Far East so far as maritime supremacy is concerned.

This Baltic "Armada" as it has been called, consists of some sixty vessels all told, including eight battleships, nine armoured cruisers, several second-class cruisers, torpedo-boats and destroyers and colliers.

It is announced that in the new programme of naval construction, which has been brought forward to make good the losses occasioned by the war, the battleships are to be of the *Borodino* type, slightly modified. The speed is to be 19 knots instead of 18, and there is to be some rearrangement of armament. The vessels of the *Imperator Pavel I.* type, which are already in hand, are of course to be continued.

UNITED STATES.

The new American battleship is to be called the *New Hampshire*. She is of the *Kansas* class and will be built by contract. The armoured cruisers are to be called *North Carolina* and *Montana*, and will be of the *Tennessee* class, with slight improvements. There will, however, be no departure from the general type in either case. Three 3,500 ton scouts, which are also to be put in hand will be known respectively as *Birmingham*, *Chester* and *Salem*.

The race in the construction of the *Connecticut* and *Louisiana* is in a very interesting stage, and the launch of these two vessels should take place within a very few days of each other. The *Louisiana*, at the time of writing, is expected to be ready for launching by August 27th, but other reports state that it will be the middle of September before she is able to get off the stocks. The date officially announced for the launch of the *Connecticut* is September 29th.

The official trials of the battleship *Ohio* are now complete. She did not attain her contract speed of 18 knots, the entries at the Navy Department showing only 17·817 knots.

The armoured cruiser, *South Dakota*, of the *California* class, was launched on July 14th, at San Francisco.

MINING NOTES.

By A. L.

Indian Mining Prospects.

A paper read before the American Institute of Mining Engineers by Sarat C. Rudra, of Calcutta, brings out the extraordinary mineral wealth of our Eastern Empire. Of the many ores available, gold, lead, copper, iron, antimony, and graphite, have a great future before them. The prospect of diamond mining is also recommended with confidence. The writer expresses his confidence that if enterprising capitalists be discreet in securing the services of engineers and mineralogists of ability and character, success is bound to follow the mining of any of the above-named minerals. Chota-Nagpur and Burma should have the greatest claims to investigation, owing to the fact that they have been only partially opened and surveyed.

Water-power for Mining Purposes in India.

This writer emphasises the inexhaustible sources of water-power which exist in India, though he adds that the numerous waterfalls have not yet been much utilised directly or indirectly to drive mills for various industrial concerns. The well-governed principality of Mysore now, however, possesses a powerful plant for generating electricity. The Cauvery Falls have been utilised to drive large dynamos, similar to those used at Niagara Falls, N.Y. The electric power so generated at the head-waters of the Cauvery is being conducted about ninety miles to the Kolar gold-fields, where it is used for mining purposes.* The Cauvery Falls are not inferior in their capacity to Niagara Falls, hence, if further mining-camps be added in Mysore, there will hardly be any difficulty concerning the supply of power. This new power system has indeed been a boon to the Kolar mining-concerns, because the rainfall in that part of the country is inadequate, and consequently the water reservoirs are incapable of furnishing all the water needed for boiler and other purposes throughout the year. Besides, every bit of coal or firewood has to be brought from a long distance, which makes steam-raising a matter of great expense. The new electric power supply has been found to be of moderate cost.

Miners' International Congress.

The International Miners' Congress, held at Paris and limited to coal miners, was attended by about 100 delegates of various nationalities, 50 of the members being English.

The first subject discussed was the question of fixing the working day in mines at eight hours. Two proposals in this sense were submitted, the one by the Miners' Federation, and the other by the National Federation of French Miners. After a discussion of considerable length, in which Messrs. Edwards and Stanley (England) took part, the French proposal was adopted. This proposal demanded the fixing by law of the working day in mines at eight hours, including ascents and descents, with extension to surface workers. The British proposal was much less definite, inasmuch as, while demanding a reduction in the hours of work, it did not fix a limit. The second part of the resolution moved by the Miners' Federation, proposing that action be taken to secure from the Governments represented at the congress the passing of such a law as was required, was adopted.

* *See* Page's Magazine for February, 1903.—Ed.

Two proposals were submitted on the subject of minimum wages. The French National Miners' Federation urged that a wage minimum should be fixed by law. The British Miners' Federation, on the other hand, submitted that the same results could be obtained by the action of trades unions, and deprecated any legal action in the matter. After a long debate, the congress adopted a resolution to the effect that the associations of every nationality represented in the congress should do their utmost to obtain for miners, by legislation or otherwise, a minimum wage such as would enable them to live comfortably. The subject of ankylostomiasis and other matters were also discussed.

The North of England Institute of Mining and Mechanical Engineers.

The report of the Council of the above Institution presented at the annual general meeting showed that 100 members of all classes have been added to the register during the past year, and after allowing for losses by deaths, resignations, etc., there is a net increase of thirty-eight members, the total now being 1,350. The library now contains 9,948 volumes and 201 unbound pamphlets.

G. C. Greenwell bronze medals have been awarded to Mr. Blakemore for his paper upon "The Fernie Explosion," to Dr. J. S. Haldane for his paper upon "Miner's Anæmia, or Ankylostomiasis," and to Mr. F. W. Hardwick for his paper upon "Underground Fires." Mr. Clarence R. Claghorn's prize of £10 for the best essay upon the "Action, Influence, and Control of the Roof in Longwall Workings" has been awarded to Mr. H. W. G. Halbaum, for his paper dealing with that subject.

Prizes of books have been awarded to the writers of the following papers communicated to the members during the year 1902–1903: "Working a Thick Coal Seam in Bengal, India," by Mr. Thomas Adamson, M.I.M.E. "The Use of Carboniferous Plants as Zonal Indices," by Mr. E. A. Newell Arber. "Description of the Lead Ore Washing Plant at the Greenside Mines, Patterdale," by Mr. Wm. H. Borlase, M.I.M.E. "The Gypsum of the Eden Valley," by Mr. D. Burns, M.I.M.E. "Sinking by the Freezing Method at Washington, County Durham," by Mr. Mark Ford, M.I.M.E. "Air Compression by Water Power; The Installation at the Belmont Gold Mine," by Mr. D. G. Kerr, M.I.M.E. "The Occurrence of Gold in Great Britain and Ireland," by Mr. J. Malcolm Maclaren, M.I.M.E. "Some of the Considerations Affecting the Choice of Pumping Machinery," by Messrs. A. H. Meysey-Thompson, M.I.M.E., and H. Lupton. "The Geology of the English Lake District," by Mr. J. Postlethwaite. "The Utilisation of Exhaust Steam by the Combined Application of Steam Accumulators and Condensing Turbines," by Professor A. Rateau, M.I.M.E. "Hematite Deposits and Hematite Mining in West Cumberland," by Mr. W. E. Walker, M.I.M.E.

It was mentioned that members had been invited to participate in the International Engineering Congress to be held in October, 1904, at St. Louis and also in an International Congress to be held in Liege in September, 1905.

Regret was expressed at the death of Mr. William Cochrane, a past president of the Institute.

THE CIVIL ENGINEER AT WORK.

By C. H.

The Birmingham Water Scheme.

I hear that since the inauguration of the Birmingham water scheme, people in the Midland capital have made it a staple subject of conversation, and many have been the congratulations on the excellence of the engineering work carried out 73 miles away in the Elan and Claerwen Valleys. These works, which have been in progress for some years, will ultimately provide a supply of 75,000,000 gallons of water daily, in addition to 27,000,000 gallons for compensation.

The portion of the scheme completed includes four great dams holding back the waters of the Elan, and the base of the dam at Dolymynach on the Claerwen, and the aqueduct to convey the water from the storage reservoirs near Rhayader to the service reservoir at Frankley together with that reservoir, filters, distributing mains, etc. Ultimately three additional reservoirs in the Claerwen Valley will be constructed, and six sets of pipes, 42 in. in diameter, two of which are at present laid, will be used for the conveyance of the water to Birmingham. The aqueduct consists of nearly half cut and cover and tunnel, and half of pipe syphon.

In order to provide for a fall of 170 ft. between Rhayader and Birmingham, the outlet from the lowest, or Caban Côch, reservoir, is constructed at an altitude of 70 ft. above the bottom, and a submerged dam has been constructed to insure that the water shall always be at a sufficient level to fill the aqueduct, its crest being 40 ft. below the top water level of the reservoir. The compensation water is delivered to the stream at bottom water level of the reservoir, and is drawn off from below the submerged dam without affecting the supply to the aqueduct. The water at present impounded in the Claerwen Valley is carried into the Caban Côch reservoir above the submerged dam by a tunnel. Of the three completed reservoirs in the Elan Valley, the Caban Côch reservoir has a top water level above ordnance datum of 822 ft., a top water area of 500 acres, and will contain 7,800,000,000 gallons. The Caban Côch dam is 122 ft. high and 600 ft. long. The Pen-y-Gareg reservoir has a top water level above ordnance datum of 945 ft., a top water area of 124 acres, and will hold 1,300,000,000 gallons. The Pen-y-Gareg dam is 123 ft. high and 500 ft. long. The Craig-Gôch reservoir has a top water level of 1,040 ft. above ordnance datum, a top water area of 217 acres, and will contain 2,000,000,000 gallons. The Craig-Gôch dam is 135 ft. high and 520 ft. long. When complete the Dolymynach reservoir in the Claerwen Valley will have a top water level above Ordnance datum of 900 ft., and a top water area of 148 acres, while its capacity will be 1,600,000,000 gallons. The Dolymynach dam will be 100 ft. high and 915 ft. long.

Important Dock Development at Swansea.

The new dock at Swansea of which His Majesty the King cut the first sod last month, will be constructed on the foreshore to the east of the existing entrance channel, and the whole of the works with the exception of the passage connecting the dock with the Prince of Wales' Dock, will be below high water mark of ordinary Spring tides, on a site which is of little value for anything outside dock purposes and has in consequence been acquired at a comparatively small price.

The collective area of the existing docks amounts to 60 acres; so that apart from any other considerations the new undertaking will more than double the present accommodation of this port.

Vessels will enter the dock through a lock situated near the end of the existing East Pier, 875 ft. long between the inner and outer gate sills, and 90 ft. wide at coping level.

There will be a depth of water on the outer sills of 40 ft. at H.W.O.S.T., 12 ft. at L.W.O.S.T., 32 ft. 3 in. at H.W.O.N.T., and 19 ft. 9 in. L.W.O.N.T. It will thus be noted that ships of the largest size now or likely to be built, will be able to enter at any tide in the year, and that the ordinary sized tramp steamer which the port now accommodates will be able to enter and leave at practically any state of the tide throughout the year.

The depth of 12 ft. over the outer sill at L.W.O.S.T., is greater than that of any other port in the Bristol Channel under similar conditions of tide, with the exception of Barry, where the depth at L.W.O.S.T. is 13 ft. 9 in.

In order to exclude the tidal waters from the site of the works a rubble embankment about 1¾ miles long will be tipped, faced with heavy blocks of stone, forming a water-tight enclosure of about 400 acres within which the dock works proper will be constructed. The area thus reclaimed provides for a dock with a water area of 107 acres, of which it is only proposed now to construct 66 acres, leaving the remainder for future extension when the necessity arises.

To protect the entrance, the present West Pier will be extended 800 ft. and a new East Pier be built with an approach jetty extending from it to the lock alongside of which ships will "bring up" before entering the lock. The approach jetty will be of timber work sufficiently open to allow of wave action expending itself before reaching the outer gates of the lock, in a basin constructed for the purpose.

The lock will have vertical side walls and a flat invert throughout its entire length, so that the depth of water over the sills will be maintained, practically, for the full width of the lock. The angle at which the lock is placed relative to the quay walls of the dock will be such that the largest vessel the dock can take in after it has passed through the lock, will be able to swing without interfering with any ship berthed alongside the adjacent quays. The dock walls will be vertical with ample quay space behind them for warehouses and railway sidings. The central position of the dock will be used for general trade. The eastern end will be reserved for a coaling arm. The Great Western Railway Company have taken 1,000 ft. of frontage on the north side of the coaling arm, and will put up coaling appliances of the most modern type, involving the use of movable coal hoists all worked on the high level so as to have the whole of the quay space below free for the main line traffic round the dock. The other railway companies are also negotiating for frontages on the southern side of the coaling arm.

The length of quays for general trade will be 7,350 ft., for coaling purposes, 3,200 ft., or an inclusive total of 10,550 ft.

The joint engineers for the dock are Mr. P. W. Meik, M.Inst.C.E., 16, Victoria Street, Westminster, and Mr. A. O. Schenk, M.Inst.C.E., the Harbour Trustees' Engineer, to whom we are indebted for the above details the plan appearing on page 224. The resident engineer is Mr. R. S. Oldham, A.M.Inst.C.E., the contractors being Messrs. Topham, Jones and Railton, of 2, Great George-street, Westminster, who are now carrying out the Government dock work at Gibraltar at a cost of about four millions, and are also constructing the new dock at Cardiff for the Cardiff Docks and Railway Company.

Light Railway Construction.

Apropos of the article which appeared in last month's issue on "The Leek and Manifold Light Railway," I note with interest that Mr. E. R. Calthrop, M.Inst.C.E., M.I.M.E., has contributed some instructive chapters on light railways to a work which has been written by Mr. E. O. Mawson, M.Inst.C.E., on "Pioneer Irrigation."[1] By a coincidence, Mr. Mawson was a contributor to PAGE'S MAGAZINE last month, his article being concerned with a new form of automatic weir crest.

The fundamental idea of light railway construction and working (says Mr. Calthrop) is the elimination of every kind of expenditure which is non-essential to its efficiency as a means of transport, and the reduction of all permanent way, works, plant, and appliances to their simplest and most inexpensive forms. The total cost of a railway on the 2 ft. 6 in. gauge, with 35 lb. rails, and equipped with rolling stock, will vary very considerably. Two thousand pounds per mile may be accepted as the minimum cost, completed under the most favourable conditions with a modest equipment of rolling stock. Three thousand pounds per mile will cover an average amount of bridging, cutting, and embanking in undulating country, and include rolling stock sufficient to carry the considerable traffic which will exist to warrant the expenditure of this amount of capital. Any excess over £3,000 can only be caused by a necessity for works of unusual magnitude or costliness, or by the circumstances demanding an unusually heavy equipment of rolling stock.

The above approximate estimates relate to a 2 ft. 6 in. light railway of heavy traffic capacity, but by diminishing the traffic capacity and reducing axle loads from 5 tons to 3 tons, and weight of rails from 35 lb. to 25 lb., the cost per mile may, under the most favourable conditions, be reduced to between £1,200 and £1,500. With the 3 ton axle load, the reduction of the gauge to 2 ft., would, under the same favourable conditions, make the cost between £1,000 and £1,300 per mile. Below these figures it is still possible to construct a railway, but only of the private plantation type.

Mr. Calthrop gives the following table, showing the train loads which can be hauled in every day working by engines of the Barsi type, allowing for a considerable margin of power :—

Conditions. Most unfavourable possible, namely, combination of steepest gradient with sharpest curve.	Train loads exclusive of engine.	
	2 ft. 6 in. at [illegible] miles per hour.	2 ft. 6 in. at [illegible] miles per hour.
	Tons.	Tons.
On gradient of 1 in 100, combined with curve of 600 ft. radius ...	300	160
On gradient of 1 in 75, combined with curve of 250 ft. radius ...	225	120
On gradient of 1 in 50, combined with curve of 250 ft. radius ...	150	80

As further evidence of the exceedingly heavy loads which can be transported by a light railway with efficiently designed rolling stock of heavy traffic capacity, a train on the Barsi Light Railway is illustrated, weighing 380 tons, exclusive of the engine.

It may be asked (says Mr. Calthrop in another informing paragraph), how has it been possible to put such powerful locomotives on rails weighing no more than 35 lb. per yard ? The answer is, by designing the locomotive in a particular way, so that its weight is distributed over a large number of axles in such a manner that, when fully loaded up in working order, there is no greater load than five tons on any one axle.

On most of the 3 ft. gauge light railways in Ireland—apart from the initial error of making them six inches too wide—an extraordinary and most expensive mistake has been made through lack of expert knowledge on this subject. The maxima axle loads on the carriage and wagon stock do not exceed 4 tons, so that, as far as they were concerned, a rail of 30 lb. per yard would have been more than ample to carry these loads. But the locomotives were built, although the traffic is light, with the absurd axle loads of 8 and 9 tons, and consequently the weight of the rails throughout the whole length of these light railways was put up to no less than 50 lb. per yard, costing *in toto* many thousands of pounds more than was at all necessary. Properly designed engines, with 4 ton axle loads, would have done all the work required.

Mr. Mawson is responsible for the greater part of the work, and has produced a freely illustrated volume, which should be invaluable to settlers in arid unexploited country. Pioneer farmers are instructed in plain terms how to conserve a precarious rainfall and apply the water for the purposes of agriculture. At the same time, easy methods of tapping the underground supply by wells are described.

[1] "Pioneer Irrigation": a manual of information for farmers in the Colonies. By E. O. Mawson, M.Inst.C.E., Executive Engineer, Public Works Department, Bombay, with additional chapters on Light Railways by E. R. Calthrop, M.Inst.C.E., M.I.M.E. Crosby, Lockwood and Son. 10s. 6d. net.

POWER STATION NOTES.

By E. K. S.

Recuperative Power of Peat.

A good deal has been heard recently about the utilisation of peat on a large scale, and it may be interesting to point out that peat differs from coal in that after removal a fresh lot *grows up* again. The rate varies in different parts of the world, but the following are some well authenticated cases :—

Lake of Constance—A layer of 3 ft. to 4 ft. thick in 24 years.

Near Hanover—A layer of 4 ft. to 9 ft. thick in 30 years.

Valley of Somme—A layer 3 ft. thick in 30 to 40 years.

Of course, a great deal depends on the peat forming value of the mosses, and on various geological and geographical features of the country. Some mosses may only give a foot thickness of peat in 30 years, but taking peat bogs the world over 10 ft. in 100 years seems to be a fair average.

Taking these figures and assuming absolutely safe data for working out the horse-power, we arrive at rather interesting figures.

