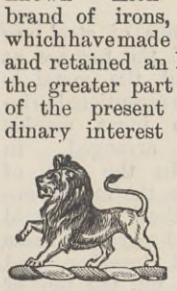
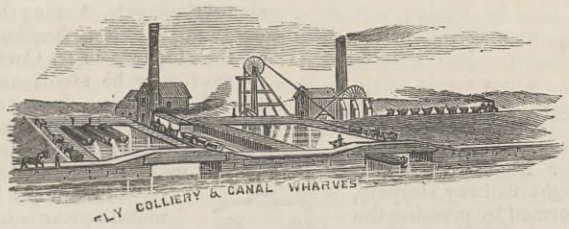
VISITS IN THE PROVINCES.

CORNGREAVES IRON AND STEEL WORKS.

THE principal works of the New British Iron Company, formed in 1845, whose Ruabon works we described in our issue of 12th instant, are situated at Corngreaves, near Birmingham. They cover an area of about forty-five acres, all freehold property, and are placed in immediate connection with the Great Western Railway by sidings. The private lines of the company, ramifying through the works and connecting them with the collieries, are altogether about thirty miles in length. This situation for the establishment of large works was clearly indicated by the valuable minerals underlying the surface, including a remarkably pure coal, one seam of which, the Staffordshire thick coal or ten-yard seam, here varies from 27ft. to 31ft. in thickness; an iron ore with very low sulphur and phosphorus, and the same band of fireclay as that identified with Stourbridge, which is only four miles distant. The section of measures on next page and analyses of the raw materials give ample indications of the extent and value of the natural resources. How these have been turned to account in producing the well-known "Lion" brand of irons, which have made and retained an honoured name among consumers during the greater part of the present century, is the object of the present article to set forth. More than ordinary interest attaches to this company's trade mark at the present time, owing to its having been copied by unscrupulous makers, as already mentioned in our columns. There are altogether six collieries, views of which are appended, extending without break of continuity about three miles in a straight line, bearing almost due north and south. About 700 tons of coal are consumed at the works in one form or another, but this is far from the maximum output. Codsall Colliery, which is





nearest to the iron-works, and the strata of which extend under them, affords the most representative section of measures; it is therefore chosen for reproduction.

In this section the productive seams, all actively worked, are indicated by a thick line at the side. They occur in the following order from the surface:—The Brooch coal, excellent for household purposes; the "thick," or "ten-yard" coal; the Gubbin ironstone; the top and bottom "heathen" coal; the white ironstone; and the fireclay at the bottom of all. The thick coal, though divided into various qualities known by the local names appended, here presents a solid face of 30ft., unbroken save by a few thin "partings." The coal is coked in batch, or large heap, made round a central chimney perforated with lateral holes at the bottom, having ashes thrown over to prevent

the access of air. In this way a larger proportion of sulphur is driven off than when the coking is effected in ovens. The following is the analysis of coke made from the thick coal:—

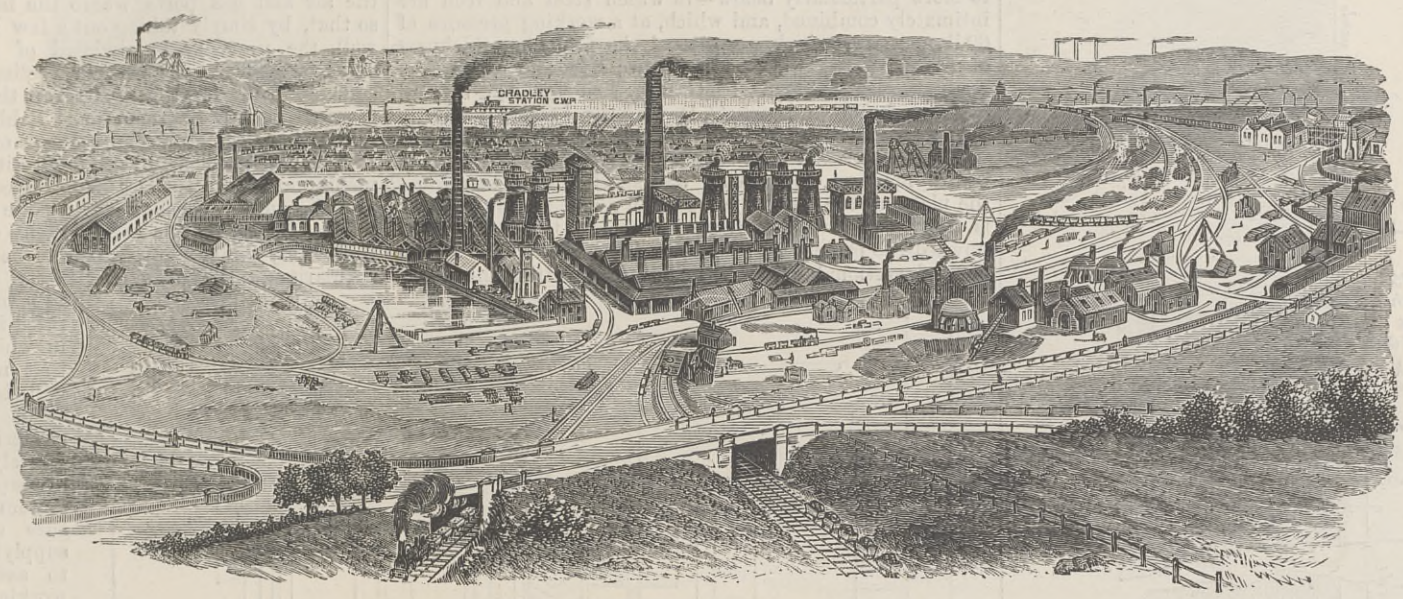
Carbon	87·15
Sulphur	0·59
Ash	5·2
Water, and probably some carbonic acid	5·32
Water (hygroscopic)	1·74
	100.

If these results are compared with those of the best Durham foundry coke, it will be seen that the former contains only half the quantity of sulphur, while the percentage of ash is also lower. The coke, which has a tendency to disintegrate rather than to cake together, as in the ordinary variety, presents an appearance resembling charcoal, to the chemical composition of which it nearly approximates, being, in fact, almost pure carbon.

The composition of the five seams of ironstone, about 300 tons of which are consumed daily, is given in the following table:—

	White.	Blueflats.	White.	Gubbin.	White.
Protoxide of iron	47·9	43·7	52·2	49·28	44·74
Protoxide of manganese	2·6	—	0·62	1·24	0·5
Lime	0·31	—	0·68	1·29	1·7
Magnesia	0·98	—	0·12	0·92	2·05
Carbonic acid	—	—	33·00	32·83	30·63
Bisulphide of iron	0·12	0·18	0·21	trace	trace
Phosphoric acid	—	0·25	0·25	0·66	0·72
Silica	10·8	8·13	9·18	—	—
Alumina	—	—	2·84	—	—
Water (hygroscopic)	—	—	—	0·26	0·34
Water (combined)	—	—	—	1·59	1·51
Organic matter	—	—	—	0·68	trace
Insoluble residue	—	—	—	11·09	18·17
			99·1	99·84	100·36
Metallic iron	37·25	33 98	40·6	38·6	35·25

These ores, which, it will be noticed, contain very little



CORNGREAVES IRON AND STEEL WORKS.

phosphorus, are calcined in a continuous batch, or in one of the blast furnaces, which, instead of being reconstructed, has been made to do duty as a kiln, a vertical partition keeping separate two classes of ore. The effect of the calcining is to drive off the carbonic acid and most of the sulphur, while oxygen is absorbed from the atmosphere, giving the following reaction:—

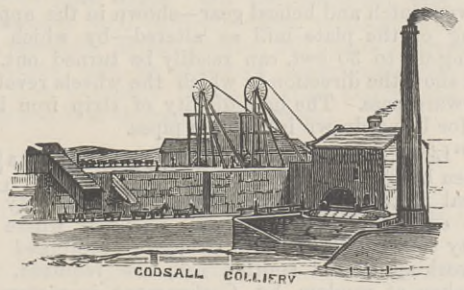
$$2\,(Fe\,C\,O_3) + O = Fe_2\,O_3 + 2\,(C\,O_2)$$

If the stones were pure carbonates, the loss in weight owing to the operation of roasting would be 31 per cent.; but, as they contain silica, the average diminution of weight is only about 25 per cent. The limestone for flux, about 50 tons of which is consumed daily, is brought from

Wrexham, near the Ruabon works. Its composition is as follows:—

Lime	54·67
Carbonic acid	42·88
Magnesia	0·02
Sesquioxide of iron	0·22
Alumina	0·12
Silica	0·52
Organic matter	0·2
	98·63

To complete this portion of the subject, it should be mentioned that no firebricks are used in the works besides



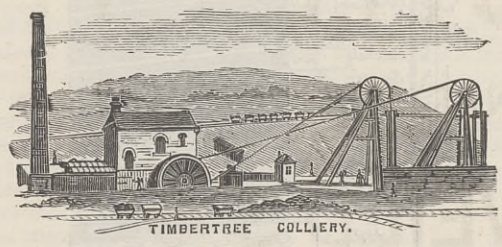
those made from the company's own seam of Stourbridge clay, nor any ordinary bricks but those made from their own surface clay.

Though large blast furnaces may be more economical in working, there is little doubt but that small furnaces are best suited for making a high-class pig iron from pure materials, which do not possess a high resistance to crushing strain. There are six furnaces, including that used as a kiln, viz., two 54ft. and three 47ft. high, with diameters in the boshes of 17ft. and 14ft. respectively. Generally three out of the five are in blast; but at the present moment one of the shorter is being relined, so that there are in blast only one each of the two sizes. Excepting one of the higher furnaces, not in blast, the mouth of which is closed by bell and cone, all the tops are open. At present the height of burden is as great as the materials will stand. To close the mouths would either reduce the useful height of furnace by 7ft., or necessitate a corresponding increase of height. The latter alternative would cause too great a crushing strain on the materials at the bottom, reduce them to powder, and prevent all access of the blast, thus favouring the formation of "scaffolds." This difficulty could be obviated by grinding the ore and coke, and agglomerating them in suitable proportions with lime, to form *briquettes* or blocks. Such a practice would have the advantage of bringing the component parts of the charge into very intimate union, so as the more readily to be acted upon by heat; but it would be almost impracticable, on account of the large quantity of materials to be dealt with. The difficulty might also be met by importing stronger, though less pure, materials; but this is just what the New British Iron Company is anxious to avoid, preferring to treat its own pure materials in furnaces of moderate height, and to preserve the high quality of its "Lion" brand.

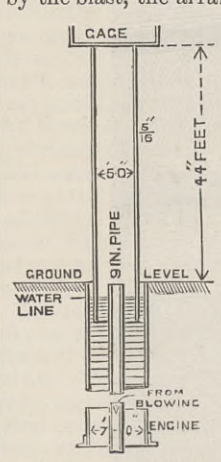
Thus it happens that, contrary to modern practice, and at a certain loss in economical working, the mouths of the furnaces are for the most part open. A considerable portion of the gas is, however, taken off, not to heat the stoves, but to fire the blowing-engine and the forge and mill engine boilers. The stoves, of primitive horseshoe type, are fired by slack, and raise the blast, at a pressure of about 4½ lb. per square inch, to a temperature of 700 deg. or 800 deg. Fah. On an average, the composition of the blast furnace burden may be taken as follows:—

Iron material, of which half will come out as iron	65·7
Coke as carbon	27·9
Lime for flux	6·4
	100·0

This charge is raised to the mouth of the larger furnaces by



an ordinary steam lift; but for the smaller the lift is worked by the blast, the arrangement being shown by the annexed sketch. To the bottom of this cage is attached a tube, 5ft. in diameter, closed at the top end, but open at the bottom, and dipping into a tube 7ft. in diameter, open at top, but closed at bottom, and sunk in the ground. Up the centre of this latter tube passes a 9in. blast pipe from the furnace blowing-engine. The lower tube is nearly filled with water, the level being about 4ft. from the surface of the ground when the hoist is down. The hoist is nearly balanced by four weights suspended from chains passing over pulleys at the top of the framing and down the columns at the four corners. When the blast is turned into the 9in. pipe by a sluice valve at the bottom, the cage is impelled to the top of the lift, being held by stops as long as it remains in that position. When it is desired to lower the cage, the blast is shut off, and an exhaust pipe opened, when the cage descends, being controlled in speed by the escaping



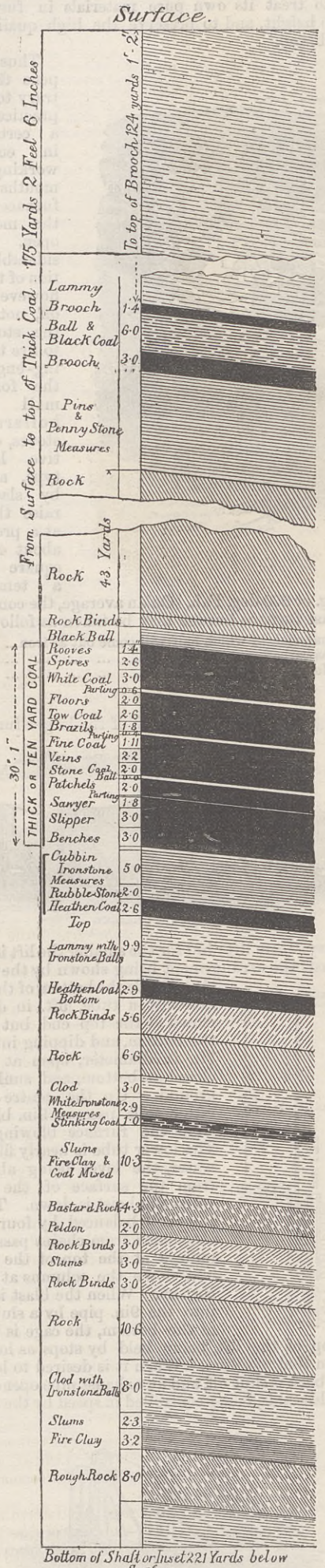
exhaust. This hoist requires no attendant like a steam lift, and, as it works with a minimum expenditure for repairs, is economical as well as effective.

A considerable portion of the pig iron produced at these works is of the description known as "cold-blast." Though this term was originally applied to iron smelted without the blast being heated, it is now generally understood to mean one made from materials selected with more than ordinary care; and it is in this sense that the term is

here understood, the pure charge being melted in the smaller furnace. The "CORNGREAVES" brand is a high quality of cold-blast pig, of the following composition:—

	No. 3.	No. 4.	No. 5. (Hard.)	Average.
Combined carbon ...	·35	·26	·58	·397
Graphite	3·06	3·01	2·48	2·85
Sulphur	·034	·05	·098	·061
Phosphorus	·217	·43	·26	·302
Manganese	1·305	1·09	·97	1·121
Silicon	1·848	1·48	·91	·413

The breaking weight of a 1in. square bar of No. 5, laid on supports 3ft. apart, was found by eighteen tests to be 9·3 cwt. on an average, while the average tensile strength of No. 4 is 10·8 tons per square inch. This iron is largely used for "chilled" rolls, and castings requiring great



SECTION OF MEASURES.

strength for marine engines and agricultural implements. It is also puddled for making special plates.

The "LION" brand of forge pig is an "all mine" iron, that is to say, made entirely from ore without any admixture of tap cinder. It is chiefly puddled at the works, so that but little finds its way into the market.

It is the aim of the general manager, Mr. George Allan, to keep in stock at least 1000 tons of each description of pig, so as to be able to puddle and roll off an order at short notice. In the puddling furnaces rich hematite ore is used on the bottoms in the case of best irons; and "bull dog" for fettling the sides. This substance is obtained by roasting puddling-furnace tap-cinder of the following composition:—

Protoxide of iron	58·85
Peroxide of iron	8·8
Protoxide of manganese	0·8
Lime...	0·32
Alumina	3·27
Silicon	21·12
Sulphur	0·53
Phosphoric acid	1·65

The roasting is effected in large but relatively narrow bins; and if the operation be complete the iron passes entirely into the sesquioxide condition, when it is found to have lost its property of fusibility, thus becoming capable of resisting great heat.

There are sixty puddling furnaces, the waste gases from which are utilised in firing two varieties of boiler, both made of Corngreaves composite plate—referred to more particularly below—in which steel and iron are intimately combined, and which, at a working pressure of 60 lb. per square inch, permits of the following thickness of plates:—end, $\frac{5}{8}$in.; shell, $\frac{7}{16}$in.; flue and tube, $\frac{3}{8}$in. Both are also provided with Galloway tubes. The vertical boiler is hung on brackets, leaving the bottom perfectly open to inspection. It is the greatest mistake possible to set a vertical boiler on a circular horizontal plate, or on a bed of masonry, because an unsuspected leak may cause the plates at the bottom to be eaten away. The flue tube is lined with firebrick from just below the water level upwards, to protect the plates; and the consequent reduction of sectional area by no means throttles the gases,

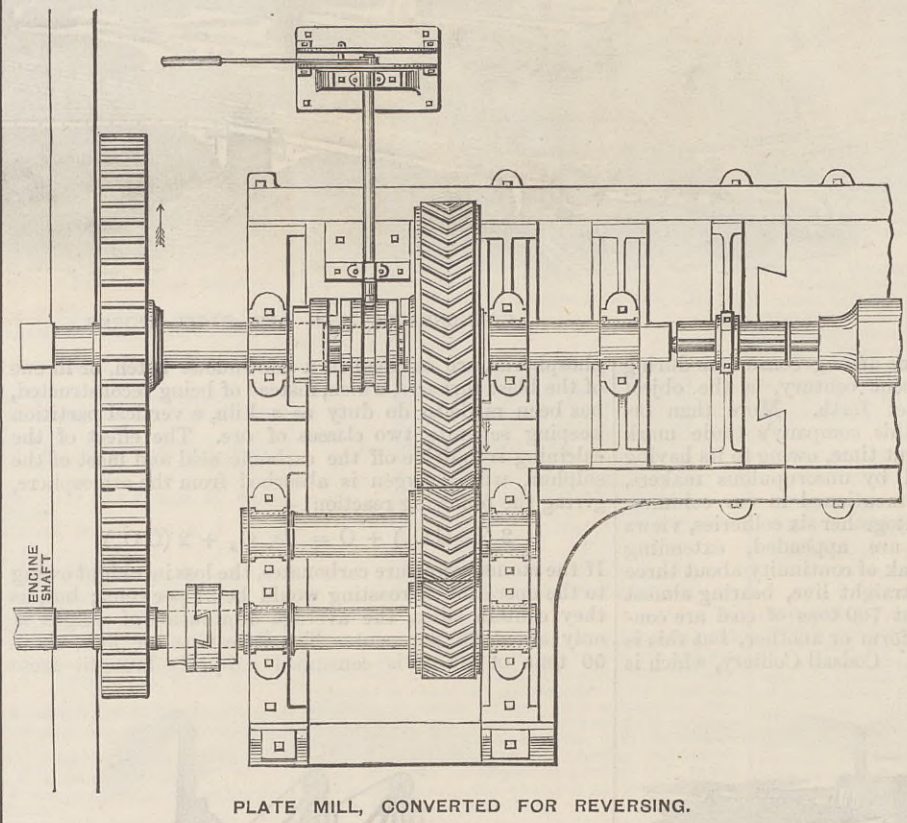


PLATE MILL, CONVERTED FOR REVERSING.

because they become so far cooled down before reaching that point as to have a considerably diminished volume.

It is preferred at Corngreaves to shingle the puddle ball for the "Lion" iron in the old-fashioned helve rather than under the steam-hammer, because the former goes on uniformly with its steady, solid blow, extracting the cinder and leaving a sound iron independently of the men's will; whereas it is possible with the steam hammer to so far humour the ball as to enclose a portion of cinder with the iron. Besides three 22in. forge trains, there are nine rolling mills, as follow:—16in. merchant train, 16in. train with slitting rolls for nail rods, 26in. plate mill, 22in. sheet mill, a 12in. and a 10in. three-high train, two hoop mills and a guide mill. As plates were demanded of continually increasing thickness, it became difficult to lift them over the upper roll for return; accordingly the mill was made reversing by the addition of a lever clutch and helical gear—shown in the appended drawing of the plate mill as altered—by which plates weighing up to 30 cwt. can readily be turned out. The arrows show the direction in which the wheels revolve for the forward pass. The best quality of strip iron is here rolled for being drawn into steam pipes.

The "Lion" brand of finished iron NB IC and NB IC LION has been honourably known in the principal markets of the world for the past sixty years, and is eminently suited for all purposes where great ductility and high tensile strength, combined with easy working at the smith's fire, are required. Test bars, taken at random by Government inspectors, frequently show an elongation of 33 per cent. in a length of 6in., while their tensile strength exceeds 22 tons per square inch, which is the Admiralty breaking test. This great ductility, a property unusual to such a degree in iron, is always to be preferred to an abnormally high tensile strength, gained at the expense of ductility. It is not surprising that with these qualifications the "Lion" brand of iron should have long been famous for chain making, as well as for rivets and boilers. The brand NBIC CORNGREAVES BEST possesses, only in a less degree, the properties of "Lion" iron, at a lower price.

Leaving now time-honoured iron, and turning to the metal of the future, steel bearing the brand NBIC CORNGREAVES STEEL is made from pure Swedish or Cumberland pig by the Martin or open-hearth process. The six different grades, distinguished by letters of the alphabet, vary from the softest quality for stamping sheets to a hardening metal, capable of taking the highest temper for cutting tools. While the former shows a tensile breaking strength of 23·8 tons per square inch, with an elongation of 36 per cent. on an 8in. length, the latter gives a tensile breaking strength of 51 tons and an elongation of 13·7 per cent. on the same length. The steel is made in a Siemens gas furnace, somewhat modified in detail, an illustration of which is given on page 428. The ends are bulged or rounded, as will readily be noticed on the plan, so as the more easily to distribute internal strain; and wrought iron retaining plates, rivetted together, are used instead of the cast iron plates usually employed. The latter frequently give trouble by cracking and failing at different points, with the alternate expansion and contraction of the brickwork through the heating and cooling of the furnace; whereas this form of wrought iron casing has sufficient elasticity to allow for the contraction and expansion. Moreover these plates are interrupted at a certain height, corresponding to the air and gas ports where the heat is most intense, so that, by simply taking out a few bricks in the outside wall, the necessity is obviated of removing the usual cast iron plates at the end, or cooling down the furnace sufficiently to effect the repairs from the inside. In this way those parts of the furnace most liable to be burnt may be renewed with a minimum cessation of working. Most of the gas heating furnaces are built with the same improvements; and each furnace is provided with its own individual chimney, consisting of a plate iron tube lined with brick. Owing to this arrangement each furnace is more thoroughly under control, so as to be worked with greater regularity than if delivering into a stack or flue common to many. The gas is generated in Wilson's producers, in which a current of air, that may be regulated at will, is constantly forced in by a jet of steam, thus rendering the operation entirely independent of atmospheric changes. This system affords such a pressure of gas in the flues supplying the furnaces as to assist still further in working and controlling them.

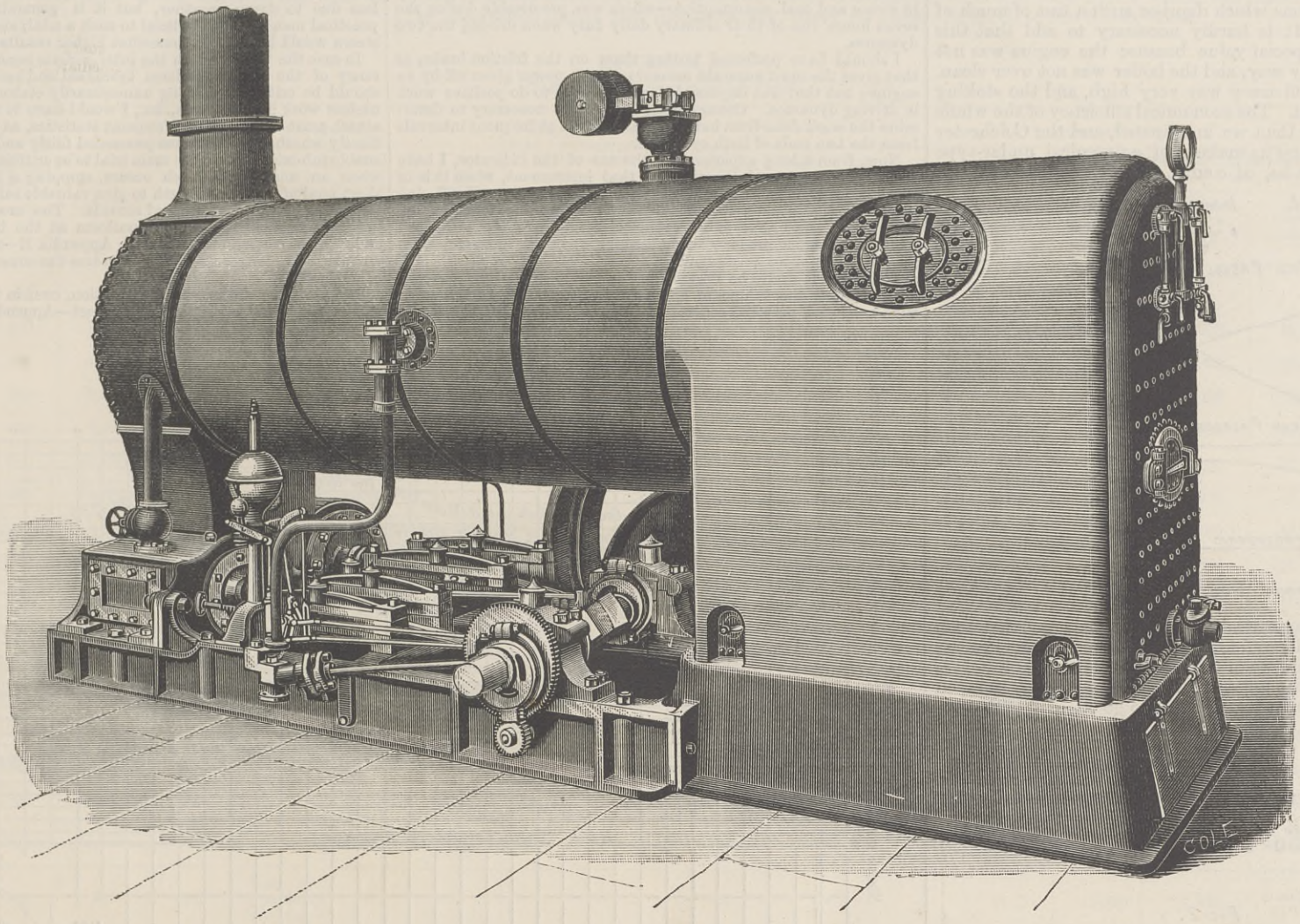
Eight tons of steel are got out of the furnace at a cast, and the metal is run, on the ascentional principle, into ingot moulds generally arranged in groups. In the case of small ingots the moulds are cast together in lateral groups; and several of these are placed together, end on, in the pit, the top of each mould receiving a fireclay ring for reducing the sectional area, and thus forming a neck to facilitate the division of the ingots. Among the many and varied applications of the steel made at Corngreaves may be mentioned the following:— Bars of channel form, with one or two ridges, are rolled for Messrs. Howard, of Bedford, to make their patented light railway sleepers, in which the jaw is formed by pressing the metal upwards instead of cutting it away.

A very tough, and at the same time rather hard, plate is made, from which the blanks for shovels are sheared or punched at the works, to be afterwards pressed into their definite form. The pieces sheared out at the sides, instead of going at once to scrap, are utilised for making washers, in the following manner:—The power press has two punches and dies corresponding to the internal and external circumference; and the two holes are punched at once, but not together. The smaller is punched first, and then set on a conical nipple as guide, when the larger is punched, and at the same time another smaller hole for the next washer. This apparently small matter evidences a watchful eye on the part of the manager to economise to the utmost both time and material in all the departments of these important works. The forges, mills, and steel works are lighted at night by twenty-two Maxim-Weston 1200-candle lamps, worked by two separate engines and dynamos in the blowing engine house, thus requiring no separate attendant, and an expenditure of steam that is scarcely missed. The alternate lamps are in two separate circuits, each maintained by its own dynamo and engine, so that a breakdown in one would only put out half the lamps. The cost has not been found greater than that of gas, while the efficiency is far higher. At first the men suffered from the glare through constantly looking at the lamps; but as soon as the novelty wore off, they found the light far better to work with than gas, and would not return to the old system upon any consideration.

The manufacture of a perfectly new and patented material has lately been started, in the composite steel and iron, bearing the annexed brand, THE NBIC CORNGREAVES COMPO PATENT and consisting of so intimate a combination of the two metals, short of their being absolutely mingled, as to give it all the advantages of each. Two iron plates are punched with a previously determined series of holes, into which corresponding bars of a high-class iron are inserted, thus forming a "cage" capable of being inserted in the ingot mould, after being heated to 700 deg. or 800 deg. Fah. by gas in the steel casting ladle. Steel of the desired grade is run into the mould, completely enveloping the iron bars, and effecting the closest union, owing to the fact that steel welds more readily to iron than to itself. When the ingot

COMPOUND SEMI-FIXED ENGINE.

MESSRS. DAVEY, PAXMAN, AND CO., COLCHESTER, ENGINEERS.



is "cogged," the steel and iron portions are drawn down evenly, so that small bars treated with acid on the planed ends show a perfect reproduction in miniature of the original ingot section. The presence of iron secures facility of welding and working this material in the smith's fire, while it is not liable to fail by cracking or tearing across, as in certain circumstances and under certain conditions has been the case with steel. It is thus specially valuable for crank shafts, railway axles, chains, and boiler plates. Short link chains made of "compo" have shown as much as 262 per cent. higher resistance, when tested to destruction, than the Admiralty tests, while the presence of steel, a layer of which is naturally outside, gives a high wearing power as compared with iron. Independent tests carried out at Lloyd's Proving House show boiler plates made of "compo," with a tensile strength of 25 to 30 tons per square inch, to be 30 to 40 per cent. stronger in this respect than iron plates across the grain, while the material will flange and weld like Lowmoor iron. In this connection an old-established firm of engineers report that they have used the material for a welded and flanged flue boiler with conical tubes, and that it was all that could be desired throughout the operations of welding, flanging, and bending; while an equally well-known firm of agricultural implement makers state that they will continue to use it wherever they possibly can. The men found it easier to work than either iron or steel alone, because it bore "punishing" so well, and worked so toughly, bearing at the same time extremes of temperature which steel could not. This material is also used for gun barrels, the intermixture of iron and steel producing a beautiful pattern on the surface when finished and browned.

Another combination, the "Safe Compo," for bankers' safes and strong rooms, is made by enclosing layers of hard between layers of soft steel, so that the rolled plates are hard inside and soft out. After they have been machined and fitted, and the holes drilled, they are heated to bright red and quenched, when the inside becomes so hard as to resist a drill, and the outside remains tough for withstanding blows, while the rivets made in the same manner cannot be drilled out. Other combinations under this ingenious process will doubtless be called into existence by practical requirements.

Samples of all materials are constantly being analysed; and frequent tests are made of the products at their various stages. For this purpose, a 50-ton testing machine has been supplied by Messrs. Tangye, of Birmingham, the hydraulic press being worked by a gas engine, so that it can be started and stopped as required. The registering is effected by a compound lever giving a proportion of 280 to 1; that is to say, 8 lb. at the end of the lever registers a strain of 1 ton on the test piece. The jaw has an internal dovetail, with corresponding tapered blocks, so as to hold the test-piece all the tighter the greater the strain put on. During our recent visit to the works we saw three tests carried out in the presence of the oldest Government inspector, who has for many years been stationed at the works. The first was a bar of "Lion" best best iron, $\frac{3}{4}$in. square, or 0·55 square inch in sectional area, tested on a length of 8in. It broke under a tensile strain of 12·95 tons, equal to 23·33 tons per square inch, with an elongation of 2·25in. on 8in., or 28 per cent. This result was rather lower than the average, viz., 24 tons, on account of a local defect, manifest in the fibrous fracture.

The next was a sample of mild steel, of the "T B," or plate and stamping grade, containing about 0·13 per cent. of carbon. The bar, originally $2\frac{1}{2}$in. by $\frac{1}{2}$in., was machined down to 2in. wide, thus leaving a sectional area of about a square inch, actually 1·04 square inch. This piece stood a tensile strain of 27·1 tons, or 26 tons per square inch, giving an elongation of 41·66 per cent. on a length of 3in. The third test was on a piece of "compo," or composite steel and iron, formed by casting an 11in. steel ingot, containing 0·2 per cent. of carbon, so as to envelope forty-four $\frac{3}{4}$in. square bars of iron. A $\frac{3}{4}$in. rod of the material, turned down so as to have a sectional area of 0·465 square inch, stood a tensile strain of 12·9 tons, equal to 27·7 tons per square inch, with an elongation on 8in. of 26·29 per cent. This compares favourably with the Admiralty limit for "best best" iron of $23\frac{1}{3}$ tons per square inch. But little importance is attached at Corngreaves to the reduction of area, on account of its being untrustworthy, owing to the difficulty of accurate measurement.

While recently visiting these old-established and justly famous works, we were gratified to observe that the New British Iron Company is in nowise disposed to rely solely on its well-earned reputation, but is in every way keeping abreast of the times, not only in modes of manufacture but also in anticipating every requirement of the market. Its book of full size sections lately issued is not only most complete in itself, but also contains some useful tables and valuable hints on the working of iron and steel, while the style of get-up may be inferred when we say that it is printed by John Bellows, of Gloucester. We learn, moreover, that one of the principal officials—possessed both of practical knowledge and business experience—has just been despatched on a tour through India and Australasia for ascertaining the requirements of those countries, so as to place the management in a better position to meet them. We are convinced that those manufacturers who cultivate direct relations with consumers, especially in the Colonies, will secure a large share of that trade; and we therefore congratulate the New British Iron Company on its spirited policy, and wish it the success it so thoroughly deserves.

TRIAL OF A COMPOUND SEMI-FIXED ENGINE.

Very little is known concerning the economic efficiency expressed in terms of horse-power, coal, and water, of the large class of compound engines without condensers. Indeed, we believe that the pages of The Engineer contain the records of only two such trials, carried out by ourselves some years since with compound portable engines made by Messrs. Richard Garrett and Sons, of Leiston. As regards the semi-fixed or "under-type" engine built by the hundred, although various statements of results of trials have from time to time been published in the catalogues and circulars of the makers of such engines, there is a total absence of records of independently conducted trials. We have no desire to impute unworthy motives to anyone, and we have no doubt that the records of private trials such as those to which we refer, honestly represent the belief of those who carried them out. But with the best intentions in the world, it is probable that errors will creep in, not adverse to the performance of the engine; and even if this were not the case, such trials fail to carry with them the conviction belonging of right to trials carried out by wholly independent and competent authorities. It is with the more pleasure that we place before our readers detailed particulars of a test worked out with all the resources of science, by men whose skill and experience in conducting this species of research is simply pre-eminent. The trial possesses a special and far-reaching value quite apart from the actual engine to which it refers; because it supplies at once extremely useful information of a general character concerning the economy of fuel to be expected from properly designed and constructed non-condensing engines, and also full instructions as to how a trial of this kind ought to be made.

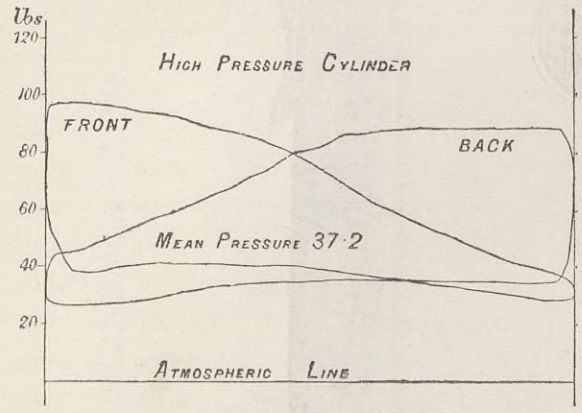
The engine in question is one of several built a few years ago by Messrs. Davey, Paxman, and Co., of Colchester, and it has been regularly employed in electric light work at South Kensington. Mr. Paxman determined some months since to have this engine tested for his own information, by independent authorities; and the steam using public are indebted to him for the courtesy with which he has placed the particulars we publish at our disposal. It was not, however, until near the close of the exhibition that an opportunity occurred for making this investigation. We need scarcely stop to point our that Mr. Rich's large experience at the Royal Agricultural Society's shows renders him eminently suited for work of this kind; while in Professor Kennedy he had a colleague in every way competent to deal scientifically with the results to the best possible advantage.

The reports are so complete that we have little to add. We give an external elevation of the engine above, and on page 424 will be found detailed engravings which explain themselves. The governor gear is Paxman's automatic. It is to be regretted that no opportunity of obtaining the electrical output was obtained, as such information would have been extremely interesting. Two dynamos by different makers were driven by the engine from one countershaft. The total power expended on the two was, of course, known. How much went to each, however, could not possibly be known, and therefore the respective merits of the machines could not be ascertained. One might be very good and the other very bad; no one could tell which was the better or the worse; and so it was decided, after the usual fashion of dynamo makers, that no information on the subject should be made public.