Assuming that one cubic foot of cut peat will give 10 lb. of solid fuel, and that 5 lb. of peat fuel are equivalent to one brake horse-power hour, then it can be shown that 640 acres or one square mile of peat bog 10 ft. thick, will give :—

$$\frac{640 \times 43560 \times 10 \times 10 \text{ lb.}}{5 \text{ lb.}} = 550{,}000{,}000 \text{ b.h.p. hours.}$$

If we assume that the square mile of peat bog grows at the rate of 10 ft. in 100 years, then we may say that such a peat bog is good for —

$$\frac{550{,}000{,}000}{365 \times 24 \times 100} = 630 \text{ b.h.p.}$$

for all time. As a matter of fact the working day may very well be taken at 10 hours, so that 1,500 b.h.p may be calculated as the output of a square mile of peat bog, so worked that it is never permanently diminished.

Peat Coke.

Ziegler has shown that it is possible to treat peat in ovens so as to give 35 per cent. of coke, 4 per cent. of tar, 40 per cent. of tar water, and 21 per cent. of gases. As the coke is almost free from sulphur and phosphorus, it can be used instead of charcoal for the finer kinds of iron. The tar gives the usual oils, creosote and paraffin, and ammonium sulphate, calcium, acetate and methylic alcohol can be made from the tar water.

The gas is partly or wholly used for heating the ovens, so that the heating which formerly required an amount of peat fuel equal to about two-thirds of the peat to be coked is now carried out entirely with the waste gases. Of course, some of the gas can be used for heating steam boilers, or it may be used for driving gas engines in the same way as blast-furnace gas.

Large Jets for Pelton Wheels.

To those who are not accustomed to the engineering details of high head water powers, the size of the jets of water for working the tangential wheels is somewhat surprising. Thus two of the Pelton wheels at the Sabla Power House of the Californian Gas and Electric Corporation, each built to give 3,700 h.p. at 240 revolutions, under a head of 1,531 ft., are driven by a solid jet of water 4½ in. diameter. A 7,500 h.p. wheel in the same station is driven by a jet of water 6 in. in diameter. When it is considered that the quick regulation of such tangential wheels under sudden load fluctuations is effected by deflection of the nozzle so as to turn the stream partially away from the wheel buckets, it will be seen that a good deal of engineering skill is required to design suitable apparatus and governing gear.

Cooling Towers.

Cooling towers have come to be used very extensively of recent years, and although they were first introduced on the continent, some of the largest in the world have been erected in this country. Amongst them may be mentioned six towers to deal with 25,000 h.p. for the Metropolitan Railway Company, two to deal with 12,000 h.p. for the Metropolitan Electric Supply Company, and three towers for the Ebbw Vale Steel Company, two dealing with 12,000 h.p., and the third with 6,000 h.p. There is no doubt that the cooling tower is a very great improvement on the old millgoit or cooling pond, as by splitting up the water into small drops the heat is carried off so much more effectually. The idea appears to have had its origin in Germany in a primitive cooling plant consisting of piles of brushwood held together by frames. When new the brushwood gave fair results, but after a time the bark peeled off the twigs choking the air spaces, and the twigs became rotten and broke off. The modern type of cooler consists of a number of shelves of rough sawn spruce, and the water to be cooled drops down from shelf to shelf, whilst the cooling air rises from the bottom by either natural or forced draught.

In order to split up the water as much as possible, seriations are cut into the shelves of some of the coolers so as to always ensure that the water shall drip from one shelf to the next in the form of drops. The framework supporting the shelves is usually built of wood, because in hot weather it acts as an insulation from the sun's rays.

Regarding the size, it is found that the best results are obtained when the water is pumped into the cooler at about 100° F., and taken away at about 70° F., this is the ratio employed by the Metropolitan Electric Supply Company, the vacuum given being 26 in. The largest difference which it is advisable to employ in a cooler is from 120° F. down to about 80° F.

SHIPBUILDING NOTES.

Third Quarter's Shipbuilding.

When these lines are in print we shall be nearing the end of the third quarter of the shipbuilding year, and while we write there is every prospect of the fourth quarter being a dull and depressing one. In June, July, and August there is usually not much done in the way of the placing of specifications for new ships, for in these months both builders and owners are more or less occupied with their summer arrangements. In August the beginning of a resumption is sometimes apparent, but if there is no run of orders between August and the end of October, then there is usually not much business done until after the New Year. There is certainly not much prospect of any resumption this month, but as the unexpected so often happens the tide may have turned before what we write has been read. The July launches would have been small but for the *Caronia*, and the August launches have been restricted by the effects of the July holidays. The present quarter started with 993,088 tons of merchant craft, and 361,335 tons of warship tonnage under construction in the United Kingdom. This was a gross total of 1,354,423 tons, as compared with 1,365,779 tons at the corresponding date of last year. But with the launches and the scarcity of orders during the quarter, the end of September will show further restriction of the tonnage on hand. The worst of it is that the work on hand is so very unevenly distributed that some yards are practically idle.

Unremunerative Shipowning.

This pause in the pace of shipbuilding is not bad for shipowning generally, which is, perhaps, at present one of the most unremunerative employments in the country. But it is only a pause, and there are numbers of owners waiting only for some gleam of encouragment to send in their orders for new ships. That encouragement might be found in many ways, not understanded of the people, but it certainly cannot be found in the present condition of the freight markets. True, rates have been paid on steamers outward to Japan and Asiatic Russia, both from this country and from America, but considering the risks, the high insurance rates, and the absence of homeward freighting, the apparent profit is probably delusive. There have been some good few sales of steamers to Japan, and a few also to Russia, but on the whole the dislocation of traffic by the war in the Far East has not been for the advantage of British maritime interests. On the other hand, peace will probably bring a good demand for boats for charter and also for purchase. American builders have no ocean tonnage on the stocks, and German builders seem to have only a small amount of work on hand. Apart from Great Britain, the additions that are being made to the world's tonnage are small, but in Great Britain there are more hands than there is employment for just now.

The "Caronia."

The great event in the shipbuilding world since our last has been the launch of the *Caronia* for the Cunard Company, by John Brown and Co., Ltd., Clydebank. The *Caronia* is the largest ship which has, so far, been built on the Clyde. The previous largest was the *Saxonia*, launched for the Cunard Company in December, 1899, also by John Brown and Co., Clydebank, while before that were the *Campania* and *Lucania*, built by the Fairfield Company. The following figures give the size of the *Caronia* :—

Extreme length	678 ft.
Moulded breadth	72 ft.
Depth to shelter deck	52 ft.
Draft loaded	32 ft.
Gross tonnage	21,000 tons
Indicated horse-power	21,000
Displacement	29,800 tons
Deadweight carrying capacity	12,000 tons
Launching weight	13,500 tons
Water ballast	3,450 tons
Boiler pressure	200 lb.
Passenger accommodation	2,650
Officers and crew	450.

The keel plate of the *Caronia* was laid in September of last year, and in little over ten months the vessel has been ready for launching. Thirteen thousand five hundred tons of steel have been worked into the structure, making a heavier weight than that of any ship previously sent off launching ways in that time. In the building of the vessel, rivets weighing 600 tons have been used, and the weight of the stern frame is 65 tons. The steel work is already finished, and the large amount of carpenters' and joiners' work connected with the passengers' quarters and the machinery departments is in a very advanced condition.

Comparisons.

The *Caronia* is 58 ft. longer than the *Campania* or *Lucania*, and 78 ft. longer than the *Saxonia*. The *Saxonia*, though shorter than the *Campania*, measured larger by 1,331 tons gross. The *Caronia* is larger still by 6,720 tons. In the matter of speed the new vessel will be behind the *Campania* and *Lucania* by about four knots. Of the four latest White Star boats, each when launched was the largest afloat, and at present the *Baltic* holds the record in the matter of gross tonnage. She is longer than the *Caronia* by 47 ft. 9 in., larger by 2,763 tons gross, and 10,200 tons displacement. The *Caronia* is, for her size, more of a liner and less of a cargo steamer than the latest White Star vessels, and is expected to resemble the *Saxonia* in this as in some other respects. The committee of experts appointed by the Admiralty to test the economy of various types of boilers, pronounced the *Saxonia* to be an exceedingly economical vessel, the machinery requiring only 134 lb. of steam per horse-power per hour, as compared with 16 lb. in some naval ships, while the boilers produced 12·33 lb. of steam per pound of coal, as compared with 9½ lb. to 11 lb. in the naval ships experimented with. Each horse-power was obtained for 1·29 lb. of fuel per hour. In the matter of comfort and freedom from vibration the *Saxonia* and her sister ship *Ivernia*—the latter built at Wallsend-on-Tyne—have all along been notable.

Transatlantic Traffic.

Every day steamers leave the ports of the United Kingdom or of the United States carrying the people and produce of the two nations. They follow one another with the regularity of railway trains. Nowadays these liners, by means of wireless telegraphy, maintain communication throughout the whole of their voyages with the land on both sides. The Cunard Company were foremost in the traffic from the very first, and are doing their best to maintain it in the future.

The policy adopted by this company is the construction not merely of the fastest ships afloat, but also of steamers of moderate speed which will be the embodiment of comfort for the travelling public. The *Caronia* is a fine example of the latter type. Her tonnage is little less than that of the White Star *Baltic*, while her other dimensions will conduce to a pleasant life at sea. The *Caronia* is to be followed in a short time by the *Carmania*, a sister ship, but while the *Caronia* is to be driven by the ordinary reciprocating twin-screw engines, the *Carmania* will be fitted with turbines.

A British India Turbine.

The turbine has also been adopted by the British India Steam Navigation Company, who have had the steel turbine steamer *Lhasa*, built for them by William Denny and Brothers, and classed by the British Corporation and also at Lloyd's. She is the first of four turbine steamers for the British India Steam Navigation Company's Indian trade. The principal dimensions are: length, 275 ft., breadth, 44 ft., depth, 25 ft. 6 in. She is of the poop bridge and forecastle type, having accommodation for first-class passengers in the bridge, for second-class in the poop, and for crew in the forecastle. The first-class passengers are berthed in large airy cabins, fitted with all the latest conveniences. The dining saloon, which is capable of accommodating all the passengers at once, is in a Romanesque design, finished in cream enamel, the spandrels between the arches being filled in with diaper, having a mosaic effect. The upholstery is in navy blue morocco. The second-class passengers are accommodated in three and four-berthed rooms, which are as large and airy as is necessary in a vessel trading within the tropics. The main deck is arranged for the carrying of native passengers, for whose comfort and convenience every arrangement has been made. The ship has fine lines to maintain a high rate of speed, so there is only a limited amount of cargo capacity. The turbines are supplied by the Parsons' Marine Steam Turbine Company, while the boilers and other propelling machinery are supplied by Denny and Co., Dumbarton.

William Beardmore and Co., Ltd.

One of the most perfectly equipped and efficient shipyards in the country is being rapidly completed at Dalmuir, on the Clyde, by William Beardmore and Co., Ltd, of Glasgow, who have made a fresh issue of capital in the form of £500,000 four and a half per cent. first mortgage debentures to meet the cost of the extensions. The incorporation of William Beardmore and Co., Ltd., was formed in January, 1902, to acquire the businesses of the private firm of William Beardmore and Co., Parkhead Forge, Napier Shipbuilding Yard, and Lancefield Engine Works, Glasgow, which was established over sixty years ago as forge-masters by the predecessors of the present company. The whole of the ordinary share capital was allotted, fully paid, as the consideration for the purchase of the business of William Beardmore and Co. In November, 1901, Vickers, Sons and Maxim, Ltd., acquired half of the ordinary share capital of this company, whose heritable properties, fixed and loose plant, exclusive of goodwill, were then valued at £830,000. The company's books show that since the auditor reported upwards of £470,000 has been expended in extension and equipment of the properties. The ordinary share capital of the company is now held as to 748,997 shares by Mr. William Beardmore, as to 1,000 shares by Mr. Joseph Beardmore, and as to 749,997 shares by Vickers, Sons and Maxim, Ltd. Of the preference share capital £500,000 has been subscribed at par by Mr. William Beardmore and Vickers, Sons and Maxim, Ltd., in equal proportions, and has been paid up in full. The business of William Beardmore and Co., Ltd., now consists of the manufacture of armour plates, forgings, and steel shafting of the heaviest class now in use, railway wheels, tyres, axles, gun forgings, steel castings, and other steel material. This company also build war vessels of every type, completely equipped with armour and engines, and also mail steamers and cargo boats. The accountants certify that the profits of William Beardmore and Co. have been as follows:—

Year ending Dec. 31st,	1899	..	£126,609	15	9
,, ,,	1900	..	203,969	1	4
,, ,,	1901	..	263,697	19	3
,, ,,	1902	..	114,991	7	0
,, ,,	1903	..	192,100	6	3

The annual average of the profits above shown is £180,273 13s. 11d.

The Magnitude of British Warship Building.

At the Cambridge University Extension summer meeting held at Exeter, Sir William White lectured on the "Modern Development of Construction of the Royal Navy." Incidentally he remarked that the Naval Defence Act had been followed by other large programmes of construction, but no special Acts of Parliament had been passed, nor had there been any corresponding publication of the details of the successive programmes laid down by the Admiralty. That change of policy had distinct advantages, because when only that portion of the programme which was to be provided for in the Navy Estimates for a particular year was disclosed, possible rivals were left in ignorance of our complete intentions, and the unrivalled resources of this country made it possible for us to keep the lead in finished ships, even if we started later than our rivals.

In 1894 Lord Spencer, then First Lord of the Admiralty, introduced a large programme of construction, and his successor, Lord Goschen, took similar steps during his long period of office as First Lord. Throughout the period from 1885 to 1902 the lecturer, as Director of Naval Construction, was responsible for the designs and construction of all the ships added to the Royal Navy, excluding destroyers. His responsibility for designs and construction included 43 battleships, 26 armoured cruisers, 21 first-class protected cruisers, 48 second-class, 33 third-class, and 74 unarmoured or unprotected vessels. The total represented 245 vessels, with an aggregate value of about 80 millions sterling, exclusive of armaments, ammunition, and reserves, for which the naval architect was not responsible. Including these three items, the first cost to the nation of the 245 ships ready for service must be at least 100 millions sterling. The magnitude of British warship building from 1885 to 1902 might be illustrated in another way. Parliamentary returns gave the expenditure on new construction in detail for each financial year from 1869 and 1870. Onwards from this record it could be seen that from 1870 to 1885 the average annual expenditure on new ships was under one-and-three-quarter millions sterling. From April, 1885, to April, 1902, 17 years, the total expenditure on new ships was about 88½ millions sterling, and the annual average was nearly five-and-a-quarter millions. For the last seven years during which Sir William held office the total expenditure on new ships exceeded 50 millions. The annual average was £7,200,000, and the *maximum* in 1900 and 1901 nearly nine millions.

AUTOMOBILE NOTES.

By J. W.

Small Car Trials.

While these lines are in the press the Automobile Club's Small Car Trials will be decided. The cars will start from Hereford on the morning of Monday, August 29th, and go over route 1, viz., to Worcester and back *via* Bromyard, and will go over the same route in the evening. On Tuesday route 2 will be taken, through Leominster to Ludlow and back, and so on throughout the week, the last run being to Kington, and on through Walton and Titley on the Saturday. There will be three hill climbs, one on Monday on the way to Worcester, viz., Frome's Hill, one on the Tuesday on the way to Ludlow, viz., Dinmore Hill, and one on the Wednesday on the return from Leominster, viz., the north side of Dinmore Hill. Each of these routes is approximately 50 miles, and the cars will have to do each journey without a stop, the award being given to the car in each class which makes the most non-stop runs.

The International Cup Contest.

Since our last issue went to press the races for the International Cup have also been decided at Ryde, and I am sorry not to be able to record a win for England, seeing that the English reserve boat *Napier Minor* made such a smart performance (20 knots) and actually outdistanced *Trefle-à-Quatre* in the final. An accident, resulting in a bad leakage in the bows of *Napier II.* prevented that boat from representing England in the final, and the reserve boat was consequently called upon. Great applause greeted the supposed victory of Edge, but since the race the Automobile Club of France have lodged an objection to the running of *Napier Minor* in the final, she having been beaten by *Napier II.* and as the objection has been upheld the honour goes to *Trefle-à-Quatre*.

The Calais-Dover Motor-Boat Race.

In this event *Trefle-à-Quatre* ran under English colours (being now the property of Mr. G. B. Thurbon) and represented England in conjunction with *Napier Minor*, entered by S. F. Edge, Ltd. Germany was represented by *Mercedès IV.*,*and Belgium by *Marcotte*. A variety of motor-boats in addition to the racers participated, and were divided up into four cruiser classes, a class for fishing boats, and two for racers. *Mercedès IV.* took the lead at an early stage, and maintained it until she reached Dover with an advantage of 5 minutes 18 seconds over *Napier Minor*. Time, 1 hour 7⅗ seconds.

The crossing of the Channel by a small boat in an hour marks a decided advance in the construction of the internal combustion engine. *Mercedès IV.* is 39 ft. 4 in. long, her motor being an 80 h.p. Daimler; *Trefle-à-Quartre* is 29 ft. 10 in. in length, and is driven by a Richard Brasier 80 h.p. motor.

Thus *Mercedès IV.* won first prize for time in the racer section. *Marthe* won the "heavy-oil fuel" prize. The alcohol fuel cup was not awarded, as there was only one entry.

Napier Minor won the prize given by the International Club of Monaco for the first boat home that raced at Monaco last spring. Out of 21 boats that started 20 finished, and the *Hotchkiss*, which did not come across, was put out of the race just after the start by faulty ignition and a burnt-out plug.

* *Mercedès IV.* has a German engine and a French hull.

Motor-Boat Reliability Trials.

The Motor-Boat Reliability Trials proved so successful that the judges had no hesitation in recommending that further trials be held next year. With regard to future trials they suggest that the following points receive the consideration of the Committee with a view to marks being awarded if possible: (1) Exhaust cooling and silencing; (2) Seaworthiness; (3) Ease of control and handling; (4) Wash (for river boats); (5) Arrangement and design; (6) Discontinuance of the use of aluminium for boats for sea work.

At the recent trials the boats were required to run for ten hours on each of two consecutive days, under the observation of the Automobile Club officials, and were only allowed ten minutes on the second day in which to prepare for the day's run. They were divided into six classes, according to length, and the following awards were made: Class 1.—Not represented; Class 2.—Messrs. The Seal Motor Company's 2½ h.p. 18 ft. launch, gold medal; Class 3.—Messrs. Vosper and Co.'s 12 h.p. 22 ft. launch, gold medal; Messrs. The Mitcham Motor Company's 6 h.p. 22 ft. launch, silver medal; Class 4.—Messrs. The Maudslay Motor Company's 20 h.p. 25 ft. launch, gold medal; Messrs. Woodnutt and Co.'s 12 h.p. 30 ft. launch, silver medal; Class 5.—Mr. S. F. Edge's 55 h.p. 35 ft. launch, gold medal; Class 6.—Messrs. John I. Thornycroft and Co.'s 20 h.p. 30 ft. launch, silver medal. Mr. Campbell Muir's Prize for the best boat using ordinary paraffin as fuel was won by Competitor No. 5, entered by the Seal Motor Company.

The judges considered the average speed shown by the boats over such a long period very satisfactory; one boat of only 35 ft. in length maintained an average speed over the whole 20 hours of nearly 14 knots, a performance that could probably not be equalled by any steam launch of her size under similar conditions. They remark that, with regard the comparative safety of boats fitted with internal combustion engines, it would appear that a large number of makers of the petrol engine do not seem to have sufficiently considered the details necessary for the perfectly safe use of this fuel. The judges expressed their satisfaction with the admirable fashion in which Mr. Basil Joy, the secretary, had organised the trials.

The Automobile in Business.

Mr. J. A. Kingman, in a recent issue of the "American Review of Reviews," remarks that the steam vehicle for business purposes has been most used in England, where it is employed for very heavy hauling work. In France as well, considerable attention has been given to steam trucks, though not nearly to such an extent as in England, where at least half a dozen manufacturers are busily engaged in the production of vehicles of this sort. Several hundred heavy steam trucks, or lorries, are now operating in and about the City of London. In the United States comparatively few delivery cars of this power have been built, although some of those constructed for experimental purposes have done very good work.

OUR TECHNICAL COLLEGES.

A PRESENTATION PORTRAIT.

A fund has been raised by members of the Governing Body and Teaching Staff of the Manchester University, and a few other scientific friends, to obtain a portrait of Professor Osborne Reynolds, LL.D., F.R.S., to be presented to the University, as a memorial of his long and distinguished services to the Owens College, and of his eminent position as a scientific investigator. The Hon. John Collier has kindly undertaken the commission to paint the portrait.

UNIVERSITY COLLEGE, NOTTINGHAM.

The list of successful candidates for the London degree of B.Sc. in engineering recently issued contains the names of six students, no fewer than five of whom are from the engineering department of University College, Nottingham. Four have obtained the degree with honours, while Mr. G. A. Tomlinson has secured first-class honours at nineteen years of age. The equipment of the engineering laboratories at University College, which is already large, is being added to for the coming session.

From this college there were no failures, and all the successes were obtained one year after passing intermediate. Many will join with me in congratulating the lecturer (Mr. Morley) upon such a striking result, which speaks volumes for the instruction given at the College.

LIVERPOOL UNIVERSITY.

I have received from the Dean of the Faculty of Engineering of the University of Liverpool, a copy of the interesting prospectus issued under the new regulations. From the introduction I note that no attempt is made to turn out "engineers" but rather to afford the best scientific training for those intending to enter this or any allied profession.

This University training—which extends over at least three years—must be regarded as either preliminary to or supplementary of a pupilage under some engineer or course of apprenticeship with some engineering firm. A number of engineers and firms in communication with the University are willing to receive students after graduation as pupils or apprentices, and to take into consideration the time spent in the University.

Students who do not proceed to University degrees may take a course of not less than two years leading to a Certificate in Engineering. Consequently, those who find it impossible to spend the three years necessary to qualify for the degree will be able to obtain this certificate in two years. The first examination is the same as that of the Intermediate Examination for the degree, and the second examination includes at least two subjects from the final examination for the ordinary degree of B.Eng.

The faculty has quite a formidable list of Professors, each a specialist in his own line, and for the Session, 1904–1905, a very complete programme has been planned, commencing on the 3rd October.

ROYAL COLLEGE OF SCIENCE AND ROYAL SCHOOL OF MINES EXAMINATION.

The associateships, scholarships, medals, and prizes awarded July, 1904— are as follows :—

ASSOCIATESHIPS.

ROYAL COLLEGE OF SCIENCE.

Mechanics.—1st Class: Henry James Jones, Sydney Frank Paul, Alec James Simpson, Alfred William Steed.

Physics.—1st Class: James Hancock Brinkworth, Herbert Moss. 2nd Class: John Beardsmore Homer, Ethel Gertrude Willis.

Botany.—1st Class: Alfred Eastwood, Malcolm Wilson.

Chemistry.—1st Class: John Bright Hoblyn, Herbert Brooke Humphries, Alfred Francis Joseph, Hilda Mary Judd, Ernest Robert Marle, Alfred Shepherd, Sydney Herbert Smith, Joseph Arthur Stokes. 2nd Class: James Edward Cunningham, Mabel Hattersley, Charles Headland, Percy Edwin Spielmann.

Geology.—1st Class: Hubert Cecil Jones, Claude George Sara. 2nd Class: Tobias Clegg.

ROYAL SCHOOL OF MINES.

Metallurgy.—1st Class: John Frederick Graham, Thomas Bevil Greenfield, Everett Unwin Pringle Laurie, Donald Myer Levy, Cosby Thomas Nesbitt, Edgar Pam, Leslie Alfred Swinney. 2nd Class: Charles Crawford Bradshaw, Guy Lovel Caulfeild, Richard Leggett Rowe, Francis Gordon Sherwood.

Mining.—1st Class: Alexander Anderson, Richard Charles Bristowe, Gilmour Ewing Brown, William Sinclair Curteis, *Jeffrey Glencairn Cunningham, Louis William Julius David, Christian Hanckel. 2nd Class: Garth Baxter Adeney, Illipparambil Corah Chacko, Claude William Courtney, Edward Henry Hubert Garbett, Charles William Hall, William Hutton-Williams, Joseph Kelly, Frank Kinloch, Everett Unwin Pringle Laurie, William Pirrie Otto Macqueen, Harry Douglas Maidment, Cyril Langley Major, Arthur Robert Mynott, Geoffrey Hamilton Norman, Hubert Francis Gardner Roose, Richard Leggett Rowe, Peter Scholer, Walter John Stewart, William Edward Turvey, Henry Theaker Austin Twigg.

*Disqualified by date of his examination for the "De La Beche" Medal and Prize.

SCHOLARSHIPS GIVEN BY THE INSTITUTION O MINING AND METALLURGY.

Metallurgy.—Leslie Alfred Edward Swinney.

ROYAL SCHOLARSHIPS.

First Year.—Frederick George Turner, Edwin Samuel Crump, Leslie George Milner, William Godden.

Second Year.—Donald Francis Blyther, William Feast.

MARSHALL SCHOLARSHIP.

Louis Edward Robinson.

MEDALS AND PRIZES.

"Edward Forbes" Medal and Prize of Books for Biology, Alfred Eastwood. "Murchison" Medal and Prize of Books for Geology, Arthur Wade. "Tyndal" Prize of Books for Physics, Part I., John Herbert Hugon. "De La Beche" Medal for Mining, Gilmour Ewing Brown. "Bessemer" Medal and Prize of Books for Metallurgy, Cosby Thomas Nesbitt. "Frank Hutton" Prize of Books for Chemistry, Hilda Mary Judd. "Edward Matthey" Prize, Frederick Alldis Eastaugh. "Warrington Smyth" Medal and Prize, Henry Briggs. "Huxley" Medal, not awarded.

Books given by the Board of Education.—Mechanics, Herbert George Tisdall. Practical Chemistry, Joseph Arthur Stokes. Mining, Gilmour Ewing Brown. Mathematics, Alfred William Steed. Physics, Herbert Moss.

LOCOMOTIVE ENGINEERING NOTES.

BY

CHARLES ROUS-MARTEN.

Locomotives and Working Expenses.

To the impartial student of railway economics there is a world of instructive meaning in some of the facts and figures presented by the chairman of the London and North-Western Railway at the recent half-yearly meeting of that company. After mentioning that the working expenses showed a decrease of £45,972, of which £10,318 had been saved in locomotive power, Lord Stalbridge said: "We have now a larger number of very efficient and powerful engines and have been able to get rid to a great extent of assistant engines for trains. We shall go on building these larger and more powerful engines, and I do not suppose we shall ever build again the small class of locomotive." Now, in these gratifying statements we have but the small kernel of a very large and far-reaching truth. It has long been the wonder of many independent critics of railway methods that the true reason of the long lowness of London and North-Western dividends has apparently failed to make itself perceived either by what I may call the "Ministry" or the "Opposition" of the great London and North-Western kingdom. It is not unreasonable to assume this imperception, because had the "Ministry" recognised the weak place one may presume it would have been mended before; had the "Opposition" detected it that would certainly have been made the definite basis of attack, instead of reliance being placed on a more or less vague tissue of generalisation. The whole subject is one of such vast interest and importance, affecting as it does all other railways in the kingdom as well as the North-Western, that I may perhaps be pardoned if I devote some extended attention to it in my Notes of this month.

The True Inwardness.

A railway's existence-reason is the rapid and punctual conveyance of traffic, live and dead. For some years prior to the advent of Mr. G. Whale's new passenger engines it was a matter of reproach to the London and North-Western that punctuality was only maintained or approximated by the employment of two engines on every train more than "17 coaches" in length, or, let us say, of a weight exceeding 300 to 320 tons. As the large majority of the London and North-Western main-line trains did exceed that weight, it followed as a natural sequence that the large majority of those trains were worked with two engines apiece. But it was also no uncommon experience to find trains of sixteen, fifteen, fourteen or sometimes thirteen "coaches" similarly piloted in order to keep the fast booked timing, *e.g.*, in the case of the 9.20 a.m. Birmingham express from Euston. Taking "17 coaches," therefore, as the standard maximum load for one engine, and as the maximum load for two was fixed as "20½," recently increased to "25," it obviously followed that an utterly inadequate load was allotted to the second engine, viz., only 3½ to 8 "coaches" even in the case of the heaviest passenger trains, while when 14-coach trains were piloted the load would be at the utmost only 7 coaches per locomotive. In these remarks I am making full allowance for those cases in which the second engine is merely a "homing" pilot. Clearly, then, very serious waste of locomotive power was pointed to in this method. Let me say at once that I am not now entering into any issue that has existed between the Locomotive and Traffic Departments. I am merely reviewing the general question in the light of its economic bearing.

Lord Stalbridge says: "We have now a large number of very efficient and powerful engines, and have been able to get rid to a great extent of assistant engines for trains." Yes; Mr. Whale's new engines, although by no means so large or so powerful as many that have been running on other British railways during the past few years, have already effected quite a metamorphosis in the working of the line, keeping time with relative ease, hauling trains with which previously one engine always lost time and with which even two seemed to have all their work to maintain punctuality. The passenger engines which directly preceded the "Precursors," namely, Mr. Webb's four-cylinder compounds of the "Alfred" class, showed themselves able to haul very heavy loads, but not at the best modern speeds. A certain fault of sluggishness seemed often to affect them, and consequently they, like their immediate predecessors, were in bad repute with the Traffic Department for losing time with the fastest expresses. It is understood that by means of a modified system of steam distribution this drawback has been largely eliminated. But the great fault of the class is self-evidently deficient boiler-power. Mere heating-surface area is of course no complete criterion of power, but it is not difficult to perceive that 1,557 sq. ft. of total heating surface, an appreciable proportion of which is theoretically given by a water-bottom to the fire-box, must needs be utterly inadequate for work such as is demanded of the engines, which, with new and much larger boilers and with the modified valve-gear, ought to be able to perform the best work demanded, even on the London and North-Western, as is now readily accomplished by Mr. Whale's non-compounds. This is the true "inwardness" of much that Lord Stalbridge said in general terms.

Some Side-Lights.

But it is not the whole case. Lord Stalbridge also said: "I do not suppose we shall ever build again the small class of locomotives." No; I should think not. The wonder always has been why so many of that small class should ever have been built. For what are called the "rebuilds" among the London and North-Western passenger-engines were practically new machines when they came out as "rebuilt." Their name-plates and number-plates doubtless were the same as before, and also perhaps the wheel-centres, but for the rest they were practically new engines built in the nineties on the obsoletely small scale of fifteen to twenty years back, viz., with 1,083 sq. ft. of heating surface, cylinders 17 by 24, and a total weight of only a little over 30 tons in working order. There are no fewer than 256 of these engines on the London and North-Western, 166 with coupled wheels variously described as 6 ft. 6 in. and 6 ft. 9 in., and 90 with coupled wheels given sometimes as 6 ft. sometimes as 6 ft. 3 in. Add to them 60 of the Ramsbottom 7 ft. 6 in. single-wheelers, also rebuilt by Mr. Webb, and we have a total of 316 small express engines whose name-plate dates range from 1859 to 1882, and whose dimensions are those of the early seventies. Then come 100 three-cylinder compounds, of which the first thirty, built more than twenty years ago, never have proved efficient express locomotives, making 346 main-line engines of a distinctly small and old-fashioned type. Last of all, under the former *regime* came the eighty four-cylinder compounds. On the strange conversion of the forty 5 ft. 6 in. coupled express engines into as many tanks—a virtual new building—and the equally peculiar conversion—only a few years ago—of no fewer than ninety little branch engines into as many small main-line expresses, I need not now dilate. But the indisputable fact does remain that up to a very recent date the London and North-Western was trying to work the heaviest and almost the fastest traffic in Britain with engines of 25 to 50 per cent. less power than those used for approximately similar work on other leading British lines. Out of the total of 436 passenger tender-engines running prior to the new era, only 100 could be said to be of a type less than twenty years old, even if the "Greater Britains" and "John Hicks" be included. And hence the constant duplication and piloting, which as was once said puffed the shareholders' dividends up the chimneys of assisting engines.

A "More Excellent Way."

But Mr. Whale is "changing all that," and I venture to predict that if his reforms receive anything like fair play, the gratifying diminution in working expenses will steadily continue, and the locomotive expenses will go down and down, now that the methods are being brought up-to-date and framed on modern lines. There is another all-important particular, however, in which the London and North-Western and Mr. Whale's predecessor deserve great credit for leading the way of reform. For many years past other countries, and even our British Colonies, have worked their heavy goods traffic with engines having eight wheels coupled. I really don't recollect how many years, but I do know that I was present by special invitation at experiments made with some of the 8-coupled locomotives in the British Colony of New Zealand just 25 years—a quarter of a century—ago. The type then had long been used in the United States and in Europe. Thus while in this country the maximum train for one goods engine was 40 to 50 loaded wagons, in France 60 to 70 were constantly taken, and in America much more. I do not ignore differences in circumstances, including sidings, etc., because these are not relevant, for since Mr. Webb introduced on the London and North-Western his eight-coupled class, that type has been largely multiplied, with the result that each virtually hauls 50 per cent. more load, and so occupies the road to a proportionately less extent. More recently the Great Western, Great Northern, North-Eastern, Great Central, Lancashire and Yorkshire, and Caledonian railways have followed suit with similar results, and also with the effect of greatly reducing the cost of haulage per ton-mile. Thus, with this atter reform, in which the London and North-Western set the good example, and with the other in which it has at last followed—with already substantial benefit—the good example set by other lines, the London and North-Western has clearly found "a more excellent way," which without doubt will yield a steady increase in dividends, through the decrease effected in working expenses.

Consequences of Former Ways.

I need not expatiate on the sufficiently-obvious drawbacks of a needless multiplication of locomotive stock such as is necessitated by excessive piloting or duplication of trains. It will be recognised that in these cases "twice one" engine is not "two" engines in point of efficiency; that four men instead of two are required for the driving and firing of each piloted train; that a proportionate increase in the number of cleaners and other hands and in cost of engines, etc., in shed accommodation, and so on, becomes inevitable. There is this further drawback, that duplication of lines has often been rendered necessary by the impossibility of getting through the traffic on existing lines owing to deficient power per engine which has compelled an undue number of trains to be run. But, indeed, the drawbacks of deficient locomotive power are almost innumerable, and I think that the London and North-Western shareholders and its directors and officers too, may look for happier and more prosperous times now that this fact has at last been realised. The same better hope applies to all the railways that have gone and done likewise.

New Locomotives.

This heading must be taken literally. If it were understood as meaning new locomotive types my remarks would have to be on the same lines as the celebrated monologue on "Snakes in Ireland," for none of the latter have appeared since last I treated the subject. On the other hand, many new locomotives of types already existing are being brought out on the various British lines. On the Great Western, Mr. Churchward is multiplying his "Counties," "County of Middlesex," having been followed by "County of Berks," and "County of Wilts." On the London and South-Western, Mr. Drummond has brought out three of his enlarged standard type, Nos. 415, 416, 417, out of twenty which are now being built. For the Great Eastern, Mr. Holden is constructing more of his improved "Claud Hamiltons," with Belpaire fireboxes, and Mr. Ivatt is providing the Great Northern with twenty more of his enlarged "Atlantic" design, similar to No. 251, to which I have made previous reference. On the London and North-Western, Mr. Whale is adding to the number of his "Precursors," and Mr. Worsdell is multiplying his "Atlantics" on the North-Eastern, while Mr. Robinson has brought out on the Great Central another batch of his "1015" class.

AMERICAN RÉSUMÉ.

BY OUR NEW YORK CORRESPONDENT.

NEW YORK, August 10th, 1904.

The s.s. "Baltic" in New York Harbour.

On the return maiden trip of the steamship *Baltic*, it was demonstrated that the new White Star liner is considerably in advance, of the facilities available in New York harbour. At high water vessels drawing 32 ft. may enter or leave the harbour, but the *Baltic* when fully loaded requires 36 ft. 6in. On this occasion she left New York with 6,000 tons weight less than her maximum capacity.

U.S. Coal Production in 1903.

The United States, according to returns made to the Geological Survey, has again exceeded all previous records in the production of coal. According to the "Iron Trades Review" the forthcoming report on the country's coal production, which Mr. E. W. Parker, statistician, will soon make, will show that the total output of the coal mines of this country in 1903 amounted to 359,421,311 short tons. This is an increase of 57,830,872 short tons, or 19 per cent. over the production of 1902, which amounted to 301,590,439 tons. The production of 1903 was nearly double that of 1893, and more than three times the output of 1883. The increase of production in 1903 over 1902 was equal to the total production of all kinds of coal in 1878, only twenty-five years ago. Large and significant as was the increase in the amount of coal produced, the increase in the value of the product was still more noticeable. The value of the coal product at the mines in 1903 amounted to $506,190,733, which, compared with the value of the output in 1902 ($367,032,069), shows an increase of $139,158,664, or nearly 38 per cent. The percentage of increase in value was almost exactly double that of the increase in production.