It will be seen that the method adopted for determining the state of the fire at the beginning and end of the trial is one suggested years ago in this journal, and first, we believe, practised by ourselves. During the engine trials of the Royal Agricultural Society steam was first raised from cold water to the working pressure. This attained, the whole of the fire was drawn, the fire-box rapidly swept out, and the fire relighted with the weighed coal. During this period, as the engine was not running, there would be little or no loss of pressure. In the present case this could not be done, as the engine was discharging its daily functions, and could not be stopped. So the fire was permitted to burn down until the pressure fell to 100 lb. Then firing with weighed coal began. At the end of the trial, in like manner, the fire was permitted to burn down until the pressure fell to 100 lb. Like causes producing like effects, the condition of the fire must have been the same at the end as at the beginning. This method can be used with much accuracy. When there

are several fires, as in the case of marine boilers, a little care is necessary to see that all the fires are about in the same condition and none of them "green." A great advantage of this system is that it permits even a very short trial, such as one of two hours' duration, to be carried out under conditions which deprive such a test of much of its uncertainty. It is hardly necessary to add that this trial possesses a special value because the engine was not "jockeyed" in any way, and the boiler was not over clean. The evaporative efficiency was very high, and the stoking skilfully conducted. The economical efficiency of the whole machine is higher than we anticipated, and the Colchester firm now stands first as makers of economical under-type engines. It may be, of course, that other firms turn out

FIG 1. INDICATOR CARDS



CARDS SET VIII 12·52 P.M.

engines equally economical, but there is no proof that such is the case, and an incredulous world demands in the present day something more than the assertion of a maker before it will believe in the efficiency of an engine. We have, in this case, a good solid basis of fact to go on.

The report is preceded by the following letter :—

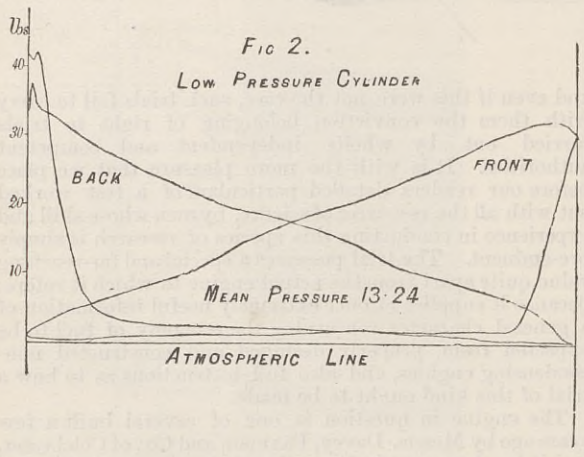
104, St. George's-square, London, S.W.
15th November, 1886.

DEAR SIR,

I thank you for placing in my hands the commission to test these engines.

All such trials are interesting to me, and this has been so especially as very little is known of the actual economic per-

FIG 2.



formances of compound high-pressure non-condensing engines, though in general recognition of their good qualities they are coming into use largely where economy is desirable and condensing water cannot be obtained.

The results of the trial detailed in the following report must tend largely, I think, to confirm the good opinions of the public regarding engines of this type.

The engines, when you first introduced me to them officially on

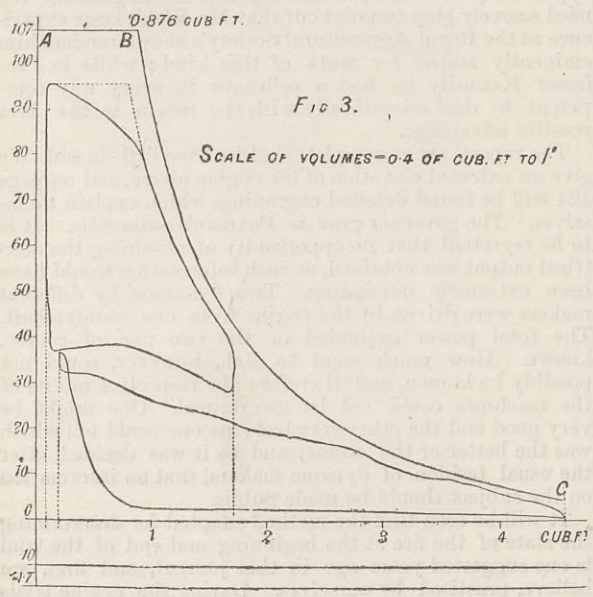


FIG 3.

SCALE OF VOLUMES = 0·4 OF CUB. FT TO 1"

The ordinates of each card in this figure are the means of a pair (front and back) of actual indicator cards. The length A B represents the volume of steam, at boiler pressure, corresponding to the measured feed-water per (single) stroke. The line B C is the theoretical (adiabatic) expansion curve for this quantity of steam in a single unjacketted cylinder.

the 20th October last, were driving two dynamos for electric lighting purposes at the Colonial and Indian Exhibition, and I learned from you that they had been working steadily, day after day, through three successive exhibition seasons on similar duties without any material repairs or overhaul; that no special overhaul of them had been made for preparing them for the present trial, which took place at the end of an exhibition season, and that consequently the present test might be taken as that of such engines in current working condition.

The normal daily duty of the engines recently has been to drive two dynamos, chiefly for charging storage batteries, during seven hours—from about 9 a.m. to 4 p.m—and then, after an hour's rest, they have been started again to drive one dynamo throughout the evening.

I understood your instructions to me to be, that you would place the engines, with the ordinary fireman and engine-driver, unreservedly under my control; and that you desired me to carry out the most perfect test of their economical performances—especially in steam and coal consumption—which was practicable during the seven hours' run of their ordinary daily duty when driving the two dynamos.

I should have preferred testing them on the friction brake, as that gives the most accurate measure of the power given off by an engine; but that was impossible, as they were to do positive work in driving dynamos. Consequently it became necessary to determine the work done from indicator cards taken at frequent intervals from the two ends of both cylinders.

Now, from a long experience in the use of the indicator, I have the highest opinion of the value of that instrument, when it is in the hands of a careful and experienced operator, and all due precautions are taken to get accurate results; but I am at the same time aware that most erroneous results are often deduced from experiments made with indicators when all necessary safeguards have not been attended to.

I felt that it would be impossible for me to give close personal supervision to the taking of frequent diagrams, and at the same time keep such personal control and current records of the whole trial as would be necessary to make all the results above suspicion, and thus I was led to ask your permission to associate with me my friend Professor Kennedy, of University College, whose experience in the testing of engines, and the use and testing of indicators, is well known in the engineering world.

His presence must add to the value of the trial, as a record of carefully ascertained facts, and deductions from them made and checked by two unprejudiced experimenters.

The trial generally—with Professor Kennedy's approval—was conducted by me on the same lines as I had originally intended, and the results, prepared and checked by us jointly, are tabulated and recorded graphically, in curves of a type which I have found by experience to give some of the best evidences of the reliability and accuracy of such records, and the results deduced from them.

We provided ourselves for the purposes of the trial with a powerful staff of assistants, so that all important records were at least doubly checked, and we divided the work of supervision in the following manner:—For the operations of starting and stopping under the most uniform conditions of coal on fire, water in boiler, steam pressure, &c., to which the greatest possible importance in such trials must be attached, we both attended in the stoke hole, and checked the facts and figures carefully with one another.

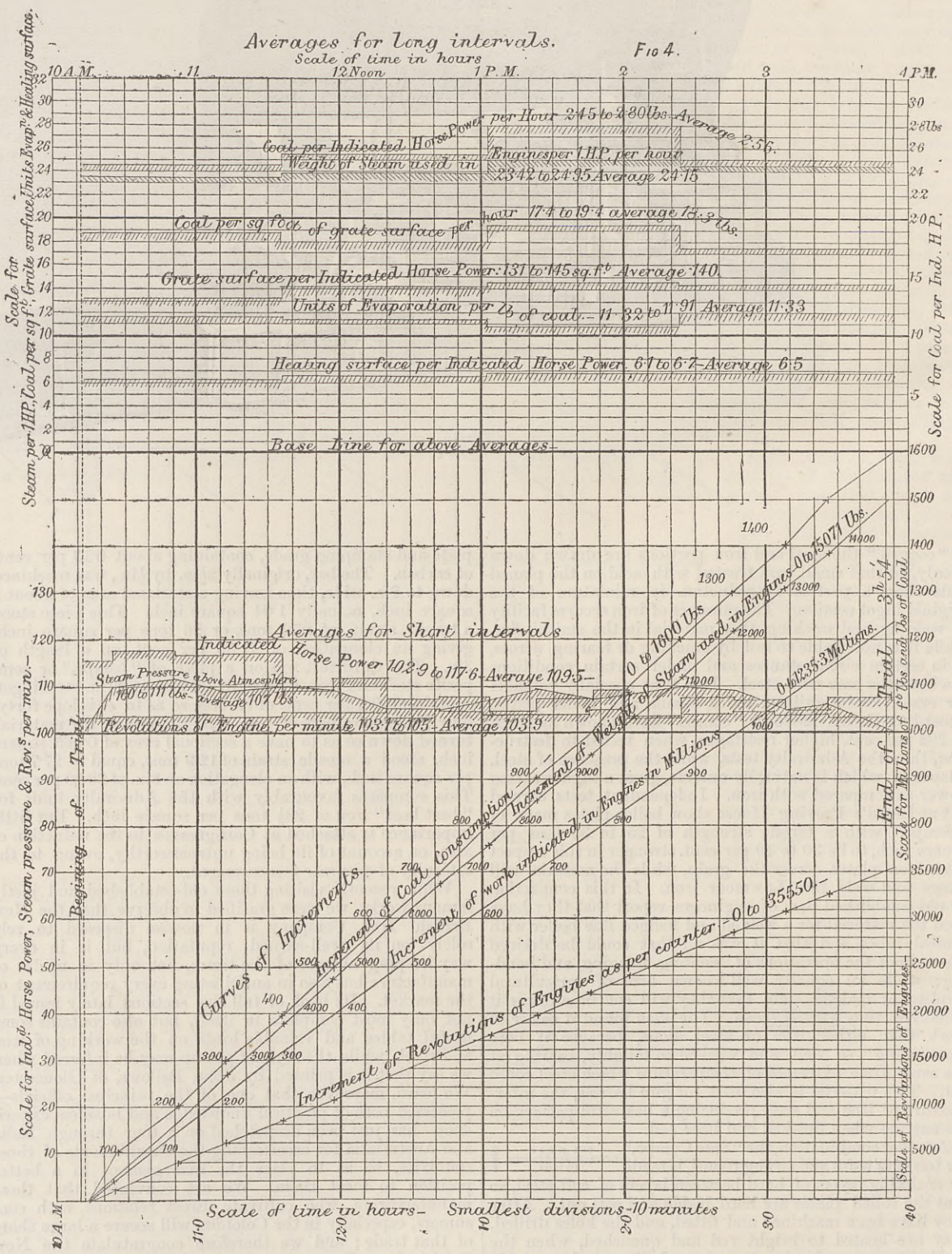
In the interim, during the currency of the trial, I devoted attention to the general control of it, the measurement and official logs of coal, feed-water, steam and water gauges, counter, and temperatures, &c., while Professor Kennedy directed the staff taking and reducing the indicator diagrams, and at a table placed near the engine he plotted the records and results, with curves of increments and averages as fast as we obtained them, so that any irregularity would have been noticed immediately; and I cannot speak too highly of the value of keeping such records up to date in such a trial.

The day was damp, indeed it was raining during the afternoon, and the steam pressure was less than that at which you desired to work. I am not prepared to give an opinion as to the amount of loss due to damp weather, but it is generally considered by practical men to be prejudicial to such a trial; and no doubt 115 lb. steam would have given somewhat higher results than 107 lb.

In case the way in which the intermediate records during the currency of the trial have been tabulated and recorded graphically should be criticised as being unnecessarily elaborate and leading to useless work in reductions, &c., I would have it understood that I attach great value to these frequent statistics, as they evidence distinctly whether the trial has proceeded fairly and uniformly; they enable sub-trials within the main trial to be criticised, and sometimes when an unexpected hitch occurs, stopping a test altogether, a short trial of sufficient length to give valuable information, may be taken out of the incompleted records. The most difficult matter in such a trial is to get the fire uniform at the beginning and the end. The curves of increment—see Appendix E—are the best check on this. The longer the trial is the less the error from such lack of uniformity.

The variation of the coal consumption, even in the long intervals, shown near the top of the curve sheet—Appendix E—shows how

FIG 4.



The report proper, addressed to Mr. Paxman, runs as follows :—

In accordance with your request, we, on October 27th last, carried out a trial of the economic performances of your 40-horse power semi-fixed compound engines which were then driving two dynamos in the South-west corner of the Electric Light shed at the Colonial and Indian Exhibition.

Description of engines.—The cylinders and working gear of these engines are fitted to a bed-plate placed beneath the barrel of the boiler, the cylinders themselves being side by side under the smoke-box. The cylinders are fitted with steam jackets, but at the time of the trial no steam was admitted to the jacket spaces, which were supposed to be full of dry warm stagnant air which would act as a non-conductor. The external cylindrical surfaces are lagged, and the boiler-shell is coated with non-conducting composition. The admission of steam to the high-pressure

little value can be attached to the reputed coal consumption when the trial is of very short duration.

I now beg to hand you the following joint report by Professor Kennedy and myself on the trial and its results.—I remain, yours very truly, (Signed) WILLIAM E. RICH.

James Paxman, Esq., Colchester.

cylinder is regulated by a gridiron valve, the stroke of which is controlled by the governor which actuates a block in a suspended link. The exhaust valve for the high-pressure cylinder and the main slide valve of the low-pressure cylinder are placed in an intermediate receiver between them.

verified the strokes and diameters. The strokes are as stated above, but the high-pressure cylinder diameter is now 12·28in. and the low pressure 20·03in. diameter, the barrels having worn slightly from continuous use, but being in excellent order. The co-efficients used in calculating the power from the diagrams are based on these

was graduated by us by pouring into the tank successive quantities of water of 60 lb. each, weighed in the same scales as were used for the coal. The feed suction pipe was connected directly to the bottom of this tank, and was furnished with a cock which was closed precisely when the float fell to the 800 lb. mark.

APPENDIX A.

TABLE I.—*Abstract Log of Trial.*

Time at which stoker began to serve each 100 lb. of coal on fire.	Total coal served on fire previously.	Other records at same time.					Evaporation out of boiler by lowering water in it since start.		Total weight of steam used in engines since start.	Indicator experiments.						
		Counter.	Steam pressure in lbs. on sq. in.	Temperature of feed-water, Fah.	Total weight of feed-water served into boiler, in lbs.	Height of water in gauge glass on boiler.	In inches on gauge.	In lbs. weight of water at 310 lb. per inch deep.		Register No. of set of diagrams, representing mean work per rev. since last reading.	Approximate time at which these diagrams were taken.	Mean pressures indicated.		Foot-pounds of work indicated per revolution, as per diagram.		
												In high-pressure cylinder.	In low-pressure cylinder.	High-pressure cylinder, = 466 p.	Low-pressure cylinder, = 1253 p.	Total.
h. m.				deg.		in.	in.	lbs.			h. m.					
10.12	0	0	100	55	0	1·4	—	—	—	—	—	—	—	—	—	—
10.25	100	1,340	110		—	1·7	−·3	−93	—	1	10.20	37·8	15·38	17,610	19,270	36,880
10.51	200	4,030	111	56	1,720	1·5	−·1	−31	1,689	2	10.37	39·1	15·40	18,220	19,300	37,520
11.12	300	6,210	109		2,600	1·0	+·4	124	2,724	3	11.1	38·7	15·15	18,030	18,980	37,010
11.36	400	8,690	110	55	3,670	·9	·5	155	3,825	4	11.25	39·0	15·22	18,180	19,070	37,250
11.57	500	10,880	109		4,560	·8	·6	186	4,746	5	11.48	36·8	13·79	17,150	17,280	34,430
12.20	600	13,280	105		5,600	·7	·7	217	5,817	6	12.8	38·6	13·77	17,990	17,250	35,240
12.42	700	15,560	105	55	6,570	·8	·6	186	6,756	7	12.30	36·7	13·53	17,100	16,950	34,050
1.3	800	17,760	107	56	7,410	·8	·6	186	7,596	8	12·52	37·2	13·24	17,340	16,590	33,930
1.23	900	19,840	109		8,360	·8	·6	186	8,546	9	1.13	35·1	13·42	16,360	16,810	33,170
1.46	1000	22,230	107	55	9,220	·5	·9	279	9,499	10	1.33	36·9	13·42	17,200	16,810	34,010
2.2	1100	23,910	108		10,000	·6	·8	248	10,248	11	1.56	37·7	13·34	17,570	16,720	34,290
2.24	1200	26,190	110	56	10,940	·7	·7	217	11,157	12	2.12	34·7	13·24	16,170	16,590	32,760
2.46	1300	28,480	109		12,000	·9	·5	155	12,155	13	2.34	37·1	13·36	17,290	16,740	34,030
3.8	1400	30,780	105	55	13,090	1·5	−·1	−31	13,059	14	2.56	37·1	13·09	17,290	16,400	33,690
3.26	1500	32,650	106		13,500	·4	1·0	310	13,810	15	3.18	36·0	13·21	16,780	16,550	33,330
3.54	1600	35,550	100		15,040	1·3	·1	31	15,071	16 17	3.36 3.50	36·7	13·72	17,100	17,190	34,290
Averages	—	—	107	Mean of 19 records, 55·5 deg.	—	—	—	—	—	—	—	37·2	13·89	17,336	17,406	34,742

APPENDIX B.

TABLE II.—*Results of Trials.*

Time.	Increments since last reading.					Totals since start.					Average since last reading.				Units of evaporation or lbs. of water at 212 evap. at 212 deg. per lb. of coal.	Coal burnt per sq. ft. of grate surface per hour.	Grate surface per indicated horse-power.	Heating surface per indicated H.P.
	Number of minutes.	Counter.	Coal in lb.	Weight of steam used in lbs.	Foot lbs. of work indicated in millions of foot lbs.	Number of minutes.	Number of revolutions.	Coal served on fire previously to this reading.	Weight of steam used in engines.	Foot lbs. of work indicated in millions and decimals.	Revolutions of engines per min.	Indicated H.P. For short intervals.	Indicated H.P. For long intervals.	Weight of steam used in engines per I.H.P. per hour.	Coal burnt per I.H.P. per hour.			Heating surface, 711 sq. ft.
A M. 10.12	—	0	co	mmence	ment of	trial.	—	—	—	—	—	—		—	—	—	—	—
10.25	13	1340	100	—	49·4	13	1,340	100	—	49·4	103·1	115·2						
10.51	26	2690	100	1689	100·9	39	4,030	200	1,689	150·3	103·5	117·6						
11.12	21	2180	100	1035	80·7	60	6,210	300	2,724	231·0	103·8	116·4	116·5	23·42	2·45	11·39	18·7	·131	6·1
11.36	24	2480	100	1101	92·4	84	8,690	400	3,825	323·4	103·3	116·7						
11.57	21	2190	100	921	75·4	105	10,880	500	4,746	398·8	104·3	108·8						
12.20	23	2400	100	1071	84·6	128	13,280	600	5,817	483·4	104·3	111·5						
P.M. 12.42	22	2280	100	939	77·6	150	15,560	700	6,756	561·0	103·6	106·9	108·8	23·92	2·54	11·32	18·0	·141	6·5
1.3	21	2200	100	840	74·6	171	17,760	800	7,596	635·6	104·8	107·6						
1.23	20	2080	100	950	69·0	191	19,840	900	8,546	704·6	104·0	104·6						
1.46	23	2390	100	953	81·3	214	22,230	1000	9,499	785·9	103·9	107·1						
2.2	16	1680	100	749	57·6	230	23,910	1100	10,248	843·5	105·0	109·1	105·7	24·95	2·80	10·69	19·4	·145	6·7
2.24	22	2280	100	909	74·7	252	26,190	1200	11,157	918·2	103·6	102·9						
2.46	22	2290	100	998	77·9	274	28,480	1300	12,155	996·1	104·1	107·3						
3.8	22	2300	100	904	77·5	296	30,780	1400	13,059	1073·6	104·5	106·7						
3.26	18	1870	100	751	62·3	314	32,650	1500	13,810	1135·9	103·9	104·9	106·8	24·44	2·50	11·91	17·4	·143	6·7
3.54	28	2900	100	1261	99·4	342	35,550	1600	15,071	1235·3	103·6	107·6						
5 h. 42 m.	342	—	—	15,071	1235·3	—	—	—	—	Averages:	103·9	109·5		24·15	2·56	11·33	18·3	·140	6·5

Leading dimensions.—The following are the leading particulars of the engines furnished to us by your firm :—

High-pressure cylinder	12¼in.	diameter by 24in. stroke.
Low ,,	20in.	,, 24in. ,,
Steam stop valve ...	3in.	,,
Exhaust nozzle	4⅜in.	,,
Steel locomotive boiler ...	... 18ft. 4in.	long over smoke-box.
Barrel of boiler 4ft. 5in. dia.	12ft. 8in.	,, ,,
Heating surface in fire-box		88 square feet.
,, Tube surface, 100 tubes, 2¼in. dia. outside, 10ft. 7in. long between tube plates		623 ,,
Total		711 ,,
Fire-grate, ordinary, 5ft. long × 3ft. 10in. wide		=19·2 sq. ft. area.
,, Reduced size for trial	4ft. 7in. × 3ft. 4¼in.	,, =15·3 ,,
Air spaces between bars		total = 4·56 square feet.
Chimney		17in. diameter.

The boiler is proportioned for a working pressure of 120 lb. to 140 lb. per square inch, but at the time of the trial the safety valves began to blow at 115 lb. per square inch.

Cylinders measured by us.—To be precise we had the cylinder covers removed after the trial, and personally figures after allowing for the piston-rods, which are 2¼in. diameter. Previously to the trial we examined the pipe connections about the boiler and engines to see that there was no connection with other boilers, and at our request the injector and its pipes were disconnected.

Coal.—The coal used on the trial was "Radford's Navigation Welsh Steam Coal," from their Hafod Colliery, Rhondda Valley, and it was weighed in lots of 100 lb. each as the trial proceeded on a new weighing machine, which was verified by us both before and during the trial. Each lot of 100 lb. was charged on to the fire before the next lot was served out on to the stoking floor. Throughout the trial the moment at which the first shovelful of each 100 lb. of coal was served on the fire was signalled by a sharp whistle to the whole staff by Mr. Rich, and records of the condition of all the gauges, the counter, and the feed-water consumption, were then taken simultaneously and recorded in the official log.

Feed-water.—The feed was measured in a rectangular tank in which we had fitted a float gauge, so that at any moment we could see how many pounds weight of water had been previously served into the boiler. The float scale was graduated by us by pouring into the tank successive quantities of water of 60 lb. each, weighed in the same scales as were used for the coal. The feed suction pipe was connected directly to the bottom of this tank, and was furnished with a cock which was closed precisely when the float fell to the 800 lb. mark.

Indicators.—We found pipes fitted to each cylinder, so that the cards from both ends could be taken on one indicator placed midway between them ; but our joint experiences told us that we could not hope to get reliable results taken in that manner, and we consequently had the pipes removed and placed two "Darke's" indicators close to the respective ends of the high-pressure cylinder, and two "Richard's" indicators on the ends of the low-pressure cylinder. The former had $\frac{1}{4\cdot5}$ springs in them and the latter $\frac{1}{2\cdot0}$ springs. The instruments and springs were all supplied by us, and had all been tested comparatively recently. The four diagrams forming a set were taken simultaneously, as nearly as possible in the middle of the interval between the times at which the successive lots of coal began to be charged on the fire, as shown in the log.

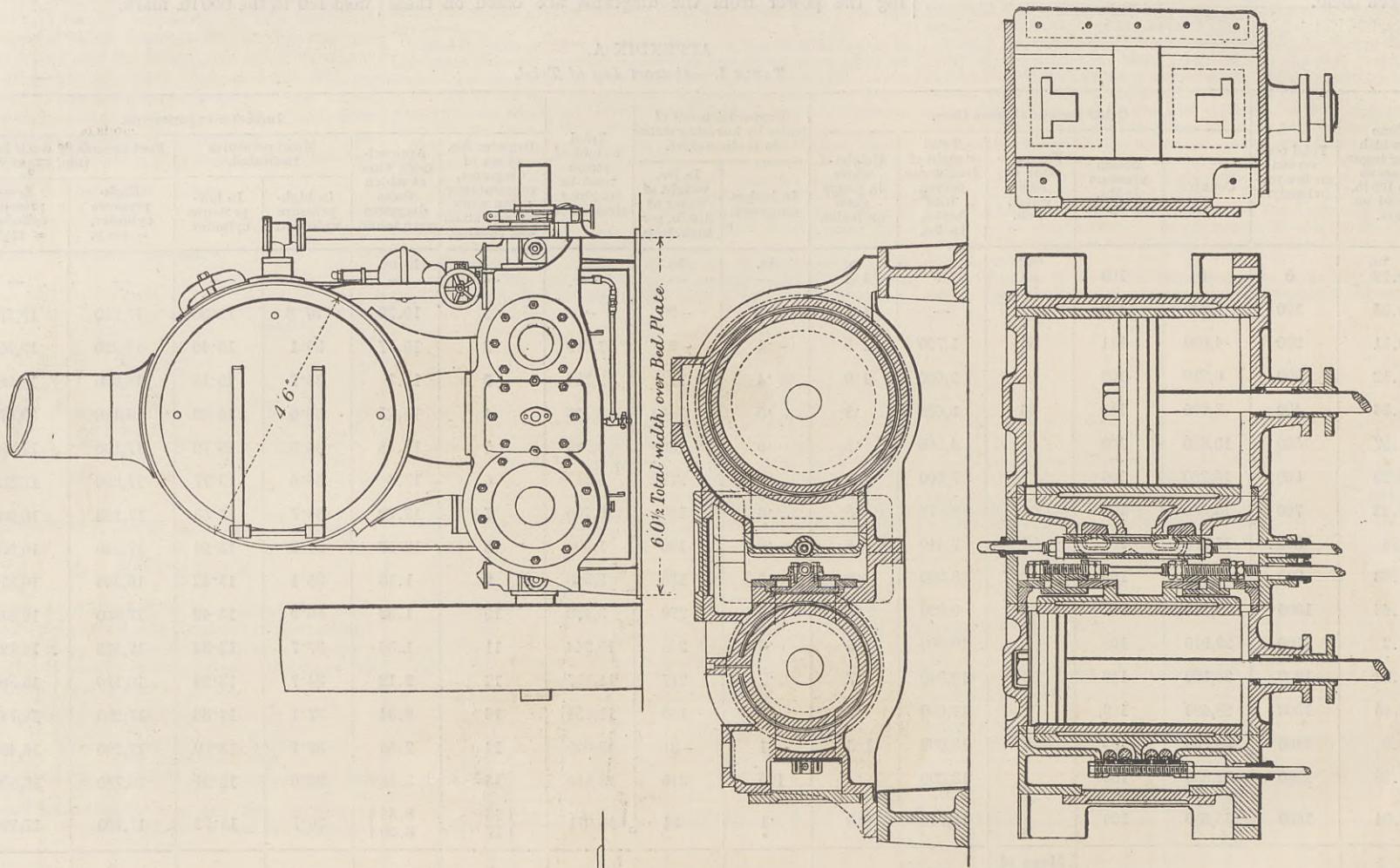
Measuring diagrams.—The indicator cards were measured in the first place during the trial by ordinates ; but subsequently, to be more precise, they were re-measured with a carefully tested planimeter, which gave results 1·8 per cent. less, and these last determinations have been adopted in the accompanying tables and records.

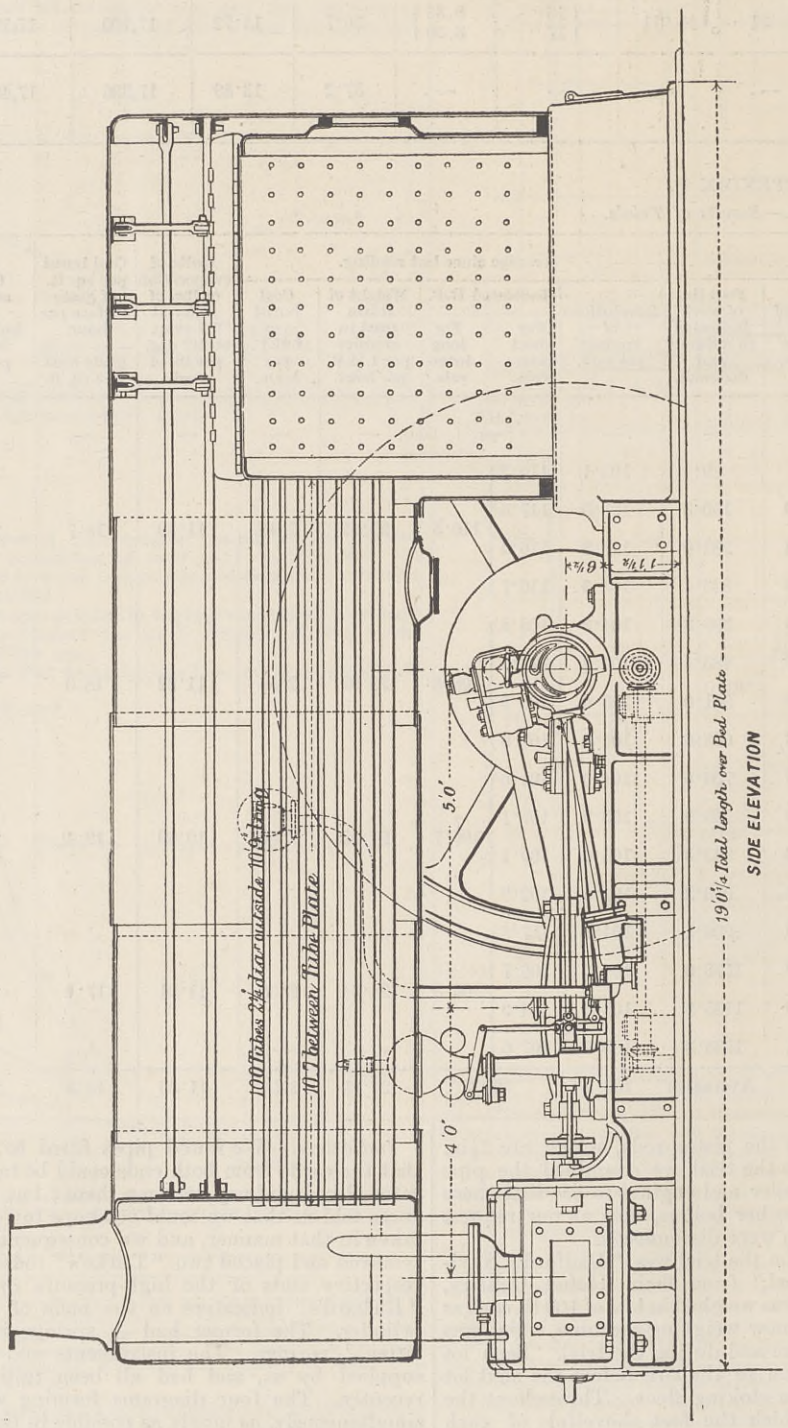
Indicators changed.—At an early period in the trial we

COMPOUND SEMI-FIXED ENGINE.

MESSRS. DAVEY, PAXMAN, AND CO., COLCHESTER, ENGINEERS.

(For description see page 421.)





STEEL-FACED ARMOUR PLATES.

Fig. 1.

Fig. 3.

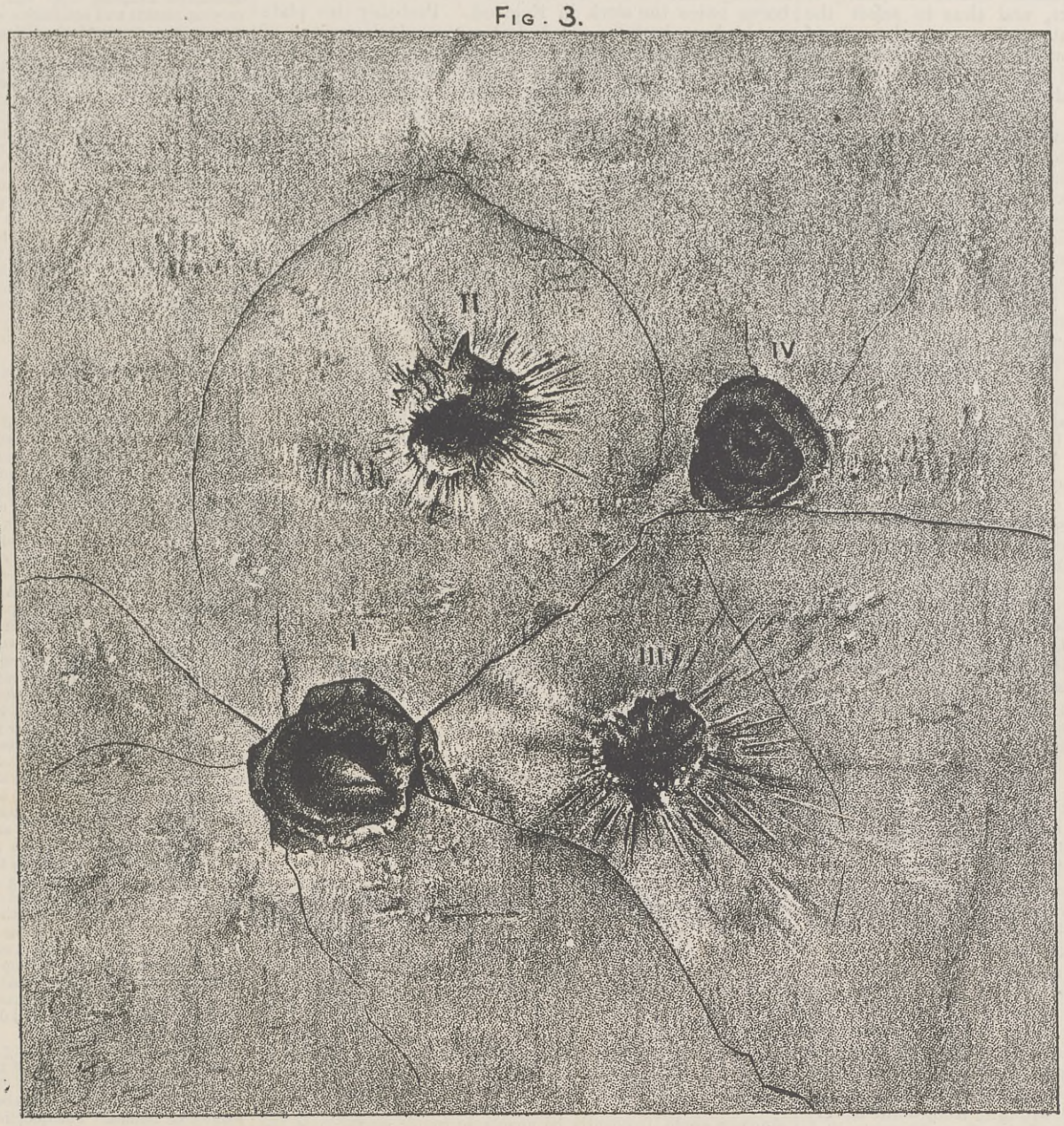


Fig. 2.

were somewhat nervous that the pressures at the back of the high-pressure cylinder were imperfectly indicated, as the initial steam pressure was much lower than at the front end. But the matter was carefully investigated by Professor Kennedy, and the indicator and spring were changed twice over, with results which confirmed the accuracy of the previous diagrams.

Water gauges.—Scales, graduated in inches and decimals, were placed against the water-gauge glasses on the boiler front, so that the variations of water level in the boiler could be recorded precisely. The alterations of level in the gauges were very gradual throughout, without any of the rapid alterations sometimes noticed on such trials. The steam supplied to the engines was apparently remarkably dry all day.

Variations in weight of water in boiler.—The area of the boiler at mean water level during the trial was measured, and the weight of water in it, at the mean steam temperature corresponding to each $\frac{1}{10}$in. on the scale, was thus estimated at 31 lb., and allowed for in determining the weight of steam used as shown in the tables.

Preparations for start.—On the 27th October the engines were started at about 9.15 a.m., and were due to stop at 4 p.m. We desired to get as long a trial as possible, under uniform conditions, out of the intervening six and three-quarter hours. At first the resistance of the dynamos was low, and the engine power was constantly increasing for a considerable time after the start; as soon as the normal resistance was reached we stopped further firing and feed, swept the stoking floor clear, and together watched the pressure-gauge till, from the lowering of the fire, which we also inspected from time to time, it fell to 100 lb. per square inch.

Trial started.—At that moment, viz., 10.12 a.m., the first signal was given, the counter, which stood at 0, was thrown into gear, the gauges were all noted, and the first shovelful of the first 100 lb. lot of coal was put on the fire. The feed tank was full, and shortly afterwards we began to charge measured feed-water into the boiler, and at 10.20 the first set of diagrams was taken. Records at frequent intervals, as described above and shown in abstract log of trial, followed for five hours forty-two minutes. At 12.30 the fireman began to use some of the few ashes which had accumulated in the ashpit since the start.