It is difficult to think in millions, but our contemporary affords a graphic idea of this enormous output by stating that if the entire production were loaded on freight cars with a capacity of 30 tons each, the trains containing it would encircle the globe at the equator about three and a third times.

The Machinery likely to be Employed on the Panama Canal.

Mr. Malcolm McDowell, in the "Technical World," gives a brief description of some of the machinery and methods that will be employed in cutting the Panama Canal.

Engineers who are acquainted with the Isthmian situation predict that several of the devices found so effective in constructing the Chicago Drainage Canal will be employed on the Panama work, especially the Lidgerwood cableways, and the dumping apparatus devised by Mr. Locker, a Drainage Canal contractor, and the movable incline of the type constructed by Mr. Heidenreich, another Drainage Canal contractor. The cableway is a suspension bridge formed of a steel cable 2½ in. in diameter stretched between two towers, one on each side of the cut. In the construction of the Drainage Canal, the towers were reared on great trucks, whose heavy wheels ran on tracks laid parallel to the channel. These towers were 700 ft. apart; one was 93 ft. high; the other, 73 ft. high, the whole apparatus moving forward with the advance of the work. On a platform under the taller tower were the engines, boiler, dynamo, and other machinery. On a steel cable bridge travelled the cable carriage that carried the pulley wheels and the sheaves of the tackle which raised the loaded "skip"—an immense steel box—from the bottom of the channel. The engineer in the power-house on the platform controlled the movements of this "skip," and he received signals given by a boy with an electric push-button, which enabled him to adjust the direction and speed of the "skip" so nicely that he could lift it, run it to the "spoil bank," dump it, and return it with amazing accuracy and celerity. Every "skip" carried 90 cubic feet of material, and travelled along the cableway at the rate of 1,000 ft. a minute.

American Iron and Steel.

The official report for the year ended June, 1904, shows a steady increase in exports of iron and steel and a decline of imports. Exports of which the tonnage is reported have grown from 302,492 gross tons in 1903 to 675,529 tons in the year under review. As will be seen from the following table, the most marked increase is in steel rails, billets, ingots and blooms.

	1903.	1904.
Pig iron	18,198	34,635
Scrap	6,043	16,845
Bar iron	18,117	22,669
Wire rods	31,834	15,780
Steel bars (not wire rods)	12,990	21,446
Iron rails	81	1,513
Steel rails	22,896	160,894
Billets, ingots and blooms	2,127	176,961
Hoop, band and scroll iron	1,669	2,835
Iron sheets and plates	2,879	5,931
Steel sheets and plates	14,144	19,150
Tin plates, terne plates and taggers' tin	683	3,623
Structural material	32,952	35,892
Wire	100,121	113,782
Cut nails	7,168	9,588
Wire nails	28,109	32,431
Other nails, including tacks	2,481	2,554
Total	302,492	675,529

Thomas Morrison, of Pittsburg.

Mr. T. Morrison, who succeeds Mr. Charles M. Schwab on the Board of Directors of the United States Steel Corporation, spent his earliest years in Scotland. He came to the States in 1886 and was employed as a machinist at the Homestead Steel Works. Promotion rapidly followed, and when Andrew Carnegie acquired the Duquesne Steel Works in 1891, Mr. Morrison was appointed superintendent. From 1895 to 1903 he acted as general superintendent of the Edgar Thomson works, and he was also a director of the Carnegie Steel Company. Born in 1861, Mr. Morrison has already retired from active participation in business.

SOUTH AFRICAN RÉSUMÉ.

The Chemical Metallurgical and Mining Society of South Africa.

The new president of this society, in the course of his inaugural address, remarked that among the possibilities of future progress two things stand out. Of our total working expenditure on gold mining companies, three-fifths or more is roughly consumed in actual mining costs alone; metallurgical costs in all amount to little more than one-quarter of the whole. Our mining members have here opportunities for economies which are denied to their less fortunate fellow-workers on the surface. The other object to be sought lies in the fact that whilst with years our metallurgical methods have improved in the directions of continually-increased percentage recovery and continually-reduced working costs, yet this has been attended by equally continuous increasing of initial capital expenditure. At present our capital expenditure on existing or future deep level mines amounts to very large sums indeed, and though this is even now most amply repaid, yet to achieve our present or better results and yet lock up less capital is an object fully as desirable as any we have striven for and achieved in the past.

Forthcoming Improvements at Bloemfontein.

A Bloemfontein engineer writes: The population of Bloemfontein, the capital of the Orange River Colony, according to the census taken on April 17th, 1904, was 25,873, of whom 11,429 were whites and 14,444 coloured. The official valuation of property in Bloemfontein is declared as follows: 1900, £654,960; 1901, £809,753; 1902, £1,045,345; 1903, £1,531,370; 1904, £1,841,165.

The additional waterworks and main drainage works for Bloemfontein, estimated to cost £223,000, are making good progress and will probably be completed during this year.

Tenders will shortly be invited for improvements of the Bloem-Spruit, consisting of a new water channel 75 ft. wide at the bottom, about 100 ft. wide at bank level, and about 4,000 ft. in length: average depth about 13 ft. Five iron or steel bridges will be required to span the new channel.

Johannesburg Destructor.

An order to duplicate the destructor plant erected for the municipality of Johannesburg, and known as the Burghersdorp destructor, has been placed with Messrs. Meldrum Bros. The existing plant is a four-grate Meldrum Simplex Regenerating Destructor of the top-fed type. The combustion chamber is arranged centrally, and is amply large enough to take entire carcases if required. The Babcock and Wilcox boiler has 1,966 square feet of heating surface.

The Labour Question.

A *Times* correspondent cables that any fears which may still be entertained that the employment of Chinese will prejudice white labour in the mines must be removed by the statement just made at the meeting of the Chamber of Mines. Last month the vice-president gave an assurance that, if it were found that the narrowness of the reefs in certain mines favoured rock-drilling by hand, and therefore it became desirable to supersede white skilled labour by Chinese hand labour, the mining companies guaranteed all the white men engaged in this work similar employment in other mines. Supplementing these remarks, Mr. Schumacher has stated that similarly in the case of white unskilled labourers, if Chinese were introduced in a mine where white men were working, the latter would not be turned adrift, but would be offered employment elsewhere.

The figures dealing with white unskilled labour, however, tend to show that the work does not attract many. About 1,000 are employed by the Eckstein group and the Rand Mines. Eight companies included in the latter have averaged 466 white unskilled workmen during the first six months of the present year; but to maintain that average 2,430 passed through the books. The average number of shifts worked by each man before leaving was 17, while only 71 of the men who started work in January remained till the end of June. Their average wage was 9s. 6d.

Rock Drill Trials.

One of the most important papers read recently before the Mechanical Engineers' Association of the Witwatersrand deals with the results of a number of tests which were made by Messrs. J. B. Carper, E. Goffe, and W. C. Docharty, at the City and Suburban Mine.

A block of granite 4 ft. 9 in. square and 2 ft. thick was set in a bed of concrete, and in this the trial holes were drilled. Two air receivers were used, having a total capacity of 756·6 cubic feet, and the pressure in these was brought up to the desired amount, generally 80 lb. One of the trial drills was then worked from these receivers until the pressure was reduced to 70 lb. The time of working and depth of hole were then noted. The same drill was then worked again until the pressure was down to 60 lb., the working time and depth of hole again recorded, and so on in definite stages until the lowest test pressure (usually 35 lb.) was reached. In this way a number of systematic and fairly comparable tests could be made in a comparatively short time. Some examples of the results obtained are given in the following table, and these show the performance of two drills of medium size.

Drill.	Air pressure. lb. per sq. in.	Size of bit. Inches.	Depth. Inches per min.	Equivalent free air used per cubic inch drilled.
$2\frac{3}{4}$ in. Slugger ..	80—70	$2—2\frac{1}{8}$	2·19	9·88
	70—60	...	3·81	18·72
	60—50	..	1·81	7·83
	50—40	..	0·95	14·03
	80—70	$3—3\frac{1}{16}$	1·08	8·75
	70—60	..	0·64	15·26
	60—50	..	0·69	11·56
	50—40	...	0·56	10·93
	40—35	...	0·51	9·11
$2\frac{3}{4}$ in. Climax ...	80—70	$1\frac{15}{16}—2$	3·37	17·89
	70—60	..	2·26	24·02
	60—50	..	2·03	17·66
	50—40	..	1·37	22·80
	40—35	..	0·88	30·50
	80—70	3	1·42	12·02
	70—60	..	1·17	14·13
	40—30	..	0·59	21·95

GERMAN RÉSUMÉ.

Wanted—Iron Pyrites.

Mr. F. H. Mason, the United States Consul-General at Berlin, reports that in consequence of the diminishing supply of sulphur containing minerals from Spain and Portugal, from which source the important German manufacturers of sulphuric acid have hitherto been mainly supplied, there is now an active demand in this country for iron pyrites and other cheap sulphide minerals which are adapted to treatment by the standard methods of making sulphuric acid.

Germany's Best Markets.

The returns presented by the Imperial Statistical Bureau show that Germany's most important markets are found in Great Britain and the Colonies. The total value of the goods imported from Great Britain and exported hither from Germany in 1903 was £91,056,000 against £78,810,000 in 1902, an increase of £12,246,000. The second place was taken by the United States with £70,630,000; the third by Austria-Hungary with £64,270,000; and the fourth by Russia with £62,730,000. It is noticeable that last year Great Britain, from being the fourth largest exporter of goods to Germany, became the second, following the United States, but beating Austria and Russia. Among Germany's exports to this country last year were the following: rough rails, ingots, etc., £1,430,000; rough iron goods, £945,000; machinery and machine parts (including electrical machines, £290,000 and steam engines £275,000), £940,000; fine iron goods, £765,000; angle iron, £690,000; raw zinc, £595,000; clocks, £415,000.

State Railway Exhibit at St. Louis.

One of the most notable outdoor features at the World's Fair is the exhibition of track and interlocking and block signal apparatus now in use in Germany, illustrating the standards of the Prussian State Railways. More than 1,500 ft. of track has been put down, showing the different types of construction, and the whole of the materials have been shipped from Germany. There are three sections of double track road, two of these being laid with chemically treated wooden ties and the other with steel ties, while all are ballasted with broken stone. The rails weigh 88 lb. per yard, and are spliced with deep section Z-bars. There is a station-house, two switch towers, and one intermediate block-signal post. One of the switch towers is fitted with mechanical, and one with electrical signal apparatus. The block system makes it impossible for a train to run into an open switch, or for one train to run down another between stations. The double-track system prevents collisions. By means of electrical apparatus all switches, except the one opening the desired track, are locked, making an error on the part of a switchman impossible. As the last wheel of the train passes, the switches are all released by rail contact, making way for the next train.. The exhibit represents service conditions in almost every detail, and has attracted much attention.

The Hibernia Mines.

The most important event which has taken place in the German mining industry for a long time is the recent offer on the part of the Prussian State to purchase the Hibernia Coal Mining Company's undertaking. This company, says a *Times* correspondent, is one of the most considerable undertakings of its kind in the Rhenish-Westphalian district, and the State has accordingly offered 8 per cent. in Three per Cent. Consols. The share capital of the company is 53,500,000 marks (£2,675,000), and, if the present price of Prussian Consols be taken into consideration, the State offer is accordingly equivalent to nearly 245 per cent. on each share. A semi-official statement declares the object of the purchase of the Hibernia mines by the State to be, not only the natural desire to assure its own independent supply of coal, but also in order that the State may be able to exercise a moderating influence upon the determination of the price of coal in the Rhenish-Westphalian mining districts. In this region the attitude of the Rhenish-Westphalian Coal Syndicate constitutes the decisive factor in the regulation of the production and the price of coal. If the State succeeds in acquiring the Hibernia Mining Company's property, it will become a member of the syndicate, with a seat and a vote in its councils. The State will thus have the opportunity of combating the monopolist tendencies of this body. The Government is one of the largest coal consumers in all Germany. In the estimates for the current financial year, for example, the estimated consumption of coal and other firing materials by the State is placed at 7,090,000 tons, of a total value of 77,780,000 marks (£3,839,000). It is therefore manifest that the State is very considerably interested in the price of coal and in the general conditions of the coal mining industry. Now the Rhenish-Westphalian coalfields are set down in the estimates as contributing to the requirements of the Government to the extent of 3,920,000 tons, of a total value of 43,520,000 marks (£2,176,000). In view of the fact that in the year 1903 the Hibernia Company alone produced 4,500,000 tons of coal, it is evident that the transfer of the company's mines to the State would enable the latter to raise from its own property the Rhenish-Westphalian contribution to the Government coal supply. It is extremely probable that the most strenuous opposition will be offered to the Government, since, despite the express official denial, it is confidently anticipated that the other large coal mining companies in the Rhenish-Westphalian district are destined gradually to share the fate of the Hibernia. The fear, moreover, finds expression that, when once the State has secured the control over the coal mining industry it will assail the independence of the iron trade as well. State interference and State control where they have once established themselves, invariably extend, for it is safe to say that, but for the fact that the State in Prussia controlled the railways, no attempt would have been made to interfere with the coal mining industry. There is, too, the further consideration that the example of Prussia appears to have inspired other German States which possess a large railway system to take steps in the direction of purchasing coal mines.

IRON AND STEEL NOTES.

By E. H. B.

The Tariff Commission.

While the August number of Page's Magazine was in the press, the interim report of the Tariff Commission, covering the iron and steel trades, came to hand, and the contents, I presume, will surprise no one. The relative decline of the British iron and steel industry is attributed to the fact that "the manufacturers of the United States and Germany, having secured control of their home markets by means of high tariffs and an organised system for the regulation of their export trade, are in a position to dump their surplus products upon the British and other markets, irrespective of cost."

It is proposed to check the practice of "dumping" by a system of tariffs arranged as follows: (*a*). A general tariff, consisting of a low scale of duties for foreign countries which admit British wares on fair terms. (*b*). A preferential tariff, lower than the general tariff, for those of our colonies which give adequate preference to British manufactures, and framed with a view to securing freer trade within the British Empire. (*c*). A maximum tariff, consisting of comparatively higher duties, but subject to reduction by negotiation to the level of the general tariff.

The committee had under consideration 480 replies from British firms and examined eighteen witnesses. The names of the latter, with the exception of Mr. J. S. Jeans and Mr. Alexander Armour, are not, however, disclosed in connection with the evidence.

The Limitations of Microscopic Analysis.

The discussion on the paper dealing with "The Variations in Structures and Tests of Steel," by Messrs. A. Campion and H. H. Watts, has been printed in the Journal of the West of Scotland Iron and Steel Institute, and makes instructive reading. The important point chiefly emphasised is that a complete knowledge of any steel can only be obtained by corollation of the results of several methods of examination.

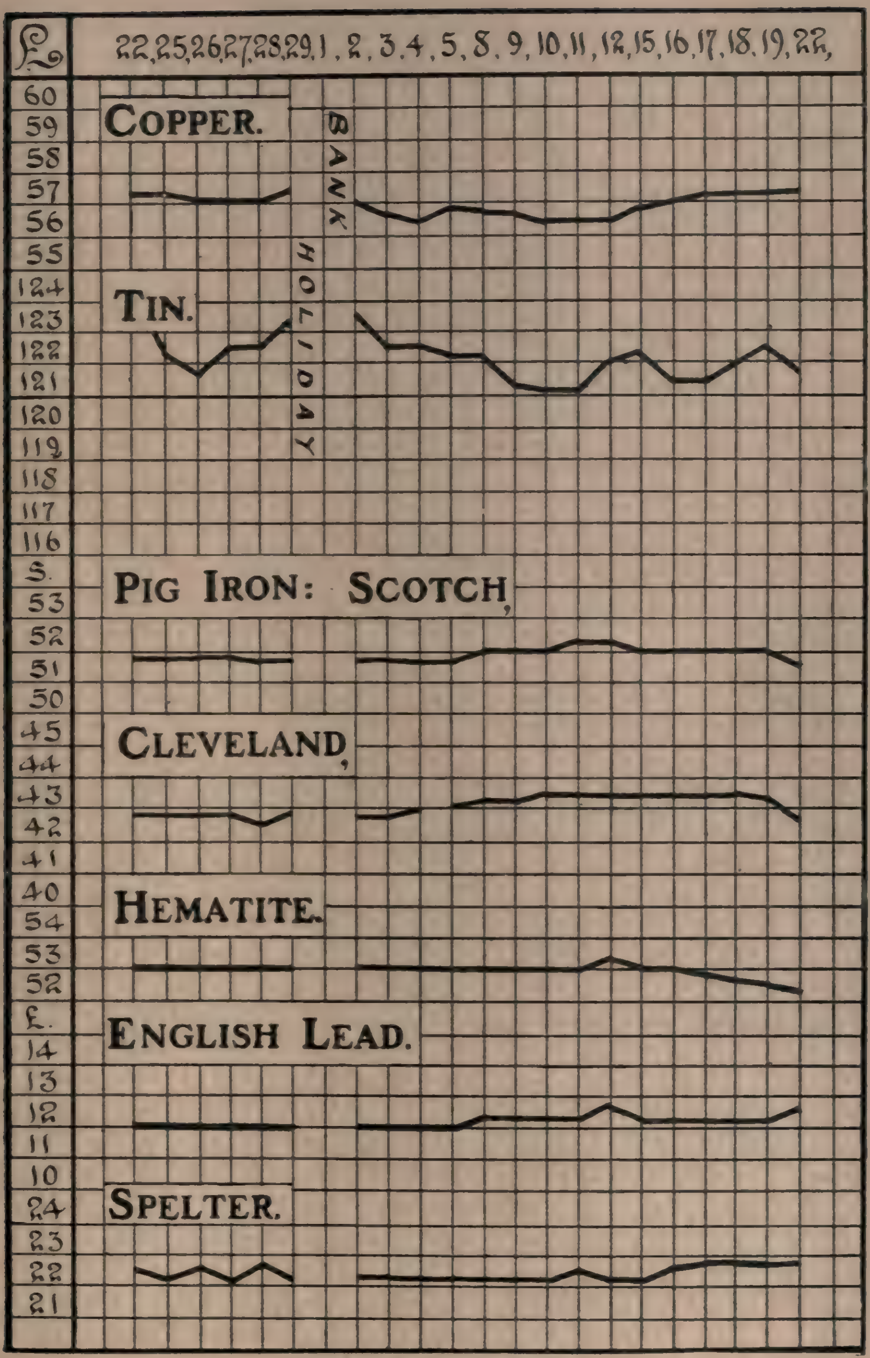
Mr. W. Cuthill remarked that the micrograph tells nothing of the composition of steel, whether high or low in impurities, but this we learn from the chemist. It tells as little of the mechanical properties of steel, whether high or low in strength and ductility, but the testing machine provides the information. It has, therefore, a distinct province of its own, and that is to reveal the work and heat treatment steel has undergone, which neither the chemist nor testing machine can indicate with any reliability. In this respect it should very usefully fill a gap in the investigation of many puzzling and difficult problems in the behaviour of finished steel. For instance, has it been burned? or has it been finished in the rolling at too high a temperature?

Mr. A. Campion subsequently said he thought that in some cases it *was* possible to gain an idea as to the amount of certain impurities which were present by microscopic analysis; for instance, steel containing much arsenic or phosphorus. Steel containing a high percentage of manganese also showed a structure, quite distinct, from that of steel containing a small amount of manganese. Regarding the question as to the possibility of distinguishing between steel which had been overheated, and that which had been burnt, he thought a steel that had actually been burnt was one of the easiest things to detect under the microscope.

Mr. F. W. Harbord wrote that microscopic analysis, like many other things, has suffered from the somewhat extravagant claims made by some of its early exponents, and the authors have done a very useful piece of work in defining the limitations of microscopic analyses, by showing that although the details of the structure may vary in various parts of a bar, the general structure remains the same. Provided that the heat treatment has been the same, the educated eye has no difficulty in discriminating between the general as distinct from the detail structure, and although the size of the grain may vary from the outside to the centre, or other parts of a large bar, the micro-constituents are clearly defined. In certain cases of marked segregation, when the metal is high in sulphur or manganese, the former may be clearly seen as buff coloured round or elongated spots, the latter by the alteration in the structure of the material. The real value, however, of microscopic work is that we are able to determine the marked influence of heat treatment, and although similar steels heated or cooled under identical conditions will often vary considerably in their detailed structure, the general type of structure of annealed or rapidly cooled, or quenched steels is so characteristic, that it can be at once identified by the practised observer. He is "glad to see that the importance of using the microscope as an adjunct to other methods of testing, and not as an independent method of investigation, has been emphasised by the authors, as it cannot be too strongly insisted upon, that it does not replace, but only supplements other methods of examination."

Rapid Cutting Steel Tools.

The Report on "Experiments with Rapid Cutting Steel Tools," made at the Manchester Municipal School of Technology, under the auspices of a joint committee of members of the Manchester Association of Engineers, and prepared by Dr. J. T. Nicolson, has been produced in book form, together with complete account of the discussion by the Manchester Association of Engineers. It makes a very interesting volume of 366 pages. There are 25 tables and 16 plates. I am informed that, although, of course, it is simply a private publication, the Council of the Manchester Association of Engineers in this instance have decided to place the work on sale, and copies can be had from the Secretary at 2s. 6d. each.



THE HOME METAL MARKET.

Chart showing daily fluctuations between July 22nd and August 22nd.

OPENINGS FOR TRADE ABROAD.

Australian Commonwealth.

There is every probability of a coming demand for hot water and steam radiators, and warm air furnaces. Last winter the two principal theatres in Melbourne were heated for the first time, one on the radiator principle, and the other by electricity, the latter not proving very successful. These are the only instances in which an attempt has been made to heat places of amusement in Victoria. The large number of halls, churches, etc., throughout the State are absolutely without heating appliances. To successfully introduce these appliances would require the services of an expert in the business, fully qualified to sell the goods and attend to their installation.

Tenders will be received at the office of the Deputy Postmaster-General, Hobart, until noon on September 30th, 1904, for the supply and delivery at the General Post Office, Hobart, of one multiple metallic branching switchboard. Tenderers must state the name of the country in which the switchboard will be manufactured.

There is a constant large sale of cheap hand pumps, and a vigorous attempt should be made by British manufacturers to secure at least a portion of this business, the bulk of Australian requirements being indented from United States makers.

France—Senegal.

The Commission appointed last year by the Governor-General of French West Africa to study the question of a railway from Thiés to Kayes, have finished their report, which is about to be submitted to the French Colonial Minister.

This railway, if constructed, will extend to the sea the existing line from the Niger to Kayes, supplementing the Senegal river, on which navigation is impossible during eight months of the year. The Commission anticipate no great technical difficulties in the construction of the railway along the route they recommend. The length of the line will be 670 kilometres (about 416 miles); the cost of the construction is estimated at £1,680,000, and of the requisite rolling stock at £280,000.

Belgium.

Tenders are invited for the construction of a second railway line between the stations of Bomal and Marlote. The estimated cost of the first portion of the work is about £31,997, and of the second portion, about £1,123. A deposit of £1,600 is required to qualify any tender. Specifications may be obtained on payment of 10d., from "La Bourse," Brussels, where tenders will be received up to September 3rd.

Spain.

H.M. Consul at Cadiz again calls attention to the probable opening for a coast railway starting from San Fernando and passing through Chiclana, Medina, Conil, Vejer and Tarifa. This railway, it is stated, would be of immense advantage to the whole district, enabling villagers to dispose of their surplus, and also reducing the cost of living in Cadiz and other towns by supplying them with fruits, vegetables, etc. The total distance is about 70 miles, and presents no serious engineering difficulties.

Italy.

Sanction has been obtained from the various authorities concerned to the project for an electric car service between Spezia and Portovenere, tapping all the intermediate suburbs and villages. When this project is carried out, it ought to prove a very paying concern, and an immense boon both to visitors and to suburban residents.

Argentina.

Tenders are in demand for presentation on September 13th next, at 3 p.m., for the construction of a net of electric tramways between the Plaza de Mayo, Buenos Ayres, and the suburbs of Ortusar, Devoto, and General Urquiza.

Brazil.

The British Vice-Consul at Santa Catharina reports that concessions have been granted for the construction of three railways in the State of Rio Grande do Sol, one from Estreito on the mainland in front of Florianopolis to Blumenau, Sao Francisco and Joinville; a second from Estreito to Lages upon the highlands; and a third from Estreito to the boundary of Rio Grande do Sul.

A Consular report from Porto Alegre states that there now seems to be a probability that the extension of the Porto Alegre and New Hamburg line to Caxias, the centre of large colonies of Italians, will be carried out, the Government having signed a contract with a local firm of engineers and contractors for the construction of the earthworks of the permanent way for a distance of about 42½ kilometres from New Hamburg. The contract price is £35,000, and it is very likely that as soon as the way is ready for traffic it will be worked under arrangement with the Porto Alegre and New Hamburg Company. The inaugural ceremony took place at Novo Hamburgo on May 3rd last, and, in the opinion of the Consul, there is a possible opportunity here for British makers to compete for the supplying of the rails when the time arrives.

Notable British Papers.

A Monthly Review of leading Papers read before the various Engineering and Technical Institutions of Great Britain.

A MODERN STEAM POWER PLANT.

WE conclude in this issue the description of a modern Factory Steam Plant, at the mills of the Bessbrook Spinning Company, being an abstract of Mr. Edward G. Hiller's paper read before the Institution of Mechanical Engineers.

ECONOMISERS.

These are of the ordinary "Green" type. The water rises through all the vertical pipes; these are arranged in three groups of 64, 96, and 64 = total 224 pipes.

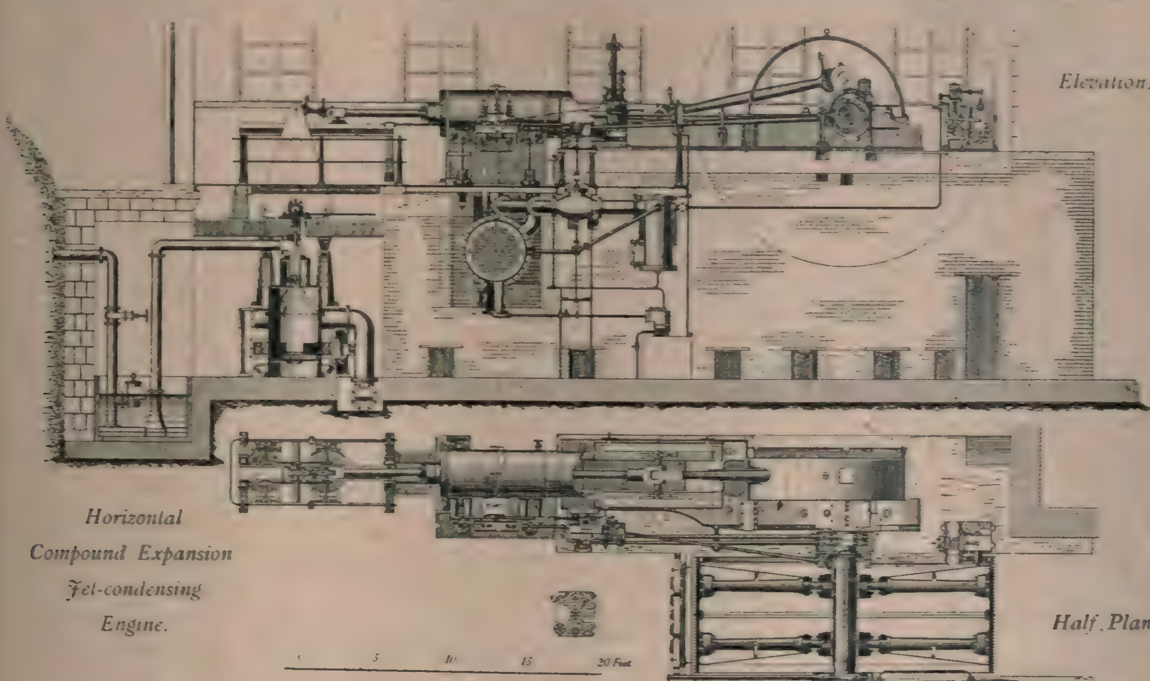
AUXILIARY FEED-PUMP.

For boiler-feeding and manufacturing purposes when the main engine is at rest, a Weir feed-pump has been erected; the pump is of the well-known type, single cylinder, double-acting vertical, and has a capacity of 4,000 gallons per hour, at a speed of 12 double-strokes to the minute. The steam cylinder is 9 in. diameter and the water cylinder 7 in. diameter, and both strokes are 21 in. This feed-pump was used for feeding during the tests.

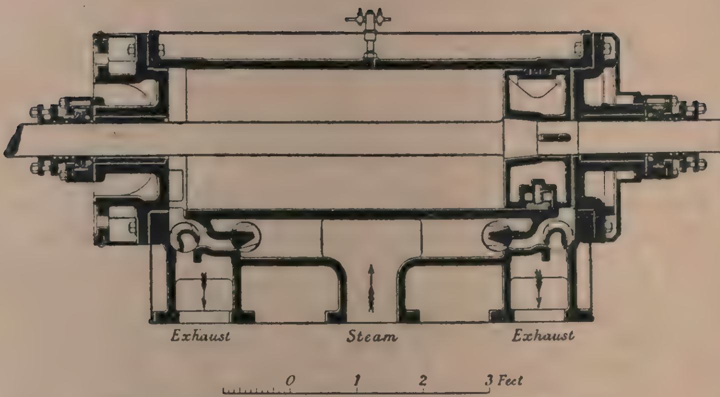
DESCRIPTION OF ENGINE.

The engine is of the horizontal compound expansion jet-condensing type, with two overhung cranks set at right angles, the high-pressure crank leading. The general arrangement of the engine is shown herewith.

The cylinders are unjacketed. The high-pressure cylinder is supplied with superheated steam, and a re-heater is fitted to heat the low-pressure cylinder steam supply. The steam used for re-heating purposes is taken by a separate 3-in. branch from the main steam-pipe, and arrangements are made to pass the hot water condensation to the feed supply of the boilers. Two, Edward's air-pumps, each 26 in.



This engine was erected for the Bessbrook Spinning Company, and is described by Mr. Hiller, in his paper, "A Modern Steam Power Plant."



HIGH PRESSURE CYLINDER—BESSBROOK PLANT.

diameter by 18 in. stroke, are worked off the tail-rod of the high-pressure piston. The fly-wheel, 20 ft. diameter, is grooved for thirty-six $1\frac{3}{4}$-in. ropes, and the power is transmitted direct from the engine to the various floors of the mill.

GENERAL SIZES.

The principal dimensions of the engine are given below :—

Economical load, 1,200 h.p.

Cylinder sizes—high-pressure, 25 and $\frac{1}{32}$ in. diameter, low-pressure, 52 and $\frac{1}{32}$ in. diameter.

Stroke of engine, 5 ft.

Revolutions per minute, 65.

Crank-shaft of forged Siemens-Martin Mild Steel—Two necks, 15 in. diameter by 31 in. long. Diameter of body of shaft, $16\frac{1}{8}$ in. Diameter of body of fly-wheel, 19 in.

Crank-pins, 9 in. diameter by $10\frac{1}{2}$ in. long.

Crank of forged scrap iron, 10 in. thick.

Piston-rods and tail-rods of mild steel—high-pressure, 6 in. diameter; low-pressure, 7 in. diameter.

Fly-wheel, 20 ft. diameter, 36–$1\frac{3}{4}$ in. ropes.

Weight of rim of wheel, 33 tons.

Steam stop-valve, 9 in. diameter.

Injection valve, 7 in. diameter.

Re-heater of mild steel—Diameter of outer shell, 3 ft. 11 in. Number of tubes, 101. Internal diameter of tubes, $2\frac{1}{2}$ in. Heating surface exposed to heating steam, 600 square feet.

CYLINDERS.

The cylinders are unjacketed. They are covered on the barrels and covers with magnesia non-conducting composition not less than $2\frac{1}{2}$ in. thick, and the whole covered with planished steel secured by screws. The inner surfaces of the cylinder are machined smooth and polished. The steam and exhaust valve chambers are cast with the cylinders, and are placed beneath the cylinder at each end, as shown in figure. The valves are of the Corliss type, arranged so that the cut-off in the high-pressure cylinder is controlled by the governor. The cut-off in the low-pressure cylinder is adjustable by hand. Floating metallic packing is used for the piston-rod glands.

The piston-rods in both cylinders are prolonged to back slides, which are so arranged as not to interfere in any way with the removal of the back covers of the cylinders. The pistons are Macbeth's patent with white-metal anti-friction shoes, and Ramsbottom spring rings which extend three-fourths of the circumference only.

FLYWHEEL.

The double flywheel is built in two sections with eight arms and eight segments each. Along the front of the flywheel is arranged a bar, which is connected by levers to a bell, so that, should any rope begin to fray or over-ride, it will come in contact with this bar, and so ring the bell to alarm the attendant.

GOVERNORS.

The governing of the engine is effected by an ordinary high-speed centrifugal loaded governor, assisted by a supplementary governor, The load on the main governor partly consists of a weight secured to the end of a screwed lever. The sensitive supplementary governor at the slightest change from the middle position can, by means of gearing, slowly screw this lever and its balance ball outwards or inwards if the engine varies from the desired mean speed, and this action takes place quite independently of any quicker movement of the main governors. In this way, while the prompt action of the main governor is not affected, nor the length of the governor rods altered, as in some arrangements, it is possible to secure an almost dead mean speed irrespective of permanent load changes, vacuum variations, or boiler pressure fluctuations. Without this device, the main governors would have to run in a different plane, and consequently at a different engine speed for each change in the cut-off point. Special devices are provided to prevent the supplementary governor being injured by over-screwing. A suitable knock-off gear is also provided.

REHEATER.

The reheater between the cylinders is of the tubular type, with boiler steam outside the tubes and low-pressure steam inside the tubes. It consists of an outer shell, 3 ft. 11 in. internal diameter, and 8 ft. long, and two tube plates with 101 tubes $2\frac{1}{2}$ in. internal diameter. On the underside of the reheater shell is fitted a drain bottle, from which the water of condensation is carried to the suction side of the boiler-feed pump. The shell, the tube plates, and the tubes are made from Siemens-Martin mild steel. This reheater is covered with heat-nonconducting composition.

TESTS.

The author describes an elaborate series of tests from which the following figures are taken :—

HEAT ACCOUNT AND DEDUCTIONS.

HEAT ACCOUNT (FROM 32° F) IN B.TH.U.

	No. of Test. First. B.Th.U.	p.c.	Second. B.Th.U.	p.c.	Third. B.Th.U.	p.c.
Heat equivalent of indicated horse-power . per min.	41641	18.28	41347	18·22	41570	17·73
Heat leaving engine in reheater jacket drain . per min.	2056	0·9	2207	1	—	—
Heat leaving engine in exhaust steam and Balance of Heat Account per min.	184153	80·82	183336	80·78	192850	82·27
Gross heat supply entering engine per min.	227850	100	226050	100	234420	100

DEDUCTIONS (RECKONED FROM EXHAUST TEMPERATURE).

		No. of Test.	
	First.	Second.	Third.
Heat supplied per minute per i.h.p. B.Th.U.	216·85	217·15	222·95
Thermal efficiency ... .per cent.	19·50	19·53	19·02
Heats theoretically required per minute by standard engine (Rankine Cycle) ... ... B.Th.U.	151·8	152·7	153·2
Efficiency ratio	0·700	0·703	0·667
Pounds of steam used per i.h.p. per hour	11·10	11·24	11·59
Making allowance for the heat available for supply to boiler in the hot drainage water from the reheater the pounds of steam used per i.h.p. per hour ... ... =	11·02	11·146	11·59

NOTE.—In all the above calculations the specific heat of the superheated steam has been taken at 0·6.

ECONOMY OF COMPLETE PLANT.

	No. of Test.	
	First Test.	Second Test.
Total heat value of fuel in boilers per minute	315995	305779
Heat equivalent per minute of i.h.p. developed	41641	41347
Percentage of heat utilised in i.h.p. ...	13·18	13·53
Coal fired per i.h.p. per hour	1·48	1·44

CAPITAL COSTS OF PLANT AND ANNUAL RUNNING CHARGES.