Trial near completion.—At 3.26 we told him that the 100 lb. lot of coal then commenced would be the last served out to him, and that he must make the most of it, and the ashes which remained. At the same time we arranged so to adjust the feed service as to get back the water in the boiler as nearly as possible to the level at which we started.

End of trial.—When at last the fire became unequal to make the steam demanded by the engines, the steam pressure began to fall, and we together watched it narrowly till on its reaching 100 lb. exactly, the final signal was given, the counter was pulled out of gear, the gauges and water tank consumption were all taken, and the trial was at an end—viz., at 3.54 p.m., having lasted 5 hours 42 minutes.

Uniform running.—During the whole trial the engine power, speed, steam pressure, &c., were remarkably uniform, the steam was dry, and there was no hitch or inconvenience of any kind from beginning to end. No handle about the engine was touched, excepting that on the feed suction cock and the water gauge cocks. The steam starting valve was wide open, the speed being controlled solely by the governor. The fireman regulated his fire and the feed-water to meet the current requirements of steam. Beyond the observations recorded, our assistants took many intermediate records, which, on being plotted, have been found to further confirm the accuracy of those given in the official log. The logs and results are given *in extenso* in appendices A, Table 1, abstract log of trial; B, Table 2, result of trial; C, specimens of indicator diagrams; D, expanded diagrams with adiabatic curve; E, diagrams showing curves of increments and averages and the general results of the trial graphically.

The following is a summary of the results:—

Duration of trial, 5 hours 42 minutes = 342 minutes, or 5·7 hours.

Totals.—Revolutions ... ... 35,550.
Coal served on fire ... ... = 1600 lb.
Weight of steam used in engines ... = 15071 lb.
Foot-pounds of work indicated ... = 1235 3 millions.
Number of sets of indicator diagrams 17.

Averages.—Steam pressure in boiler = 107 lb. per square inch.
Revolutions per minute ... 103·9.
Indicated pressure in high-pressure cylinder ... 37·2
" " low-pressure " ... 13·8
Indicated horse-power, high-pressure cylinder ... 54·6
" " low-pressure " ... 54·9
Total ... ... 109·5
Weight of steam used in engines per indicated horse-power per hour ... ... 24 15 lb.
Coal burnt per I.H.P. per hour ... ... 2·56 lb.
Water evaporated per lb. of coal ... ... 9·42 lb.
Mean temperature of feed ... ... 55·5 deg.
Units of evaporation or equivalent weight of water at 212 deg. evaporated at 212 deg. per lb. of coal ... ... 11·33
Calorific value of coal used as per means of six experiments with calorimeter at University College ... ... 13·9
Efficiency of fireman, furnace, and boiler = $\frac{11·33}{13·9}$ = ·815
Coal burnt per sq. ft. of reduced grate per hour 18·3 lb.
Grate surface per indicated horse-power ... ... ·14 sq. ft.
Heating surface ... ... 6·5 sq. ft.

The above results speak for themselves. We consider them eminently satisfactory for high-pressure engines in regular work without any special preparation for trial.—We remain, dear Sir, yours faithfully,

(Signed) William E. Rich, Mem. Inst. C.E.
Alex. B. W. Kennedy, Mem. Inst. C.E.

STEEL AND STEEL-FACED ARMOUR.

To make a full comparison between steel and steel-faced armour it would be necessary to be so far in the confidence of the manufacturers of both kinds of plate that the whole of the records, both of successful and unsuccessful trials, should be placed at our disposal. This is, obviously, never likely to happen. Our immediate object, then, is not to attempt this task, but rather to review data which have been placed in our hands, which are unimpeachable in their authority, depending chiefly on Government photographs, and facts, and figures; data which certainly deserve to be known and weighed before judging the merits of the question. In the nature of things, the information likely to be drawn out by the sweeping strictures to which we referred in our last article would be in favour of steel-faced armour, and this, undoubtedly, is the case. We have in our hands certain good results obtained with steel-faced armour which we had not before met with. Seeing that they chiefly refer to foreign trials, this is no great wonder. We have also some bad results obtained with steel plates; worse, we admit, than we expected. We are naturally inclined to wish well to British armour, but we should be lost to a sense of fairness if we regarded this as furnishing us with fair samples of the information we need. We are aware that it does nothing of the kind. Nevertheless, the results may be sufficiently important to make us feel that common justice requires that they should be noticed, and we are quite willing and anxious to give equal publicity to the best results obtained with steel and the worst with steel-faced armour, supposing the information sent for publication to be of the unimpeachable authority that belongs to Government photographs and records.

In discussing trials that have occurred with armour-plates, we may point out three or four features that have all tended to injure the reputation of steel-faced armour when compared with steel. (1) Steel-faced armour opposes a very hard face backed by a tough foundation plate. The face plate is thin, and by a direct blow it is possible at times, with a sharp-pointed projectile, to force it back, and so open it into the yielding iron behind it as to effect complete perforation. The wrought iron then bulges backwards and tears open. Steel has not so hard a surface but has more stiffness in its mass, it therefore does not bulge back, but swells up round the sides of the shot, coming forward and splitting as it rises up. We believe, then, that soft backing and direct attack favour the steel; and hard backing, and oblique attack the steel-faced shield. Competitive trials have generally been made with soft backing, and always, so far as we know, by direct attack. The oblique firing which is just commencing at Shoeburyness, though not competitive as to the plates, will soon tell us more on this head. (2) Steel, it will be acknowledged by all who are acquainted with it, varies much more in its quality than does wrought iron. Thus,

it would be only reasonable to expect that occasionally a steel plate might be found which would display exceptional qualities, and at other times one which would disappoint all hopes. If, however, it is possible to test the quality of a finished plate to any extent, and thus to select the best, it becomes obvious that steel accommodates itself to the picking out of champion plates better than to the regular supply of armour, and this would favour its reputation rather than its actual value on service. But of this more by-and-bye.

We do not mean that we have never been disappointed, nay, we might say disgusted, by the behaviour of a steel-faced plate; but we believe that when once the manufacture of plates of any given thickness has been mastered, it is easier to secure the conditions of uniformity in steel-faced armour than in steel. The imperfect rolling and other causes of bad union of the layers of the steel-faced iron plates are, we believe, simpler matters to deal with than the strange capriciousness of steel. It may naturally be urged that eventually the manufacture that shows the possibility of the highest qualities ought to have the greatest future before it, though troubles may long beset it. The question, however, is whether steel may not by a happy combination of circumstances, have achieved occasional success before steel-faced armour had been perfected on the same scale, without it being by any means proved that eventually the latter may not be as good or better than steel. The advocates of steel-faced armour claim the victory in every competition with plates of 12in. thick and under; that is, plates of such dimensions as have been thoroughly mastered in manufacture, and fall within the scope of certainty of supply. The competitions referred to are Ochta, in 1882-83—*vide* ENGINEER, Dec. 8th, 1882, and April 6th, 1883—when the Russians decided in favour of a Wilson's plate compared with a Schneider; Amager, in March, 1884—*vide* ENGINEER, May 30th, 1884—after which the Danish Government gave the order of supply to Messrs. Cammell and Co.; and lastly, only a few months since, Pola, when the Austrian Government decided in favour of steel-faced armour, Schneider's plate having in each of the two latter cases broken across the middle.

In the case of 19in. plates, at Spezia, in 1882 and 1884, the advocates of steel admit that the plates were not as good as they would hope to make when the manufacture on that scale is as completely mastered as on the 12in. scale; but they argue that in 1882 the Italian authorities decided in their favour, and gave them the order depending on the trial; although in 1884 the order went to Schneider Thus, if these orders be taken as the test of success, steel-faced plates have secured them in the three competitions with thinner plates, and in one out of two with the thick ones. If it be urged that 1884 was the more recent trial of the two, it is to be remembered that the test was a peculiar one. The plates had to receive the blow of one shell from the 100-ton breech-loading gun and four from a 10in. gun. No 19in. plate would stop the first projectile, for it had power to perforate 30·27in. of wrought iron, while a very mild plate of this thickness would stop the 10in. projectiles. Consequently the plate which would behave best under this trial would be a soft one which would let the 100-ton gun shot through easily without the shock being transmitted into the surrounding parts of the plate, so that the latter might maintain its full resisting powers against the subsequent attack. The heavy projectile was but little broken in passing through the steel plate, and it is urged that the greater extent that the heavy projectile was broken up by each steel-faced plate was the equivalent of the greater injury it suffered. This argument is undoubtedly good up to a point. The question is, whether it will hold to the extent required in order to rob the Schneider plate of its apparent superiority.—See ENGINEER, February 27th, 1885. —We do not know how this can be ascertained, but the mind can hardly fail to be influenced by the ugly coarse crystalline fracture and gaping layers of iron in a compound plate that breaks up badly, when compared with the fine, fibrous, and almost gentlemanlike character of fractured steel. Something also must be allowed to the steel on the score that it was represented by a single plate, while there were two compound ones. In fact, the steel has, we believe, invariably been represented by a single sample. Had Messrs. Brown and Messrs. Cammell thought proper to meet the test of 1884 by opposite properties in their two plates—one by trying to stop the big shot at any cost, and the other to let it through easily, and save the plate for the small ones—they would have puzzled the Commission. Of course the more honest plan was for each maker to send the best plate for service. To pass on, however, to the examples we wish to give.

At Ochta, on October 23rd and November 4th, 1885, a flat plate was tested which had been made on Wilson's patent at the Ijora Works, Kolpino, near St. Petersburg, for the Admiral Nachimoff. It was 8ft. by 7ft. 6in. by 9in. thick. The first round was fired from a 9in. Abuchoff Krupp, with an Abuchoff forged steel projectile, weighing 314 Russian pounds (283 lb. English), and charge of 71½ lb. Russian. The striking velocity was 1478ft., the energy 4280 foot-tons, and the perforating power 12·6in. of iron—see I. on Fig. 3. Next followed two rounds with Upper Turin chilled iron projectiles, weighing 308 lb. Russian (277 lb. English); charge, 64 lb. Russian; striking velocity, 1420ft.; energy, 3875 foot-tons; and perforation equal to 11·9in. of iron. Lastly, a 6in. breech-loading Brynk gun was fired, with an Abuchoff forged steel projectile of 97 lb. Russian (87 lb. English); charge, 39 lb. Russian; striking velocity, 1850 lb.; energy, 2072 foot-tons; and perforation, 10·9in. of iron. Taking the weight of the plate as 9·675 tons, the total energy of these blows amounted to 1457 foot-tons per ton of plate, that of the first being 442 foot-tons per ton. It may be seen that the plate has suffered but little. The steel projectiles I. and IV. have entered much deeper than the chilled ones II. and III. We may observe that this plate illustrates well the distinctive character of the shot and its effect on impact. The chilled points of impact are marked, it will be seen, by radiating lines, like the rays of the sun, made by the splash of the pulverised fragments of shot, for the lines are not cracks. The steel projectiles make much more distinct tracks and clean holes with no splashes. This result is good, but the plate was not very severely tested. Plates both of Brown and Cammell have borne twice the work in England. Probably this plate would have borne a good deal more. It is worthy of notice, as a foreign sample of manufacture.

Of the English armour tested abroad, on August 6th and September 10th, 1885, a Wilson compound plate was tested at Amager, supplied for the Iver Hvitfeldt. It was a flat plate, 5ft. square by 11½in. thick. The steel face was 4⅛in. and the iron 7⅜in. thick. It was attacked by a 10in. Armstrong muzzle-loading gun, firing an Ankarsrum chilled iron projectile, weight 181·5 kg. (400 lb. English), with a striking velocity of 423·6m. (1390ft.), an energy of 1660 metre-tons (5358 foot-tons), and a perforation of 13·4 of iron. The projectile broke up, producing some face cracks only. The shock per ton of plate, taking the weight of the latter at 5·151 tons, was 1040 foot-tons. The plate was then cut into two pieces through the point of impact, giving the section. Fig. 1 is a copy of a photograph of this section. It will be seen how well the steel has done its duty in distributing the work done on a large surface, so that the iron back or foundation has suffered very little.

A similar plate was attacked by the same gun with forged steel projectiles, weighing 182·5 kg. (402 lb.), on September 10th, having a striking velocity of 438 m. (1437ft.), and an energy of 1784 metre-tons (5760 foot-tons). The perforating power was 13·9in. of wrought iron, and the energy per ton of plate 1118 foot-tons. Fig. 3 shows a section made by cutting this plate across. The plate behaved admirably, having only a bulge and slight crack at the back—see Fig. 2. It may be seen that this very considerable blow was transmitted by the steel-faced plate on a large area of the iron foundation. Although the gun, being one of old type, did not deliver a shot with much perforating power, its striking energy was great and well disposed of. Plates seldom survive a blow exceeding 1000 foot-tons energy per ton of plate. This plate, therefore, has stood remarkably well.

LETTERS TO THE EDITOR.

RAILWAY COUPLINGS.

SIR,—I fully anticipated that the abstract published in your columns of Mr. Heinke's lecture upon this subject would have been more fully criticised than it has been by the advocates of automatic coupling. Mr. Heinke's conclusions seem to be based upon a somewhat superficial acquaintance with the systems of this coupling which are now claiming precedence, and having myself taken a great interest in the subject, I should like to trespass upon your space, and give my reasons for differing from him upon some vital points.

The result of Mr. Heinke's investigations leads him to the conclusion that hand couplings are more likely to secure general adoption on railways than automatic couplings. Now I must entirely differ from him here. In my opinion hand couplings are not even as effective as the ordinary shunting-pole now used, as shunters would frequently be unable to couple or uncouple the wagons when the buffers were "driven home," or when the wagons themselves were in motion. This defect in hand couplings was obvious to anyone who was present at the coupling competition at Nine Elms.

Again, time is of the utmost importance in the working of goods and mineral traffic, not only during the formation and "splitting up" of trains in large shunting yards, but also at roadside stations and junctions. The few minutes lost in backing or going ahead to get the required distance between wagons which is necessary for the working of hand couplings would frequently delay goods trains, with the result of their having to be shunted on sidings to allow passenger traffic to pass. At night time the shunter would require one hand to throw the light on the draw-hook whilst he worked the hand-coupler lever with the other. This is no easy task by daylight, unless the wagons are standing on a straight road, and at equal distances apart. Loss of time must result from these causes, without taking into consideration the liability of the lifting gear to get out of order; and its position being lower than the level of the buffers would increase the danger of passing between the wagons.

Now as Mr. Heinke fails to show that these points would be remedied by his own hand-coupling—of which he gives a description in his lecture—I do not think he has made out his case as regards hand couplings. In fact the shunting-pole, as I said previously, is more effective, notwithstanding its various drawbacks.

I should like to say a few words about the advantages of an automatic coupling, as contrasted with the non-automatic. I may remark here, by way of parenthesis, that the ideal coupling described by Mr. Heinke—in which description I fully concur—must be automatic, as the description would apply to no other class of coupling. The advantages I claim for an automatic over a hand coupling may be described as follows:—(1) Saving of labour and time. During the formation of trains any number of wagons can be instantaneously coupled, without the necessity for the shunter running from one wagon to another to couple up. (2) Saving of engine power. It is unnecessary to back and go ahead to obtain the requisite distance between wagons to enable the hand coupling to be worked. (3) Saving of wear and tear of rolling stock, as concussions caused by getting wagons in a position to couple or uncouple would be avoided, and the damage resulting therefrom dispensed with.

Now if I may be allowed a few more words, I would say that my investigations have led me to select a coupling which, as far as my humble opinion goes, fulfils all the conditions which can reasonably be required of it. It has no rigid projection—this Mr. Heinke describes as the basis of all automatic couplings—few joints, no springs, requires no lubrication, can be fitted to any vehicle at a cost little more than the ordinary coupling in use—as it can be made at the anvil—and in fact seems to realise all the requirements of Mr. Heinke's ideal coupling. I should have liked to have gone more thoroughly into matters of detail, but have already trespassed too much on your space.

The couplings, in full size, can be seen at the office of the Safety Automatic Railway Couplings Company, 23, Lime-street, London, where I have myself seen them practically at work. I understand from the inventor, Mr. Betteley, that they are already working, and have been so for some months, both in London and on the Cheshire lines. They have also been inspected by the officers of the Board of Trade, upon whose recommendation a special medal was awarded at the Inventions Exhibition. I hope to have some further ideas on this important matter brought forward in your columns by others interested in the subject. A. WARD, C.E.

Hyde Park Mansions, W.,
November 9th.

SIR,—Mr. Heinke—in your issue of 12th—has referred to automatic couplings generally, and to mine in particular. What he says concerning automatic couplings, as usually displayed, is quite true, but he is in ignorance of what has been actually done, when he comes to the conclusion that they can never be worked without uniform lengths of buffers or buffer stroke, and that they will fly apart. "Common Sense" knows far less on this matter than Mr. Heinke, but even Mr. Heinke has yet to design a non automatic coupling that can be worked under the immensely varying strains and conditions of traffic, and without danger to the men in the cramped conditions in which they at times have to work.

The attempt to provide that the same action shall be accomplished with the old links—or substitntes—vivified; in fact, that the work shall be done better than ever with the directing power, manipulation, and brain thought which now directs it, absent or at least a yard and a-half away, is an impossibility, as those who are seeking to provide it are gradually finding out. However meritorious as mechanical apparatus, no attempt to make the present links worked from the side, or actually automatic, can be worked in varied traffic, as after long practical study I know right well. What coupling inventors have to do is not to struggle each against the other, but to set to work by hook or by crook to practically prove the superiority of the appliance they put forward.

I only write you in order that the statements concerning automatic couplers contained in the letter referred to may not remain unquestioned, for I have no desire in so sacred a work as saving of human life to dispute with my competitors. It is a matter which only practical working can solve.

T. ATTWOOD BROCKELBANK.
24, Budge-row, Cannon-street, E.C., Nov. 16th.

SIR,—May I be permitted a few remarks in reply to Mr. Heinke's letter in your last issue? It does not follow that because I agree on the whole with his general introductory remarks, my views should of necessity coincide with his as to what follows. I do no not admit his arguments as to the comparative uselessness of automatic couplings when only partially adopted. The system I have selected for illustration is quite capable of working in conjunction with wagons fitted with dead buffers or with any stroke of buffer spring. Certainly during the period of transition the necessity for coupling as at present will occasionally exist, but not to anything like the extent Mr. Heinke suggests; for it must be remembered that a large proportion of the wagons so fitted would be confined to the district in which they are adopted, also that their proportionate number would increase annually. Mr. Heinke states that in any case his coupling could be worked from the side. I would ask, if the moving truck were fitted with his coupling, and the stationary one unfitted, would the shunter run alongside, holding the lever of his apparatus till the moment of impact? I think not. This would still further reduce his effective proportion. He further assumes that the rebound of the trucks on coming into contact would prevent an automatic coupling from working effectually. On reflection he will find that with such an automatic coupling as that referred to by me, such a result of a rebound is very remote, whereas with a hand coupling it is impossible to effect a coupling till after repeated attempts. He surely does not find in practice that the trucks are all stationary and close up for the work, and altogether ignores the frequency of fly shunting. Mr. Heinke can only be speaking from a very superficial examination of the drawings, or he would not have made the assertion as to fouling. Further, he has entirely mistaken the object with which provision is make for raising the shackle out of action, which is simply to avoid the accidental coupling of trucks when not intended, and corresponds with the drop of his coupling. Surely he cannot be serious when he states that he does not consider the ability to uncouple in tension an advantage, notwithstanding that the waste of time, damage to stock, and danger to the servants would thereby be greatly diminished.

His fears as to uncoupling accidentally are hardly justified in practice, as in consequence of the double hold such a coupling will bear the strains of a heavy goods train on a bad road, and when the engine has made several abortive attempts to start, without the results he names. The question of saving time is not altogether a matter affecting single trucks, but the whole train must be considered.

Finally, I take it that the question under consideration is the general one of non-automatic *versus* automatic couplings, from a mechanical and practical point of view. Mr. Heinke takes his own as a type of the non-automatic system, and I select the Copland-Gilmour coupling as being, in my judgment, the best representative of the other. COMMON SENSE.

London, November 17th.

DIRECTORIES.

SIR,—Messrs. Kelly's letter in your issue of the 19th inst. does not deal with the point as to "charging for entries of names in Trades Directories." I would ask, in special reference to the instance they give of one firm asking for their name to be inserted under eighty different trades, would Messrs Kelly or would they not have sent the member of their staff to remonstrate with the firm in question if the requisition for such a number of insertions had been accompanied by a consent to pay for seventy-four of these as advertisements? I maintain that a very large number of firms could not be properly or adequately represented without their names being inserted under twenty or more different headings; if they are limited to six, the Directory only conveys to the purchaser part of the information he thinks he is buying. And again, many persons would feel inclined to refuse to assist in their own imperfect representation, by refusing to select for Messrs. Kelly's information the six headings to which they are limited. How then do Messrs. Kelly represent such firms? I must contend that no Directory compiler can consistently make any such charges as I am objecting to; as soon as he does so, he should cease to sell his book as a Directory and should give it away, instead, as the advertisers' list, which in fact it is.

London, November 22nd. B. T.

EROSION OF GUN BARRELS BY POWDER PRODUCTS.

SIR,—My attention was attracted by the paper read by Colonel Maitland on the above subject, at the meeting of the Iron and Steel Institute, reported in THE ENGINEER of the 8th ult. The author was unable to account for the singular phenomenon that the erosion under similar conditions was greater in the barrels of the hardest steel, and less in those of the softer descriptions on which the experiments were carried out, and the discussion that followed failed to elicit it. If the following facts, acquired from practical experience, be considered worthy of publication, a corner may be allowed for them in your popular and valuable journal, which may throw light on this interesting subject.

Those who have used a diamond tool for turning are aware that while the diamond will cut the hardest hardened steel freely, it will not remove a cut from annealed steel or iron, so likewise—particularly in dry grinding—emery wheels will grind hardened steel freely, but will scarcely act on soft steel or iron, and much less on copper. In both cases the hardened steel will cut with a crisp feel under the diamond tool or emery wheel, whereas the softer metals will cling tenaciously and drag under the treatment, the particles yielding slowly, being torn off with great force rather than cut.

There is no question that the erosion is due to the impact of the particles of powder and its products after explosion against the interior of the gun barrels, acting like the well-known sand blast. Reasoning, therefore, from analogy of the behaviour of hardened and soft steel under the diamond tool and emery wheel, it would account for the rapid erosion of the hard steel barrels, and the resistance against the action by the softer steel. This fact will also account for the superiority of copper over steel for vent plugs.

Cawnpore, November 2nd. GAVIN JONES.

For continuation of Letters see page 433.)

RAILWAY MATTERS.

Li Hung-Chang formally opened the experimental line of light railway laid in the Decauville permanent way on the 21st inst.

A very successful test of the Sprague electric railway system was made the week before last on Thirty-Fourth-street, elevated branch of the New York Railways. The cars were lit by Edison lamps.

The men employed in the great locomotive works of the Midland Railway Company at Derby, who have been for some time past working only four days per week, have received notice that they are to work in future on Fridays, thus making up their time to five days per week.

A movement is on foot at Flamborough for the construction of a steam tramway to Flamborough Head. Mr. F. G. Fairbank, C.E., has made two surveys, one by the road-side from Flamborough Station, and the other through the fields. The latter route is decided upon as being far preferable.

It is stated that permission will be sought from the Privy Council of Ireland to incorporate a company for making an electric tramway from the Dublin, Wicklow, and Wexford Railway Station, at Bray, on to the Esplanade-road, and continuing along the shore side to the fort of Bray Head.

At the meeting of the Crewe Town Council on Wednesday, the Mayor, Alderman F. W. Webb, chief engineer of the London and North-Western Railway Company, laid before the members a plan of the improvements intended to be carried out by the directors of the company during next year in commemoration of her Majesty's Jubilee. The improvements include a public park, the land being given and laid out by the company.

A Bill is now in course of preparation, and will be brought forward in the next session of Parliament, for the purpose of seeking powers to amalgamate into one united and consolidated company the five distinct and independent railways now working between towns in the Isle of Wight. Permissive powers will also be sought to lease or sell the railways when consolidated to the London and Brighton, the South-Western, the Midland, or Great Western Railway Companies.

It has been definitely decided to open the Severn Tunnel for passenger traffic on the 1st of next month; but, pending the completion of the doubling line to Bristol, the Great Western Company will content themselves with establishing efficient local service between Bristol and Cardiff, arranging this so as to fit in with through fast services from Bristol on the one hand, and Cardiff and Newport on the other. Ten trains will run each way, and the time of the journey will be reduced one hour.

The Indian railways are again on the market with some acceptable inquiries. The State Railways are about to place contracts for iron bridges, carriage ironwork, and fish-bolts, nuts, and washers; and the Bombay, Baroda, and Central Railway Co. are enquiring for light ironwork, such as tires, axles, chains, tubes, and wire. They also need, they intimate, platform weighing machines, and a supply of steel. Orders which the Southern Mahratta Co. are willing to give out include a supply of switches and traversing jacks.

The first locomotive line opened in South Australia was in 1856, a line of seven miles, connecting the City of Adelaide with the port. Its gauge was 5ft. 3in. The total length of line which was open for traffic on the 30th of June last year was 1076 miles. At that date an additional 407 miles were under construction, and a further 315 miles authorised. A much-to-be-regretted diversity of gauge has been introduced into the colony. Of the 1798 miles completed, under construction, and authorised, 521 miles are on the 5ft. 3in. gauge, and 1277 miles are on the 3ft. 6in. gauge. With the exception of two surburban lines near Adelaide, all are the property of the State.

Notices have been posted in Margate intimating that on or before December 23rd application will be made by Messrs. Tomson and Ritchie, of Old Bond-street, London, to the Board of Trade for a provisional order to authorise the laying down of a tramway, plans of which will be deposited at the Town Clerk's office and other places by the end of the month. The project is for an electric tramway from the foot of the Jetty to Westbrook, and extensions will be made from thence to Westgate on the west, and from the Jetty to New Town on the east. The *Thanet Free Press* thinks this proposed tramway may be looked upon as a promised boon to both Margate and Westgate.

In reporting upon an accident which occurred on September 8th between Woodlawn and Ballinasloe stations, on the Midland Great Western Railway of Ireland, when a wagon near the centre of a train left the rails and ran along the ballast for three miles, Major-General C. S. Hutchinson says:—"The driver of the train deserves credit for having behaved with intelligence on observing that a wagon was off the rails. Had he at once checked the speed at the head of the train by applying the engine or tender brake, as is so often done by drivers under similar circumstances, the accident would probably have been far more serious; as it was, he managed—aided by the application of the guard's brake—to keep the couplings tight, and thus confined the accident to the one wagon."

A general classification of the September railway accidents in America is made as follows by the *Railroad Gazette*:—

	Collisions.	Derailments.	Other.	Total.
Defects of road	—	13	—	13
Defects of equipment	8	18	7	33
Negligence in operating	48	16	—	64
Unforeseen obstructions	2	7	1	10
Maliciously caused	—	4	—	4
Unexplained	—	11	—	11
Total	58	69	8	135

Negligence in operating is thus charged with 47·4 per cent. of the total number of accidents; defects of equipment with 24·4, and defects of road with 9·6 per cent.

The promoters of the railway from Windermere to Ambleside have given public notice of their intention to apply to Parliament for the necessary powers. The proposed line will run from the present terminus of the London and North-Western Railway at Windermere to Ambleside, the lower level, though more expensive, being chosen on account of the easy gradients. The preliminary work in constructing the line is being taken up by the residents of the district, and capital is being raised for this purpose. It is stated that not a single landowner will oppose the Bill, Mr. Heywood, of Elleray, who is himself adverse to a railway, giving way to the public wish for one. Colonel Rhodes has promised to give two or three acres of land for a station at Ambleside, near Stock Ghyll Park, and other land at reasonable terms has been offered.

The official statement of accidents on the German State and private railways, exclusive of the Bavarian lines, for the month of September, is given as follows:—In all there were 195 accidents, 4 derailments and 5 collisions on the road, 22 derailments and 15 collisions at stations, and 149 accidents of various kinds, as running over vehicles of all sorts, boiler explosions, fire in the trains, and so forth, through which death or injury to persons occurred; 186 persons were affected by these accidents, 2 passengers were killed and 15 injured, 30 railway servants were killed and 92 injured; of other persons, not connected with the railway, 15 were killed and 12 injured. There were 17 persons killed by suicide. Of all the accidents, with the exception of those caused by suicide, the most took place in the Magdeburg, Erfurt, and Elberfeld divisions of the State railways—157 cases in all. On the private roads there were 10 cases, of which 6 occurred on the Hessian-Ludwigs railway alone.

NOTES AND MEMORANDA.

The production in the United States last year of Portland cement amounted to 150,000 barrels of 400 lb. each, with a total value of 292,500 dols. The total production of cement of all kinds was 4,150,000 barrels, valued at 3,492,500 dols., against 3,720,000 dols. in 1884.

The production of copper in the United States in 1885, including 5,086,841 lb. made from imported pyrites, was 170,962,607 lb., valued in New York at 18,292,999 dols. at the average price of 10·7 cents per pound. The increase in pounds over 1884 was 25,740,667; in value, 503,312 dols.

The production of lead in the United States in 1885 was 129,412 short tons. Total value, at an average price of 81 dols. per short ton at the Atlantic coast, 10,469,431 dols., a decline of 10,485 tons and 67,611 dols. in value from the product of 1884. The production of white lead is estimated at 60,000 short tons, worth, at 5¼ cents per pound, 6,300,000 dols.

A French inventor proposes to use electricity for bleaching paper pulp in the following manner. A solution of chloride of magnesium is used. This is of the strength of about 16 deg. Beaumé. On passing a current through, electrolysis taking place, various chemical reactions occur, setting free divers oxychlorides, which, so it is said, effectively bleach the fibre.

The most common adulterant of white lead is permanent white, or sulphate of baryta. This admixture may be recognised by boiling a small quantity of the pigment in a glass test tube or flask, with nitric acid diluted with an equal measure of water. The white lead dissolves, but any sulphate of baryta remains as a white residue. The residue should be allowed to settle, the clear liquid poured off, and the deposit again treated with nitric acid and then boiled with water.

The results of a series of analyses by F. Raschig of explosive silver show that this substance consists of a mixture of Ag_3N, with varying quantities of metallic silver. Dilute sulphuric acid dissolves the explosive compound but leaves the metallic silver undissolved. Explosive silver is best prepared by dissolving freshly precipitated silver oxide in strong ammonia. The compound is deposited from this solution either by exposure to the air, by the application of gentle heat, or by the addition of alcohol.

Some very vague statements are going the round of the American papers to the effect that a patent has been issued to Mr. George Westinghouse, of Pittsburgh, inventor of the Westinghouse brake, for a new system of distributing electricity, which, it is alleged, "effects a saving of about 95 per cent. in distributing wires as compared with the Edison wire system. In tests of the invention a single main circuit of wire less than ¼in. in diameter carried the current for 850 16-candle power incandecent lights, all situated at a distance of three miles from the dynamo. The inventor claims that to light this number of lamps at an equal distance the Edison system would require from ninety to 100 wires of the same size." This is what American papers say, but English readers will recognise an exaggerated account of the saving due to Goulard and Gibbs' transformer.

The microphone is now being used in Germany, the *Scientific American* says, for the purpose of detecting loss of water through leakage in town mains. "The apparatus consists of a steel rod, which is placed upon the cock in the neighbourhood of which the leak is suspected, and a microphone attached to the upper end of the rod. A dry battery and a telephone complete the equipment. No sound is heard in the telephone if the cocks are closed and no leak occurs; but a leak of even a few drops through a badly fitting cock causes sufficient vibration in the pipe to affect the microphone, and to give audible sounds in the telephone. At the recent meeting of gas and water engineers in Eisenach, it was stated that the apparatus is so simple to handle that, with a little practice, ordinary workmen are able to detect and localise any leak." The microphone was long since tried in Liverpool by Mr. G. F. Deacon, and found to be much too sensitive for this purpose. It transmitted so many slight sounds that the louder sound due to a leak was confused among them.

In January, 1884, four lengths of the carriageway of the Chelsea Embankment were laid with different granites under identical conditions, so as to be subject to equal traffic weights, in order that the relative suitability and wearing powers of each might be determined. They were all laid at the same time, and every care was taken to make the experiment a trustworthy and just one. The experiments were made with Guernsey, Enderby, and Quenast granite, on macadamised roadways, by Mr. George R. Strachan, surveyor to the vestry, and in concluding his recent report on the results, he says:—"In my opinion these results show (1) that granite chippings are not suitable for a binding material; (2) that Quenast granite is at least equal to Guernsey granite in resisting the crushing and abrading influence of the traffic, and in keeping an even surface; (3) that Enderby granite is not in the same class of worth as Guernsey or Quenast granite. The results show that the Quenast granite came out of the experiment the most creditably, but I hesitate to class it as superior to Guernsey granite on the result of one experiment."

As the result of recent experiments, Herr W. Fischer gives the vapour tension of water or ice at 0 deg. = 4·63 mm. (Regnault, 4·60.) Since the vapour tensions of ice and water at 0 deg. are the same, the latent heat of vaporisation of ice is equal to the sum of the latent heats of vaporisation of water and the latent heat of fusion of ice. Similar experiments were made with benzene carefully purified and dried, and gave data from which were deduced the equations—for solid benzene, $p = 24{\cdot}985 + 1{\cdot}6856t + 0{\cdot}031339t^2$; for liquid benzene, $p = 26{\cdot}40 + 1{\cdot}4295t + 0{\cdot}04505t^2$. The two curves do not meet at the melting point—5·3 deg.—but are 0·44 mm. apart at this point. The author further determines —*Journal of the Chemical Society*—the specific heat of liquid benzene = $0{\cdot}3102 + 0{\cdot}002168t$, of solid benzene = 0·319, and the latent heat of fusion of benzene = 30 085. From these, together with the latent heat of vaporisation, 107·17—*Mousson's Physik*—the equation $R = r + q - 1{\cdot}5 = 136{\cdot}7$ cal. at 5·3 deg. is obtained from Clausius' formulæ, where R is the latent heat of vaporisation of solid benzene, r that of liquid benzene, and q the latent heat of fusion of benzene.

In a paper by Lord Rayleigh, "On the Intensity of Reflection from Glass and other Surfaces," the author pointed out that in his experiments the amount of reflected light was measured directly. Light from a cloud was passed through ground glass in the window of a darkened room, and made to fall at the polarising angle on a plate of glass. The transmitted and reflected rays were conducted along different paths by a series of reflectors, but finally emerged side by side and of equal intensity. One of the reflectors in the path of the reflected ray was the glass surface to be tested, the light falling on it at an almost perpendicular incidence. This glass was now removed, and a single mirror was shifted so as to make the angles and points of incidence of the reflected ray on the several mirrors the same as before. The reflected ray was now brighter than the transmitted. To re-establish equality a disc with holes in a ring round the centre was rotated in the path. The ratio of the sum of the breadth of the holes to the whole circumference of the ring gave the percentage of the light that was reflected. For a piece of optically-worked blackened glass the amount reflected was ·058 of the total incident light. It was found that the amount of reflection depended greatly on the clearness and polish of the surface. Thus in one case re-polishing increased the amount from ·04095 to ·0445. Fresnel's formula gave in this case ·04514. Generally it appeared that the amount reflected was less than according to Fresnel's formula—a result contrary to that of Rood's. The numbers for polished glass and for silver on glass were ·94 and ·83.

MISCELLANEA.

Messrs. J. and S. Roberts, of West Bromwich, have secured an import contract for cast iron water pipes for municipal waterworks at Cape Colony.

At the recent Edinburgh Exhibition Messrs. Douglas and Grant, of Kirkcaldy, were awarded the gold medal for their inverted compound Corliss engine.

The Sheffield Corporation are opposing the water company's application for new power, and have given notice of their intention to apply for Parliamentary sanction to acquire the undertaking from the town.

Farmers in the Peak of Derbyshire have been pleased to hear that the London and North-Western Railway Company intend constructing a new line of railway from Buxlin, *vid* Hindlow and Sterndale, to Leek.

Now is the chance for an old 12-horse portable, tired of sawmill work, the nearest dynamo, a few lamps, a mile or two of wires, and the electrician who waits an opportunity. Wokingham has given up gas in favour of oil for lighting the town.

Dr. R. Mullineux Walmsley, Senior Demonstrator at the Finsbury Technical College in the Department of Applied Physics and Electrical Engineering, has been appointed Principal of the Sind Aided Technical College, which is now being established at Kurrachee.

It is stated that the promoters of the Channel Tunnel scheme intend, during the next session of Parliament, to apply for powers to extend their experimental operations in connection with the Tunnel. The sinking of the new boring is still proceeding, and has now reached a great depth.

A general meeting of the National Association of British and Irish Millers is to be held on the 8th December. In connection therewith, Messrs. J. and H. Robinson, the defendants in the recent milling patent case, will, on the following day, place a portion of their mill at Deptford at the disposal of the Association for the purpose of practically demonstrating the value of sprinklers.

The Bartholdi statue of Liberty was illuminated on Monday night for the first time by the Lighthouse Board. The *Times* Philadelphia correspondent says this result has only been accomplished after great efforts, owing to the official red-tape spirit, the statue having been left in darkness since the dedication. The light supplied is of low power, and this causes dissatisfaction to all except the navigators concerned, who object to a bright light at that point.

Following up the dinner which was given to Mr. Francis Wiswall, C.E., on his resignation of the post of engineer to the Bridgwater Navigation Company, the workmen employed in the engineering department of the company have presented to Mr. Wiswall a gold watch as a tribute of their esteem and regard, and an illuminated address in recognition of his valuable services and the kindness and consideration he has shown to all under his control during his time of office.

The Wolverhampton Chamber of Commerce is about to establish a commercial museum of foreign metal manufactures. The Chamber has applied to the Secretary for Foreign Affairs to instruct her Majesty's Consul at Madrid to transmit to the Chamber a full collection of the locks in common use in Spain other than those of English make, together with the prices attached. Earl Iddesleigh, in reply, has expressed the pleasure afforded him in instructing the consul to forward the articles required. The Walsall Chamber of Commerce is about to make a similar application to the Foreign-office regarding leather wares.

At a meeting last week of the Birmingham Chamber of Commerce, the replies received from the members of the Chamber to a circular asking for suggestions as to improvements in the method of distributing Ordnance contracts were instructed to be forwarded to the Government Committee on that department. The Wolverhampton Chamber has forwarded suggestions to the Committee to the effect that it should not be compulsory to mark Government goods with the broad arrow until after they have been passed by the inspector. The Chamber declares that the vexatious objections frequently made by the department against goods supplied prevent many leading manufacturers from tendering.

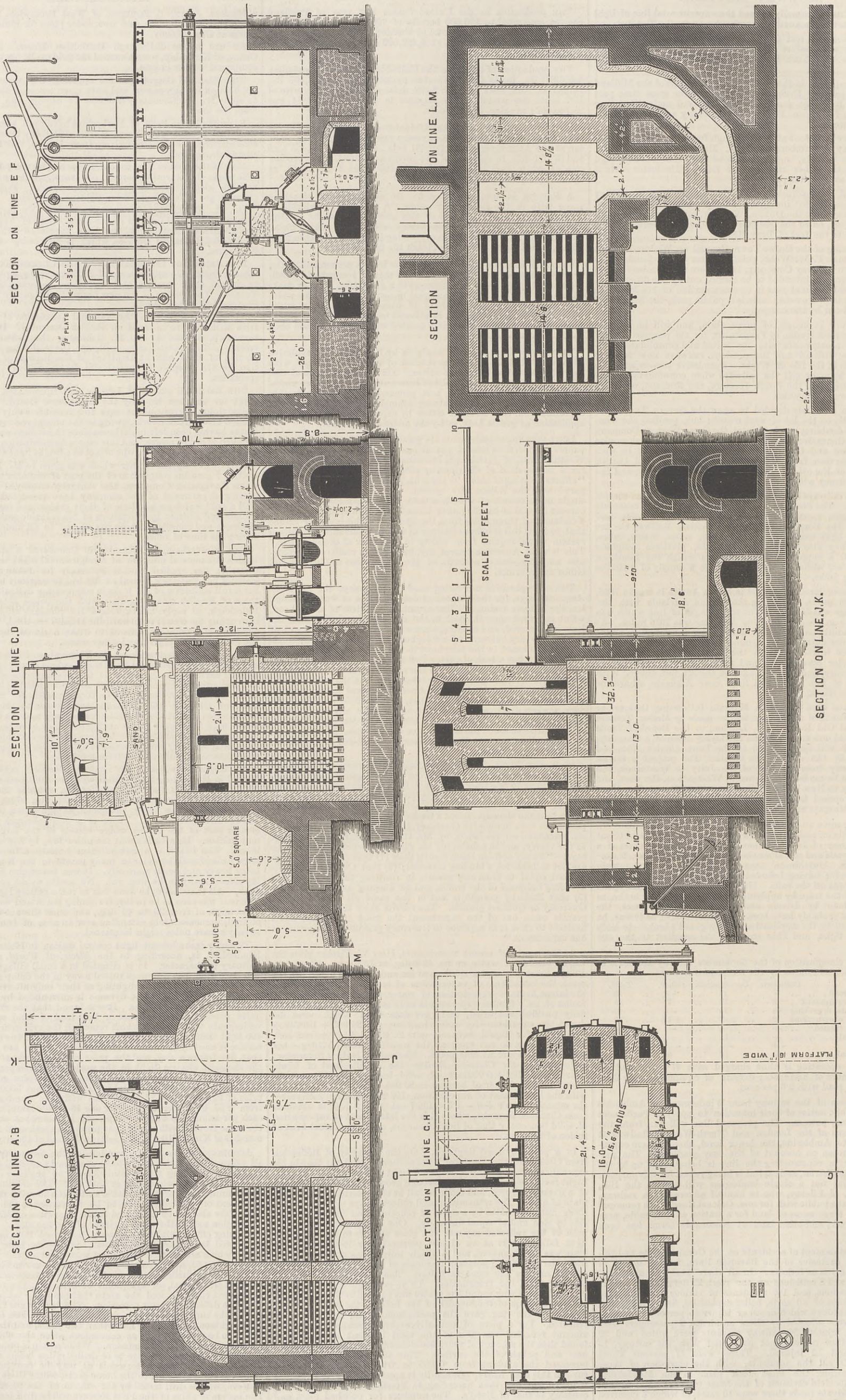
An English syndicate, the *Indian Engineer* says, has been formed in Hong Kong to negotiate with the Annamese Government for the purchase of the island of Hongay, which is the name of a strip of land on the south-east coast of Tonkin, which is joined to the mainland at low water, but which, at high water, is completely surrounded with water. There is a deep channel around the greater part of the island, where vessels of the largest tonnage may anchor. Its area is about ten miles long by five or six miles broad. The island is a carboniferous limestone formation, with large beds of coal, superior in many points to the Nagasaki coal, being heavy and much more oily. It was found also that the coal lay almost ready to be dug out. No shafts would require to be sunk. All that had to be done was to run a gallery right through. The coal was seen to be in layers running north and south, resting at an angle of from 20 to 40 deg., and once the outer crust was cleared, immense mines extending over an area of from fifteen to twenty square miles might be started.

The only incandescent light central station in Holland, that at Kinderdijk, is, according to the *Electrical World*, most extraordinary in character. It is situated in a small village where gas was once used, but the pipes rusted away in the damp soil, and the company took up electric lighting as their only alternative. The house for engine, boiler and dynamo is surrounded by water, and the building stands on piles. It was found that the vibration was quite perceptible, and hence a boat-load of sand was dumped underneath the building, which remedied the evil entirely. It is a 400-light Edison plant, and is now running in fine order. The service is used by the most humble, whose wages are not higher than five francs a day, and the price charged makes it probably the cheapest electric light in the world. The company are only allowed to pay five per cent. per annum, the surplus going toward increase of plant. The capital invested is about 3000 dols. The price of lighting up to 12 p.m. varies with the number of lamps from 2·57 dols. per annum for one 16-candle lamp, to 2·12 dols. each per annum for twenty lamps. It is somewhat striking that the same trouble with rusting gas-pipes is experienced alike in the marshes of Kinderdijk and the lofty table-land of the city of Mexico.

According to the new instructions of the Admiralty, boilers of all ships in commission are to be examined and drill-tested from time to time during the commission by an engineer officer other than the officer in whose charge they are. The detailed results of the examination, together with a statement showing the previous treatment of the boilers, are to be forwarded to the Admiralty. Copies are also to be furnished to the Inspector of Machinery on the station and to the chief engineer of the flag ship. Unless the examining officer thinks it necessary, not more than one boiler in four need be drilled for thickness, preference being given to those which are deemed to be most worn; but all the boilers are to be examined, and separate detailed reports are to be forwarded for each boiler drilled. Should there be any defects in the boilers, internal or external, or symptoms of corrosion, the report is to state what they are, and the steps that are being taken to make good the defects or arrest corrosion. The boilers are to be drilled during the time the ship is in commission at intervals of not less then eighteen months, nor more than two years, and the first drill test is to be made as soon as convenient after the ship has been eighteen months in commission. When a ship is ordered to be commissioned her boilers are to be drilled either before she is commissioned, or as soon afterwards as may be convenient. The boilers of ships attached to the home ports, where there is a Steam Reserve, will be drill tested by the officers of the Steam Reserve. The boilers of ships of the First Reserve will be drill tested by the dockyard officers when in hand for the annual refit.

SIEMENS' STEEL-MELTING FURNACE, WITH IMPROVEMENTS BY THE NEW BRITISH IRON COMPANY.

(For description see page 419.)



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SMALL TRANSMISSION DYNAMOMETERS.

(To the Editor of The Engineer.)

Sir,—We venture to ask do you or any of your readers happen to know of a maker of a small handy dynamometer which can easily be applied to individual machines. We want to check the power used by certain machines in a plant, and are anxious to secure a good dynamometer for the purpose. T. E. R. F.

November 23rd.

CALORIC ENGINES.

(To the Editor of The Engineer.)

Sir,—Can any reader tell me what is the lowest consumption of coal per brake horse-power in hot-air engines? Which of the three gives the best results as regards economy of fuel: (1) That known as Ericsson's; (2) engines in which the products of combustion pass through the cylinder; (3) that known as Rider's, in which air is alternately heated and cooled? J. H. K.

Farnham, Nov. 18th.

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Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. George Leopold Riche; all other letters to be addressed to the Editor of The Engineer, 163, *Strand.*

MEETINGS NEXT WEEK.

The Institution of Civil Engineers, 25, Great George-street, Westminster, S.W. Session 1886-7. Ordinary meeting, Tuesday, November 30th, 1886, at 8 p.m.: Renewed discussion "On Concrete, as Applied in the Construction of Harbours." Students' meeting, Friday, December 3rd, at 7.30 p.m.: Paper to be read "Ranging Circular Curves," by Harley H. Dalrymple-Hay, Stud. Inst. C.E.

Association of Municipal and Sanitary Engineers and Surveyors.—Lancashire and Cheshire District Meeting, Warrington, Saturday, 27th November, 1886: Appointment of Hon. District Secretary. Paper to be read and discussed:—"Public Health Act, 1875, the 150th Section—Remarks on its Operation and Suggested Remedies for its Defects," by W. Spinks, A.M.I.C.E, Dukinfield. 1 p.m.: Short adjournment for luncheon, kindly provided by the Mayor of Warrington. 1.30 p.m.: Under the guidance of Mr. Longdin, borough surveyor of Warrington, visit Mersey-street Gasworks to inspect air compressors for working Shone's ejectors for Latchford sewerage, thence to Latchford, to inspect Shone's system in operation. 2.30 p.m.: Visit Howley-lane intercepting depôt for collection of excreta. 2.40 p.m.: Visit Lythgoe's-lane intercepting depôt, to inspect the ejector and see the transmission of excreta to the manufacturing depôt. 3 p.m.: If time permits, to visit manufacturing depôt at Longford, Infectious Diseases Hospital, &c.

Society of Arts, John-street, Adelphi, London, W.C.—Monday, November 29th, at 8 p.m.: Cantor Lectures. "The Principle and Practice of Ornamental Design," by Lewis Foreman Day. Lecture I.: The Anatomy of Pattern: the Origin of Pattern; its construction; the dissection of pattern design; the skeleton, and its modification by the conditions of manufacture and commerce; practical hints on pattern planning. Wednesday, December 1st, at 8 p.m.: Third ordinary meeting. Adjourned discussion on the paper by Dr. C. Meymott Tidy on "Sewage Disposal." Sir Frederick Abel, C.B., D.C.L., F.R.S., vice-president of the Society, will preside.

Geologists' Association.—The next meeting of the Association will be held at University College, Gower-street, W.C., on Friday, December 3rd, when the following papers will be read:—"On Fossil Leathery Turtles and their Occurrence in British Eocene Deposits," by A. Smith Woodward, F.G.S, assistant in the Geological Department, British Museum—Natural History; "On some Further Researches in Bone Caves in Wales," by Dr. Henry Hicks, F.R.S., &c. The chair will be taken at 8 p.m.

DEATHS.

On the morning of the 18th Nov., at Rounton Grange, Northallerton, Margaret, the wife of Sir Lowthian Bell, Bart.

On the 22nd Nov., 1886, at his residence, Elm House, Wimbledon, Samuel Collett Homersham, M. Inst. C.E., of 19, Buckingham-street, Adelphi, aged 72 years.

On the 19th inst., at 116, Marine Parade, Brighton, Mr. John Bramley-Moore, D.L., J.P., Dignitary of the Imperial Order of the Rose of Brazil, of Langley Lodge, Gerrard's-cross, Bucks, and of Liverpool, in his 87th year.

THE ENGINEER.

NOVEMBER 26, 1886.

THE AMERICAN MAIL CONTRACTS.

The Postmaster-General has succeeded in making with much difficulty, exceedingly unsatisfactory arrangements for the conveyance of her Majesty's mails to and from America. Considering the fact that the Post-office is immensely profitable commercially speaking; and that the maritime resources of this country are simply unrivalled, it must be admitted that genius of no common order has been required to achieve such a result. The difficulties standing in the way of making anything but an eminently satisfactory contract are obviously enormous; but the Postmaster has managed to adjust matters, not on a moderately bad basis, but on perhaps the worst possible. There is only one failure in the whole affair. For a time the chances were altogether in favour of a total breakdown, which would have left the old and new worlds relying on chance for the transmission of mails; but this crowning mercy has not been vouchsafed, and there will be no certain interruption of the Atlantic postal service. The daily papers have already informed our readers that provisional contracts have been made with the Inman and Guion companies; the contracts to remain in force for three months. The Tuesday's mails will be carried by the newly-constructed Inman line. The Guion Company will carry Saturday's mails, and the Thursday's mails will go, *vid* Southampton, by the North German Lloyd's. Against the Guion Company there is not a word to be said, save that it does not possess a sufficient number of high-speed steamers; the Alaska and the Arizona are indeed the only two really first-class mail steamers owned by the company. About the Inman Company it is impossible to say much, for it has only just been formed. It is a new company built up on the ruins of the old company. The directors admit that they do not possess the necessary ships, but they undertake to procure them. This can only be done by building or buying, For the former there is not time. As to the latter, there are not many vessels available. There is the America, belonging to the National Company, a fine and a fast steamer, and the Anchor Company has the City of Rome. These, perhaps, might be purchased, although we doubt it. The number of ships able to cross the Atlantic in seven days can be counted on the fingers, and most of them are in the hands of the Cunard and White Star companies, which have hitherto carried the bulk of the mails. The Postmaster-General, in order to save a few thousands a year, has declined to renew the contracts on the old terms and this is the cause of all the trouble.

The worst part of the whole transaction is the employment of German steamers while English ships are left idle. A more unpatriotic thing has never been done for the sake of a small commercial gain. The contract is fortunately for only three months, and we trust that long before that period has elapsed the Postmaster-General will have come to understand how impolitic is the policy he has pursued. The North German boats are neither so large nor so fast as the crack Liverpool steamers, and they are able to compete with our own great companies because they are subsidised by the German Government. If the people of Germany see fit to take on their own shoulders a part of the cost of carrying English mails, it may be said that we ought to take advantage of their generosity or their folly. This we entirely dispute. The saving effected by the Post-office is paltry. Such as it is, it represents a national gain; but can such a gain be compared for a moment with the national loss incurred? Why should we employ and pay foreigners for doing indifferently that which English shipping companies can do better than any one else in the world? The thing does not bear discussion. It means not only the payment with English gold of foreign engineers and sailors, but the supply of a powerful stimulus to Germans to persevere in competing with Great Britain for the carrying trade of the world. We can well fancy how much the hands of the party in favour of shipping bounties will be strengthened in the German Parliament when they announce the news that England has to rely on Germany for assistance in carrying mails. Again, in order to save a subsidy of £1200 a year, the contract for carrying the Gambia mails has been transferred to a French company. Economy is all very well in its way, but this is economy with a vengeance. Why has not the Postmaster been consistent, and let the whole American mail contract to foreigners? He might have divided it among the Germans, French, and Italians, and we have not the least doubt he would have saved money. There is only one possible excuse for this transaction, that is, that the Postmaster-General had got into a tremendous difficulty—thanks to procrastination—and that at the eleventh hour he was glad to close with any one who offered to help him on his own terms. The mails must be carried, and it is better to send them by German ships than not at all. We commend to the attention of our readers an admirable letter on the subject, by Mr. George Baden-Powell, which will be found in the *Times* of Monday last:—"There is talk," he writes, "in the newspapers of the transference of our American mails to foreign companies simply on the score of lower tenders as to cost. But the foreign lines now running depend on the artificial support of State subsidies or bounties. There is a large and influential body of public opinion in this country which will never agree to such a transference of this important item in our ocean carrying trade to foreign State-paid competitors." This we fully believe. He goes on to point out that there is much more in this than a sentimental objection to employ foreigners. "Assume for one moment that for the saving of a few paltry thousands our American mails were carried under the German and French flags. Our whole business intercourse with America is then placed under the control of foreign States. To say nothing of war with this country, a resolution, peaceful or otherwise, in Paris may any day, so history warns us, suddenly cut off the ship bounties and wreck the French Atlantic lines. A war in Eastern Europe may, this coming spring, oblige Germany to call to Government service all her subsidised mail liners. To either outcome England could have no say; in either event the American mail service would be completely disorganised."

This is a specimen of the so-called economy which is the worst possible extravagance. We all know what a "cheap bargain" means. Is the Postmaster-General equally wise? Up to the present moment the American mails have been carried in British steamers with a speed, safety, and punctuality which left nothing to be desired. Why is the country to be launched into uncertainty on these most important points? An attempt to save a little money will not, we believe, be for one moment accepted as a sufficient excuse. There is no certainty whatever that the Cunard or White Star companies have made an undue profit out of the work they have done. We have only to look at the accounts of either company to see that they have not. The Cunard Company pays a very small dividend. There is no security whatever that the Inman or the Guion Company can make it pay to carry the mails at the required maximum speed for less money than the Cunard Company has had. We can perfectly understand the new Inman Company moving heaven and earth to get a good mail contract as a start; but has this company experience enough to know whether it has got a good contract or not? It really matters nothing to any one whether the American mails are or are not to be carried in future more cheaply than they were in the past. The rate of postage will still be the same. The country will be saved—perhaps—a few thousands of pounds of extra taxation; but it should not be forgotten that, in this matter, money paid to an English company goes out of one pocket into another. Thus, for example, the Inman Company proposes to build new steamers. This will be good for a very large number of trades and industries in this country. But the Postmaster-General, if he had only been a little more grasping, might have secured the doing of this work in German or French shipyards. That he has not been so grasping is something for which to be thankful.

In one point the Cunard Company has been very impolitic. The arrangements for the comfort of the passengers in the matter of food are not what they ought to be. Passengers at sea require something more than a rude plenty, and the Cunard Company furnish nothing else. On all sides we hear the same complaints. The cooking is detestable. Furthermore, in the Cunard boats passengers receive little more than bare courtesy. These things drive large numbers of passengers to the German and French boats, in both of which an admirable table is kept, while civility is exchanged for courtesy. It is quite time that the Cunard directors looked to these things; no one will accuse us of favouring foreign rivals, and it is the best policy to tell those whom we wish to be successful against the competition of the whole world when their cause is weak or their policy unwise.

NEW RAILWAY-MANAGEMENT BILL FOR NEW SOUTH WALES.

In view of the political and other mischievous influences under which the Railway Department of New South Wales has long suffered, and the serious and steadily increasing fall in the rate of interest paid by the railways during recent years, it is not surprising to learn by the Sydney press that the Government have at length brought in a new Railway Bill, having for its object the removal of the Department from the pernicious sway and mismanagement to which it is now exposed, by abolishing the existing office of "Commissioner for Railways," and placing the Department under a Board of Management, or Commission, consisting of three members. Although it is satisfactory, as an evidence of the growing force of public opinion on such matters, to find that New South Wales is taking action in the direction of freeing the public service of the baleful influences to which we called attention as long ago as 1884, yet it must be borne in mind that the changes contemplated by the Bill can be of little avail in checking prevailing abuses unless upright and competent Commissioners are appointed. This opinion was forcibly expressed by one of the speakers in the Legislative Assembly on the introduction of the Bill, when he remarked:—"The Bill would not be worth the paper it was written on, and would do more harm than good, unless the Commissioners were of the right stamp. If the

Government got gentlemen of the right stamp they did not need a Minister to look after them." The allusion to a Minister, it may be explained, was suggested by a clause in the Bill providing for the Department being presided over by a new Minister, distinct from the Minister for Public Works.

Whether the appointment of a Minister as nominal chief over the Board of Management be, or be not, essential to the symmetry of the Bill as drafted, it is not clear what useful purpose a Minister is to serve; seeing that by a clause in the Bill the new Board is to be practically independent of the Ministry. In fact, the very object and essence of the Bill, so far as it aims at removing the Department from political influence, would be frustrated unless this were so. It is certainly not a little difficult to understand what useful object was sought to be attained, or has been served, by placing the management of the Railway Department on the footing it has held since 1878, when the present Commissionership, under the nominal control of the Minister for Public Works, was instituted. Under the existing *régime* of divided authority, much valuable time has been lost; and the efficient working of the railways hindered, by unseemly disputations with the heads of the technical departments on questions which from their position and experience they were, one would suppose, best fitted to deal with and settle; while from evidence given recently at the committal for trial of an ex high official, and others in his employment, for conspiracy to defraud the Railway Department, it would appear that the management of those matters which it was to be expected would come more immediately under the ken, and would specially appertain to the duties of the Commissioner for Railways, was such that even so simple and necessary an appliance as a weighing machine could not be supplied where it was most needed, because of some red-tape—if not more occult—reference of the matter to the Minister. What, it may well be asked, could be the worth to the community of a "management" which sat contentedly by with folded arms, so far, at all all events, as the evidence adduced at the inquiry showed—and notwithstanding that, as the Commissioner for Railways himself stated in evidence, "the Minister left the management of all internal working of the railway to him"—without offering a suggestion or remark when the Minister—whose wool-carrying business was, as the evidence showed, liable to be affected by the question—thought fit to endorse a minute from one of the traffic officials, pointing out that a cart weighing-machine was urgently wanted at one of the very stations where the frauds are alleged to have been committed, with the extraordinary dictum that "he did not think that a cart weighing-bridge was wanted as the weight of wool, &c., could, at all times, be ascertained by asking the teamsters to produce their way-bills." Thus, while the details of such matters as rail-making, barbed-wire, paint, "dump-cars," machinery and American locomotives, which are usually left to the care and decision of the technical staff, occupied the attention of the Commissioner for Railways, under the fitful auspices of the Minister for Public Works, and were deemed worthy of copious minutes and lavish expenditure of money, little attention and no money apparently could be spared for providing appliances obviously required to enable the traffic to be efficiently and properly conducted. This, too, while sums of money to the amount of hundreds of thousands of pounds, could be voted at frequent intervals, and spent under the auspices of the Commissioner and Minister on so-called "additions and improvements" to the lines after they had left the hands of the engineer-in-chief. If such a state of things is to continue from the combination of Commissioners and Ministers in the management of the railways under the new scheme, better, say we, dispense with such an arrangement. There is something inexpressibly ludicrous in the spectacle of a country like New South Wales aspiring to the position of a great commercial State, and laying out millions of pounds per annum in the construction of railways and other public works, yet exhibiting such impotency in the conduct of its affairs. As further evincing the need for putting the management of the railways without loss of time in better hands, and on a more economical footing, is the fact to which we have already alluded, that the interest paid by the lines in operation has been decreasing year by year, having fallen last year to 3·37 per cent., or below the rate at which the money has been borrowed for their construction. The rates of interest paid during the last five years are as follows:—In 1881, 5·31 per cent.; in 1882, 5·14 per cent.; in 1883, 4·48 per cent.; in 1884, 4·20 per cent.; and in 1885, as we have said, only 3·37 per cent. This too, be it noted, in the face of a deficiency in the general revenue of the colony, as recently announced, of about £2,000,000. No wonder, then, that the country is rousing from its lethargy in regard to the management of its railways, and is impressing upon its rulers the necessity for making clean the Augean stable, and for putting on a sound footing the administration of a department on the efficient working of which the credit of the colony largely depends.

One point of special interest to the profession we may refer to in conclusion. The Bill provides for the whole of the technical departments being placed under the charge of the Engineer-in-Chief for Railways and not, as is the case at present in regard to the working and maintenance departments, under the non-professional headship of the Commissioner for Railways. This is as it should be, and will correct an absurd and anomalous state of things brought into existence by the calling up of an obsolete clause in the original Railway Act of the colony, which was never intended to operate in the way it has been attempted to be enforced since the institution, in 1878, of the present Commissionership.

THE GERM MILLING PATENT CASE.

THE decision in the case, the Germ Milling Company *v.* Robinson, which came before Mr. Justice Stirling in June last and again in the Court of Appeal recently, as reported in our last impression, is one to which special attention must be drawn, for it might affect the validity of a large number of patents now existing which are supposed to be invulnerable. The Germ Milling Company own the patent granted on the 17th July, 1882, to Thomas Muir, a miller, for a roller milling process, by means of which the germ is separated from the flour of wheat and maize. Mr. Muir's process, or that which is described in his specification, has been generally adopted in all roller mills, and is almost an accident of the complete roller milling system, and millers as well as mill manufacturers endeavoured to prove that Mr. Muir's invention was not new, and that the use of the now general series of operations in a complete roller mill plant did not constitute an infringement. Messrs. J. and H. Robinson of Deptford, millers, were defendants in this action, which was commenced in June last, and which was much of the nature of a test case.

The trial had proceeded for several days, with all the leading expert witnesses, and with the strongest legal assistance. The case promised to equal the celebrated Bovill case, but it collapsed suddenly on a technical point bearing upon the patent law, a point which, in fairness and justice, ought not to remain law another session. Mr. Muir, in giving evidence, said that he had in the ordinary course of his business sold flour made by the process he patented in June, 1875, or a month before his patent was taken out. This was held to constitute a public user of the invention before the date of the patent; that is to say, that Mr. Muir having sold the experimental product of his invention had thus, according to the present state of the law, made his invention public property and useless to himself except so far as he could himself use it. He had not buried or burned the tons of meal and flour he was obliged to make to test his invention, but had sold it. He might naturally have asked what else could he have done with it, and the law would tell him "anything, so long as you didn't sell it." This would entail an enormous loss which few inventors could afford. To test a new process in flour milling a very large quantity of flour must not only be made, but the miller must be satisfied that his mode of operation is one which can give, continuously, a uniform product, so that he may be sure that the good results which he had obtained had not been the chance effects of a combination of favourable circumstances and conditions, a thing not at all unlikely in flour milling, with so many different kinds and conditions of wheat. Again, it must be remembered that although a miller may be a good judge of the flour product of a certain kind or mixture of wheat, no miller could have told what the public reception would be of germless flour, and still less could he tell what would be the public verdict after an extended trial. It is exceedingly difficult, and often impossible, even to the best judges, to say to what extent a new, or modified, article of consumption will find public favour. For this reason Mr. Muir wanted to learn as much as he possibly could how his new flour would be received after some hundreds of puddings and thousands of loaves had been made, and until he was sure not only that he had succeeded in removing the germs, but that the public liked the flour without any germ, he did not take out his patent. It will be said that he should have taken out his patent earlier; but it must be remembered that a large number of inventions had been made with a view to remove the whole or a part of the germ from flour, or from the grain in the flour-making process, and none had been quite successful. Mr. Muir might, therefore, very naturally be a little slow in placing complete confidence in his own success. He would naturally feel that, with so many failures to look back to, he ought to work the machinery carrying out his process a considerable time before he allowed himself to pronounce it perfect.

Mr. Muir was a little too careful. He did not know of that little snake-in-the-grass point in the law that made it necessary that he should burn or throw away the tons of flour he was making to test his process. Yet, after all, he did not allow much time to pass after he found he could make germless flour before he applied for his patent—only a month; and whether it was quite so long as that is doubtful. And, moreover, in the Court of Appeal when the plaintiffs sought a new trial it was stated that germless flour, *as such*, was not really sold for some months after the date of the patent. Mr. Muir was in fact allowed to say that which he need not have said, that which was not strictly accurate as to date, and that which has robbed him and the Germ Milling Company of all right to his invention.

If an inventor cannot sell the experimental product of his invention without invalidating the patent he may take out at a reasonable date after his experimental enquiry, then it must be said that not only has the Germ Milling Company *v.* Robinson case brought to light another of the snares and pitfalls always unexpectedly discovering themselves to the loss or ruin of the inventor whom the law is supposed to be made to protect, but it shows that many investigations with a view to new processes intended to be the subjects of patents can only be carried on either, at a great loss for materials, or at a great expense for useless patents taken out at every stage of such experimental investigation. It further shows how a case is to be lost, not on the merits of an invention, but through want of knowledge by an inventor of every point in the Patent Law.

THE COAL TRADE CRISIS.

WE pointed out two months ago in THE ENGINEER that in the Northumberland coal trade there would be notice given for the termination of the sliding scale arrangement; and although there was some little doubt cast on the statement, it has been verified, and the preliminary negotiations between owners and workmen have been commenced for the settling of the basis of another scale. But there is one point in relation to the coal trade of the country which has not had full consideration, and which must have great weight on all the methods of attempting to regulate wages. It is an undoubted fact that there is now a much thinner working of the seams of coal in Northumberland than there was. Some of the best seams of coal have been entirely wrought out, and the average thickness is less than it was. The bearing of this is simple. If the workman's wage is kept up to a standard rate, as the sliding-scale system provides, then it is unquestionable that there will be a less return to the employer as the seams work thin. There is less coal to get out, whilst the cost of working is, on the whole, larger; and thus working charges being spread over a smaller production, there is a heavier burden on the coal. The Northumberland coalowners have now the heavier burden to bear, and as the competition in the coal trade is greater instead of less, there is no possibility of their raising the price of coal. Indeed, at the present time there is a price, which is perhaps 6d. to 9d. per ton, being received for the best coal lower than a year ago. There is, of course, a little compensation in the fact that the collieries producing the best steam coal are working fuller time, but it is at the expense of the second class of collieries, some of which are extremely ill employed. The employer feels this keenly, for if the colliery is employed one-third of the time, the standing charges are as heavy in the gross as if it were occupied fully, whilst in the proportion that the charge has to the ton of coal it is of course much more. It remains therefore a fact that, owing to the natural cause of the working out or the working thinner of the seams, there is less possibility of paying a rate of wage which is considerably above that of the competing coal districts of the country. The coalowner has to meet that competition; and it is inevitable that the altered condition of things should be borne in mind now that the bargaining as to a new sliding scale has been commenced. The basis of the wage must be adjusted to the altered condition of the trade, but it is tolerably certain that if it be so changed there will be a counterbalancing advantage. The miners will have the benefit of any fuller time worked that they can obtain from the price of the coal that they produce being brought within the range of purchase by those who now buy cheaper coal. It is evident that the working of five days in the week at, say, 4s. 6d. per day, is incomparably better for both the employer and the workman than is the working of two or three days at the present standard wage of 5s. 2d. Yet over a large part of the winter that amount of work is what the trade permits, and largely the cause of it is the fact above alluded to.

A GREAT DRAINAGE ENTERPRISE.

THE Russian Government is engaged in one of the most extensive drainage enterprises ever undertaken in any portion of world. The location is what is known as the Pinsk Marshes in the south-west of Russia, near the borders of Galicia. This region is so extensive as to secure special designation in the ordinary map of Europe, and, in point of area, is very much larger than Ireland. The marshes have become famous in Russian history as a refuge of all manner of romantic characters, and have remained an irreclaimable wilderness up to within the last two or three years. In 1870 the Russian Government first took in hand seriously the abolition of this wild expanse, owing to its being perpetually more or less submerged and covered with a jungle growth of forest, preventing not only communication between the Russian districts on either side, but also between Russia and Austro-Germany. A large staff of engineering officers and several thousand troops were drafted into the region, and these have been engaged upon the undertaking since. Up to the present time about 4,000,000 acres have been reclaimed by means of the construction of several thousand miles of ditches and canals so broad as to be navigable for barges of several hundred tons burden. Just now the engineers are drawing up the programme for next year, which comprises the drainage of 350,000 acres by means of the construction of 120 miles more of ditches and canals. Of the 4,000,000 acres already reclaimed 600,000 acres consisted of sheer bog, which has been converted into good meadow land; 900,000 acres of "forest tangle," which have been prepared for timber purposes by cutting down the underwood and thinning the trees; 500,000 acres of good forest land—forest oases in the middle of marshes—hitherto inaccessible, but which have been connected more or less by navigable canals, and thereby with the distant markets; and finally, 2,000,000 acres have been thrown open to cultivation, 120,000 acres of which have already been actually occupied. Besides making the canals and ditches, the engineers have built 179 bridges, bored 577 wells from 20 ft. to 80 ft. deep, and have made a survey of 20,000 square miles of country hitherto unmapped. When the task is finished Russia will have effaced from the map of Europe one of the oldest and toughest bits of savage nature on the Continent. From an engineering, geological, and scientific point of view generally, the work is one of special interest.

RAILWAYS IN SOUTH AFRICA.

AN apparently unimportant but really most significant bit of news comes from Brussels. We learn that Dr. Jorissen, a member of the Transvaal Parliament, is delivering lectures in Holland with the object of inducing Dutch capitalists to construct a railway to Delagoa Bay, so as to prevent the execution of the enterprise by the English company formed for the purpose, and to hinder English influence from regaining its lost ground in the Transvaal. At first sight it may seem to be little matter whether we do or do not regain ground in the Transvaal, but this we may for the moment put on one side. We are in a position to state that in this country dense ignorance exists, and unavoidably so, because the facts have not yet been made public, concerning very important railway enterprises in South Africa. An attempt will in all probability be made by the Dutch within a very short time to raise, in this country, funds for carrying out schemes which are directly intended to be antagonistic to English interests. Dr. Jorissen's lectures are the first steps in an organised movement. For the moment we must content ourselves with counselling our readers to observe the greatest caution in dealing with Dutch or Boer statements concerning South African railways; to ascertain for their own satisfaction what concessions have already been granted by the Boer Government; and to see their way very clearly indeed before they invest a shilling in the Dutch or Boer schemes. As we have already said in other words, there is a great deal behind the scenes, and Boers have not hitherto enjoyed so high a reputation for truthfulness that their statements are to be accepted without question. It may, at all events, be taken for granted that neither they nor their Dutch friends will manifest any special consideration for English interests. That railways must be made in South Africa is certain. It is equally certain that they will be made by Englishmen with English money, if only a little caution and patience are manifested by Englishmen at the present juncture.

NEW MARKETS FOR SHEFFIELD AND BIRMINGHAM.

VERY great interest has been excited in Staffordshire—and, in a modified degree, at Birmingham—by a collection of Chinese edge tools, forwarded by the Consular authorities for the inspection of English firms. This action of the British representative at Pekin has been endorsed by the Foreign-office, and is expected to be the beginning of a general scheme of instructions to our Consular service abroad. The tools now on view at Sheffield and

Birmingham consist mainly of hoes, picks, hatchets, trowels, spades, billhooks, plough coulters, and razors. They are very rude examples of native manufacture, with the exception of the hatchets and billhooks, which are well-shaped and serviceable-looking articles. The important point is this—that all the articles can be made in England of much superior quality, and delivered in China at prices quite as low as those charged on the spot. The collection has been made at Tientsin and Shanghai, and some of the productions exhibit considerable ingenuity in adaptation to easy labour in the field. The razors are singular samples of cutlery; and it is impossible to imagine a shrewd people like the Chinese continuing to shave with Tientsin razors if they once familiarised themselves with the article made by the outer-barbarian. In the meantime, however, the English make will aim at giving the Chinese the patterns and styles to which they have been accustomed.

LITERATURE.

The Windmill as a Prime Mover. By ALFRED R. WOLFE, M.E. New York: J. Wiley and Sons. London: Trübner and Co., 1885. 159 pp.

THERE is not a very great demand for windmills in this country, and there is not much available practical information concerning them; most of that to which one may turn being of the old kind, which in some respects treats many simple questions in a rather complicated fashion. With the increasing application of mechanical power in small quantities in manufactures, and for work of every kind, it is not at all impossible that windmills, if taken in hand as machines which it is worth while to develope, might become very common. At the present time there are very few makers in this country, and even those who do make them do not give in their catalogues any quotation of power of the wheels they make, either for average or specific velocities and pressures of wind. This fact has deterred many a man who has wanted one, two, or three horse-power from using a windmill, it being so easy to get on all hands prices and horse-powers of steam and gas engines. Without entering into any discussion of the possible uses for windmills with the aid of storage batteries, which it may be expected will soon be better and cheaper, it may be admitted that information on windmills may become more widely useful than it has been; and readers may be glad to turn to this book by Mr. Wolf, which treats the subject in ten chapters and an introduction on the use of the windmill. From the introduction it appears that several thousands of windmills are made per year in the States, where hundreds of thousands are in use; and that more windmills are in use now than in any past history of the world. After suggesting various uses for windmills, the author deals in Chapter I. with wind, its velocity and pressure, and in Chapter II. with impulse of wind on windmill blades. In the first of these he may be said to collate information of which we have already an enormous quantity in the more recent volumes of the "Proceedings" of our societies, and particularly of the Institution of Civil Engineers, vol. lxix., which contains two papers and very long discussions and correspondence; a paper by Colonel H. A. Brownlow in the "Professional Papers on Indian Engineering," No. 33, vol. viii., also contains some very useful information resulting from an "enquiry into the possibility of the use of wind-power for irrigation."