The contract for all the engineering work was let in one sum to the general contractors, but the subdivision of the cost of each section is about as follows :—

Engine complete 25 in. and 52 in. by 5 ft. cylinders	£5,875
Three boilers 8 ft. by 30 ft.	1,840
Steam and feed pipes, pumps and valves ..	865
Economiser, 224 pipes with details	396
Three superheaters with cast steel boxes ..	352
Sundries and travelling crane	332
	£9,660

In addition to the above the mill gearing alterations cost about £2,740. This formed a large proportion of the total cost, but the subsequent running of the whole of the shafting under the smooth steady rope drive has been found of the greatest advantage in the mill, and to be well worth the additional expenditure which was necessary to secure this result.

The cost of the substantial granite engine house the firm preferred to erect, with the new rope race walls and the boiler house alterations, was about £5,000. The total gross cost of the new scheme, therefore, including a bonus paid to the engine builders, may be taken as about £18,000.

A careful examination by the firm of their subsequent annual running charges and other items affected by the alterations has shown a decrease per annum of about £3,000.

This large reduction sufficiently shows that the new plant was well justified, but it may be interesting to note that this gain is not solely due to coal saving, but to other important items, as follows :—

Coal reduction in the high-pressure and low-pressure batteries of boiler due to the change, 2,000 tons @ 16s.	£1,600
Reduced labour in boiler house	75
Reduced labour in repairing old gearing ..	150
Reduced oil and stores, one engine instead of three	155
Reduced charges for wheels and breakages, etc.	250
Estimated value of steadier turning-in shed and factory	670
Value of floor space, due to vacant engine houses to be used for looms, etc.	100
Gross gain per annum ..	£3,000

The results of the working of the Bessbrook engine and other engines of similar design show that high economy is obtainable with a compound engine free from the complications and difficulties resulting from the use of three cylinders with steam jackets.

THE CARE OF ROAD LOCOMOTIVES.

BY T. C. AVELING. A.M.Inst.C.E.

WEAR AND TEAR.

To keep your boiler in good condition, cleanliness is the first law. If a rivet leaks or any leakage takes place, attention should be given to it immediately, and this should be carried out by a competent locomotive boiler maker. Boilers should be cleaned out at least once a fortnight ; all covers should be removed, and firebars drawn, the tubes and firebox swept with a hard broom, and any accumulated ashes should be removed, as there is a strong possibility of local corrosion being set up from the contact of these ashes with the plate. The riveted heads of the screw stays the heads of the crown stay bolts, and all seams and joints should be examined. The safety plug should be drawn and cleaned, and all scale removed from the end of the plug which is in contact with the water. The supporting brackets for firebars should be watched, and the seam between foundation ring and firebox sides carefully inspected for leakage. Externally, inspection should be made round the mudholes, blow-off tap, water-gauge fittings, joints, and any joints in connection with the boiler, also the liners in between horn plates and crown plates and riveted stay heads. If a joint is leaking it should immediately be re-made. The smoke-box tube plate should be carefully examined for wasting, which may be set up through priming or even by leakage of rain down the funnel. Tube ends should be examined, as these will deteriorate from the same cause. The joint between the cylinder and boiler should be watched, and in examining tube plates all oxidation, etc., should be cleared away between tubes and bottom flange. In fitting the safety plug, tallow should be applied to the thread of same internally. A force pump for country use should be used for washing out the boiler, or in towns by the town supply if head is sufficient. The hose should enter at the manhole, and the boiler be well swilled out, allowing the refuse to run out of mudholes. If the scale is thick, a slight tapping of the stay heads, internally and externally, and plates will cause this deposit to leave the surface of the firebox. A scaling slice should be entered through the manhole and the scale on the crown of firebox removed, short rakes of flat iron or copper should be introduced through the mudhole door, and the mud and loose scale removed. Too much attention cannot be given to internal cleanliness, as the accumulation of scale is a frequent cause of bulging and burning of the plates, in addition to concealing any wasting of the plates which may have been set up through defective feed water.

FEED WATER.

The purest water should always be used. Grease, oil, or bran, which is often recommended for leaking tubes, should not be allowed to enter the feed tank or boiler. A very moderate use of common soda in many cases will counteract the action of acids in the feed water.

RE-MAKING JOINTS.

The jointing surface of the plates should be carefully scraped and all red lead removed. Grummets of yarn should be made to fit the covers and the joint should be covered with a mixture of red and white lead in proportion of 1 to 2. When raising steam, as the boiler warms, these joints should be carefully gone over with a spanner to take up any slackness ca sed by the softening of the joint due to heat.

BLOW-OFF TAP.

The blow-off tap should be used daily, as this is the first and best preventive of scale. The tap should be opened when the engine is at rest with, say, a pressure of 50 lb. per gauge, the boiler not making any steam. By these means the sediment is allowed to settle to the lowest part of the boiler, and is swept out by the rush of escaping steam and water. In using, the blow-off tap should be turned in the same direction to prevent ridges forming on barrel and plug.

GAUGE FITTINGS.

The screwed plug opposite the supply hole should be withdrawn every cleaning time, and the deposit removed with a piece of wire or small drill, otherwise these become choked and show a false water-level. Taps should be kept in working condition, and gauges blown through at least three times a day.

SAFETY VALVES.

These should be frequently removed and cleaned, and screws and pins kept in free working condition, care being taken to test them every day.

LEAKY TUBES.

If a tube should burst or leak, never drive a taper plug in the ends as a permanent repair. A new tube should be fitted immediately. Depreciation of boilers takes place (1) from external corrosion; (2) from internal corrosion; (3) from overheating of plates and corrosion in firebox.

EXTERNAL CORROSION.

One of the greatest evils occurs in the shell barrel. As this cannot be detected owing to the lagging concealing the plates, leakages from joints and from rain settle in the lagging, keeping it in a moist condition, thus transmitting the moisture to the plate, forming a red oxide scale. Now, this process occurring daily gradually eats the plate away. On the shell barrel the joints of the feed-pump chest and cylinder supply give the greatest trouble, and after a period of from five to ten years, when the lagging is removed at these parts, the plates are often found wasted from leakage, the water oozing out and eating the plate away. These parts will require patches, or in some cases a new shell. To prevent this the lagging should be removed at least every two years. A leaky pump gland will have as detrimental an effect as a leaky joint, and round the blow-off tap corrosion is often set up through leakage, and in some cases the tap has had to be removed and replaced on some other part of the box owing to the carelessness of watching this joint. The same remarks apply to the injector inlet tap.

INTERNAL CORROSION.

This is often caused by defective feed water. Bad feed water has a general wasting effect on all the plates, and evidence of it sometimes appears in large blotches on the plates, and again in the form of pitting of the plates. When internal corrosion appears from the above cause change of water is beneficial. Local corrosion may appear at the shell water-line at the bottom of shell, or the firebox alone may be affected, owing to the great affinity the destructive agent may have for the hottest surface.

GROOVING.

This comes under the heading of corrosion, though at its commencement it is a mechanical defect. It is generally found at the underlap of the shell longitudinal seams, in the old types of boilers on the firebox and firebox casing plates, and at the edge of the foundation ring. The cause of grooving is the contraction and expansion of the plates, the metal thereby becoming fatigued, and each time more susceptible to the action of a destructive agent.

OVERHEATING PLATES AND CORROSION OF FIREBOX.

The corrosion of firebox is found at firebar level round the heads of the riveted screw stays, the underlap of the vertical seams, and between the tubes at the firebox tube plate. The first-mentioned is generally caused by the use of coke, which gives off a large proportion of an acidulated gas. The combustion of both coal and coke liberates H_2O in small proportions, setting up local corrosion of the plates at bar level. Corrosion on round stays is due to leakage, and the grooving of tube plate springs from the same cause.

OVERHEATING OF PLATES.

The effect of deposit exposed to the heated gases of the fire is in proportion to its thickness and non-conducting properties. This deposit prevents the heat being taken up readily by the water, and it is thereby liable to cause such overheating of the plates.

GREASE HAS THE SAME EFFECT AS DEPOSIT.

Munroe, on boilers, page 29, states that the Board of Trade have found the majority of explosions of this type of boiler to be caused by longitudinal grooving in the shell—the tendency of the shell plate being to take a truly cylindrical shape. But if, in the first instance, the shell has not been truly cylindrical this process continues, and grooving is set up. I again draw your attention to the present method of manufacture of the shell, the longitudinal seams being butt-jointed and above water-level, thus doing away with one of the most likely causes of explosion.

LAYING ASIDE ENGINE.

Remove mud- and man-hole covers, and keep the engine in a dry situation. Wash out and examine plates and mountings before refilling for work. In frosty weather special precaution should be taken as regards the water in the boiler during the night. Shut the water gauge taps, empty the glass tubes, and drain the steam-gauge connection. Examine the feed pipes and injector connection before starting. It is well when working next day to keep fire in all night if frost is likely; but before leaving, carefully note that all steam and water connections are not leaking, to prevent lowering of the water-level and consequent overheating of plates.

THE CYLINDER.

The piston should be withdrawn every three months and the rings and cylinder examined, the casing cover removed, and the slide valve examined, note being made that the lead is equal on either end; also, when reversing, lever is in forward or backward notch. See that the starting valve has sufficient opening for steam inlet. Whilst the engine is in motion, notice should be taken of escaping exhaust steam. An accumulation of oil and soot in the exhaust pipe will close up its orifice, and set up a back pressure in the cylinder, with a consequential increase of consumption of fuel and depreciation of motion. Test the steam-tightness of steam slide valve by putting the valve in mid position and admitting steam. There should be no leakage from exhaust pipe if the valve is tight. To test tightness of a piston admit steam at one end and open draincock at opposite, and a continuous blow through will denote leakage.

LUBRICATION.

A moderate amount of good oil will give satisfactory results, the condensation of steam on the walls of the cylinder forming a natural lubrication. Oil-cups should be fitted with wire and worsted siphons, the wire hanging in the tube below bottom level of the cup. The worsted should be renewed at least every three weeks, as it loses its capillary attraction when dirty.

CONNECTING ROD.

If a knock develops, adjust the brasses. The neck crank shaft bearing should be examined every three months for fracture, and the bearings should be adjusted if a knock is evident. There is a considerable amount of wear in eccentric straps, and these should be properly adjusted.

THE FLYWHEEL.

Watch the boss of the flywheel and see that the key, if it should become slack, is carefully tightened. If loose, the key should be withdrawn and carefully refitted, and not driven home with a sledge-hammer. If this latter is done, it is possible to fracture the flywheel.

PUMP.

The suction and delivery valves should be withdrawn and examined, and re-ground in if required. A lift of $\frac{1}{4}$ in. to the suction valve and $\frac{3}{16}$ in. to the delivery being allowed, the screw opposite supply pipe withdrawn, and the supply pipe cleaned and drilled clear of deposit.

DRIVING WHEELS.

Considerable wear takes place on the face of these wheels, and this is sometimes increased owing to rolling in the fast speed. In going round corners the driving pin should always be withdrawn from the inside wheel. In the boss of the wheel the cap on axle may want washering up.

MOTION AND REVERSING GEAR.

Particular wear will take place in the pin and in the tongue of the reversing lever and rack; this should be attended to so soon as the vibration on the motion is susceptible.

STEERAGE.

Slight wear may take place in the steerage spindle, which should be washered up and the steerage chains tightened.

TENDER.

The tender and mudguards should be withdrawn at least every twelve months, the axleboxes and bolts examined, the water-tank and coal-bunker scraped and washed out as often as the boiler is.

AXLE.

Notice should be taken as to whether the driving bosses are tight on the keys on axle, and the wear on wooden blocks on brake band should not be allowed to go too far.

From a paper read before the Midland Municipal Officers' Association at Birmingham.

MERSEY DOCKS IMPROVEMENTS.

The Mersey Docks and Harbour Board has adopted a recommendation by the committee of works to spend £222,000 upon an extension of the Brunswick Dock and the provision of single-storey sheds. In the annual report of the engineer (Mr. Anthony G. Lyster), on the general state and progress of the Dock Works at Liverpool and Birkenhead, it is mentioned that the dock gates for the entrances to the new Brocklebank graving dock, which is being constructed under the Act of 1903, are wider than any in Liverpool or in any other port. They are 135 ft. wide, and are being constructed of steel. Particulars are given of the work of deepening several of the docks, and under the heading of dredging in the river it is stated that the sand pump dredger *Coronation*, which began operations in the river in September, 1903, has pumped and conveyed to sea 2,995,500 tons of sand. From the bar and shoals in the Queen's and Crosby Channels there have been removed during the year ended July 1st, 7,923,300 tons, the total quantity of sand removed since the beginning of dredging in 1890 having been 30,930,640 tons from the bar, and from the shoals in the Queen's and Crosby Channels 48,052,230 tons. The condition of the bar had been fairly maintained during the year, the ruling depth in the dredged cut being about 27 ft. at low water spring tides. The ruling depth of the Crosby Channel might also be taken at 27 ft., though along the eastern portion between C 6 and C 8 black buoys it was somewhat less.

COMING EVENTS.

September.

3rd.—Midland Counties Institution of Engineers: Annual General Meeting at 3.15, in the University College, Nottingham.

14th—16th.—Institution of Mining Engineers: Annual General Meeting in Birmingham.

19th—23rd.—North of England Institute of Mining and Mechanical Engineers: Excursion Meetings in the neighbourhood of Newcastle-upon-Tyne.

BOOKS OF THE MONTH.

"THE SHIPBUILDING INDUSTRY OF GERMANY."

Compiled and edited by G. Lehmann-Felskowski. With coloured prints, art supplements, and numerous illustrations throughout the text. Crosby, Lockwood and Son. 10s. 6d. net.

This neat pictorial album, with instructive letterpress on German ship-building and the industries depending upon it, has been compiled by Mr. G. Lehmann-Felskowski from two works by a well-known German writer. The development of German ship-building is first traced, after which we are taken upon a personally conducted tour round the German shipyards—a most entertaining and instructive excursion. The author then turns to the German Iron Industry in relation to ship-building, and we are shortly making a tour of the Krupp Works. Ships' equipment and armament, mechanical hoisting apparatus for shipyard and harbour work and Germany's Submarine Cables are then dealt with, and one closes the work with an involuntary tribute not only to the shipbuilding enterprise of Germany, but also to the author for his artistic conceptions and the excellent pictorial treatment which obtains throughout.

"MODERN MACHINE SHOP TOOLS."

By William H. Van Dervoort, M.E. Fourth edition. Crosby Lockwood and Son. 21s. net.

This work, which the author tells us, is the outgrowth of a series of articles designed for students at the University of Illinois, takes a comprehensive view of the ever-increasing output of machine tools, and is illustrated by no less than 673 engravings, illustrating tools and methods, all of which are carefully described. It includes chapters in filing, fitting and scraping surfaces; drills, reamers, taps and dies; planers, shapers and their tools; milling; machines and cutters; gear cutters and gear cutting drilling machines and drill work; grinding machines; hardening and tempering, gearing, belting and transmission machinery; useful data and tables. The young mechanical engineer will find in this book an invaluable companion, and he can scarcely fail to profit by the excellent advice which he will find in the opening pages.

"BRITISH ENGINEERING STANDARDS CODED LISTS."

Issued by authority of the Engineering Standards Committee. Volume I. "Rolled Sections for Constructional Iron and Steel Tram Rails." Compiled by Robert Atkinson. Published by Robert Atkinson (London), Ltd. 21s. net.

The *raison d'etre* of this unique reference work is succinctly explained by the preface: It has been recognised by the Engineering Standards Committee, that the objects of Standardisation will be furthered to an appreciable extent by the publication of the Committee's findings in a commercial form. With this view, the British Engineering Standards Coded Lists have been prepared under the authority of the Committee, to place within the reach of merchants, rollers, constructional engineers and others, a useful Telegraphic Code containing the technical details of British Standards as formulated by the Committee, and a series of Code Phrases and Tables enabling buyers and sellers to communicate by cable at the minimum of expense.

In the present volume much other useful matter will be found, including lists of British rollers and merchants, with particulars of the sections they roll or stock, which should be of considerable assistance to users of the book. The Code words throughout are taken from Whitelaw's well-known vocabulary. It only remains to add that the work is well printed on stout paper and that everything possible has been apparently done to arrange these lists on sound common-sense lines. The whole compilation forms a heavy volume of 475 pages, exclusive of advertisements. It is rendered conspicuous in the reference library by a vermilion cloth binding with gilt lettering.

"DYNAMO, MOTOR AND SWITCHBOARD CIRCUITS FOR ELECTRICAL ENGINEERS."

A practical book dealing with the subject of Direct, Alternating and Polyphase Currents. By William R. Bowker, C.E., M.E., E.E. Crosby Lockwood and Son. 6s. net.

Although not intended as a theoretical text-book Dr. Bowker's work devotes considerable attention to introductory terms and explanations which will be valuable to those who approach the subject for the first time. An excellent feature of the work is its numerous diagrams which should be of considerable use to the artizan for whom the work is largely intended. The arrangement is by numbered paragraphs, the author dealing with his subject in the following order: Continuous Current Dynamos, Direct Current Motors, Electric Traction, Combined Lighting and Power Schemes, Alternating and Polyphase Currents. Students who are taking the City and Guilds of London examinations in electrical engineering, will find in Dr. Bowker's carefully prepared pages much that is helpful and suggestive.

"THE DESIGN AND CONSTRUCTION OF OIL ENGINES."

With full directions for Erecting, Testing, Installing, Running and Repairing, Including descriptions of American and English Kerosene Oil Engines. By A. H. Goldingham, M.E. Fully illustrated. Second edition. Revised and Enlarged. E. and F. N. Spon, Ltd. 6s. 6d. net.

In producing a second edition of this well printed and illustrated little work, the author has taken the opportunity of adding four chapters dealing with oil engine troubles, fuels, and miscellaneous information. In the first mentioned chapter he gives some practical hints upon such points as failure of igniter, defective oil supply, knocking, piston, blowing, leakage of water, etc. A useful section is that in which the various engines are described and illustrated by means of photographic reproductions and diagrams. In an important chapter on designing oil engines, the author remarks that simplicity of construction is the essential feature of this form of engine. To be successful mechanically and commercially it should be so constructed that it can be worked, cleaned and adjusted by unskilled attendants.

OUR DIARY.

July.

21st.—His Majesty the King inaugurates at Rhayader the new water supply for Birmingham.

23rd.—Death of Sir John Simon.

25th.—Lord Blythswood delivers his presidential address at the opening of the Sanitary Institute's Annual Congress.