It is remarkable that the only experiments that can be appealed to for figures showing the actual power of windmills are those given by Coulomb; and many mills as are made in America, the actual horse-power as found either by brakes or water pumping, does not seem to have been carefully ascertained. Smeaton's experiments with model mills formed the basis of the most commonly used information and formulæ; and although the more complex formulæ of Mr. Wolf for power (or "actual mechanical effect," as his prodigality of words makes him call it) appears to be more accurate for each special case, it is questionable whether professedly minutely accurate estimates of power of a windmill are not as inaccurate as those which are good approximations for general cases. As an example of the use of his formulæ, he applies it to a test made by Coulomb of a mill which gave him 269,600 foot-pounds per minute, and gets as result 236,994 foot-pounds per minute, which, by assuming other barometric pressures, and a slight difference in wind velocity, he is able to alter into figures very nearly the same as Coulomb's. If we take the old formula based on Smeaton's experiments and observations, namely, $\text{H.P.} = \frac{A V^3}{1{,}080{,}000}$, we get 7·45-horse power, which is very near Mr. Wolfe's result; or if we take $\frac{A P C R}{33{,}000}$, in which A is area of sails, C equals circumference of circle described by centre of figure of that area, P equals effective pressure on that area, and R revolutions, we get 8-horse power; so there is not much difference in the several ways of treating the subject, and the simplest recommends itself. After glancing at the early history of windmills, the author very briefly describes some European mills, and then at some length deals with American mills. This part of the book will interest our English windmill manufacturers, as showing American practice, and taken with the parts dealing with wind pressures and velocities and sail angles, will be useful to most of them; but a sufficiently complete book on the windmill has not—combining theory, and applied theory and practice—yet, however, been published, if we look at the subject from the point of view of the intelligent manufacturing engineer who would like to enter upon the manufacture of windmills.

Note-book and Price List, with Useful Formulæ. R. E. Crompton and Co., London and Chelmsford.

THIS is a useful note-book, with formulæ relating to electrical subjects, combined with a price list of the machinery and apparatus made by Messrs. R. E. Crompton and Co., of Mansion House-buildings and Chelmsford. The Crompton machines are illustrated by diagrams, and the formulæ to machines, lamps, power, work, circuits, and other things of importance to the engineer engaged on electrical installation. The book is small, compact, and cheap.

BOOKS RECEIVED.

Watch and Clockmakers' Handbook, Dictionary, and Guide. By F. J. Britten. Sixth edition. London: Kent and Co., and E. and F. N. Spon. 1886.

The Vital Statistics of the City of Glasgow. By James B. Russell, M.D., LL.D. Part II., Districts of Glasgow. Glasgow: Alex. Macdougal.

Stationary Engine-driving: a practical manual for engineers in charge of stationary engines. By Michael Reynolds. Third edition. Weale's Series. London: Crosby Lockwood and Co.

Letters from an Engineer while on Service in Syria in connection with the Proposed Euphrates Valley Railway and Beyrout Waterworks. London: Marcus Ward and Co.

The Law and Practice relating to the Prolongation of the Term of Letters Patent, with a Full Table of Cases, and a Synopsis of Colonial and Foreign Laws. By John Francis Waggett, M.A. London: Butterworths. 1887.

JOHN BRAMLEY-MOORE.

BY the death of Mr. Bramley-Moore a link is broken in the historic chain which connects the Liverpool of the present with the Liverpool of the past, especially in his connection with the Dock Board and the large dock extension works promoted by him. His connection with the Board, then known as the Dock Committee, has been thus briefly summarised by the *Liverpool Post*:—On November 9th, 1842, he was appointed a member of the Dock Committee. On the 17th of the same month he was elected to serve on the sub-committee of works. On November 20th, 1843, he was elected chairman of the Dock Committee. On August 3rd, 1846, he retired; but two days later was re-elected chairman, and again in November of the following year he was re-appointed chairman. On November 15th, 1848, he was elected Mayor of Liverpool, and, as a consequence, resigned his chairmanship of the Dock Committee, which afterwards, by Act of Parliament, was constituted as the Dock Board.

In 1842 Mr. Bramley-Moore was elected chairman of the Liverpool Docks Committee, and he gave himself up to the care of the Dock Estate with enthusiastic zeal. On the 19th of January, 1846, he brought forward in the town council his scheme, "Dock Extension," when he described what would be the future requirements of the docks, even when these plans were carried out. In an interview with Lord Derby—the grandfather of the present earl—at Knowsley on the subject, Mr. Bramley-Moore said:—"I have come, my lord, to ask you to give me the north shore, together with its lordships and rights, and it will be greatly to the gain of the Derby family for you to do so." His lordship was somewhat surprised at the request, and replied, "I think you will have some difficulty of convincing me of that; I have been offered by others £90,000 for the grounds in these quarters." "If you will give me," continued the chairman, "the foreshore for such a distance, I will make for you all the back land behind, with the spoil of the docks, and this land will be your compensation, and will become of immense value, soon, if not in your lifetime, being enhanced in value by the docks which I purpose to construct." The result of the interview was that the earl gave the chairman what he asked for, so that this long line of river frontage, to the extent of about two miles, did not cost the estate a penny. Mr. Bramley-Moore kept his plans and his transactions with Lord Derby a secret, so as to avoid any land jobbing, for had the scheme got wind the adjoining land would have risen in value, and thousands of pounds might have been realised. He was also fortunate enough to buy from the Government the right of the woods and forests over the north shore for the sum of £800, the omission of which might have caused an infinity of trouble.

The project excited in the first instance the greatest opposition, and the scheme was loudly applauded in some quarters, and as loudly condemned in others. The chairman was accused of truckling to aristocratic influence, and making political capital out of a commercial transaction. It was asserted that the land which was made for Lord Derby would have to be purchased back at a high price, and the whole affair was denounced as a job.

A noted event in the history of the Liverpool Docks was the opening of the Albert Dock in 1846, when Prince Albert came down for the ceremony, and was entertained by the Dock Committee and by the Mayor. It was after this occurrence that Mr. Bramley-Moore, the chairman, together with Mr. David Hodgson, the Mayor, were offered the honour of knighthood, which, however, was respectfully declined in both instances. Mr. Bramley-Moore was present in September, 1881, at the opening of new docks in Liverpool by the Prince of Wales. These were but the continuation and crown of the scheme which he initiated in 1846, and which Mr. Jesse Hartley carried out. The next great leap in dock making was the construction of the immense system made up of the Salisbury, Nelson, Collingwood, Stanley, and Bramley-Moore Docks, all opened on the 4th August, 1848, by Mr. Bramley-Moore. As chairman of the docks he was also a party to the introduction of the first landing-stage at Liverpool, which was set up at George's Pier, under the direction of Sir William Cubitt, and opened on the 1st June, 1847.

One of the events which occurred during Mr. Bramley-Moore's chairmanship was the Chartist movement in July, 1848. He gave orders that all the dock labourers who would not be sworn as special constables should be discharged. A large number, amounting to 500 or 600, refused to do so, and anxiety was excited about the peace of the town. The chairman, in order to be at hand for any emergency, slept during two nights in the warehouses of the Albert Docks, and was at the north gate on the following Monday morning to receive them, and to see that the loyal men were not molested. He stood at the gates surrounded by an Irish mob; the ringleaders came up to him and asked him to be taken on again, and on his distinct reply, "not a man of you enters these gates," they dispersed without disorder.

In 1849 Mr. Bramley-Moore was elected Mayor of Liverpool. In 1854 he was returned to Parliament as a Conservative member for the town of Maldon, which he represented to the year 1859. He also represented the city of Lincoln from 1862 to 1865; and contested, unsuccessfully, Hull, Liverpool, and Lymington.

Mr. Bramley-Moore was a magistrate for the counties of Lancashire and Buckingham, and a Deputy-Lieutenant for that of Lancashire. He was for some time a director of the London and North-Western and North Staffordshire Railways, and chairman of several financial companies in the city. In the district of Gerrard's Cross, where Mr. Bramley-Moore resided, he has been respected for his kindness to the poor, and by his generous gift of a free reading-room. He died at Brighton on the 19th inst., at the age of eighty-six years. The funeral took place at St. Michael's-in-the-Hamlet yesterday.

THE WASTE OF WATER IN TOWN WATER SUPPLIES.

WE have from time to time noticed the investigations of municipal engineers in connection with the waste of water and its prevention. When properly understood the sum of all the information now available assumes a significance of which few but those who have made the investigations have the slightest idea. A recent report by Mr. Alexander R. Binnie, M. Inst. C.E., waterworks engineer to the Bradford Corporation, places the subject in a striking light; and it is important that Mr. Binnie's work in Bradford should be more widely known. Let us, however, in the first instance say that this subject of the waste of water and its advocated suppression is not, as appears to be too often ignorantly supposed, the outcome of any desire for niggard supply or parsimonious use. Precisely the opposite view has been consistently held by those who have been most energetic and successful in the suppression of waste. All that is demanded is that so far as possible the water shall be led without waste *to* the consumer's fittings, where he may draw to his heart's content.

Thus, Mr. Binnie, in his recommendations to the Corporation of Bradford, pointed out last year that "by the prevention of waste is not to be understood that it is either contemplated or desired to deprive our customers of one drop of water which they can reasonably or even lavishly require for any useful purpose. Briefly it may be summed up as an attempt to stop that continual flow of water which is always going on in large towns, and which, in a great measure, passes through the pipes not only without doing good to anyone, but in many instances in a manner quite unknown and unthought of by the great bulk of the consumers." And again, in 1882, Mr. Deacon, who had been so signally successful in suppressing the waste in Liverpool, and introducing constant supply with great financial benefit to the Corporation, said at the Society of Arts:—"The prevention of the waste of water is not, in any sense, a restriction of the use or misuse of water, by the consumer, but may even conduce to the greater use or misuse by rendering the water more readily available, under high pressure, and at all times. Not that misuse is a good thing, but that absolute absence of restriction is, I think, a good thing. It would be better to allow a gallon to be misused than, even if there were the power—which there is not—to prevent it, to restrict the proper employment of a pint."

It is, in short, no part of the water Authorities' business to inquire how the consumer uses the water, subject, of course, to his not employing it for trade purposes. It is the Authority's duty to lay the water on, and to maintain a high and constant pressure; and it has been shown beyond all question that this can be done with profit to the Authority, and without any interference with the consumer, even to the extent of entering his premises, unless unnecessary waste, previously ascertained by external means, is actually taking place within those premises.

"It is," says Mr. Binnie, eleven years since I began to urge the necessity of some effective steps being taken to prevent the waste which I at that time proved to be going on." But it was not until August, 1885, that the Corporation of Bradford determined, upon his recommendation, to institute a proper and efficient system for the prevention of waste of water. In his report of 1st October, 1886, giving the results of his first thirteen months' work, Mr. Binnie writes concerning the prevention of waste: "The system which you determined to adopt to effect this latter object was arrived at after an inquiry as to what had been done in other towns, and an experimental trial extending from October, 1884, to July, 1885, the result of which was fully described in my report to you dated the 14th of August of last year. The system on which you determined to work may be briefly described as cutting the town up into a series of small districts, the water supply of each of which is made to pass through one of Deacon's self-recording meters, which registers on a diagram from minute to minute, and from hour to hour, the water passing through it." The meter in question and Mr. Deacon's method have been frequently described, and it is only necessary here to point out that the most important features of the instrument are the two following. (1) That inasmuch as the water way increases as the flow increases, there can be no appreciable loss of head, so that the instrument may be placed in the line of any water main without in any degree—capable of determination by ordinary pressure gauges—restricting the flow. (2) That the differential diagram drawn by the meter enables one to distinguish between water wasted and water drawn for use. The latter being a steady uniform flow, produces a steady line of uniform volume; and the former being a constantly varying flow, produces an irregular line of varying volume. Towards midnight the irregular flow rapidly diminishes, and a steady line becomes visible; not yet a line of uniform volume, however, for cisterns are still filling, and the line, steady though it may be, gradually curves towards an asymptote of uniform flow. This asymptote is obviously therefore a true measure of the waste. For all practical purposes it may be regarded as coincident with the line of minimum steady flow.

"The amount of waste," writes Mr. Binnie, "having been determined, its source is next sought out, and detected by various expedients, such as night inspections, shutting off portions of the district to detect the particular street, or streets, in which the waste is going on; and afterwards, in a similar manner, each house is isolated until the exact locality of the waste is determined." "No attempt is made to limit or control the free and ample use of water for all purposes, and I am happy to be able to say that the supply has been maintained at constant pressure during the whole of the past year." Mr. Binnie next proceeds to explain the results of his work in two districts, the first containing 81,038 persons and 40,643 taps. In this district the total supply of water before inspection was 1,821,200 gallons, or 22·47 gallons per head per day, which in many towns would be thought by no means high.

After inspection and repair the rate of supply was reduced by suppression of waste to 14·35, but there still

remained waste, which was calculated from the diagrams to amount to 5·55 gallons per head per day, from which it appears that the 80,000 people of this first district draw off on the average less than 9 gallons per head per day, though the pressure is high and constant. It is not that the supply is limited, or that the employment of water is in any way restricted, but simply that with present domestic habits the people will not, or at all events do not, on the average, take more. We do not advocate the reduction of the water supply of any town to 9 gallons per head per day, or even to 15 gallons, which would cover the residual waste hitherto checked in the Bradford district, and which probably represents the fringe of waste that must always remain when the more palpable cases have been suppressed. It is essential that the supply should always be much in excess of the demand, as indeed it would be, in almost every place in the kingdom, if the example of the Bradford Corporation were followed. After explaining the results obtained in other districts still more recently placed under the system, Mr. Binnie proceeds to report the cost of the work, concerning which he says—"Viewing it in the most unfavourable manner, and taking into account all items of expenditure up to date, including the experimental work noted in my last report, capital charges and working expenses, it amounts to £3675 9s. 1d. By this expenditure a saving of 472,602,000 gallons has been effected in one year, the value of which to the Corporation is £12,799 12s. 9d. per annum, equivalent to a capital sum of £284,436. Thus, according to Mr. Binnie, the value of water saved in the first year is three and a-half times the total capital expenditure involved in the purchase and fixing of all the necessary apparatus, including stopcocks outside the houses and the working expenses combined. Spreading this capital sum over twelve years, Mr. Binnie states that the cost per annum is £922, or about one-fourteenth of the annual value of the water saved. We have stated the Bradford results in some detail, not because they are more remarkable than those obtained in other places, but because they constitute the latest contribution to our store of information concerning the enormous benefits which may accrue to water Authority and water consumer alike, by a proper and unprejudiced understanding of the subject and by energetic and systematic action; and we heartily endorse Mr. Binnie's congratulations to the Bradford Corporation on the result of their first season's work, which, as he says, far exceeds his best anticipations. We shall look with much interest for the completion of this work, which, notwithstanding the great benefit already accruing, appears to be scarcely half finished.

It is now some twelve years since Mr. Deacon's paper read before the Institution of Civil Engineers first made known the experimental results obtained in Liverpoool by the waste-water meter system. Shortly after that time the system was extended to the whole district of supply, and it is now in operation over a population in this country and abroad of between three and four millions. In Carlisle, Gloucester, Portsmouth, Hereford, Hertford, and Exeter, the method has quite recently achieved successes little, if at all, inferior to those obtained in Bradford ; and that London presents no exceptional difficulty has been shown by the Lambeth Water Company, whose secretary, Mr. Louttit, stated to the Society of Arts in 1882, when speaking of certain Lambeth districts, that the average consumption before this system was introduced was 35·09 gallons per head per day ; but afterwards it was reduced to 15·28 gallons, so that the saving per head per day was 19·81, or about 20 gallons. This, be it remembered, is under constant supply. How then is it that in the face of facts like these two-thirds of the metropolis still submits to an intermittent supply with the notoriously insanitary conditions inseparable from it? And why is it that the companies continue to supply, day after day, thirty to forty gallons a-head under intermittent service if, with all credit to themselves, they could give a constant supply, and, with all pecuniary benefit to themselves, they could reduce the waste in the manner effected elsewhere? For this astounding anomaly we at once say that we do not believe the companies are—now, at least—wholly or even chiefly to blame. With the people of the metropolis at large, and with the municipal authorities in particular, the companies have, it must be conceded, a bad name. But there have been misunderstandings innumerable, and so long as the acts of the companies—though precisely the acts which a wise municipality, if constituted the water Authority, would itself adopt—are not only discouraged, but arbitrarily put a stop to, the citizens and the companies must suffer alike—though the companies are likely, in this case, to suffer least. As an example of our meaning we will cite again the well-worn subject of outside stopcocks on the service pipes. Such stopcocks have been found most important adjuncts in the prevention of waste. The greatest municipal water Authorities in the country have employed them, and have placed them with proper protecting covers beneath the footways. Without such means, it is certain that the suppression of waste and the maintenance of constant supply can only be effected by dint of frequent inquisitorial visits to private houses, and even then the very waste which is most constant—the hidden waste, of which the consumer knows nothing, but for which he pays—can rarely be detected. In the Lambeth Company's district no objection seems to have been made by the vestry to the very proper action of the company in requiring outside stopcocks to be fixed, and the result has been the adoption of a rational course of waste prevention, and a far greater growth of the system of constant supply than in any other London company's works. We cannot suppose that the vestries who have elsewhere opposed this work can have fully understood the grave consequences of their action if successful. If London is ever to have a permanently constant supply of water, it will not be by the mere introduction of what are known as constant-supply fittings. Constant supply, to be maintained at all, must yield a profit to the Companies. It cannot do this if it involves the expenditure of more water than intermittent supply. *Cæteris paribus*, it necessarily involves more water ; but if the vestries will only assist the companies in preventing the waste, it will involve much less waste than the former intermittent supply, the cost of the supply per house will be reduced, and, sooner or later, the consumer will be benefitted in pocket, as he would already have been benefitted in health.

We have referred to one detail in which a misunderstanding has harmed the interests of company and consumer alike; but a more general evil arises from the well-founded view of the companies that the few outsiders who examine water statistics, and who are, to the companies, the leaders of the opposition, are apt to compare the quantity of water supplied with the price paid for it by the public and to regard the result as the true measure of the right performance of the company's functions. Suppose, for example, that Company A, by reason of the defective condition of its works, is unable to give a better supply than one hour a day, within which time it expends, as commonly happens, 35 gallons per head. Company B at the same time gives a constant supply at higher pressure than Company A, and in doing so expends, as is frequently the case, only 20 gallons a head, simply because reasonable care has been taken of the water, and a waste of 15 gallons per head per day has been prevented. We profess to desire to encourage the work done by Company B and to acknowledge the harmful results of Company A's negligence, which renders it impossible to give a supply which would be regarded as adequate by a provincial corporation, while Company B is supplying all that the people will take. Yet, with these facts before us, we are undoubtedly still influenced by mere questions of price paid for given volumes of water—whether that water ever reaches the consumer or not—to the infinite discouragement of the companies in their desire to benefit the public, and concurrently, of course, themselves.

Year by year London grows, and the demand upon the Thames must grow ; and unless some measures are taken to prevent loss between the companies' works and the consumers premises very grave results will follow in dry seasons. At present the companies send out from their works, say, 35 gallons per head per day. It is commonly supposed that about this quantity reaches the consumer. It cannot be too soon learned that only about half this is really consumed, the rest is wasted, chiefly underground. The companies could, by adopting the means which Mr. Binnie describes, thus prevent the water famine which must come in a greater or less degree in a few years if the present growth of London continues. The companies do not, however, do this because vestries and public at present confound waste with actual consumption. The companies can send out of their works twenty or thirty gallons; ten, at least, of the thirty will be wasted underground. They can, at considerable outlay, save this ten, and still the consumers have their twenty, or all they like to take, but the cost to the companies remains practically the same.

THE COST OF PRIVATE BILL LEGISLATION.

A HIGHLY interesting and instructive Parliamentary return has been published, showing the expenses incurred in 1883, 1884, and 1885 by corporations and other public bodies, railway, tramway, canal, and other companies, in promoting or opposing Private Bills in Parliament. A fair and practical study of this document is calculated to impart powerful impetus to the perceptibly growing agitation—mainly led by Mr. Craig Sellar—for a reform in the existing costly, cumbersome, and tedious system. We propose only to give some of the largest items, leaving it to legislators and others most directly concerned to deal with the full details. With a few exceptions it will be sufficient to give the total expenditure of the triennial period in supporting or resisting private measures. The first exception is the Corporation of London, who it appears spent in 1883 £24 for, and £862 against; in 1884, £3443 for, and £1393 against; in 1885, £14,215 for, and £52 against ; total, £19,993. The Metropolitan Board of Works, as would be expected, exceeded this total, expending altogether £35,543, viz., 1883, £7128 for, and £3826 against ; 1884, £10,492 for, and £3969 against; 1885, £5282 for, and £4844 against. Far more fortunate were the Commissioners of Sewers, who spent in 1883 £2119 for, and £951 against ; in 1884, £3 for, and £191 against; in 1885, "nil" for, and £19 against ; total, £3286. Turning next to the provincial corporations, we see that Liverpool stands at the head with a total of £23,500, £4240 only being for the promotion of Bills, and £19,200 odd for opposition. For the larger part of the latter sum the Manchester Ship Canal is probably responsible. From that figure there is a considerable drop, for Preston comes next with £10,000, £9500 being for promotion—mainly probably of the Ribble improvements. Next in order follow Birkenhead and Cardiff, between £8000 and £9000 each—the former largely concerned in the Ship Canal Bill; Hull, Northampton, and Bury, with over £7000 each; York and Longton, over £6000 each; and Birmingham, Hastings, and Manchester with between £5000 and £6000 each. Manchester, of course, took a leading part in the Canal Bill, but less by Corporation than private funds. From this point the amounts gradually descend, with many curious results, until we reach the lowest and most absurd sum ever returned as private legislation expenses—viz., Faversham, "2s. in opposing Bills."

The figures attached to the other and general local authorities do not reach very high, and present no special features, with one exception, which will appear later. But with regard to the railway companies there is much that is interesting. Here one may get lost in amazement at the sums set down. At the top of the list stands the London and North-Western Company, which in the three years dealt with £149,000 in "law and Parliamentary" business, and when comparing this company with most of the others, something must be added to this total, because a large part of the work which in other cases is done by outside solicitors and Parliamentary agents is here carried out by a salaried solicitor and staff, also on salary. How much of this amount belongs to strictly Parliamentary business does not appear, but it is certain that that portion is very large, and may be nearer £100,000 than £50,000. Running this company closely come the Great Western with £68,000, and then the South-Eastern with a total of £57,000—much of it, no doubt, due to the Channel Tunnel, for which, however, there is a separate figure of £3482; and after these there are the Taff Vale, £32,000; the London and Brighton, £31,000; the Midland, £28,000; the Great Eastern, the London and South-Western, and the Lancashire and Yorkshire, £27,000 each; the Metropolitan District, £24,000; the Manchester, Sheffield, and Lincolnshire, £23,000; and the Great Northern, £20,000. The totals of all the railways combined amount to £1,036,568. Some of these expenses, like those of the Liverpool Corporation, also arise from the Canal contests; and this brings us to the Ship Canal Company, whose total is put down at £146,500, made up thus:—1883, £62,484; 1884, £42,422; 1885, £41,594. By these figures the London and North-Western total is completely eclipsed; but the amount will cause little surprise, because of the sustained attention with which the scheme was watched by the public. But if people are not much astonished, for that reason, they may well feel that a severe reform is necessary in regard to the cost of merely getting through Parliament or defeating a project. By the side of this no other canal total is worth noticing, for the total spent by all the canal companies only amounts to £163,233, the Ship Canal included. For the most part the totals of the water companies are small, the West Gloucestershire Company showing £10,000 odd, the Southwark Company £7000 odd, the Bristol Company £8000, the Southwark and Vauxhall Company £6235, the grand aggregate being only £85,577. The complete total for all the gas companies is even less, amounting to only £45,774 ; but from this there is a tremendous leap up to £117,363, the expenditure of the tramway companies in the United Kingdom. Under this head the North Metropolitan Tramway Company leads with £11,000, the Birmingham Company and the Oldham Company coming next with £7000 each, and after them the South London, £6000. Not many more examples need be given ; but among the returns relating to harbour and dock and other authorities, the Mersey Docks and Harbour Board is conspicuous with a total of £52,164, of which £51,690 went in opposing Bills—principally the Ship Canal Bill. The Thames Conservancy only expended in the three years £5349 ; but the Aire and Calder Navigation Trustees got rid of over £14,000, while the Clyde Trustees disposed of £9263. This return would have been more effective if the whole of the items had been brought up to one gigantic total ; but as it stands, as indicated by the specimens selected, it is imposing enough.

While treating of Private Bills from the above point of view, we may complete our periodical review of their progress during the past year by showing which of the Bills suspended at the dissolution in June eventually reached the statute book. The following received the Royal Assent on the last day of Parliament, September 25th :—Exeter, Teign Valley, and Chagford Railway (extension of time); Plymouth, Devonport, and District Tramways ; Salford Corporation ; Moore-street Market and North Dublin City Improvement ; Warehousemen's and Clerks' Schools ; River Suck Drainage ; Ionian Bank ; Woodstock Railway; Leeds Compressed Air-power Company; Lynton Railway; St. Helens and Wigan Junction Railway; Ardrossan Harbour (Sale and Transfer); Muswell Hill and Palace Railway ; Chatham and Brompton Tramways; Barry and Cadoxton Gas and Water; Nelson Improvement; North London Tramways; Rotherham and Bawtry Railway; Hampstead Heath Enlargement; Metropolitan Railway; Plymouth and Devonport (Extension) Tramways; Seacombe, Hoylake, and Deeside Railway; Halifax High Level and North and South Junction Railway ; Mersey Railway ; Midland and South-Western Junction Railway; Portsmouth and Hayling Railway; Sutton and Willoughby Railway (Mablethorpe Extension); Manchester, Sheffield, and Lincolnshire Railway (Additional Powers) ; Bank of South Australia ; Midland and Central Wales Junction Railway (Abandonment); North Pembrokeshire and Fishguard Railway; Bridgewater Railway, and Neath Harbour Acts. This result was much better than was considered possible during the second session, but the following Bills had to be suspended and carried over for the next session:—Barnet District Gas and Water; Belfast Main Drainage; Carlisle Corporation; Hillhead and Kelvinside (Annexation to Glasgow); Kanturk and Newmarket Railway; London Street Tramways Extensions; Midland and South-Western Junction Railway (No. 2); North Metropolitan Tramways; Skegness, Chapel, St. Leonards, and Alford Tramways (Abandonment); Southend Local Board; Clyde Navigation; Easton and Church Hope Railway; Edinburgh Improvement; Kensington Vestry ; Kingstown and Kingsbridge Junction Railway; Manchester, Bury, Rochdale, and Oldham Steam Tramways; Rhymney Railway; and Stratford-upon-Avon, Towcester, and Midland Junction Railway.

EXPLOSION ON BOARD THE STEAM TUG SEA GULL.

ON page 433 we give illustrations showing the exploded boiler of the steam tug Sea Gull, copied from those published officially by the Board of Trade. The explosion took place about 1 p.m., on the 2nd of September, in the East Float, Birkenhead, The master, the engineer, and the fireman were killed, and the mate and two other men were injured by the explosion.

The boiler was made of iron, and was of the ordinary cylindrical and tubular type, containing two furnaces and two combustion chambers. It was 8ft. 6in. in. diameter by 8ft. 9½in. in length. The shell was made of three rings with three plates in each, originally ½in. thick, lap-jointed and single-rivetted in the cross, and double-rivetted in the longitudinal joints, with ⅞in. rivets spaced about 2½in. apart. The furnaces were 2ft. 9in. in diameter by about 6ft. 2in. in length, each made of two $\frac{7}{16}$in. plates, lap-jointed and single-rivetted with the longitudinal joints below the level of the fire bars. The combustion chambers were made of $\frac{7}{16}$in. plates supported by 1¼in. stays spaced about 9in. apart. The ends of the boiler were made of ½in. plates, supported by screwed and nutted stays in accordance with the practice observed in the construction of this type of boiler. There was a dome on the top of the shell about 3ft. 6in. in diameter by 3ft. 3½in. in height. The crown of this dome was flat, and supported by one vertical stay.

The boiler mountings consisted of:—One 4in. safety valve said to have been loaded by lever and ball to about 45 lb. per square inch; one 3in. safety valve loaded by dead weight to about 49½ lb. per square inch. These valves were in one chest, the lever of the 4in. valve was exposed, and the weights of the 3in. valve were hung inside the steam dome. One glass water gauge; one test cock; one steam gauge; one stop valve—steam; one blow-off cock; one feed valve ; one steam whistle; one donkey feed valve.

Mr. William Williams of Seacombe, the owner of the tug from 1879 to the beginning of 1885, bought the boiler in 1881 from a broker at Liverpool, whose name and address are unknown, for the sum of £30, and after repair it was placed on board the Sea Gull for the purpose of supplying steam to the main engines. The boiler is said to have been an old donkey boiler removed from the s.s. City of Richmond—Inman Line—in the beginning of 1881. If this be correct, it must have been made by Messrs. Tod and McGregor, Glasgow, in the year 1873. According to the statement of Mr. William Williams, the boiler was repaired, at a cost of £130, prior to being placed in the tug in 1881. These repairs consisted of :—

New steam dome. Taking out all rivets in the cross seams on

EXPLODED BOILER OF THE STEAM TUG SEA GULL.

Fig 1.

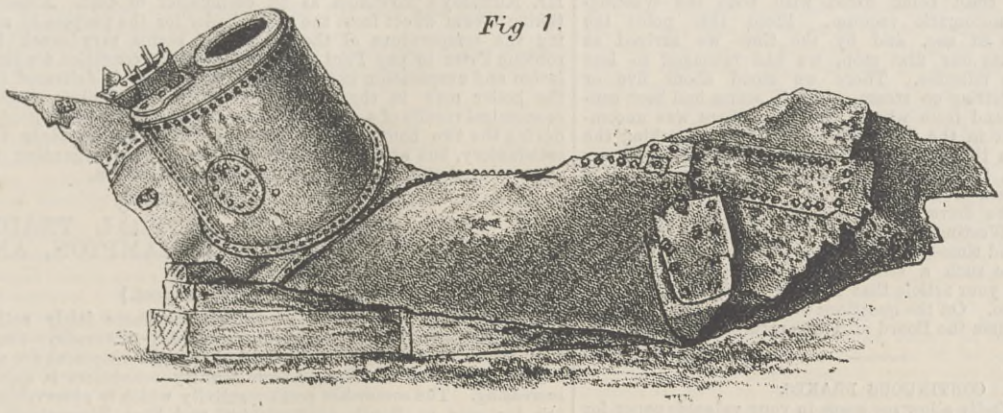


Fig 2.

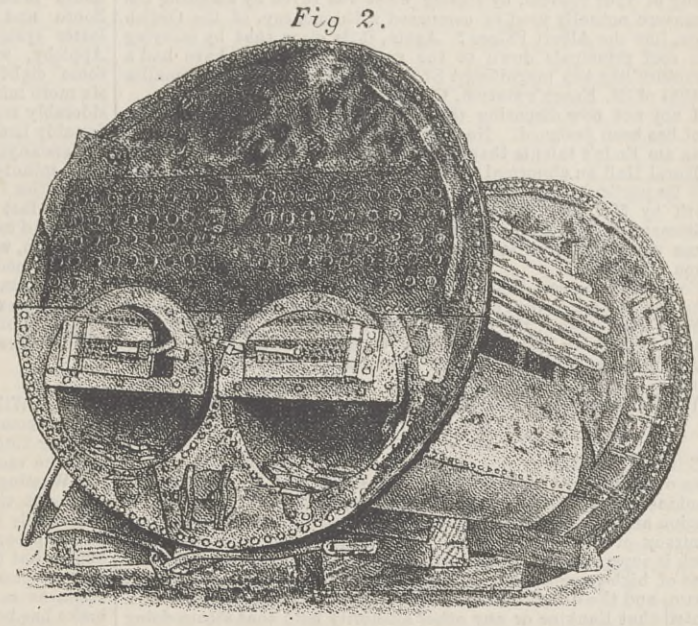


Fig 3.

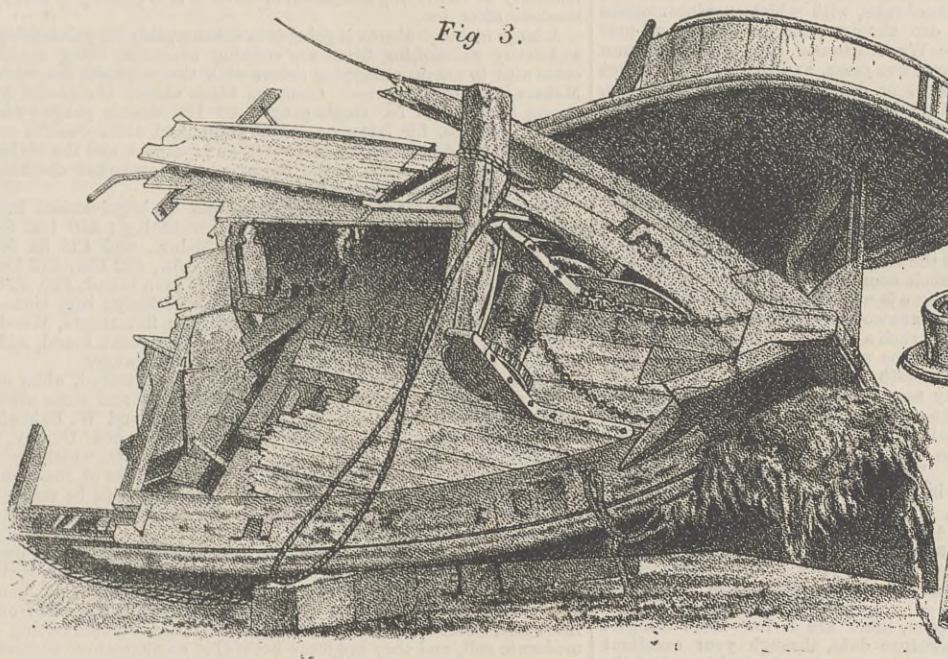


Fig 4.

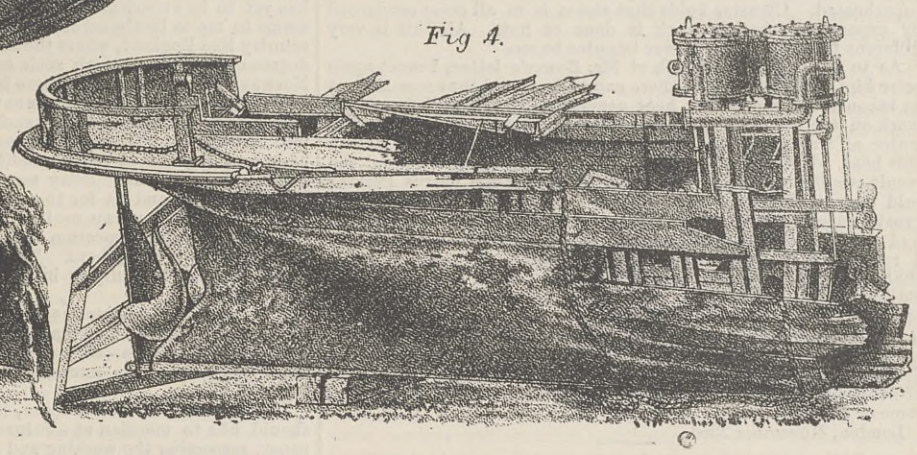


Fig 5.

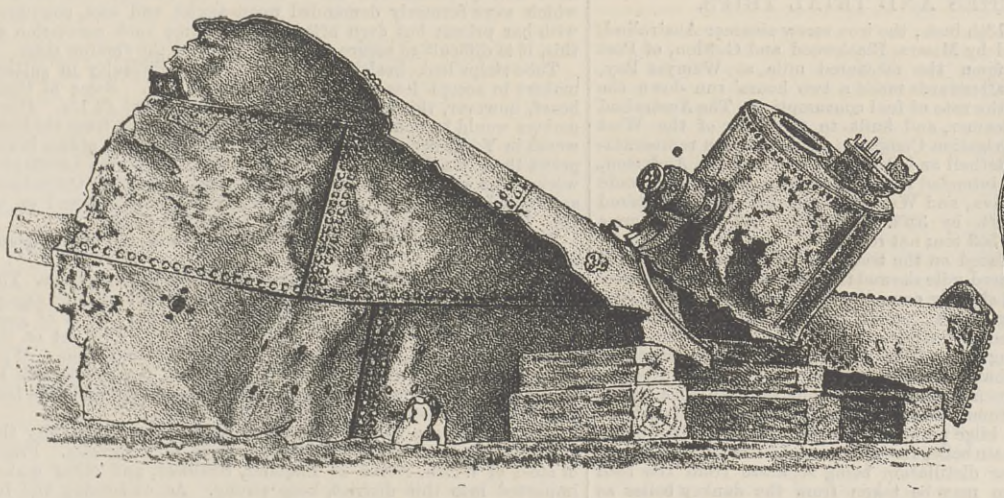
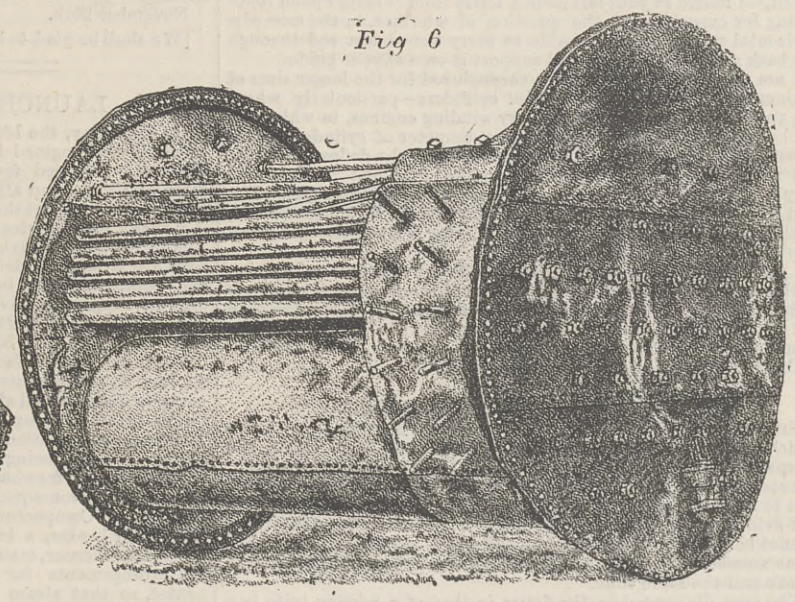


Fig 6



the lower half of the shell, and fitting new ones. Four stays to crown of combustion chamber. Boiler caulked throughout. One patch at back end of each furnace renewed. Shell drilled at bottom to ascertain thickness of plate, which was found to be $\frac{7}{8}$in. New safety valve chest. On the completion of the repairs the boiler was tested by hydraulic pressure to 120 lb. per square inch, when it was found to be tight, except a few rivets and the back ends of three or four tubes. The pressure at which the boiler was subsequently worked was 60 lb. About nine months after the boiler was placed in the tug a bolted patch 6in. square was put on the shell at the starboard side of the bottom, about 2ft. from the front, and a patch on the back tube plate to cover a crack between two of the tubes.

The present owner stated that he purchased the tug for £350 on the 3rd of March, 1885, and prior to being used for towing, &c., he had it overhauled and put in what he thought good and safe order. The repairs to the boiler at that time consisted in hammering up tube ends, and renewing patches at the back end in the combustion chambers. No repairs were effected to the outside of the boiler, and he was not aware that any were required. When steam was raised to from 40 lb. to 45 lb. the boiler was found to be quite tight as far as he knew, and after the tug was seen by the assistant harbour-master at Birkenhead it was used for towing floats and other small crafts. From that time until the occurrence of the explosion the tug has been in constant use, except when laid up for slight repairs.

The repairs to the boiler were executed by jobbing boilermakers, and consisted of caulking tubes and fitting patches to the shell at the bottom, to replace others that had given way.

The boiler has not been inspected by any person other than the jobbing boilermakers who effected the repairs referred to.

The boiler was not insured.

The shell at the bottom gave way in a longitudinal direction, the rent extending from end to end of the boiler, then developing round the circumference at the roots of the flanges, thereby liberating nearly the whole of the shell from the front and the back ends. The fragments of the boiler, as seen after they were lifted from the bottom of the float, are shown by our engraving, and those of the hull of the tug.

This explosion occurred because the under side of the boiler shell had become too weak, through external and internal corrosion, to any longer sustain the ordinary working pressure; it was unfit for any useful pressure whatever. In some places there was scarcely any metal left, and there cannot be any doubt but that the boiler had been in a very unsafe condition for some time. Indeed, it is scarcely credible, having regard to the diameter of the boiler and the wasted condition of the plate in the vicinity of the fracture, that the boiler could have been water-tight with any pressure at all approaching as much as 40 lb. or 45 lb.

What was really the load upon the lever safety valve could not be determined, as the ball that was attached to the lever has not been found. The dead-weighted valve was loaded to 49 lb., and if it was in good order that load represents the maximum pressure at which the steam would begin to blow off, and it is probably about the pressure at which the boiler was usually worked. Figs. 1, 2, 5, and 6 show the fragments of the boiler after being lifted out of the water, while Figs. 3 and 4 show the fragments of the tug.

INDUSTRIAL EXHIBITION AT VENICE.—The site of the Exhibition which is to be opened in Venice on April 25th, 1887, is in the public garden at the end of the Quai des Esclavons. The building will have an area of about 6000 yards, and it will be occupied by painting, sculpture in marble, bronze, and wood, mosaics, glass, and all kind of work that can be considered as related to art. The modern plan of eking out the interest by means of concerts, games, fireworks, &c., is also to be adopted.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our Correspondents.*]

THE ROOF OF THE NEW AGRICULTURAL HALL.

SIR,—I have read with much interest, and with some profit, Mr. Max am Ende's splendid monograph on the roof of the new Agricultural Hall. With your permission, however, I would like to make a few remarks on the whole subject. They are intended not as a criticism of Mr. Max am Ende, but of the design.

Many of your readers not quite familiar with the subject will perhaps have failed to catch the central idea. Permit me, therefore, to give a timely illustration of what is involved.

The usual practice is to make kitchen tables with legs fast to them; by this means stability is obtained and the table is not readily overthrown. In Colonial life my experience shows me that the reverse practice is adopted. The legs of tables are posts driven into the ground and the table top is laid on the posts. Hitherto a combination of both devices has been adopted in constructing iron roofs—the analogue of the table top. They have, that is to say, been secured to iron columns, and the columns have been secured to the ground, and in this way stability has been obtained.

In the new Agricultural Hall neither expedient has been resorted to. The columns carrying the roof take nothing but vertical thrusts, and to prevent the whole from tumbling down on the first gust of wind, trussed annexes are added at each side to keep it up. We have here a table balanced on legs, not secured to it, or to the ground, and to keep it from falling down it is propped up with chairs at each side.

Now I submit that this is magnificent, but it is not engineering. There is no earthly reason why a vertical column should not take a side as well as a vertical stress, provided it is designed for it; and there is no special reason why the stability of an arched roof against wind pressure should be secured by trussed annexes. I speak now of roofs in general. Leaving the general, and coming to the particular, the object of this letter is to get from Mr. Max am Ende a definite statement of the reasons why ordinary practice has in this

case been departed from. It is folly to say that it was done simply to prevent cast iron columns getting a side stress. There is something much more than this at issue. Was it a question of cost, and if so, will Mr. Max am Ende favour, not only myself, but I am sure many of your readers, by stating what was saved by adopting the structure actually used as compared with one, say, of the Ordish type, like the Albert Palace? Again, it is clear that by carrying the roof principals down to the ground we should have had a structure like the magnificent St. Pancras roof, or—a little smaller—that of St. Enoch's-station, Glasgow.

I am not now disputing the consummate skill with which the roof has been designed. No man living more fully recognises Mr. Max am Ende's talents than I do. But we have in the new Agricultural Hall an abnormal structure, and I want to know in what lies its particular advantages. This point is not sufficiently set forth by Mr. Max am Ende, and they are not self-evident. A statement of this kind will be of great use, because it will enable those who imitate it to say when its adoption is desirable and when it is not.

So far as I can see, the structure must be much more expensive than one relying in part on the stiffness of its columns for support against wind strains, the columns being, of course, then assisted by braced annexes or their equivalents. On this point I may be wrong. If Mr. Max am Ende will set me right I shall be much indebted to him. J. W. BURNS.

Westminster, November 22nd.

THE MARCHANT ENGINE.

SIR,—If Mr. Bower will kindly read my letter which he criticises over again, he will see that I have not said anything about Rankine contrary to the quotation from page 386 of "The Steam Engine and other Prime Movers." Rankine does not dispute the accuracy of the statement that steam expanding without doing work is superheated. Apparently it must be so, because the total heat of high-pressure steam is greater than that of low-pressure steam, and the difference must appear as superheat. I never even hinted that Rankine or any other authority held that steam doing work was superheated. If I have conveyed a different impression to Mr. Bower, I am very sorry for it.

What I did mean to say is that Clausius has shown that steam is condensed when it expands, whether *it does work or not during expansion*, and that this was opposed to Rankine's views. To sum up. Rankine held that steam expanding and doing work was in part condensed, that steam expanding without doing work was superheated. Clausius holds that steam is in all cases condensed by expansion, whether work is done or not. All this is very different from what Mr. Bower imputes to me.

As to the third paragraph of Mr. Bower's letter, I must again refer him to mine. I have there expressly stated that means must be taken to dispose of the heat generated by the performance of work on the steam, and for this reason I assumed the presence of water as well as steam. Feed water Mr. Marchant uses to absorb this heat. Under the circumstances, I am not sure whether the result would be water or steam. The present Mr. Loftus Perkins told me, in course of conversation several years ago, that his great predecessor, Jacob Perkins, never was certain whether he had water or steam in his pipes when the said pipes were red hot, a result which he had frequently obtained, and I know that eudiometer experiments do not quite bear out Mr. Bower's views, although I am at present unable to lay my hands on the data. There appears to be, as I have said, a critical point reached during which the contents of the eudiometer are clear, and then in one moment a meniscus becomes evident, demonstrating that fluid has become liquid. I know this is true of other fluids than steam. I am not sure about steam. Perhaps some of your readers can aid me. L. P. B.

London, November 23rd.

SLIPPER GUIDES.

SIR,—I notice in your last issue a letter from "Long Piston Rod" asking for experience on the question of whether, in the case of a horizontal engine, it is advisable to carry the piston rod through the back cover of cylinder, and support it on a slipper guide.

I am decidedly in favour of a through rod for the larger sizes of engines—say, above 18in. or 20in. cylinders—particularly where the stroke is very long, as in colliery winding engines, in which the stroke is commonly equal to twice the diameter of cylinder, and is sometimes as long as 7ft. The argument that the deflection of the rod neutralises any advantage a support at each end gives, is true only so far as it concerns a rod which is put in quite straight. The best practice is, however, to give the rod sufficient camber upward, so that the weight of the piston will bring the rod straight when in place.

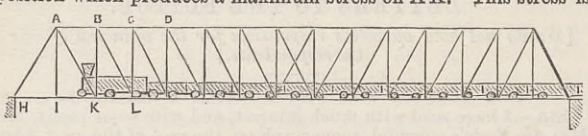
I can fully bear out the statement as to the difference of opinion on this question. Not only are new engines turned out without a back or tail rod, but I know of several cases where the tail rod has been cut off to save the trouble of keeping up the packing of what was thought to be an unnecessary rod. J. SILVESTER.

Brixton, London, S.W., November 20th.

RAILWAY BRIDGE OVER THE RIACHUELO.

SIR,—I am obliged to Mr. Woodcock for his courteous letter which appeared in your columns last week, and hope I shall not trespass too much on his time by asking a little more explanation. He states that A I in the following figure is a tie, and never subject to compressive stresses. I think this can scarcely be called a self-evident proposition. One thing is certain, viz., that there cannot be a compressive and a tensile strain simultaneously in the same member, because the fibre cannot be lengthened and shortened at one and the same time.

The case illustrated in the figure is that of a passing train in a position which produces a maximum stress on A K. This stress is



tensile, and largely in excess of any compressive stress that would accrue in the opposite direction due to dead load at I, and consequently there is only a pull in A K. This pull produces at A compressive strains in A B and A H, which are only determinate by statical law, when A I is precluded by its construction from acting as a strut, as there are three unknown stresses, A I, A H, and A B; but when A I can only act as a tie, there are only two unknown stresses, which can therefore be ascertained.

A higher investigation, such as that adopted for frames with superfluous members, would no doubt establish the point clearly; but if a model of the end of the truss is made and a pull produced in A K, a dynamometer under I will record a pressure even when H is firmly fixed. If a finger be placed under H and another finger at I, the pull on A K appears to produce, firstly, a pressure on A I as being the shortest route to the ground, and as the finger at I is squeezed, the finger H begins to feel the pressure.

I do not mean to set up a rough experiment such as I have described as a determination of the point, but I think there is sufficient ground for asking Mr. Woodcock a proof that no such compression as I have described can possibly take place. If it were to occur, the effect would be to produce a deflection in H K and at I which would occasion a greatly increased unit strain in the lower fibre of the bottom chord. T. GRAHAM GRIBBLE.

Richmond, November 22nd.

TROUBLESOME BRAKES.

SIR,—Your article on continuous brakes in your issue of October 29th last led me, on a recent journey, to take particular notice of their working. I travelled from Edinburgh to Leeds by the 10.30 train on the 19th inst., and up to Carlisle, being upon the North British Railway, the Westinghouse brakes were in use upon both engine and train. Leaving Carlisle at 1.18 p.m. for Leeds, the train was drawn by a Midland engine fitted with the Westinghouse brake, the train being fitted with both the Westinghouse and the automatic vacuum. From this point the latter system was in use, and by the time we arrived at Appleby, which was our first stop, we had managed to lose some eight or ten minutes. There we stood about five or six more minutes getting up steam, which it seems had been considerably reduced, and from what I could see there was uncomfortably little water in the gauge glass. It is no use asking the drivers anything on this line, but it was pretty clear that in our fifty minutes' run from Carlisle we had got into considerable difficulties by the use of the vacuum brake. This was confirmed by the fact that the driver before proceeding disconnected this brake and used the Westinghouse up to Leeds, with the object of saving steam, water, and time—a result which was certainly obtained. This seemed to me such a striking confirmation of the statements contained in your article that I thought you might like to insert my experience. On the questions of steam, water, and fuel consumption, of course the Board of Trade returns are silent.

November 24th. ECONOMY.

CONTINUOUS BRAKES.

SIR,—Will you kindly allow me space in your valuable paper for a few remarks on the vacuum brake? I see in your article of October 29th, on "The Brake Returns to the Board of Trade," that the vacuum brake seems to you to be nearly all wrong, and the Westinghouse to be all right, or nearly so. You say you have no doubt that ultimately it, or something very like it, will be universally in use in this—England—and other countries. Without any disparagement to the Westinghouse brake, I may venture to affirm that the Hardy vacuum brake, with which our locomotives and vehicles are equipped, can show results for safety and precision as satisfactory as the Westinghouse. The Hardy vacuum brake has been in use here over five years, and there has never yet been anything like an accident or delay of any kind whatever, which you will admit speaks a volume for the careful working and management of this railway—Jutland and Funen, in Denmark—with respect to this brake. We have 160 engines and vehicles in proportion fitted with it, and such a thing as to overshoot a platform has never yet been known, and anything like a tendency to "gorge cotton waste, sponge cloth, or other indigestible delicacies" has yet to be experienced; and for ice being a cause of failure it seems to me to be almost comical to hear of ice doing mischief in a country like England, where the winters will not admit the smallest degree of comparison with such countries as Denmark, Sweden, Norway, and Russia, where there is winter from October to the end of March. Ay! and such winters as would rather astonish the natives of England. I cannot imagine such a thing as cotton-waste getting into the vacuum pipe without some very gross negligence or wilfulness; and a piece of sponge cloth in the ejector clapper valve causing "one minute" delay seems to approach something very like absurdity; and as for the adjustment of the brake causing delay, that only confirms me in the belief that there must be a very sad want of proper inspection. I should just like to see any of these things causing a delay here. Why, our locomotive superintendent would overhaul the culprit in such a manner that it would never happen again.

I trust you will forgive the length of this letter, but I only wish to point out that the vacuum brake has some friends, and my belief that nearly all the cases mentioned in your article on its failures could easily have been remedied by better attention of the parties concerned.

If you would allow me space, there are a few more things I should like to mention at a future date, through your excellent paper, respecting the working and management of this out-of-the way railway in comparison with some of the crack lines in Great Britain. A ROUNDHOUSE FOREMAN IN DENMARK.

November 20th.

[We shall be glad to hear again from our correspondent.—ED. E.]

LAUNCHES AND TRIAL TRIPS.

ON Thursday, the 18th inst., the iron screw steamer Australind, just built and engined by Messrs. Blackwood and Gordon, of Port Glasgow, was tried upon the measured mile at Wemyss Bay, Firth of Clyde, and afterwards made a two hours' run down the Firth in order to test the rate of fuel consumption. The Australind is a shade decked steamer, and built to the order of the West Australian Steam Navigation Company, whose London representatives are Messrs. C. Bethell and Company, and Trinder, Anderson, and Company, being intended for the passenger and cargo trade between Singapore, Java, and Western Australia. Her registered dimensions are 224·8ft. by 32ft. by 14·65ft. and she measures 1018 tons gross, and 553 tons net register. Upon a mean draught of 12ft. 1in. she displaced on the trial trip 1480 tons. A mean of six runs on the measured mile showed that with an indicated horse-power of 780, a speed slightly exceeding 11 knots was attained, the steam pressure being 150 lb., revolutions 68, and vacuum 26in. The Australind is fitted with triple expansion engines, the diameters of the cylinders being 19in., 30in. and 50in., and the length of stroke 36in. Somewhat more than ordinary interest was taken in these trials in consequence of the vessel being supplied with two of Kirkaldy's "Compactums," which apparatus operates as a live steam feed-water heater, a bilge pump, ballast pump, circulating pump for main condenser, main boiler feed pump and fresh water distiller; the arrangements for distillation being separate from the feed heater, so that steam may be taken from the donkey boiler as required by the Board of Trade Regulations on the subject. One of the Compactums supplied to the Australind is employed only for heating feed-water, and for that purpose it is fixed to the back of the main condenser. This apparatus was referred to in THE ENGINEER of April 16th in the present year, and at the same time an explanation was suggested which might account for the economical results that have been obtained by heating feed-water with live steam. The other Compactum, which is fixed against an adjacent bulkhead in the vessel, combines by means of valve arrangements the many functions already recorded. Among its other duties is that of a condenser for dealing with the exhaust steam from the winches, and other auxiliary engines, by means of which the donkey boiler is supplied with hot and almost entirely fresh feed-water. The economy resulting from this arrangement is obvious, besides the advantage resulting from carrying away the waste steam instead of blowing it all over the decks and against the sides of the vessel when working cargo. The winches, too, are necessarily benefitted by the removal of all back pressure and condensed steam. The two machines, as fitted in the Australind, form a combination, which by setting the stop valves, will perform all the various duties of bilge, ballast, and other pumps, as usually fitted in the engine rooms of steamers. Altogether the apparatus seems to fairly merit the title given to it by Mr. Kirkaldy. But although capable of so many uses, it was chiefly in regard to its efficiency as a feed heater that interest was centred upon it during the steam trials of the Australind. It is therefore much to be regretted that no opportunity was afforded upon that occasion for determining the difference of the fuel consumption, with and without the use of the feed heater. The feed-water was passed through the Compactum attached to the main engines throughout all the runs made by the vessel, and it remains for her owners now to discover what increase, if any, is made in the fuel consumption when the feed heater is not in use. A two hours' full power run showed a fuel consumption of 20 cwt. 2 qr. 13 lb., during which the average indicated horse-power was 780, thus showing a consumption of 1·48 lb. of the best Welsh steam coal per indicated horse-power per hour. The steam trials were of course made under the direction of the builders of the vessel and makers of the engines—Messrs. Blackwood and Gordon—in order to prove fulfilment of the contract conditions in regard to speed, &c., and it is to be hoped that now the Australind is in the hands of Messrs. Bethell and Trinder they will take steps to determine the actual value of Mr. Kirkaldy's invention as an economiser of fuel. Although taking steam direct from the main boiler for the purpose of raising the temperature of the feed-water seems very much like robbing Peter to pay Paul, yet the favourable condition for circulation and evaporation in which the feed-water is delivered into the boiler may in the case of most marine boilers produce economical results of a tangible character. The coal consumption during the two hours' run of the Australind was certainly very satisfactory, but at present nothing can be said regarding the share contributed thereto by Kirkaldy's Compactum.

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

(*From our own Correspondent.*)

BUSINESS in manufactured iron this week keeps fairly active. Ironmasters, on 'Change in Birmingham to-day—Thursday—stated that orders for finished iron from merchants for shipment are still arriving, and that the demand from country consumers is quietly increasing. The somewhat greater activity which is observable at the factories in South Staffordshire and East Worcestershire, where the iron rolled for local consumption is worked up, is a favourable feature. It argues that the demand from these buyers is likely to show further augmentation. At some of the hardware factories, where until recently very short time has been made, four, and in some cases five days a week are now being run. In other cases hardware makers' order-books are filling up well, and the necessity of employing additional operatives is beginning to occupy masters' attention.

A large make of sheets is going into consumption for galvanising, and many galvanising firms are running overtime, being unable otherwise to execute shipping orders with the requisite despatch. Makers keep firm in price. Common black sheets are quoted by strong firms at £6 5s. single gauge; £6 10s. double gauge; and £7 5s. to £7 10s. for lattens. In the galvanised state doubles are about £10 2s. 6d. to £10 5s. delivered at Liverpool, and the higher prices asked for next year's business are somewhat checking contracts for spring shipment.

The quotations for Messrs. Morewood and Co.'s galvanised iron are:—Sheets, Red Star brand, £10 10s. for 18 b.g.; £10 15s. for 24 b.g.; £12 5s. for 26 b.g.; £13 5s. for 28 b.g., and £15 5s. for 30 b.g. Tinned sheets, Lion brand, £11, £11 5s., £12 15s., £13 15s. and £15 15s.; double best tinned flat sheets, Lion brand, £20, £21, £23 and £24 for the first four gauges respectively; best tinned sheets, Anchor brand, £17, £18, £20 and £21; flat sheets, Woodford brand, £14 10s., £15, £16 and £18; Wheatsheaf brand, £13, £13 10s., £15 10s. and £16 10s. for the respective gauges.

The demand for thin sheets and tin-plates is sustained, alike on home and export account, though the Canadian and some other distant markets are now closed. Messrs. E. P. and W. Baldwin have this week started at their Swindon works, near Dudley, a new tinning shop, for the treatment of large sheets, which have hitherto had to be sent by canal to the Wilden works of the same firm, some sixteen miles distant. An advantage will be secured in greater economy, and in increased rapidity of execution of orders at the Swindon works.

Some accession of orders has lately been experienced by the best bar makers, who have not hitherto seen much increase of work. Not only, as I last week reported, are the Admiralty buying from Earl Dudley's works, but his horseshoe bars are in better call from Australia. Merchant and common bar makers are experiencing a moderate call, and they are more hopeful of an augmented demand early next year. Marked bars remain at £7 to £7 12s. 6d.; merchant bars, £5 10s.; and common are quoted £4 17s. 6d. to £5.

In engineering sections of iron and in plates a considerable number of orders continues to pass through this district, and find lodgment in the North of England mills, whose facilities enable them to fill the contracts much below Staffordshire prices. With a view to retain as much of the trade as possible, local ironmasters have largely abandoned the "extras" of 10s. to 20s. per ton which were formerly demanded upon angles and tees, compared with bar prices; but even after making some such concession as this, it is difficult to secure orders for any but the smaller sizes.

Tube strips look healthy, and buyers have difficulty in getting makers to accept less than £4 17s. 6d. per ton. Some of them boast, however, this week that they can still buy at £4 15s. Hoop makers would be doing more but for the competition from the iron-works in Yorkshire, who can quote for London export orders lower prices than Staffordshire, and the competition of the Lancashire works, who carry off the bulk of the Liverpool orders. Quotations are named at £5 5s. to £5 10s. at Staffordshire works, and on to £6. Puddled bars are in more inquiry at £3 to £3 5s.

Nail rods are in better call, on account of China and other distant markets.

Wire rods are in larger demand at the works in Shropshire. The better inquiries are on account of South America and other export markets, and also for wire barb fencing purposes. It is of good augury that the Shropshire Iron Company has now put on its second works, which have been standing for some time. Wire rods are quoted £6 10s. delivered Birmingham, but £6 5s. will be accepted by some firms. Indeed, there is no alternative in the face of the Westphalian competition.

Steel sheets are quoted with more firmness, and generally the steel trade appears to show gratifying signs of expansion. Prices of steel of Welsh, North of England, Sheffield, and other makes imported into this district, keep strong. As evidencing the increased demand for steel of all descriptions, I may mention that steel sleeper crop-ends cannot now be bought except at 2s. 6d. to 5s. advance on the rate of some little while back.

Little credence is given among steelmasters in Wolverhampton to the report from Berlin, which is said to have originated in London, that negotiations are being carried on with a view to the renewal of the International Steel Rail Convention. The dissolution has been so much to the advantage of steelworks that it is thought here to be wholly unlikely that our makers would consent to a re-established syndicate.

The millmen employed at the Gospel Oak Ironworks, Tipton, who were required to submit to a reduction in wages of 10 per cent. have now come out on strike, after working at the drop for a fortnight. They now express their determination of resisting the demand in every possible way, and with that object they have made a general appeal for support throughout the district. The sudden change of front is understood to be due to pressure brought to bear on the men by the Ironworkers' Organisation, which is afraid that if the Gospel Oak Company were successful other sheet makers would take similar steps for a reduction.

The position on the Birmingham and Wolverhampton Exchanges, of Lincolnshire, Derbyshire, Nottingham, Northampton, and similar pigs, is slightly improved this week by the stronger tone of the North of England market. Sellers are quick to take advantage of every turn of the market in their favour, and are again showing a somewhat independent front. 37s. to 38s. is again quoted for Derbyshires delivered to consumers here. Good Northamptons are 36s. 6d. to 37s., but common sorts are less. Hematites keep strong at 54s. to 56s. for best Lancashire brands, delivered. Business is quiet.

Staffordshire pig makers continue active, and deliveries are going away from the furnaces in larger bulk than at any other time this year. Preparations for blowing-in idle furnaces are in hand in certain localities. Prices remain at 52s. 6d. to 55s. for best sorts, 35s. to 40s. for ordinary part-mines, 30s. for common foundry, and about 27s. 6d. as the minimum for common forge pigs. Best part-mines are being sold out of stock rather more freely, at 40s. to 42s. 6d.

The coal trade is quiet. Some collieries are getting 6d. per ton advance on house coals. Manufacturing coal is not, however, stronger. Forge coal on the Cannock Chase side of the district is as low as 4s. 9d. per ton, while the old Staffordshire collieries ask 5s. 3d. to 5s. 6d. Ironworks' mill coal is 6s. to 7s., and furnace coal 7s. to 8s., and occasionally 9s. for the very best thick sorts. House coal, deep one-way, is 7s. per ton.

The North Staffordshire finished iron trade has slightly relaxed this week, owing to merchants having made sufficient purchases to cover their probable requirements until the end of the year. With the advent of the new year, however, there is a general opinion that an increased demand will become apparent, but meantime specifications which are coming to hand are sufficient to keep the mills fairly well employed for the next month or two. Hoops are being inquired for with increasing freedom, but plates and sheets do not show up so well as recently. Prices remain firm at recent quotations.

Constructive ironwork makers are steadily engaged. The galvanised iron roofing manufacturers are well employed on colonial orders, and somewhat better prices continue to be realised.

A contract for cast iron pipes required by the St. Helens Corporation will, it is hoped, find its way into this district. It is for 700 tons of 15in. cast iron pipes, about 10 tons of special 15in. pipes, and about 96 tons of 3in. pipes.

Manufacturers in this district are endeavouring to secure an order which is about to be given out by the Director of Navy Contracts for a supply of wrought iron nuts and bolts and bar iron.

The dispute in the South Staffordshire and East Worcestershire wrought nail trade terminated on Wednesday. A month ago the largest employers agreed to pay an advance in wages of 10 per cent.; but as this concession was refused by other makers, the operatives came out on strike. The whole of the employers, however, have now agreed to pay the advance, and work has been resumed.

Tne Cradley Heath chainmakers have entered on the seventeenth week of their strike, with a determination to increase their demands for advanced wages. They have decided this week to accept nothing under the 4s. list, and as a means of making their position more secure they have again paraded the district with a view to seeing whether any operatives were transgressing their union law.

'Change closed yesterday with a better feeling. Thin sheets, merchant bars, and hoops were reported in brisker inquiry. Distant markets, such as China and India, are buying with reserved energy. One firm announced they had received more orders from China in the past two months than for five years. These resumed operations are attributed mainly to the effect of the rise in silver. Some native pig makers are busier than for ten or twelve years.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business in the iron trade of this district seems now to have settled down into a state of quietude until the turn of the year. There is certainly no likelihood that consumers will have requirements of any weight that they have not already covered, and makers have mostly sufficient contracts on their books, deliveries on account of which will pretty well take away all their present output for the next two or three months, so that they will be under no necessity to come into the market to seek for orders which would be difficult to obtain at their present prices, and what little business there may be offering will, in all probability, be sought after by second-hand holders of iron, anxious to realise at under current rates. This applies chiefly to pig iron; finished iron did not participate in the recent spurt in trade to the same extent as the raw material, and has not felt the reaction to the same extent. In manufactured iron, there is still a steady business doing with very little underselling, and makers have no difficulty in holding to the moderate advance they put upon their prices.

There was a full average attendance on the Manchester iron market on Tuesday, but the actual business doing was only small in weight. Buyers of pig iron who were not particular as to brand, were able to pick up second-hand parcels at low prices, and with speculative holders more or less anxious to realise, a considerable proportion of the limited business doing was practicable at under current rates. Makers, however, were generally very firm in maintaining their prices, and for delivery equal to Manchester quotations remain at 37s. to 38s., less 2½ per cent., for forge and foundry Lancashire; 36s. 6d. to 37s. 6d. and 38s., less 2½ per cent., for forge and foundry Lincolnshire; and 39s. 6d. to 40s. 6d., less 2½ per cent., for foundry Derbyshire. For outside brands offering here makers' prices also are very firm, but there is still underselling both in Scotch and Middlesbrough iron.

Hematites still meet with only a slow sale in this district; one or two makers hold to 54s. 6d., less 2½ per cent., as their minimum quotation for No. 3 foundry delivered equal to Manchester; but this is little more than a nominal price, and it is altogether out of the market, as there are sellers who would readily take 1s. per ton less for good brands.

The leading finished iron makers in this district are kept fully employed with the orders they have already on their books, and there is a moderate business doing with prices steady at £5 per ton for bars, £5 5s. to £5 7s. 6d. for hoops, and about £6 10s. for sheets delivered into the Manchester district, but in North-country plates there is some low cutting to secure orders.

Although there is still no appreciably increased weight of actual work coming forward generally in the engineering branches of industry in this district, the prospects of the former seem to be rather more hopeful, and here and there a little more activity is noticeable in districts which for a considerable time past have been in a very depressed condition.

I understand that a limited company is being formed by Mr. Hampton—late of Messrs. Steel, Tozer, and Hampton—for working the tire mills belonging to the Ashbury Company, Manchester, for steel castings, forgings, &c.; and the mills, I hear, have been taken on a rental for this purpose.

Messrs. De Bergue and Co., of Manchester, who have long been seeking for some arrangement by which the disadvantages connected with the application of hydraulic power to portable rivetting machinery might be overcome, have just succeeded in securing an American invention—Allen's patent—by which compressed air is made applicable for the actuating of portable rivetting machines in a much more handy form, and at a considerably less cost, than hydraulic power. One of the chief features of this invention is that the compressed air only requires to be at a pressure of about 70 lb. to work the rivetters, and it can thus be carried without difficulty by ordinary gas piping to convenient feed points in the yards or shops, and from thence by ordinary flexible tubing of any convenient length to the rivetters. With the view of lightness and strength the machines are almost entirely of steel, and their action is extremely simple. The compressed air is admitted to a cylinder, placed on the top of the rivetter, by a hand valve at each stroke of the header, and the pressure from the piston is conveyed to the vertical ram through differential levers, forming in combination a toggle joint, so that the pressure on the head of the ram, very moderate at first, rapidly increases as the ram descends, and attains its maximum as the heading operation is completed. Thus, with a small cylinder of 10in. diameter, a pressure of about 50 tons can be exerted, and this is amply sufficient for rivets of 1in. diameter. The heading ram descends in a direct line with the axis of the rivets, and the machine being balanced, it will work either horizontally or vertically. I saw last week the first of these rivetters that has yet been introduced to this country in operation in Messrs. de Bergue's girder yard, and it has done its work exceedingly well; it was easily handled, and suspended from a light travelling crane, it was being traversed from end to end of a long girder, closing the rivets as quickly as they could be placed in the holes, the compressed air being supplied by an ordinary flexible tube, which in no way interfered with the operation of the workmen.

In the coal trade of this district there is still only a very slow business doing for the time of year, and pits generally are not making more than four to five days a week. The continued openness of the weather is, of course, checking the demand for all descriptions of house fire, and in these there is scarcely more than an ordinary summer's trade being done, whilst the stocks which have been put down for winter requirements in most cases remain practically untouched. All other descriptions of round coal for steam and forge purposes are also bad to sell, and a drug in the market; engine fuel, owing to the quantity of slack just now being screened being very much below the average, does not hang in the market so much as it might otherwise do, but the actual demand is dull, and supplies plentiful. As regards prices, there is a talk of some advance in the Manchester district at the end of the month, but such a step can only be taken in anticipation of a possible improvement, which has not yet made its appearance. Generally, colliery proprietors are waiting for the advent of something like winter weather before making any further advance, and in the meantime prices are weak rather than firm, with coal from Yorkshire and Derbyshire offering here at low prices. At the pitmouth the average quoted prices remain at 8s. 6d. to 9s. for best coals; 7s. to 7s. 6d. seconds; 5s. 6d. to 6s. common house coals; 5s. to 5s. 6d. steam and forge coals; 4s. 3d. to 4s. 9d. burgy; 3s. 6d. to 4s. best slack, and 2s. 9d. to 3s. for common sorts.

In the shipping trade there is only a very quiet business doing. Buyers seem to be fighting against the small advance which has recently been asked, and with supplies of common coal so plentiful in the market, orders can be placed at very low figures. For good qualities of steam coal delivered at the high level, Liverpool, or the Garston Docks, sellers are not disposed to take less than 7s. per ton; but there are lower qualities to be got at 6s. 9d. per ton.

Manchester is a favourite meeting place for miners' conferences, and this week an assembly, said to represent 347,327 coal miners, has been holding its sittings in this city. The delegates, no doubt recognising that in the present depressed state of trade the usual programme of higher wages and reduced hours of labour would be likely to fall rather flat, have gone further afield for questions which they might profitably discuss. An amendment of the Mines Regulation Act, the making of the Employers' Liability Act compulsory, the present royalties on minerals, and the London coal dues have been amongst the subjects which they have taken into consideration. Amongst the business done up to the close of the sitting on Wednesday was the passing of resolutions in favour of waiting until the Government introduce their new Mines Bill, and then moving such amendments as might be considered necessary in favour of the appointment of a Minister of Mines, with facilities of obtaining powers for the appointment of workmen representatives at inquests; and finally, the conference was requested, by an almost unanimous resolution, "to use their utmost exertions to bring about an organised restriction of labour of considerable extent throughout the principal producing districts with the least possible delay."

Barrow.—There is a continuance of the quieter tone in the hematite pig iron trade, but the market occupies, nevertheless, a very satisfactory position. There is a good demand for both Bessemer and ordinary forge and hematite qualities of pig iron. The market is especially good for the former, and makers are fully sold forward for some months to come. There is a probability that for some time prices will be steadily maintained at present rates, but it is not thought a judicious thing on the part of makers to sell much more heavily forward than they have already done, as the indications all round are in the direction of better prices after the turn of the year. Iron ore has already advanced in price, and even common qualities are now selling at 9s. per ton; average qualities at 10s., and Hodbarrow and Lindal Moor descriptions at 11s. per ton net at mines. Pig iron is quoted at 45s. 6d. per ton net at maker's works for mixed Bessemer parcels, prompt delivery. Sales, however, have been made by speculative holders at 44s. 6d. per ton. These holders still have large stocks in hand, but in many cases they are holding for an advance. The steel trade is very brisk in railway material, both in a commercial and in an industrial sense. The demand is maintained from a very large area, and foreign and colonial orders are as good as our continental and home contracts. £3 17s. 6d. may be regarded as the market price for average heavy sections of rails, but in some cases £4 is quoted. The former figure, however, more actually represents the sale price of most of the parcels which are changing hands. Other descriptions of steel are in good demand, and it is noticeable that even the quietest branch of trade is improving, there being now a good demand for steel for shipbuilding purposes, owing to the placing of large orders for steel steamers on the West Coast. Shipbuilders have no new orders in hand. Engineers, ironfounders, and boiler-makers are alike short of work. Iron ore brisk. Coal and coke steady. Shipping fairly employed at improving freights.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE latest tender for steel rails was not taken in this district. It was for India, and was 8000 tons of a light section. A Welsh firm obtained the work at £3 17s. 6d. per ton f.o.b. at Cardiff. The Northern firms having heavy carriage rates, quoted £4 5s. It is hard to see a profit at the successful quotation.