27th.—Lord Ebrington inaugurates a new water supply for Ilfracombe.

28th.—Mr. Alfred Hewlett presides over an adjourned meeting of the Coal Conciliation Board.—The Society of Engineers visit the shipbuilding and engineering works of Messrs. Yarrow & Co., Ltd., at Poplar.

29th.—A special conference of the Miners' Federation of Great Britain meets at the Westminster Palace Hotel to consider the position of wages in Scotland.—Issue of a Parliamentary paper explanatory of the Wireless Telegraphy Bill.—Publication of the final report of the Uganda Railway Committee.

30th.—The International Cup Contest at Ryde.—Mr. Douglas Owen leaves for South Africa, in order to attend the Johannesburg Conference on shipping freights.—The imports into the Transvaal for the first five months of 1904 amount to £5,799,271, and the Customs receipts during the same period to £712,709, as against £9,761,566 and £961,647 respectively in the corresponding period of last year.—The revenue of Cape Colony for the financial year ended June 30th last amounts to £9,910,000, and the expenditure to £10,849,000, leaving a deficit of £939,000—the revenue was reduced by £400,000 owing to the reduction of Customs duties.

August.

1st.—It is announced that next year's Earl's Court Exhibition will be devoted to the Naval, Shipping and Fishing industries.

2nd.—The combined Home and Channel Fleets and the cruiser squadron leave Mount's Bay for fleet evolutions.—It is reported from New York that the outlook for another great strike in the anthracite coal region is now very grave—The executive board of the United Mine Workers (No. 1 district) practically resolve on a strike which will affect about 80,000 workers.

3rd.—Sir W. White lectures at Exeter on "Modern Development of Construction of the Royal Navy."—The Coal Conciliation Board, meeting at the Westminster Palace Hotel, decides, by the casting vote of the chairman, Lord James of Hereford, that a reduction of 5 per cent. in miners' wages shall come into operation on the first making-up day in the present month.—Inauguration of wireless telegraphic communication between Bari and Antivari.—Issue of Parliamentary paper on Navy boilers.

6th.—At Cowes Regatta the American schooner *Ingomar* wins the Royal Yacht Squadron Cup.—The Conciliation Board in the Durham coal trade meets to consider the miners' wages for the ensuing three months.

7th.—An express train falls through a bridge in Colorado—125 lives are reported to have been lost.

8th.—Disastrous fire at the Toulon Arsenal.—Commencement of the torpedo manœuvres.—*Mercédès IV.*, wins the International Motor-boat race from Calais to Dover.—Opening of the International Miners' Congress.

9th.—The Miners' International Congress assembled in Paris resolves unanimously that "if the hours of labour in and about the mine are to be shortened permanently, it must be done by Act of Parliament."—Issue of report by Sir W. Garstin on schemes under consideration for the improvement of the Upper Nile.—The re-appointment of Lord Curzon as Viceroy of India is announced.

10th.—The Engineering Standards Committee publish an interim report on British standards for electrical machinery.—Organisation in Montreal of the Grand Trunk Pacific Railway Company.

11th.—The Mersey Docks and Harbour Board decide to spend £222,000 on an extension of the Brunswick Dock.—Publication of the annual Blue-book containing the return of net public income and expenditure for the financial year 1903-4.

12th.—Widespread forest fires are devastating the Kootenay country, British Columbia, and causing much damage to the mines.—Opening of a new graving dock at Hebburn-on-Tyne.—The Transvaal exports during the first half of the current year amount to £8,406,247, as compared with £5,708,515 for the corresponding period of 1903. The chief items composing the above total are gold, £7,710,534; diamonds, £341,160; wool, £35,033.

13th.—Summer meeting of the Junior Institution of Engineers opens at Düsseldorf.—The German battleship *Kaiser Friedrich III.* grounded to-day in the Great Belt, 30 plates being stove in.—During the torpedo manœuvres two destroyers collide, resulting in the loss of the *Decoy*.

14th.—Opening of a new railway line from St. Petersburg to Vitebsk—this line places the capital in through communication with Kieff.

15th.—Termination of the torpedo manœuvres.—Issue of the principal chemist's report on the work of the Government Laboratory for the year 1903-4.

17th.—The British Association opens its annual congress at Cambridge.

19th.—A meeting of the Engineering Section of the British Association is devoted to the discussion of problems connected with internal-combustion engines.—The Engineering Standards Committee issue the British standard specification for tubular tramway poles.

20th.—The Federal Council of Switzerland decides to denounce the commercial treaty between Spain and Switzerland—the treaty will remain in force one year longer.—The Roumanian Government steamer *Buccanesti*, while leaving Penarth Dock, crashes into the caisson protecting the dock gates, the dock gates being damaged to the extent of £5,000.

NEW CATALOGUES AND TRADE PUBLICATIONS.

J. Hopkinson and Co., Ltd., of Huddersfield, forward a well arranged and excellently printed catalogue of safety valves. The numerous half-tone illustrations are of the highest possible grade.

J. Bennett Von der Heyde, of 6, Brown Street, Manchester, sends a very neat little pamphlet, which gives in a few words the chief points with regard to engine packing, to be kept in view by steam users.

Mr. W. Clark Fisher, Mechanical and Electrical Engineer, of Gordon Works, Gordon Road, West Ealing, forwards us illustrated circulars upon the "Compensating" Potentiometer, and the Improved D'Arsonval Galvanometers.

Tangyes, Ltd., Cornwall Works, Birmingham.—List No. 63 gives particulars of a new "Suction" Gas Producer for which remarkable economies are claimed, *e.g.*, 10 b.h.p. for one penny per hour, or 100 b.h.p. for under 10d. per hour.

E. Green and Son, Ltd., 2, Exchange Street, Manchester, forward details and illustrations of Green's Patent Air Heater, by means of which hot air from a waste source can be utilised for drying, heating and ventilating mills, factories, and public institutions, etc.

The Electric and Ordnance Accessories Company, Ltd., Stellite Works, Birmingham.—From this firm we have received a catalogue regarding Stellite S. D. (short distance) telephones for use in connection with existing electric bell systems and for intercommunication.

Mather and Platt, Ltd., of Manchester, have just brought out the second edition of their descriptive pamphlet dealing with "Mather-Reynolds Patent High-Lift Turbine Pump." From this firm we have also received the seventh edition of their pamphlet on Steel-clad Motors.

Horsfall Destructor Company, Ltd., Leeds, are issuing an instructive report of the West Hartlepool Horsfall Destructor, by Mr. J. W. Brown, M.Inst.C.E., F.G.S. This should be obtained by all members of Town Councils and others who are called upon to consider the important question of refuse disposal.

Charles Churchill and Co., Ltd., 9–15, Leonard Street, E.C.—A useful catalogue of American tools reaches us from this firm, comprising lathes and turret machines, drills, planers, shapers, milling and grinding machines, mechanics' fine tools, etc. The catalogue will be found a valuable acquisition by users of machine tools, and an early application should be made for it as the edition is limited. A smaller edition of the catalogue is also issued.

Nalder Bros. and Thompson, Ltd., 34, Queen Street, E.C.—This firm's price list is issued in five sections, the one before us (second edition, section II.) dealing with dead-beat moving coil ammeters and volt-meters. This has been revised and extended throughout, and has several new features. It includes some interesting views of the firm's machine shops at Dalston Works, Typical N.C.S. Moving Coil Instrument Scales, etc.

C. W. Burton, Griffiths and Co., 1, 2, and 3, Ludgate Square, Ludgate Hill, E.C.—This small pamphlet comprises a list of American Machine Tools, for which the firm act as agents, their machine tool warehouses at London and Glasgow, covering about 16,000 sq. ft. A list of the firm's own specialities includes patent triple action chucking lathe, special heavy high-speed gap lathe, Burton disc grinder, oil grooving machine, and self-sustaining pulley blocks and crabs.

William Asquith, Ltd., of Highroad Well Works, Halifax, send us the following circulars, all of which are attractively printed and illustrated: List No. R 1. "Improved 3 ft. 6 in. Radial Drilling, Boring and Tapping Machine"; List No. R 2, "Strong and Powerful Improved Radial, Drilling, Boring, Tapping and Studding Machines"; List No. VI. "Improved Vertical Drilling, Boring, Tapping and Studding Machine"; List No. GR 1, "High-Speed Radials for Bridge, Constructional Rail, Plate and Girder Drilling."

The United States Metallic Packing Company, Ltd.—An exceedingly novel calendar in the form of an aluminium disc, about the size of a five-shilling piece, has been issued by this company. On the one side we get a diagram and inscription setting forth the merits of the packing, while attached to the other side is a thin rotating disc bearing the names of the months and a separate division for dates. By adjusting the disc so that the month divisions are brought into line with the respective years marked on the edge of the calendar, the date division is brought into correct position in relation to the days of the week for each particular month from the beginning of 1904 until the end of 1925.

W. T. Glover and Co., Ltd., of Trafford Park, Manchester, forward a well-printed detailed catalogue of electrical wires and cables. Several new features have been introduced, notably the classification of various types of "Diatrine" paper lead covered cables for lighting and power mains, suitable for either low or high voltages. It is mentioned that all the paper lead covered cables manufactured by the firm are now subjected to their patent hydraulic test. Among new types of cables to which attention is drawn are "Diatrine Paper Leadless" cables, for underground mains and mining work; "Bitumen Insulated" cables, specially suitable for solid systems; "Leather Sheathed" cables, specially suitable for rough usage; "Fire-resisting" cables, for switchboard connections for train, theatre, and ship lighting, etc.

Gent and Co., Ltd., Faraday Works, Leicester, forward an illustrated catalogue, printed in two colours, dealing with their patent watchman's clocks or electric tell-tales, for checking the movements of night watchmen in factories, etc. They specially call attention to their dry-ink-marking watchman's tell-tale clock, and an illustration is shown of a watchman recording his round by means of a portable magneto generator. By this method the use of a battery of cells is dispensed with. Details are also given of a watchman's relief alarm. This provides for a special attachment by means of which a loud bell is rung at some suitable place if the specified time elapses without a record being made on the tell-tale clock. We have also received a circular describing the firm's water-level alarm apparatus.

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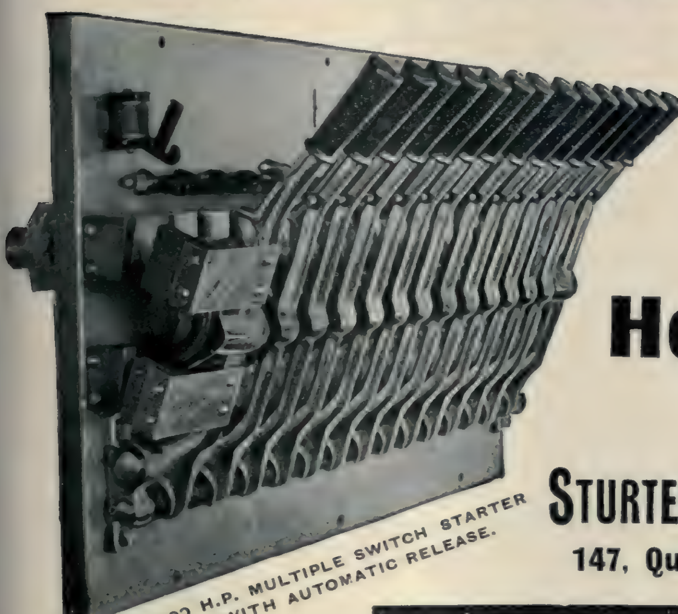

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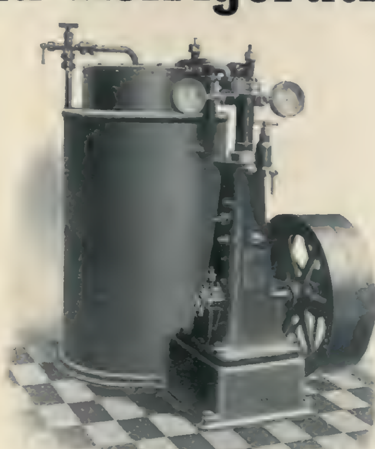

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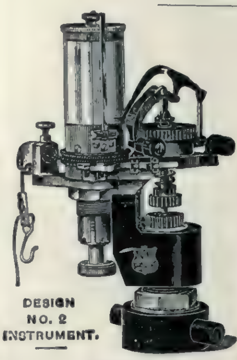

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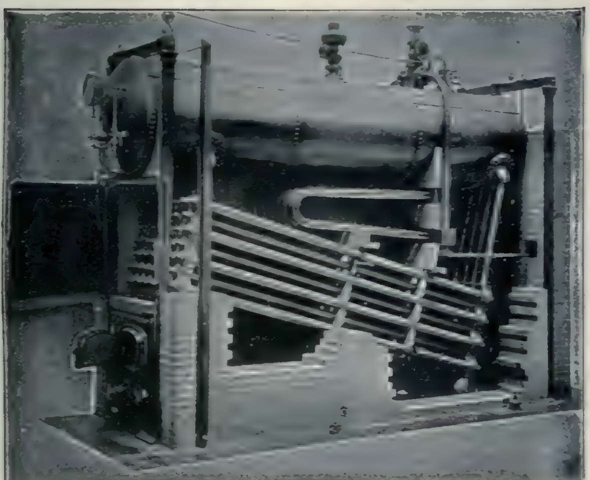

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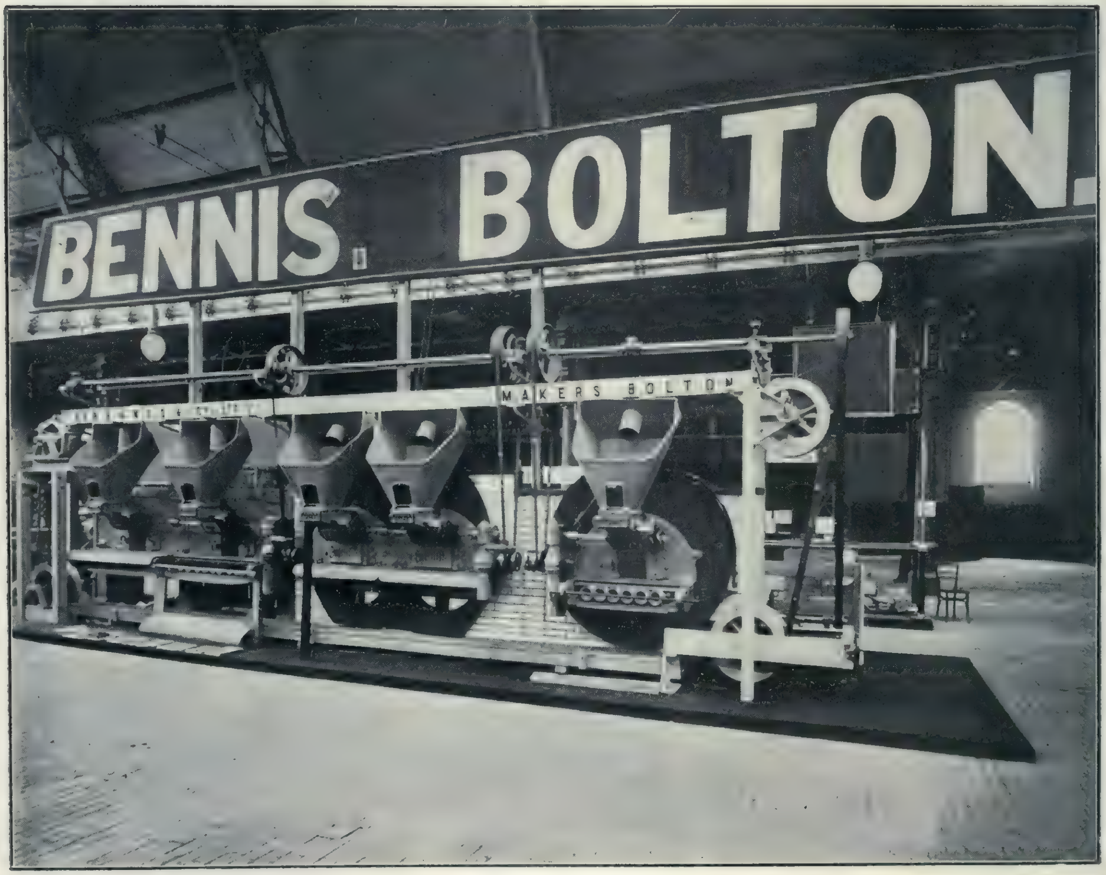

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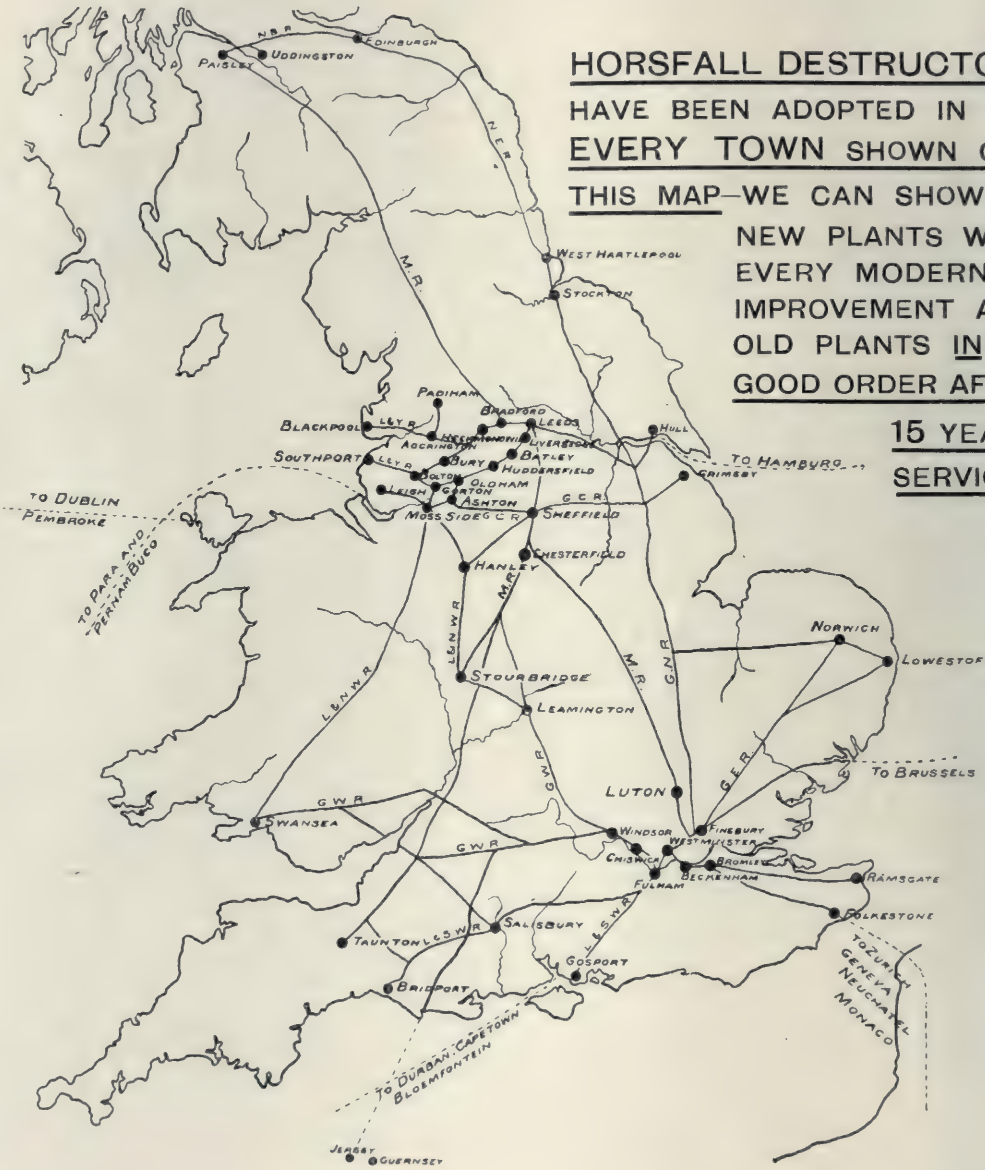

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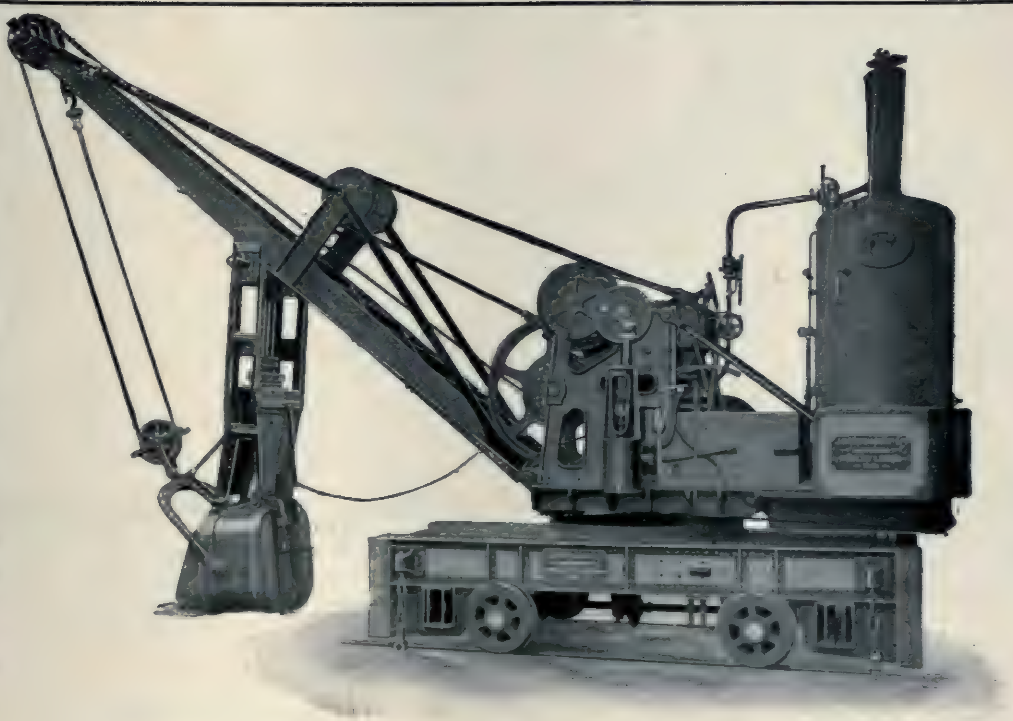

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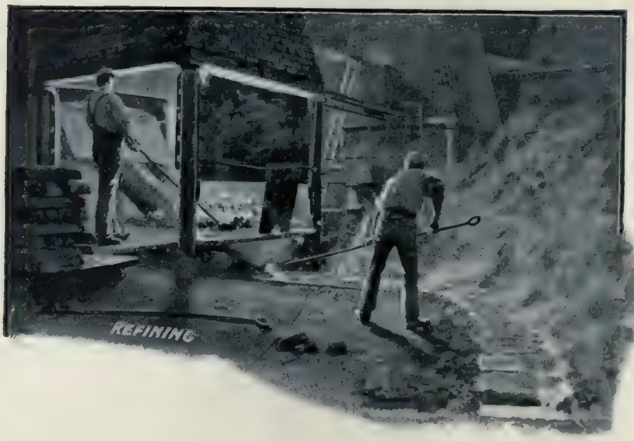

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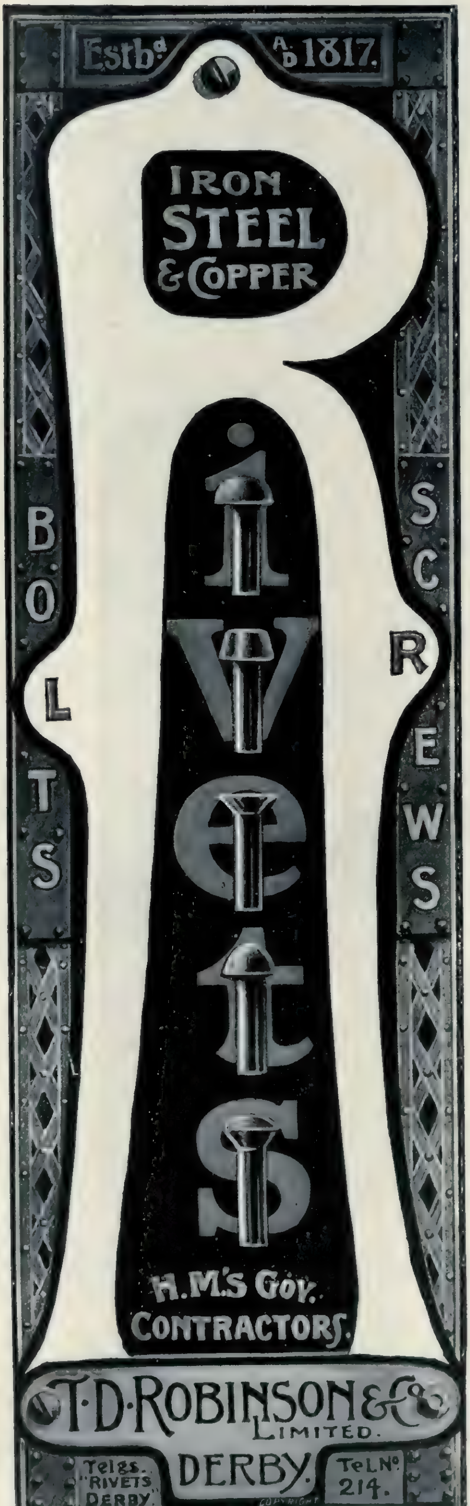
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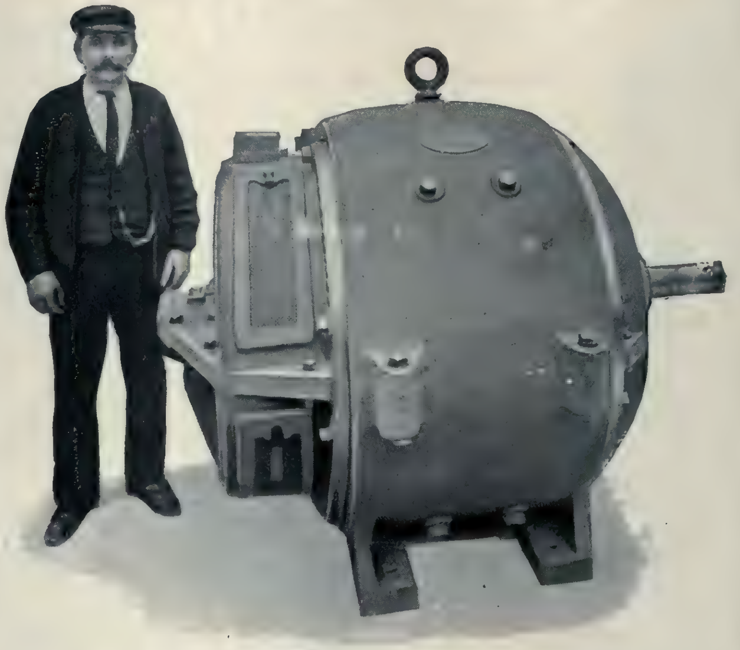

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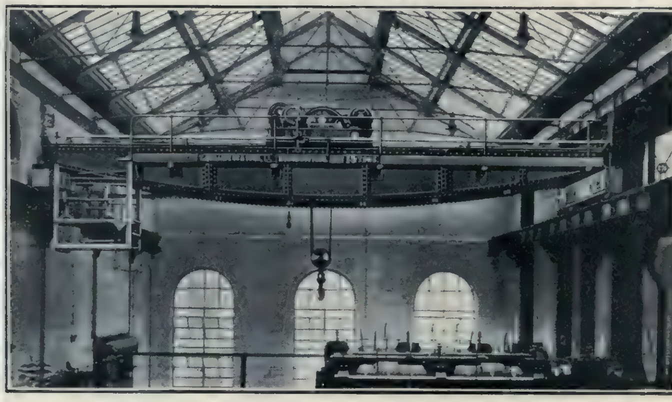

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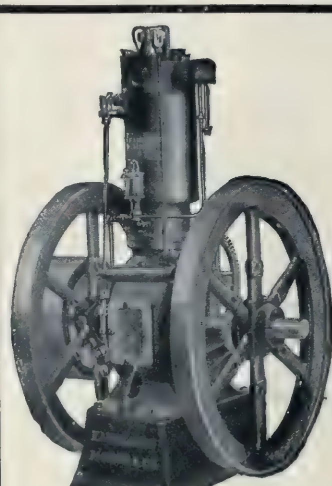

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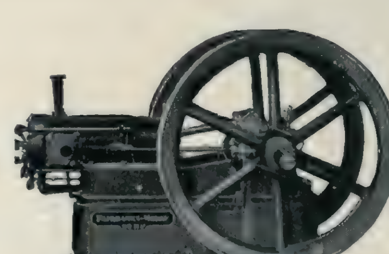

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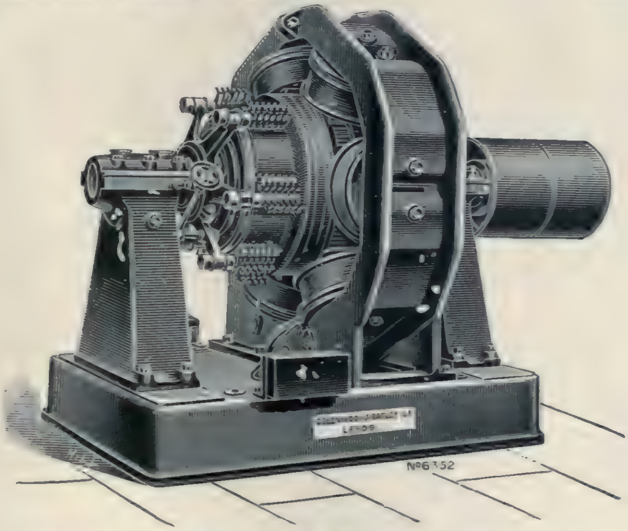

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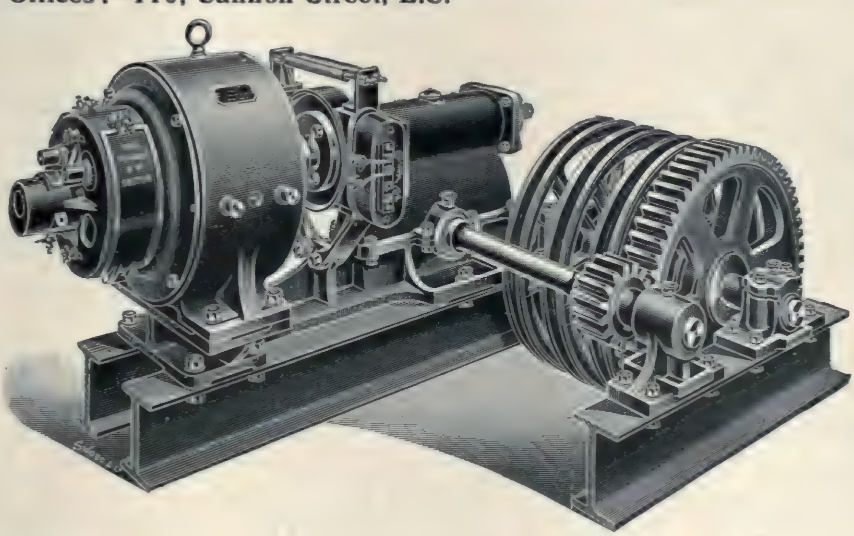

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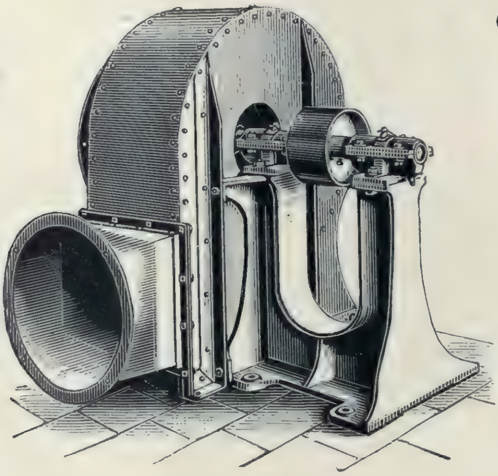

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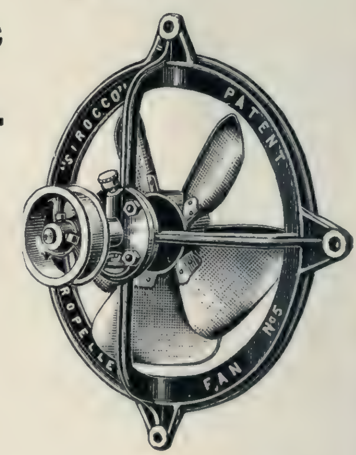

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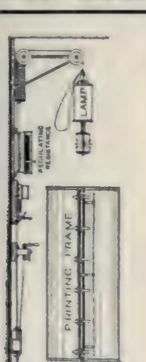

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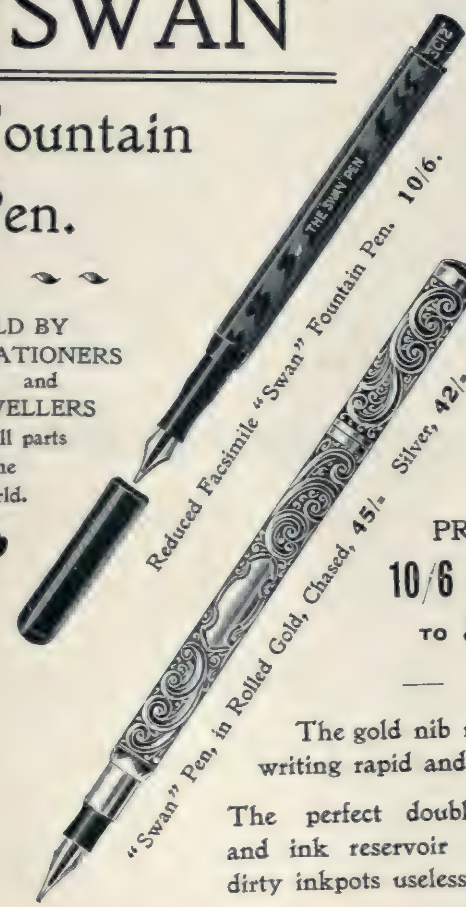

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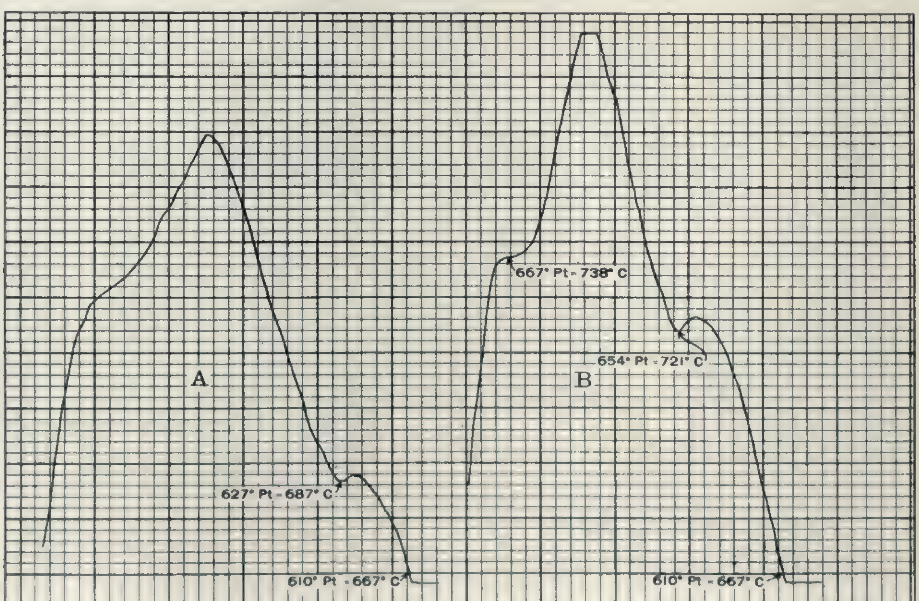

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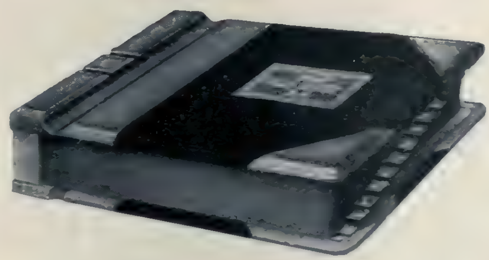

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