Messrs. Newton, Chambers, and Co., Thorncliffe Ironworks, are stated to have secured the contract for the erection of a very large cast iron tank and gasholder for the Hastings Gas Works. Some other good orders in manufactured irons are now with local firms, giving them fuller employment than they have had during the year.

The season orders for silver goods are exceptionally large. Nearly all the establishments are full of work, and in one or two instances they are making overtime. Silver has risen 2d. an ounce, being now quoted at 3s. 11d. This is regarded as a most gratifying sign, but the advance in value does not affect the business. The orders from London are exceedingly satisfactory. In the cheaper class of salvers the Birmingham firms are taking the lead with articles cleverly made in brass, and brilliantly covered with floral and other subjects. Some of these, bought at 4s. to 6s. each, were shown to me the other day by a leading Sheffield manufacturer, who described them as regular "eye-openers." They beat the German productions quite out of the field.

A deputation from the Cutlers' Company, consisting of Mr. G. F. Lockwood, the Master Cutler; Mr. Charles Beek, the ex-Master Cutler; and Mr. Herbert Hughes, from the Law Clerk's office; is to wait upon the President of the Board of Trade on the 26th inst., to discuss the provisions of the Bill for suppressing false marking which the Cutlers' Company suggested. The Bill is to be introduced into Parliament next session, and was being prepared prior to the local agitation on the subject.

Messrs. Tasker, Sons, and Co., electrical engineers, Sheffield, have established an electric light supply station, with the object of supplying light to public buildings, hotels, shops, works, &c. There has been fixed a compound condensing engine of 200 indicated horse-power, either side of which is arranged to work the electric light machinery in case of accident to the other, and in order to avoid any stoppage in the supply of light. Steam is supplied by a large Galloway boiler, fitted with Proctor's mechanical stoker and other improvements. The fly-wheel of the engine works on to counter shafting, and from this the power of the dynamos is taken. In the dynamo room is fixed a Thomson-Houston 45-light machine, and one Siemens shunt-wound machine, the latter to be employed to charge secondary batteries for incandescent lamps. Lights are rented out to consumers for an annual sum per lamp, which will include maintenance and attention. Several of these lamps are already in operation by merchants. The station is on a scale not hitherto attempted by private enterprise.

A deplorable accident, involving the loss of two lives, occurred at Aldwarke Main Colliery, the property of Messrs. John Brown and Co., on Monday. About 100 members and friends of the Rotherham Literary and Book Society had arranged to descend the shaft, and Mr. C. E. Rhodes, the certificated manager, had made all necessary arrangements. After the party had gone down, Mr. Robert Harris, who arrived late, began to descend, accompanied by a banksman named William Clayton. In some way not yet explained the cage tilted, and the men were dashed to the bottom and instantly killed. The shaft is 440 yards deep, and it is believed the accident occurred when the cage was 150 yards from the bottom. Mr. Rhodes had himself a narrow escape. Hurrying to the spot, he was in the act of removing the mangled remains, when, hearing a noise above him, he had just time to step back before the cage, which had been apparently fast in the shaft, came crashing down. An inquiry takes place to-day. The colliery is managed with great ability and the utmost possible care, as I can personally testify, having descended the workings of this very shaft where the distressing calamity occurred. The party in the pits knew nothing of the occurrence until after they reached the surface again by the other shaft, it being prudently determined to keep the matter private, lest a panic should be caused.

I had an opportunity this week of seeing the Chinese tools which have been forwarded from Tientsin and Shanghai by Mr. O'Conor, recently her Majesty's Chargé d'Affaires at Pekin. Accompanied by a thoroughly experienced gentleman, who was at one time a grinder, every tool was carefully examined. The collection includes three remarkable-looking razors from Teintsin, which seems to be the Sheffield of China. They resemble the Rattler razor, which was the precursor of the hollow ground. The blade is hammered well out, leaving a strong back. A razor blade 1½in. at its broadest part is a novelty. The handle looks like a twig taken from the tree, bark and all, without any preparation. There is a piece of tin round one end to form a ferrule, in which the blade is rivetted. A shallow groove in the handle receives the blade when not in use. The razors are marked at 8, 8½, and 9½ cents—from 4d. to 4¾d.—and there would be no difficulty in placing these patterns in the market, and of much superior quality, at the figures. It will be the duty of the local makers to give the Chinese what they want as to style, trusting to their own shrewdness to adopt a more convenient form in time. Two picks, both from Tientsin, are marked 68 cents and 26 cents. The Deare pick, unlike the curved English pattern, is almost straight, and about 3in. broad all down the blade. The body is of iron, the striking edge being formed by a piece of hard steel inserted in the middle. The smaller pick consists of two thin layers of iron, with a layer of steel in the centre, and a piece of iron welded on to form the eye. These articles could now be easily cast in run steel, at prices much cheaper than the Chinese charge. Two hatchets, though rough in finish, are light and well-shaped. One from Tientsin, which combines the purpose of both hatchet and hammer, is of solid steel, and marked 20½ cents; the other, from Shanghai, is priced 32 cents; but why it should be 1s. 4d., and the other only 10¼d., is not clear, except labour is dearer at Shanghai. The Tientsin tool is decidedly the best. The hoes are made from a fair quality of steel. A plough coulter, from Tientsin, is shaped like a sharp pointed shovel, with singularly wide socket; it is of good hard steel well hammered. Two trowels, from Tientsin and Shanghai, are curious tools. The Tientsin trowel is square at the point and tapers a little towards the "tang," which is drawn out of one end of the steel, and put into a handle with a rude iron ferrule. The Shanghai trowel is of steel hammered out and then bent to form the socket; the blade, which is 5in. long and 2in. broad, bears little evidence of grinding except perhaps at the edge, the steel having simply been hammered and the socket bent. The prettily-shaped tool, stated to be a sickle, and sent from Shanghai, is priced at 23 cents—11½d. It struck me as more likely to be a billhook used for cropping hedges or pruning tea plants. It is of steel and nearly 3in. wide. A hoe, handle, and blade, marked at 66 cents has been hammered out of a piece of steel. These tools could all be made in Sheffield and Birmingham of much superior quality, and delivered in China at prices quite as low as those marked on the specimens sent. Of course, they would have to be ordered in quantities to justify production, as they would in many instances require special tools for their manufacture. Our Chamber of Commerce heartily approve of the Foreign-office encouraging their representatives abroad to pick up the patterns and styles actually in use, and forward them for the inspection of English firms. No doubt an energetic effort will be made to occupy the new market these tools seem to point out.

A model of the "Hope" gun, the invention of Mr. F. J. Hall—Messrs. Wm. Jessop and Sons, Brightside Steel Works—has been forwarded to Messrs. Maudslay, Sons, and Field, of Lambeth, to be rifled. The gun is to undergo a preliminary trial for a large gun of the same kind. The tests will be made by the Admiralty officials. This is the gun referred to by Mr. Hall at the last meeting of the Iron and Steel Institute. If the gun proves a success, I believe it is the intention of the firm to undertake the manufacture of ordnance. One of the chief objects aimed at is the prevention of erosion.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland iron market, held at Middlesbrough on Tuesday last, was well attended, and the tone was certainly firmer and more hopeful than it has been for some weeks past. The amount of business actually done was not large, but buyers were more numerous and eager than sellers, and prices advanced 3d. per ton. Some merchants were willing to sell No. 3 g.m.b. at 32s. 6d. per ton, but others asked 32s. 9d., and could not be prevailed on to take less. Most makers have sufficient orders for the next two or three months. They are consequently very firm, and quote 33s. per ton as their very lowest price. Forge iron remains at 31s. 3d. per ton. Few sales have been made for next year's delivery, there being as yet but little harmony of views as to what prices ought to be paid when the winter is over.

Warrants are very firmly held, and the price asked by sellers has advanced to 32s. 9d. per ton.

Messrs. Connal and Co.'s Middlesbrough stock decreased 133 tons last week; the quantity now held being 299,524 tons. At Glasgow an increase of 2525 tons has taken place, raising the total to 838,020 tons.

Pig iron shipments from Teesside wharves are proceeding more slowly than they did last month; but still they are not below the average for November. Between the 1st and 22nd inst. 53,844 tons had left the river; last month 66,378 tons; and in November, 1885, 51,764 tons had left during the corresponding periods.

There is no alteration in the prices obtainable for finished iron, and specifications are as scarce as ever. The improvement which has certainly taken place in shipbuilding is not helping iron-plate makers, as almost all the vessels in course of construction are specified to be built of steel.

The opening meeting for the session of the Cleveland Institution of Engineers was held on Tuesday evening last at Middlesbrough. After reading and adopting the report of the Council, and other formal business, Mr. R. Howson, the new president, read his inaugural address. The subject selected was the "Conversion of Force, and some of its Possibilities." The author said all the natural powers made use of by man depended upon the development of potential or static energy into the energy of motion, and that when that motion had been fully utilised the originating energy was lost. The principle was exemplified by the cases of falling water, the steam engine, voltaic electricity, and the muscular efforts of animals. It was shown that in every instance the force utilised was less than that generated, and that the difference or waste must be made up or the system involved would come to an end. Outside terrestrial boundaries the conditions were different, and therefore the results were different. Mr. Howson then went on to explain a new theory of his own,

whereby the operation of gravitation could, he thought, be better understood, both as regards its operation here and in planetary systems generally. A hearty vote of thanks was passed to the new president for his able and thoughtful address.

It is a pity that none of the northern iron manufacturers, who have suffered so long and so keenly from a deficiency of orders, have seriously taken up the supply of iron sheets of the thinner gauges. Iron plates are made in some mills in excess of the demand for them, from 1½in. down to $\frac{1}{16}$in. thick. Iron sheets are made in other mills from the latter thickness down to No. 20 b.w.g. But nothing from 20 to 26 is made in the North, even though the heaviest demand of all has recently been for those gauges. They are used for roofing purposes, after being corrugated, and in most cases galvanised. The great bulk of the orders are for export to the colonies, but a few are for consumption in our own country. Steel has as yet made no inroad upon this particular trade, for iron does just as well, is cheaper, and, should the zinc become worn off in places, it does not become perforated by corrosion quite so quickly. Except for tin-plates, stamping sheets, and for cut nails, thin sheets seem still to be made almost exclusively of puddled iron, and not yet of steel.

For tin-plates, blooms are rapidly supplanting what are known as tin bars. The steel makers can supply them somewhat cheaper, and their customers can utilise their old forge trains in rolling them down into bars. For nail sheets nothing need be specially made. The ends of plates, or of sleeper bars, or steel scrap of almost any kind, provided it has some weight and substance, answer well enough for nail sheets.

Where galvanising is required there seems to be a great deal of uncertainty as to how well and how thickly steel sheets will take a coating of zinc. What the cause of variability may be does not appear to be known. But it is certain that all steel is not equally susceptible of being efficiently protected. Whether this is due to difference of composition or of surface is not clear.

All engaged in the iron and allied trades at Middlesborough and Stockton, were summoned to the Exchange at the first-named town on the 19th inst., to hear and discuss an exposition of the principles adopted by the "Fair-Trade League." The deputation which attended from the latter organisation was a Mr. Edgcome, who stated his case fairly and moderately. He contended that experience had shown that free trade had failed to effect what was expected of it; not because it was wrong in principle, but because it had been somewhat rashly adopted, without demanding equivalent concessions from foreign countries. He desired a return to the original position in order to recover the lost "bargaining power," which might then be used as opportunity offered in promotion of mutual free, or in other words, fair trade. The discussion which followed was, on the whole, adverse to the doctrines advocated by the deputation. One speaker urged that import duties on food meant dearer labour, and, therefore, dearer products of all kinds. Another thought that an import duty on Spanish ore would seriously affect the price of hematite pig, and so would prejudice the Cleveland district very seriously as compared with Cumberland and other competing localities. On the whole the proposed new direction for legislation was not favourably entertained.

Can nothing be done to prevent the loss of life in mines from falls of the roof? Only the other day two men were at the face of the coal in a pit, timber props having duly been placed on either side of where the leading one was working. Suddenly a portion of the roof 10ft. long by 5ft. broad, and estimated to weigh two tons, fell on him, crushing him to death. He did not utter a sound, and was completely hidden from view. Other men were quickly on the spot, and in twenty minutes they had wedged the superincumbent mass into several pieces, and raised them sufficiently to extract the poor fellow, who was of course quite dead. The timber props were found forced aside and broken. A widow and four children are left totally unprovided for.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron market has been comparatively firm this week. Prices were not only maintained, but on some days made a little improvement. This attitude of the market has been due, not to any increasing demand, but to the state of the labour market and the position of the affairs of the Monkland Iron Company, which will now go into liquidation. At two of the ironworks furnaces have had to be damped down, in consequence of a strike of workmen for an advance of wages, and it is probable that a third company will be obliged immediately to adopt a similar course. This has reduced the output to a considerable extent; but although the production is thus curtailed, and the holdings of the ironmasters are believed not to be on the increase, additions continue to be made to the stock in Messrs. Connal and Co.'s Glasgow stores. The quantity added in the past week is about 2300 tons.

Business was done in the warrant market on Friday at 42s. 2d. cash. Monday's market was firm, at 42s. 3d. to 42s. 1½d., closing with buyers at 42s. 2½d. cash. On Tuesday the tone was quiet but steady, at 42s. 3½d. to 42s. 2d. cash. On Wednesday business was done at 42s. 1½d. to 41s. 9d. and 41s. 9½d. cash. To-day—Thursday—the market was steady, with business at 41s. 10½d. to 42s. 2½d., closing one halfpenny less.

The current values of makers' iron are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 47s.; No. 3, 43s. 6d.; Coltness, 50s. and 44s. 6d.; Langloan, 47s. and 44s. 6d.; Summerlee, 49s. and 44s.; Calder, 48s. and 43s.; Carnbroe, 44s. 6d. and 41s.; Clyde, 45s. and 41s.; Monkland, 43s. 3d. and 39s.; Govan, at Broomielaw, 43s. 6d. and 39s.; Shotts, at Leith, 46s. and 44s. 6d.; Carron, at Grangemouth, 46s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 44s. 6d. and 41s.; Eglinton, 42s. 6d. and 39s. 3d.; Dalmellington, 44s. and 40s.

The shipments of pigs from Scotch ports in the past week were 5899 tons as compared with 7202 in the preceding week and 7961 in the corresponding week of 1883.

The steel trade keeps very busy, the works at present being full of orders and several of them doing overtime. There are inquiries here for steel rails for America, which if arranged will be placed in England, as the steel makers of Scotland are not prepared to undertake the work. Thomas steel has lately been wanted for the States, and orders have been placed for a considerable quantity, for the shipment of which tonnage has also been engaged.

During the past week there was shipped from Glasgow, locomotives to the value of £2400 for Antwerp; machinery, £10,050, of which £6225 were marine engines for Calcutta, and there was also some valuable sugar plant for Demerara and Trinidad; steel goods, £18,600, of which £15,800 were railway sleepers for Port Darwin; general iron manufactures, £24,500, of which £6360 were wagons, sheets, &c., for Calcutta; £5580 bridge work, bars and tubes for Bombay, and the rest was for the most part pipes, tubes, &c., for India and Australia.

There is a decided change in the circumstances of the coal trade within the last week or ten days. Since the colliers reverted from the four days' to the five days' work a week the supply of coals has become much more abundant. It has been found much more difficult to make sales for shipment. Shippers have been asking for a reduction of prices. The past week's shipments have, however, been larger than usual, particularly from Fife. At Glasgow 19,178 tons were despatched; Greenock, 2540; Ayr, 6871; Irvine, 1512; Troon, 6344; Burntisland, 23,175; Leith, 2611; Grangemouth, 12,674; Bo'ness, 4676; and Port Glasgow, 750; total, 80,331, as compared with 55,507 tons in the corresponding week of 1885.

The miners are still endeavouring to influence the coalmasters to pay higher wages by keeping certain collieries on strike. The owners of these collieries are being supported and compensated for their loss by the masters' associations, so that there is a probability of some of these disputes being prolonged if the Union should be able to keep up the rate of strike relief, between 9s. and 10s. a week, which they are now paying to the men who are out.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

IT has a cheering effect to see new companies being formed, and stagnant industries re-started. Without being too much of an optimist, I may be excused for the thought that the corner has been turned at last, and that Wales will again have a prosperous run.

It was gravely hinted about six months ago that Treforest Iron and Steel Works would fall into decay, like Plymouth, Penydarran, Gadlys, and Llwydcoed. "Its speciality for tin-plate requirements had been replaced by Bessemer and Siemens steel." So ran the reason; but I am glad to announce that the repairers are at work, and that a re-start is certain.

Scattered over Wales are numerous industries which a small capital would set in motion, and I hear of inquiries being made which may result in business.

As it is, a good deal of English capital is in connection with Welsh industries. London merchants, Manchester and Birmingham merchants, and small capitalists as well as large, of English towns are deeply interested in the brushing away of the cloud from the principality, and I think there is now strong ground for giving them hope. New companies are being formed, new movements are on foot. It is proposed in Cardiff to start a sugar refinery, and obtain the saccharine extract from coal. This will employ a large number of men, and lead, I believe, to that increase of merchant traffic apart from coal which is so much required at port.

Swansea, too, is on the alert, as shown by Mr. Capper's letter in the *Times* pointing out the superiority of that port for a mail station.

New coal companies are forming, and one of the latest has strong merit. This is the Aber Rhondda. This is floated in £10 shares, total capital £10,000, and a leading subscriber is the well-known D. Owen, Ash Hall, Cowbridge.

Several house fire collieries are being offered for private contract, and on the tide of a revival may be taken up. But in connection with collieries there are, I must admit, some rumours circulating of possible financial disaster, which is the outcome of the long and trying struggle; but we must all hope that stoppage may be averted.

Judging from exports and outputs there is a good deal more vitality in the coal trade. Newport sent away coastwise 27,000 tons last week, and Cardiff exceeded its previous total by over 25,000 tons. If this should keep on the year's total may not compare so badly with the previous, though I see that a local contemporary affirms that taking month for month the last twelve months, as compared with the previous twelve months, there is a falling off of 400,000 tons in the coal exports to foreign destinations from Cardiff alone. This shows the hard times which must have been endured by coalowners.

One feature remains, unchanged prices. Good steam coal is obtainable at prices varying from 7s. to 8s., and small steam is no longer firm at 5s. The best prices now prevail in the house coal district, and most of the districts of Rhymney, Bargoed, and other valleys are busy. The Powell Duffryn pits in the Monmouthshire districts are doing well, and complain only of shortness of hands.

The coke trade of Monmouthshire is nothing like so good as it used to be, the Rhondda Valley now having a strong superiority of business with adjoining districts, such as the Dinas Main. Llwynypia coke has perhaps the widest of all range, and is known in every part of the world.

The improving character of the steel rail trade continues, and prices are looking still upward. Extensive improvements are to be seen in progress at the chief works, and every effort is being made to dispense with labour and make water and wheel do instead of native or Hibernian aid. In coke making, or at the rolls, the question of best and not cheapest prevails.

I noticed lately the growth of the use of the electric light in connection with collieries. It was first tried at the Mardy Colliery, and lately introduced to the stables and main levels of one of the Plymouth company's pits. Now the whole question has been brought in a masterly manner before the notice of the South Wales Institute of Engineers by Mr. Hann, one of the Powell Duffryn managers. Mr. Hann's theory was to have no naked light in the colliery at all, but to light the miners' lamps by electricity from accumulators in the colliery. The meeting listened favourably to the details of patent, and it was decided by several coalowners present to try the plan.

The Monmouthshire coalowners are waking up to a necessity of strongly supporting the Bill for obtaining a line to Cardiff next session, and a stout effort is certain. Until they have a railway they cannot compete well with Glamorgan. Some samples of Monmouthshire coal are 1s. less in the Cardiff market than Rhondda coals, but this is done in the eagerness to push trade, handicapped as they are with difficulties.

The tin-plate trade is not so satisfactory again. Most of the best makers are well sold, so are safe for a month or two. Present prices are 3d. lower than last week, but few sales effected. Market rates asked: Bessemer, 13s. 3d. to 13s. 4½d.; Siemens as much as 13s. 9d.

A large meeting of delegates has been held in Cardiff to organise against the offered reduction, and provide for men who are locked out. Makers are asking men to give so many boxes per week free, and in many quarters this is resisted. If what I hear be true of the amounts that tin-plate workers can earn in the Swansea Valley, the more convinced am I that the men will do a similar amount of mischief to their trade as was done by ironworkers to theirs in unionistic days. Said the late Mr. Crawshay to a friend: "I would have gone on working until every yard of my park was covered with iron; but when my men would not give way until they had consulted the Union agent, then I let the works go out of blast, and, for all I cared, for ever."

NOTES FROM GERMANY.

(*From our own Correspondent.*)

IN the pig iron market of Silesia there is still a good deal of movement, caused rather by the export to Russia anticipatory of the enhanced duties next January, than by the influx of orders to the rolling mills and foundries; and this works so far favourably that the prices are maintained steadily, with a prospect of a slight advance in them in a little while. Crude iron varies now in price for all sorts from 43 to 50 M. p.t. The rolling mills have abundance of orders from near and distant parts—more indeed than is commonly the case in November—for merchant iron, plates, and rails, which excites hopes that at last the worst period of depression yet experienced is passing away. Bars are noted 88 to 93; boiler plates, 130 to 138; thin sheets, 123 to 125; girders, 80 to 90; angles, 100 to 105; and rails, 100 to 105 p.t. The railway tariff conflict between Austria-Hungary and Roumania has now been amicably settled, so that already transports of gas and other good sorts of bituminous coals are being forwarded to the chief towns on the Lower Danube, which gives a little more life to the coal trade. These come into competition with sea-borne coal from England to the same district.

With the exception of wire rods and thin sheets, which are a little dearer, there is no great change to note this week concerning the iron market of Rheinland-Westphalia, all other articles having maintained their prices, a result which may be considered so far satisfactory. Native ores remain stationary, as last noted. In Bilbao a syndicate of mine owners has been formed with the object of regulating monthly the prices of ores sold there. In pig iron, especially for forge purposes, a good sale is being effected, and prices are firmer and maintained, and in the Siegerland there is so great a demand for it that there in the very near future a rise in price is expected. Spiegeleisen is going off well for export. Foundry is a little more lively. Luxemberg forge free at works costs 35.50f. to 36f. p.t. Westphalian sorts are unchanged in price since last quoted. There is a good sale for most kinds of wrought iron, and generally the works are fully employed, but more could be sold for abroad if railway rates could be lowered. Prices, on the whole, do not rise, caused, probably, by many works still continuing to sell at the whole prices; but this state of things will soon cease, as last week the ironmasters all met at Düsseldorf and came to an understanding as to future prices and conditions of sale for finished iron and steel. The works which roll boiler plates are, as a rule, busy, and the thin sheet rollers have quite as much to do as they can conveniently get through, and in consequence the prices have been put up M. 3 to 5 since October 1st. They still have orders to keep them at full work for six weeks to come. A very brisk demand has set in for drawn wire and wire nails, without prices having been affected, however, though the raw materials, as pig-iron, billets, and wire rods are all dearer. The wagon builders have latterly received more orders, but the prices are far from being remunerative. The list quotations for iron and steel goods are: For good merchant bars 90 to 96, hoop 100 to 105, in steel up to 112·50, best boiler plates 139 to 142, II. Q. 131 to 132, thin sheets 123 to 125 and higher, heavy steel plates 143 to 145, iron wire rods 95 to 100, in steel 97 to 100, rivet iron 110 to 120, wire nails 125 to 130, rivets 150 to 160, drawn wire in iron 112, in steel 115 to 120M. p. t., wheels and axles 315 the set, steel tires 210 to 225. The constructive ironworks are in no better position than when last reported.

The brassfounders have received an influx of orders, which will keep them well employed this month, but at prices unchanged from the last notation.

In Belgium prices are maintained through the curtailed output, bars being quoted at 100f., angles 115f., and plates at 120 p.t. The engine and machine makers complain loudly of want of orders. The works in France, which hold strictly and firmly to their convention, have met the buyers, who endeavoured to force down prices by announcing that they had lengthened the term of their combination for six months, and threatening further restriction of output. The works are, in consequence, complete masters of the situation at 130f. for merchant iron.

The late director-general of the John Cockerill Company, Baron Sadoine, is proceeding to China, as is said in some quarters by invitation from one of the most influential and powerful persons in the country, to consult about the establishment of very extensive arsenals and shipbuilding yards. This may or may not be. He will, however, find that the French have anticipated him in these two matters; but, at any rate, he goes in the interest of Belgian industry, and the masters of works expect great results from his mission. Now, all our rivals—America, France, Belgium, and Germany—will be represented in China, and it would afford some comfort to know that England was worthily represented by some one as eminently qualified for the undertaking as Baron Sadoine. No nation is in a position, politically or industrially, to give a return to China for favours received like England; it would, therefore, be exceedingly mortifying to learn too late that England had not received its legitimate share of work or orders given out in China, simply because it had failed to take the same initiative, and have as a representative the right man in the right place at the right time. With so conservative a people as the Chinese it was a great blunder, an ignorant want of appreciation of the situation, to allow Krupp to take the first order ever openly tendered for in the country, for England ought to have secured it *à tout prix*, and doubtless would have done so if a proper representative had been on the spot at the right time, even if only with the lukewarm assistance of our diplomacy, which, in the case of other nationalities, is so heartily given.

It is reported that at Elbing—Schicpau's Yard—at the present time, torpedo boats are being constructed for Austria, Italy, Russia, Turkey, China, and Japan, and that, through the improvements in both boats and engines, those already tried have attained a speed of twenty-four knots an hour!

Trials, which appear to warrant success, have been made here for hardening or consolidating petroleum and naphtha, for the convenience of overland transport. The material—at present kept secret—by which this is accomplished is a well-known commercial article. It is true that it costs two and a-half times as much as the petroleum; but it is not lost by the process, as it is regained. The advantages claimed are that no evaporation takes place, and, consequently, that no explosions can occur, and that there is a great gain in freight; for instance, between Hamburg and Vienna, 70 per cent.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Nov. 20th, 1886:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 8057; mercantile marine, Indian section, and other collections, 2589. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 894; mercantile marine, Indian section, and other collections, 143. Total, 11,683. Average of corresponding week in former years, 13,009. Total from the opening of the Museum, 25,276,836.

THE NEW EIGHT-INCH THIRTEEN-TON GUN.—The Ordnance Department is much pleased, the *Army and Navy Register* says, with the performance of the new 8in. steel gun at Sandy Hook. "This gun, which weighs thirteen tons, and whose length of bore is thirty calibres, was manufactured at the West Point Foundry. The tube and jacket were obtained from Whitworth, and the hoops and the breech mechanism forgings from the Midvale Steel Company. The gun was first tried with the German brown prismatic powder, when the following results were reached:—With a charge of 100 lb., and with a shot weighing 182 lb., the muzzle velocity was 2145ft., and the pressure 29,500 lb.; with a 235 lb. shot the velocity was 1942ft., and the pressure 32,250 lb.; with a shot weighing 286 lb. the velocity was 1795ft., and the pressure 32,800 lb. The gun was next tried with Du Pont's brown prismatic powder, the charge being the same. The velocity with a 235 lb. shot was 1937ft., and the pressure 32,950 lb.; with a 286 lb. shot the velocity was 1820ft., and the pressure 35,450 lb. The gun has been fired thirteen times, and will now be turned over to the testing board. It is worthy of remark that when this gun was designed, the computed velocity with the 286 lb. shot was 1825ft., and the computed pressure 36,000 lb. This is almost exactly verified by the firing with the Du Pont powder."

GUINNESS'S BREWERY.—The great Dublin brewery, which is now far and away the largest in the world, has had no very remarkable history beyond its regular and marvellous prosperity. Its rise and progress has been due mainly to the excellent quality of the article produced, and also to the skill and enterprise with which the business has been conducted by its late proprietors. In 1759 the St. James's Gate Brewery was owned by a Mr. Ransford, and contained only one mash-tun and a seventy-barrel copper. It was at that period that the concern passed into the hands of the Guinness family. The property was then only about one acre in extent; now the breweries and other buildings cover between forty and fifty acres. It was not, however, until the last twenty years that the concern made such marvellous progress; for in 1866 the annual profits were only £122,119, whilst last year they had risen to the magnificent sum of £452,294. It is very difficult to realise the enormous size and trade of this brewery, but those who have an opportunity of visiting the largest of our metropolitan breweries—Messrs. Barclay, Perkins, and Co.—may obtain some idea of the St. James's Gate Brewery when we state that its output is as near as possible three times as much as the London brewery referred to. Much of the success of Guinness's brewery is attributed to the fact that they have never used anything but malt and hops in the production of beer; for the official statistics have recorded this important fact for many years past.—*Brewers' Guardian.*

NEW COMPANIES.

THE following companies have just been registered:—

Aber Rhondda Coal Company, Limited.

Registered on the 15th inst. with a capital of £10,000, in £10 shares, to carry on the business of colliery proprietors, coke manufacturers, and miners. The subscribers are:—

	Shares.
D. Owen, Ystradowen, Glamorgan	1
W. H. Matthias, Pontypridd, contractor	1
R. Matthias, Pontypridd, contractor	1
I. J. Roberts, Cardiff, public accountant	1
W. Powell, Cardiff, accountant	1
R. Wain, Penarth, wine merchant	1
W. W. Bartlett, Penarth, accountant	1

The number of directors is not to be less than three nor more than five; qualification, twenty-five shares; the subscribers are to nominate the first; the company in general meeting will determine remuneration.

Anglo-Spanish Gas Company, Limited.

This company proposes to acquire concession for gas lighting and otherwise in cities, towns, and other places in Spain and her colonies or dependencies or elsewhere, power being taken to acquire existing gas and other lighting works. It was registered on the 17th inst., with a capital of £200,000, in £5 shares. The subscribers are:—

	Shares.
*J. Ernest Spencer, 4, Brick-court, Temple	1
*W. Coward, 143, Queen Victoria-street	1
*W. C. Parkinson, Cottage-lane, City-road, manufacturer	1
W. P. Gibbons, Dudley, gas-engineer	1
*D. Howard, West Bromwich, manufacturer	1
S. Spencer, C.E., 3, Queen-street-place	1
B. Gibbons, Dudley, manufacturer	1

The number of directors is not to be less than three nor more than seven; qualification, £250 of nominal capital; the first are the subscribers denoted by an asterisk. Remuneration, £100 per annum and 1 per cent. per annum on the subscribed capital; in the event of the number of directors exceeding five, the remuneration will be increased proportionally.

Castings Improvement Syndicate, Limited.

This syndicate was registered on the 11th inst., with a capital of £30,000, in £100 shares, to acquire from Thorsten Nordenfelt, C.E., of 53, Parliament-street, the right to work for a limited period certain patented inventions for an improved method for castings in wrought iron or steel. The subscribers are:—

	Shares.
J. M. Berner, 7, Fenchurch-avenue, merchant	20
M. Delmard, Old Charlton, Kent, engineer	2
H. Benham, 5, Roland-houses, Kensington, ship owner	15
*B. T. Moore, C.E., Longwood, Bexley	10
A. A. Clark, 87, Addison-road, merchant	20
Hy. Seebohm, 22, Courtfield-gardens, South Kensington, steel manufacturer	5
F. Carkeet Bryant, Woodlands Park, near Leatherhead	20

The number of directors is not to be less than three nor more than five; the first are Lord Thurlow, of 33, Chesham-place, B. T. Moore, and Thorsten Nordenfelt; qualification, £500 in shares or stock; the company in general meeting will determine remuneration.

Electric Sewage Utilisation and Improvements Company, Limited.

This company proposes to purchase certain patents and other premises described in an unregistered agreement of the 13th ult. between the International Canalisation Company — H. de Grousillieres and Co., of Berlin, and others—and Arthur E. Woodington, as trustee for this company. It was incorporated on the 15th inst., with a capital of £500,000, in £1 shares, power being taken to carry on the business of electricians in all branches. The subscribers are:—

	Shares.
A. E. Woodington, 33, The Chase, Clapham Common, accountant	1
L. Hertz, 19, Canfield-gardens, West Hampstead	1
F. Howard, Bromley Common, Kent	1
F. Grant, 72, Bishopsgate-street Within, chartered accountant	1
G. Smith, 3, Copthall-buildings, stock and share-broker	1
W. Kern, 44, Hereford-road, Bayswater	1
A. R. Morgan, Riverhead, Sevenoaks, clerk	1

Registered without special articles.

Shannon File Company, Limited.

This company was registered on the 12th inst., with a capital of £50,000, in £10 shares, to manufacture and vend an invention called "the Shannon File," and to acquire the following letters patent:—No. 3075, dated 29th July, 1879; No. 4159, dated 29th February, 1884; and No. 4471, dated 30th March, 1886, and also the rights under the following application for patents:—No. 10,215, dated 10th August, 1886; and No. 12,355, dated 29th September, 1886. The subscribers are:—

	Shares.
*George Dixey, 9, Air-street, Regent-street, chartered accountant	20
*F. W. Schafer, 1, Golden-square, merchant	20
*W. H. Goodall, 7, Conduit-street, tailor	40
*W. H. Burgess, 20, Piccadilly, wine merchant	20
E. F. Johnston, 3, Queen-street, E.C., secretary to a company	20
G. E. Davenport, 9, Air-street, accountant	1
J. Pain, 15, Kilburn-square, accountant's clerk	1

The number of directors is not to be less than three nor more than five; qualification, twenty shares, remuneration, £1 1s. for every meeting attended. The first four subscribers are the first directors.

Consumer's Economic Water Softening and Purifying Company, Limited.

This company proposes to carry into effect an agreement of the 25th ult., between the Atkins Filter and Engineering Company, Limited, of the first part, the Provisional Syndicate, Limited, of the second part, and Charles Imray, for this company, for the third part, for the purchase of license to use certain patents in the counties of Surrey, Sussex, Kent, and Hants, and to manufacture and deal in filters, filtering materials, and apparatus. It was registered on the 17th inst., with a capital of £150,000, in £5 shares, with the following as first subscribers:—

	Shares.
F. H. Atkins, C.E., 3, Bouverie-street	1
P. F. Nursey, 161, Fleet-street, consulting engineer	1
J. Church, C.E., 17b, Great George-street	1
J. B. Hutchins, Clemping, Sussex	1
V. H. Straker, 124, Fenchurch-street, printer	1
W. G. Atkins, C.E., St. Albans	1
A. Smith, 14, Vivian-road, Peckham-rye, secretary to a company	1

The number of directors is not to be less than three nor more than six; qualification, twenty shares; the subscribers are to appoint the first, and act *ad interim*; remuneration, £125 per annum each.

AN OLD AMERICAN RAILWAY CAR.

THERE is on the Marysville and Blue Valley branch of the Union Pacific road an old dilapidated car. Its exterior is in sad need of the painter's brush. Its interior is rough and dirty. It is fitted up with rough bunks, and is used to transport section hands from point to point. A close inspection, however, of its present condition will reveal features which would puzzle one who had seen it years ago. Here and there will be discovered a trace of gilding. The woodwork, if you scratch off the soot and dirt, will be found to be solid mahogany and black walnut. In short, it is a relic of faded gentility. Although it now "takes in lodgers," like the traditional landlady, it has "seen better days." The poor old, shabby-genteel common-carrier was once considered the finest car ever built in the United States. Mechanics from all parts of the country, who were master workmen, were secured to work in its construction. It once shone resplendent in red velvet and gilding. It is in short, the famous car, "Abraham Lincoln." This car was built in Alexandria, Virginia, in 1864. It was intended for a directors' car, to run on the military railroads; that is, the roads which ran into the section of the country where heavy fighting was going on. These roads had either been seized from the Secessionists or appropiated by the Federals, as the case may be, and this car was used by the directors of the roads and by the military officials. It was, at the time, considered *par excellence*. It wore all the trappings belonging to wealth and rank. It shone resplendent in scarlet and gold. Soft Turkey carpet covered its floors, velvet couches and chairs adorned its central reception room. At one end were state rooms for sleeping purposes, at the other was a dining room and kitchen, over which presided a *chef* of supreme attainments in his profession. Statesmen, famous over the civilised world, reclined on its upholstered couches and dined at its tables. The original cost of this car was something over 30,000 dols. When Lincoln was assassinated, to this car, his namesake, was entailed the duty of conveying his remains to Springfield. From the performance of this duty, the car attained a national reputation, and speculators began at once to make bids for it, with a view to putting it on exhibition in dime museums. To prevent this the car was bought up by Mr. Lincoln's old law partner, Mr. Ward H. Lamon, now a resident of Denver. He purchased it at a Government sale at Alexandria in 1865. Shortly after Mr. Lamon had bought it Secretary Stanton wrote him a letter begging that the car be kept out of the hands of exhibitors. This Mr. Lamon assured him was his intention. In 1866 the car was sold by Mr. Lamon to Mr. Henry S. McComb, of Delaware, one of the directors of the Union Pacific, for that road. It was then used to bring out from New York Mr. T. C. Durant and party, who made a trip to what was then the western terminus of the road. At that time the different tribes of Indians along the line were throwing obstructions in the way of the further progress of the road, and in this car the officials met representatives of the various tribes to discuss the matter. On the return of the car to Omaha it was held here, and was used as an officers' car up to 1869. It was then, on orders from Sidney Dillon, changed to an emigrant car, and remained in that service up to 1874. Afterwards it was sold to the Colorado Central for 3000 dols. and marked "Colorado Central No. 4." It was used by this road as a chief engineer's car. In 1879 Mr. Lamon was making a trip to Georgetown over the Colorado Central. Walking along the platform while the train was waiting at a station he saw an old car which attracted his attention. Something about the springs seemed to him peculiar and he stooped to examine them. One of the brakemen noticed him and went to Mr. Loveland, who was inside, and told him that there was a man outside who was looking at the car in a suspicious manner. Governor Loveland came out and inquired the name of the suspicious character. "Ward H. Lamon," he said. "Then you are the man who sold this car to the Union Pacific twelve years ago." And so it turned out to be. The old car has been knocked around from place to place, at every move descending lower and lower from its exalted height, until now in its battered old age, it transfers the section hands from point to point over the road.—*Omaha Republican.*

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—John C. Weeks, fleet engineer, to the Hotspur; Inspector of Machinery Henry Benbow, to the Victor Emanuel, additional, for service in Hongkong Yard; Charles Lane, chief engineer, to the Vernon, additional; Edwin J. Jeffery, engineer, to the Flamingo; William J. Abbott, engineer, to the Buzzard; Thomas Thorne, engineer, to the Victor Emanuel, additional, for Hongkong Yard; Henry J. Lock, engineer, to the Griffon; William Cook, engineer, to the Euphrates; J. Ryan, assistant engineer, to the Brisk; and F. W. Highton, assistant engineer, to the Asia.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

16th November, 1886.

14,820. CAR COUPLING, R. Perry, London.
14,821. BORING METALS, &c., R. Storey, Darlington.
14,822. GREASE GUARD, &c., for CANDLES, D. W. C. Piggott, London.
14,823. LIFTING and HAULING MACHINERY, A. G. Adams, Liverpool.
14,824. FORK GUARD, M. Roberts and E. Thicket, Sheffield.
14,825. CUSHION CARRIERS for SEATS, G. and E. Woods, Liverpool.
14,826. CUTTING KEYWAYS in WHEEL BOSSES, &c., F. H. Hallard, Liverpool.
14,827. SHELLING SHRIMPS, &c., E. H. Chesterton, Birmingham.
14,828. COUPLING APPARATUS, E. Fox, London.
14,829. JUBILEE COIN JEWEL ORNAMENT, M. Welchman, London.
14,830. PHOTOGRAPHIC DARK SLIDES, C. J. Murton, Newcastle-on-Tyne.
14,831. WIRE FABRICS, J. S. W. Whitehead, Manchester.
14,832. SPINNING and DOUBLING FIBRES, H. Stevenson, J. Webb, and S. Hallam, Manchester.
14,833. METAL BARS and PLATES direct from MOLTEN METAL, C. M. Pielsticker, London.
14,834. SELF-ADAPTING CANDLESTICK, L. S. Plowman, Bicknoller.
14,835. LUBRICATING COMPOSITION, F. T. Archer, G. W. Hardy, and F. J. Archer, London.
14,836. IRONS for IRONING FABRICS, &c., J. Redman, Halifax.
14,837. SKYLIGHT or FANLIGHT OPENER, H. K. Bromhead, London.
14,838. PRICE TICKETS, C. Gulath, United States.
14,839. FOLDING WATER-TIGHT COMMODE, H. A. de Salis, London.
14,840. COAL CARBONISING or DISTILLATION, J. Young, Stoke-on-Trent.
14,841. MOWING and TEDDING MACHINE, T. R. Cattell and A. H. Summers, London.
14,842. GUMMING of LABELS, &c., W. Mawson, Leicester.
14,843. TREATMENT of SLAG to CONVERT into a USEFUL PRODUCT, W. Thornycroft, Glasgow.
14,844. CLOG PROTECTORS, W. Carter and W. Chaloner, Preston.
14,845. DRIVING GEAR for FANS, &c., R. J. Hodges, London.
14,846. LAMPS for BURNING HYDROCARBON and other OILS, D. C. Defries, London.
14,847. DOUBLE-ACTION CUTTERS for NEWSPAPERS, &c., A. J. Sutton, London.
14 848. VENTILATING BUILDINGS, G. Barker, Birmingham.
13,849. ZINC WATER-TUBES for CUT FLOWERS, W. and H. Christmas, London.
14,850. SOCKET for EARTHENWARE, &c., PIPES, S. S. Phillips and H. F. Green, London.
14,851. ELECTRIC INCANDESCENT or GLOW LAMP HOLDING APPARATUS, J. G. W. Fairbairn, London.
14,852. IMPROVED TOY or GAME, R. J. H. Eccles, Brixton.
14,853. VERTICAL STEAM BOILERS, J. H. Hopwood Hull.
14,854. ROTARY VALVES, G. H. Wailes, London.
14,855. BARRELS, M. E. Beasley, London.
14,856. GENERATION, &c., of MOTIVE-FLUID, O. G. V. Stenberg, London.
14,857. CIGARETTES, E. C. Allam, London.
14,858. FIRE DOORS for BOILERS, &c., P. Jensen.—(*Messrs. Hoy and Bussman Hamburg.*)
14,859. PAPER FILES, H. J. Haddan.—(*A. B. Sherwood, United States.*)
14,860. RAILWAY CAR COUPLINGS, H. J. Haddan.—(*D. L. Richards, Canada.*)
14,861. RAILWAY CHAIR KEY, B. Ford, Edgbaston.
14,862. BICYCLES, &c., F. A. Gregory, E. W. Adcock, and J. W. Trotman, London.
14,863. STAIGHTENING METAL BARS, P. and W. Medart, London.
14,864. DOCTORS for CALENDER ROLLS, R. Smith, London.
14,865. STRENGTHENING PAPER BAGS, E. Mileson, Woodford.
14,866. FASTENINGS for CORSETS, L. Sanders, London.
14,867. ELECTRIC SWITCH, J. D. F. Andrews, London.
14,868. RIVETTING COPPER VESSELS, H. J. Worssam, London.
14,869. CONSTRUCTING METALLIC BOATS, H. F. Coombs, Canada.
14,870. STEAM MOTIVE POWER ENGINE, J. Tangye and R. J. Connock, London.
14,871. TELEGRAPH POLES, H. Johnson, London.
14.872. NOVEL MANUFACTURE of WATERPROOF GLOVE, S. W. Silver, London.
14,873. COOLING of LIQUIDS, H. H. Lake.—(*M. Hanford and C. C. Hanford, United States.*)
14,874. BREECH-LOADING FIRE ARMS, A. Bertrand, London.
14,875. OBTAINING SULPHUR, &c., from ORES, J. R. Francis and F. F. Jones, London.
14,876. CAR AXLES, E. Peckham, London.
14,877. VEHICLE AXLES, E. Peckham, London.
14,878. HAWKS for PLASTERS, H. H. Lake.—(*R. R. Coursen, United States.*)
14,879. UMBRELLA STANDS, H. H. Lake.—(*C. W. Rogers, United States.*)
14,880. METALLIC LATHING, H. H. Lake.—(*J. W. Kensett, United States.*)
14,881. VEHICLE TOPS, A. J. Boult.—(*G. Gifford, United States.*)
14,882. SEWING, A. J. Boult.—(*C. M. Hooker, United States.*)

17th November, 1886.

14,883. COMBINED METALLIC BELL, &c., for a CHILD'S TOY, A. S. Cartwright, Hockley.
14,884. WOVE WIRE BLINDS for VENTILATING RAILWAY, CARRIAGES, &c., J. W. C. Doyne, London.
14,885. HOLD INTERCOSTAL STRINGERS, &c., H. Withy and G. W. Sivewright, Stockton-on-Tees.
14,886. CHIMNEYS for BOILERS, D. George, Birmingham.
14 887. CREATING DRAUGHT in BOILER FLUES, D. George, Birmingham.
14,888. WINDOW SASH FASTENINGS, J. Brown, Glasgow.
14,889. SECTIONAL WARPING MACHINE, J. H. Stott and J. Smith, Manchester.
14,890. MECHANICAL TOY, T. R. Weston, London.
14,891. ROTARY MULTIPLICATION TABLES, &c., S. H. Sutton, Edgbaston.
14,892. WINDING of YARN, &c., G. Clegg, J. Thomas, and W. H. Harrison, Halifax.
14,893. PRESSING GRASS, &c., A. C. Smethurst, Manchester.
14,894. CONTINUOUS MATCHES, &c., R. Galland-Mason, Douglas.
14,895. CLOCKS, H. Davey, Headingley,
14,896. FUSEE BOXES, &c., R. Galland.Mason, Douglas.
14,897. FACILITATING the REMOVAL of MUD from STEAM BOILERS, T. Bowen, London.
14,898. GILL BOXES, J. A. Berley.—(*G. Riche, France.*)
14,899. COPYING DESIGNS and PROFILING, T. Gare, Edgeley.
14,900. FEEDING ROLLERS of CARDING ENGINES, O. Eastwood, West Bowling.
14,901. RINGS ATTACHED to WHEELS for SUSPENDING CURTAINS, J. W. Thomas, Oswestry.
14,902. ELECTRIC MOTORS, G. Price.—(*L. Gur and E. D. Fournier, Paris.*)
14,903. MACHINERY for DRILLING ROCK, &c., J. G. Cranston, Newcastle-upon-Tyne.
14,904. LOWERING, &c., PERSONS from or to the UPPER PART of HIGH BUILDINGS, J. Coulson, Buckie.
14,905. PRINTING, M. Condon, J. E. Singleton, and J. Walmsley, Barrow-in-Furness.
14,906. RAILWAY, &c., COUPLING, J. Hartill, Dudley.
14,907. APRONS for PERAMBULATORS, J. Aylward, Coventry.
14,908. CONVEYING REAPING MACHINES over ORDINARY ROADS, S. W. T. Vickery, Uffculme.
14,909. SUPPORTING, &c., TENNIS NETS, J. W. Hornsby, Grantham.
14,910. CARTRIDGE BELT, W. Hewitt and T. Dineen, Leeds.
14,911. STOPPERS for BOTTLES, &c., C. Turner, Manchesterr.
14,912. SPINNING MACHINERY, G., T., and J. W. Rothwell, Manchester.
14,913. RAILWAY TRUCKS, R. Wilson, Manchester.
14,914. SEALING ENVELOPES, A. Barker, Levenshulme.
14,915. WATER WASTE PREVENTER, W. Jones, Bangor.
14,916. BOLTS for DOORS, &c., A. Edmondson, J. B. Moorhouse, and T. A. Proctor, Yorkshire.
14,917. PICTURE BOOK, A. A. Melville, Birmingham.
14,918. MANGO FORK, D. D. Austin.—(*R. Catton, Sandwich Islands.*)
14,919. GAS HEATED LAUNDRY, &c., IRONS, J. Wood, Greetland.
14,920. VALENTINE and other PRESENTATION CARDS, V. Sockl and S. Nathan, London.
14,921. SAFETY LAMPS, A. N. J. Contarini, London.
14,922. WATER-CLOSETS, J. West, London.
14,923. IRONING LACE, &c., A. J. Ward, London.
14,924. JOINING together TUBING, D. Joy, London.
14,925. PREPARING COTTON, &c., W. Catterall, W. Riley, and J. Dunn, London.
14,926. FASTENINGS for BRACELETS, &c., F. E. Hollyer, Brentford.
14,927. CASTING METALS, J. R. Whitney, London.
14,928. CASTING METALS, J. R. Whitney, London.
14,929. DRIVING BELTS and WHEELS, W. L. Purves, Wimbledon.
14,930. CLOSETS, &c., G. J. F. Tate, London.
14,931. FRAMES of INDIA-RUBBER, W. Burns, London.
14,932. STATION INDICATORS, H. Crookes and H. W. Hake, London.
14,933. SELF-ACTING SAFETY BYE-PASS GAS VALVES, A. Cockey and W. Smith, London.
14,934. RAISING SASHES, &c., T. Cooke and W. H. Boyens, London.
14,935. LETTER BOX, M. N. Nathan, London.
14,936. AUTOMATIC WATER MOTOR, W. J. S. Barber-Starkey, London.
14,937. PREVENTING the ESCAPE of NOXIOUS FUMES from ELECTRICAL BATTERIES, M. Bailey and J. Warner, London.
14,938. MOTIVE POWER ENGINES, A. C. and J. Sterry, London.
14,939. REGULATING the SUPPLY of WATER to WATER-CLOSETS, E. Smith, London.
14,940. ENVELOPE BAGS, J. Brooks and W. S. Wooton, London.
14,941. AUTOMATIC WEFT STOP MECHANISM, J. Paterson and T. Brook, London.
14,942. VOLTMETERS, J. S. Raworth, London.
14,943. ADAPTING ELECTRIC LIGHT APPLIANCES to ARTICLES, &c., C. Ferranti, London.
14,944. BOILER TUBE BRUSH, T. Sadler, London.
14,945. TUBE STOPPER, W. Seymour, London.
14,946. PRESERVING HIDES, E. A. Brydges, London.
14,947. UMBRELLA FRAMES, E. A. R. Geisler, London.
14,948. HEATING REGULATORS, G. P. Réal, London.
14,949. BURNERS for PETROLEUM and other LAMPS, A. Cautius and C. Pataky, London.
14,950. GRINDING the EDGES of BUTTONS, J. Mahla, London.
14,951. UNDER VESTS, &c., M. Orr, London.
14,952. COATING IRON, &c., with TIN, D. Edwards, R. Lewis, and P. Jones, Morriston.

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14,953. BEER, &c., TAPS, J. G. Redgrave, Birmingham.
14,954. LATCHES for DOORS, &c., J. and G. Turner, Yorkshire.
14,955. ATTACHING BRUSH HEADS to their HANDLES, J. Crabtree, Halifax.
14,956 REELING SILK from the COCOON, E. W. Serrell, Paris.
14,957. VALVES for CONTROLLING the SUPPLY of LIQUIDS, J. Barr, Glasgow.
14,958. DISTILLATION of TAR, &c., W. Burns, Leith.
14,959. CORSETS, J. B. Seel, Manchester.
14,960. COLLAPSIBLE DRINKING CUPS, H. Levetus, Birmingham.
14,961. BELT ADJUSTING APPLIANCE, W. Hewitt and T. Dineen, Leeds.
14,962. SMOKE CONSUMING FURNACES, &c., H. N. Box and H. Davison, Manchester.
14,963. KEYED MUSICAL INSTRUMENTS, H. C. Hiller, Withington.
14,964. EXPELLING CARTRIDGE CASES from FIRE-ARMS, W. H. Beck.—(*A. Francotte, Belgium.*)
14,965. FASTENER for BOOT LACES, C. H. M. Wharton, Manchester.
14,966. ATTACHING BEARINGS to VELOCIPEDES, J. and C. J. Howes, Cambridge.
14,967. REMOVING INCRUSTATIONS in STEAM BOILERS, E. O. and W. T. Cooper, London.
14,968. FIRE LIGHTERS, C. Y. C. Dawbarn, Liverpool.
14,969. LINKS for DRIVING CHAINS, &c., R. Green, Birmingham.
14,970. STEERING VELOCIPEDES, R. Green, Birmingham.
14,971. BLEACHING, &c., LOOSE FIBRE YARNS, E. and G. E. Sutcliffe, Halifax.
14,972. PRESSING BRICKS, &c., T. C. Fawcett, Halifax.
14,973. SPANNERS, H. Harford and C. F. Sutcliffe, Durham.
14,974. ELECTRIC SAFETY LAMPS for MINES, M. Settle, Manchester.
14,975. MOWING and REAPING MACHINES, P. and T. Murphy, Tipperary.
14,976. TOY representing a FOOTBALL PLAYER, J. Melville and T. Smith, Oswaldtwistle.
14,977. TROUSERS STRETCHER, J. Smith, Stoke-upon-Trent.
14,978. MOULDING GLASS into STOPPERS for BOTTLES, J. H. B. Denison, Kingston-upon-Hull.
14,979. IRON STONEWARE, W. H. Blessley, Middlesbrough.
14,980. MOTIVE-POWER by WATER, &c., W. Aldred, London.
14,981. TRUSSES for HERNIA, S. Carpenter, Birmingham.
14,982. ROCK DRILLS, C. W. Thompson, London.
14,983. ELECTRICALLY-ACTUATED MECHANICAL DEVICES, E. W. Serrell, Paris.
14,984. WASH or DIP for SHEEP, &c., A. Macarthur, Glasgow.
14,985. CHEQUES, &c., to guard against FRAUD, G. Rae, Liverpool.
14,986. CRANK SHAFTS, J. M. Paterson, Liverpool.
14,987. WEIGHING MACHINES, E. Wölner, Liverpool.
14,988. AMALGAMATION of GOLD, &c., ORES, P. Higgs, London.
14,989. COMPOSITE DOOR PLATE, B. Finch, Manchester.
14,990. TOY ANIMAL, G. W. Courtier, London.
14,991. BOTTLES, and in CASES for SAME, R. Parsell, Tenby.
14,992. HYDRAULIC LIFTS, H. C. Walker and R. Carey, London.
14,993. JOINTS for METALLIC TUBES, &c., J. Robertson, Glasgow.
14,994. BALL BEARINGS for SPINDLES, A. Behr, London.
14,995. LACING of BOOTS, &c., O. J. Obbard, London.
14,996. AUTOMATIC ELECTRIC GOVERNORS, &c., H. J. Haddan.—(*C. F. Brush, United States.*)
14,997. MARINE ENGINE BRIDGE TELL-TALE, R. Balfour, London.
14,998. PORTABLE WASHING COPPER, C. W. Smallbone, London.
14,999. BOLTS and NUTS, P. de Heen, London.
15,000. COIN RECEIVER and DELIVERER, W. S. Simpson, London.

15,001. Hardening Shells and other Articles of Steel, A. M. Clark.—(*H. A. Brustlein, France.*)
15,002. Gentlemen's Shirts, B. Vàrady, London.
15,003. Lubricators, W. Robinson, London.
15,004. Gyrophones or Musical Tops, A. Browett, London.
15,005. Water-tight Doors, J. Rogerson and A. Downie, London.
15,006. Crushing, &c., Fibrous Materials, &c., T. Routledge.—(*A. Abadie, France.*)
15,007. Purification of Coal Gas from Sulphur Compounds, C. Estcourt, H. Veevers, and M. Schwab, London.
15,008. Penknife, H. H. Lake.—(*C. G. Bac, France.*)
15,009. Self-registering Money-tills, B. W. Webb, London.
15,010. Shirts, F. McTier and J. C. Lines, London.
15,011. Coating Water-pipes, D. J. R. Duncan and H. C. Mylne, London.
15,012. Portland Cement, H. Macevoy, H. Holt, L. White, and W. Wilders, London.
15,013. Artificial Fuel, I. Lilley and F. Metgé, London.
15,014. Enamel Surface to Cuffs, &c., J. P. Mullins, London.

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15,015. Screw Stoppers, &c., A. C. Farrington, Diss.
15,016. Broaching Bottle, &c., A. C. Farrington, Diss.
15,017. Syphon Water Waste Preventers, M. Syer, London.
15,018. Repeating Fire-arms, H. E. Procter, Darlaston.
15,019. Self-feeding Kiln Fire Apparatus, &c., D. Smith, Inverness.
15,020. Tires for Road Vehicle Wheels, H. H. Hosack, Liverpool.
15,021. Grooves in Boards for Box-making, W. Crosland, Manchester.
15,022. Boiler Incrustation Preventer, J. Thomas, Newcastle-on-Tyne.
15,023. Combination Knife and Desk Companion, S. Staight, London.
15,024. Ventilators, W. G. Sudbury and W. Spreadburey, New Maldon.
15,025. Compound Lever for Starting Tramcars, &c., W. Batchelor, Kingston.
15,026. Connecting the Check Strap to Loom Pickers, W. A. Craven, Halifax.
15,027. Lucifer or other Match Boxes, C. Baker, Dewsbury.
15,028. Fastenings for Wearing Apparel, F. French and J. Stobie, Handsworth.
15,029. Raising, &c., Roller Blinds, A. W. Read, Birkenhead.
15,030. Dynamo-electric Machines, G. Hookham, Birmingham.
15,031. Dynamo-electric Machines, G. Hookham, Birmingham.
15,032. Gas Engines, A. Ridge, Manchester.
15,033. Looms, R. Boyd and E. Lepainteur, Glasgow.
15,034. Jacquard Cards, B. Toone, Glasgow.
15,035. Wire Cards, G. and E. Ashworth, Manchester.
15,036. Spinning Machinery, T. H. Wharton and J. Wheater, Bradford.
15,037. Bobbins, &c., J. and W. Schofield, Oldham.
15,038. Stove, &c., Pipes, J. Gregson, London.
15,039. Spring Mattresses, J. P. Skinner, Sheffield.
15,040. Coating Metal Plates, &c., with Tin, &c. P. Rogers and J. Player, Swansea.
15,041. Velocipedes, H. J. Lawson, Coventry.
15,042. Chain Belts, J. A. Yeadon and R. Middleton, Leeds.
15,043. Umbrellas, &c., S. Wildeblood, Stoke-on-Trent.
15,044. Pianofortes, J. E. A. Gautier, London.
15,045. Clocks and Watches, H. Dalgetty, London.
15,046. Spiral Mixing Machine, T. Lowe, London.
15,047. Coupling, W. Munro, London.
15,048. Velocipede Saddles, J. B. Brooks, Birmingham.
15,049. Testing Machines, G. H. Denison, London.
15,050. Pipes, &c., G. Jones, London.
15,051. Furnaces, &c., J. Lyle, Glasgow.
15,052. Clipping Horses, &c., A. Davison, Glasgow.
15,053. Electric Arc Lamps, A. J. Beaumont, London.
15,054. Hydro-steam Engine, J. Mutch, London.
15,055. Gladstone Bag Rug Protector, T. A. Pawlikowski, London.
15,056. Umbrellas and Parasols, W. A. Bindley and W. J. Gell, London.
15,057. Safes, &c., G. Allan, London.
15,058. Waterproof, &c., Garments, M. Rothenbücher, London.
15,059. Shoes for Horses, &c., C. J. Jutson and F. A. Poupard, London.
15,060. Button-hole Cutter, G. G. Cotsworth, London.
15,061. Brushes, G. J. Beissbarth, London.
15,062. Revolvers, F. Praunegger, London.
15,063. Attachments for Engines, &c., W. Gilbert, London.
15,064. Railway Sleepers, W. A. Brown, London.
15,065. Sewing Machines, W. Jones, London.
15,066. Producing Steam in Boilers, E. W. Collier, London.
15,067. Velocipedes, W. E. Orowther, London.
15,068. Lubricators, J. B. Fondu, London.
15,069. Wall or Ceiling Coverings, S. Fisher, London.
15,070. Cork Quartering Machine, J. Lowman, London.
15,071. Valveless Pump Engines, &c., A. Perrare, London.
15,072. Reversing Mechanism for Engines, A. M. Clark.—(*W. E. Tally.*)
15,073. Coupling Railway Vehicles, W. and L. Younghusband, and T. Hudson, London.
15,074. Portable Jigger, W. Shapton, London.
15,075. Combined Portable Engine and Dynamo-electrical Machine, T. L. Aveling, London.
15,076. Projecting Oil into Furnaces, C. A. Sahlström, Aberdeen.
15,077. Electric Arc Lamps, F. C. Phillips and H. E. Harrison, London.

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15,078. Automatic Electric Liquid Level Indicators, J. J. Ghegan, London.
15,079. Boot Protectors, &c., W. E. Partridge, Birmingham.
15,080. Ornamental Baskets, &c., W. Staniforth, London.
15,081. Treating Coal to Separate Pyrites, H. Barclay and R. Simpson, Cumberland.
15,082. Ash Pans, B. Sugden, Yorkshire.
15,083. Driving Mechanism of Washing Machines, W. Smith, D. Marks, and R. Watson, Yorkshire.
15,084. Thrashing Grain, J. Russell, Belfast.
15,085. Wheels for Vehicles, &c., J. Nuttall, Manchester.
15,086. Shoes and Slippers, G. Cummings, jun., Blyth.
15,087. Pocket Sewing Machine, A. F. Wileman, Ealing.
15,088. Gratings, J. Austin, Birmingham.
15,089. Finishing Calenders, H. Bury, Lancashire.
15,090. Pipe Tongs, T. A. W. Clarke, Leicester.
15,091. Extending Sconce, C. F. G. Boyes and J. H. Herbert, Wolverhampton.
15,092. Tubular Iron Roofs, W. Bagshaw, Dudley.
15,093. Showing Photographs Through a Frame, S. T. Lander, Wiltshire.
15,094. Supports for Incandescent Electric Lamps, J. H. Holmes, Newcastle-on-Tyne.
15,095. Oil Lamps, W. J. Spurrier and W. H. Pasby, Birmingham.
15,096. Telegraph Posts, W. Bagshaw, Dudley.
15,097. Manufacture of Ingot Moulds, D. P. G. Matthews, Newport.
15,098. Printing from Stereotype Plates, J. Denby, Edinburgh.
15,099. Annealing Glass, J. D. Watson, Glasgow.
15,100. Pumping Engines, E. Clark, Stroud.
15,101. Stabber for Paper Fasteners, L. Myers, Birmingham.
15,102. Looms for Weaving Mesh Fabrics, J. Strathdee, Glasgow.
15,103. Oscillating Tappets of Looms for Weaving, T. H. Chadwick, B. Marshall, and W. Taylor, Manchester.
15,104. Haulage Clam, S. Cope, Sheffield.
15,105. Travelling Sack, G. Ellis, London.
15,106. Cleaning Wool, &c., T. and S. Buckley, London.
15,107. Studs for Bearings of Machinery, J. Haydock, Halifax.
15,108. Printing Presses, G. Downing.—(*M. Gally, United States.*)
15,109. Mouthpieces for Cigars, &c., H. K. Bromhead and R. Lees, London.
15,110. Reducing Tubular Bodies, W. Lorenz, London.
15,111. Compressing Powder, &c., in Cartridge Cases, W. Lorenz, London.
15,112. Little Motor for Industry, C. Robin, Paris.
15,113. Lock, J. D. Tucker, London.
15,114. Weighing Machines, P. Hobson, London.
15,115. Sugar Wafers, &c., J., J. A., W. K., and G. S. Baker, London.
15,116. Spanners and Wrenches, A. C. Hickling and H. F. Griffin, London.
15,117. Fastenings for Wearing Apparel, W. H. Beck.—(*B. Fontan, France.*)
15,118. Matches, C. H. Russell, London.
15,119. Bicycles, W. Hillman, W. H. Herbert, G. B. Cooper, R. A. Dalton, G. F. Twist, and A. Rotherham, London.
15,120. Ivory for Pianoforte and other Keys, S. Staight, London.
15,121. Forming, &c., Cutting Edges of Cutting Tools, G. D. Edmeston, London.
15,122. Game Carrier, &c., A. M. Clark.—(*J. H. Stevens, United States.*)
15,123. Incandescence Lamps, G. C. Sillar and L. S. Powell, London.
15,124. Rotary Engine, F. T. Adams, London.
15,125. Retort Fire-bar, F. L. Merritt, London.
15,126. Joints of Perambulator, &c., Hoods, W. H. Dunkley, London.
15,127. Axles of Perambulators, &c., W. H. Dunkley, London.
15,128. Direct-acting Duplex Pumping Engine, J. H. Street, London.
15,129. Corkscrews, F. A. Whelan, London.
15,130. Regulating the Tension of Warp in Looms, B. Wilkinson, K. Jowett, and A. E. Parratt, Bradford.
15,131. Furnaces for Baker's Ovens, &c., C. Hill, London.
15,132. Evaporating Fluids, W. Boggett, London.
15,133. Compound Hydraulic Coaling Apparatus, B, Walker, Hunslet.
15,134. Steering Gear, T. B. Hart.—(*J. T. Hart, New Zealand.*)

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15,135. Self-feeding, &c., Fire Grates, L. Hopcraft, London.
15,136. Treatment of Cotton, &c., prior to Weaving, T. Pickles, Manchester.
15,137. Anatomical Safety Horseshoe Pad, J. N. Haslam, Manchester.
15,138. Mechanical Refrigerating Machines, W. Hargreaves and W. Inglis, Glasgow.
15,139. Printer's Blocks, A. Hutton and J. Stewart, Edinburgh.
15,140. Gloves, H. Urwick, Malvern.
15,141. Manufacture of Bottle Necks, T. Kilner, Halifax.
15,142. Weldless Rolled Rim, D. Elliot, Leeds.
15,143. Fire-iron Rest, T. Wells, Birmingham.
15,144. Water Taps, W. Phillips, Ipswich.
15,145. Watch Protectors, E. J. Trevitt, Birmingham.
15,146. Red Aro Dye Stuffs, T. Bang.—(*Messrs. Dahl and Co., Prussia.*)
15,147. Machinery for Slotting Metallic Hoops, &c., J. W. Wilson, Halifax.
15,148. Bolts, &c., A. Bell, Manchester.
15,149. Ring for Scarves, C. H. Collins, Birmingham.
15,150. Pipe for Smoking, J. Elliott, Leeds.
15,151. Self-registering Weighing Machine, W. M. Preston, Pagnol.
15,152. Boot and Shoe Fastenings, I. Jacobs, London.
15,153. Centrifugal Pumps, J. Cooper, London.
15,154. Manufacture of Mineral Wool, J. T. King.—(*H. Kennedy, United States.*)
15,155. Measuring Taps, J. Steel, London.
15,156. Electrical Conductors, C. S. E. Crakanthorp, and A. W. Brewtnall, London.
15,157. Supporting, &c., Overhead Flexible Metal Roads, C. S. E. Crakanthorp, London.
15,158. Filters, J. E. Hodgkin and E. Perrett, London.
15,159. Belts for Driving Machinery, M. Gandy, Liverpool.
15,160. Electric Meters, A. G. Brookes.—(*K. Leitner, Austria.*)
15,161. Attaching Cigarette Papers to Tobacco Pouches, R. M. Atkinson, Ashton-on-Mersey.
15,162. Spring Mattress Frames, J. E. Preston and J. Kerry, Sheffield.
15,163. Invisible Drifting Floating Nets, W. R. Fynmore, London.
15,164. Unsinkable Copper, &c., Boats, W. R. Fynmore, London.
15,165. Incandescent Electric Lamps, W. Maxwell, London.
15,166. Fastenings for Railway Carriage, &c., Doors, J. Wroe, Manchester.
15,167. Attaching Handles to Brushes, J. A. Marshall, Dewsbury.
15,168. Working Signals, &c., W. H. Elliott, Tipperary.
15,169. Velocipedes, H. J. Lawson, Coventry.
15,170. Ventilator and Man-hole, M. P. Crofton, London.
15,171. Separation of Smoke from Gases, T. Richmond.—(*W. Wills, United States.*)
15,172. Appliance for Supporting the Under Garments of Women, S. May, London.
15,173. Egg Beaters, H. J. Haddan.—(*T. W. Brown, United States.*)
15,174. Iron Chains, A. Thiry, London.
15,175. Ozone, J. C. Mewburn.—(*L. Teilliard, France.*)
15,176. Feeding Marine Boilers, E. M. B. Faull and F. W. Cannon, London.
15,177. Marine Boilers, E. M. B. Faull and F. W. Cannon, London.
15,178. Shoemaker's Rasps, T. Froggatt, London.
15,179. Fire Lighters, H. B. Wedlake, London.
15,180. Lock Nut and Bolt, G. A. Goodwin and W. F. How, London.
15,181. Automatic Steering, H. Laming, London.
15,182. Mother Liquors, E. P. Alexander.—(*E. J. L. Delsel, France.*)
15,183. Cartridge Magazines, E. G. N. Selenius, London.
15,184. Fanlights, &c., G. Stierlin, London.
15,185. Velocipedes, S. Martin, London.
15,186. Range Instruments for Guns, M. J. O'Farrell, London.
15,187. Photographic Camera, &c., W. P. O'Reilly, London.
15,188. Treatment of Yeast, H. H. R. Jensen, W. B. Mears, and J. Brunt, London.
15,189. Gas, A. J. Boult.—(*W. P. Lane and A. M. Sutherland, United States.*)
15,190. Playing Pianos, &c., J. M. Grob, A. O. Schultze, and A. V. Niemczik, London.
15,191. Mechanism for Pianos, J. M. Grob, A. O. Shultze, and A. V. Niemczik, London.
15,192. Dissolving Views, E. S. Bruce, London.
15,193. Magnetic Sock Lining, L. H. Hart, London.
15,194. Automatic Apparatus for Delivering Cigars, &c., G. Anthony, London.
15,195. Drilling, &c., Holes, R. Hodson, London.
15,196. Boat Detaching Apparatus, E. J. Hill, London.
15,197. Banjos, &c., W. B. Basset, London.
15,198. Electrical Connections with Moving Bodies, T. A. Garrett, London.
15,199. Velocipedes, I. W. Boothroyd and P. L. C. F. Renouf, London.
15,200. Tanning, H. H. Lake.—(*A. Millochau and F. Chailly, France.*)
15,201. Deodorising, J. Watt, London.
15,202. Smelting Ores, L. Grabau, London.
15,203. Sash Pulleys, W. T. Kellogg, London.
15,204. Locks and Keys, A. W. O. Kleinau, London.
15,205. Tubes and Rods, G. A. Dick, London.
15,206. Amalgamating Gold, &c., B. C. Molloy, London.
15,207. Journal Thermostats, L. B. Stone, Massachusetts.
15,208. Stone Crushing Machinery, J. S. Gabriel, London.
15,209. Electro Deposition of Metals, T. Fenwick, London.
15,210. Scissors, H. H. Lake.—(*The Henry Seymour Cutlery Company, United States.*)
15,211. Beton or Concrete, J. Y. Johnson.—(*E. Coignet, France.*)
15,212. Water-closets, D. Grove, London.
15,213. Gas Burner, E. D. Barker and S. E. Gunyon, London.
15,214. Cutting Machine, W. H. Beck.—(*F. Inglesias, France.*)

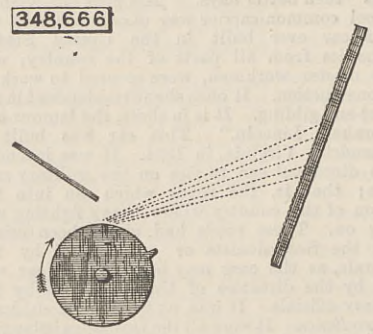
SELECTED AMERICAN PATENTS.

(*From the United States' Patent Office official Gazette.*)

348,666. Sand and Gravel Separator, *Samuel Friend, Decatur, Ill.—Filed April 26th*, 1886.

Claim.—A separator for sand and gravel, consisting in a longitudinally-ribbed cylinder adapted to rotate rapidly on a horizontal axis, means for conveying the

348,666

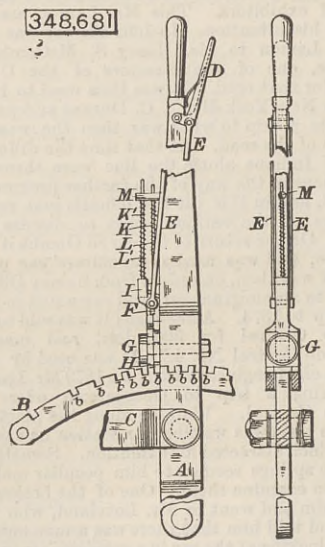


sand and gravel to the upper surface of the cylinder, and a separating screen having its face opposed to the centrifugal discharge of the cylinder, as and for the purpose set forth.

348,681. Lock for Reverse and Throttle Levers, *Chas. May, Sunbury, Pa.—Filed June 23rd*, 1886.

Claim.—(1) The combination, with a lever and its quadrant, of a main locking mechanism and an auxiliary locking mechanism operated by the same handle that controls the main locking mechanism, substantially as and for the purpose described. (2) The combination, with a lever and its notched quadrant, of a latch to lock the lever in a position corresponding to any one of said notches, and an auxiliary locking device to lock the lever in intermediate positions, said auxiliary locking device being operated by the same handle that controls the latch, substantially as and for the purpose set forth. (3) The combination, with a lever and its notched quadrant, of a main latch and one or more auxiliary latches, all operated by the same handle, substantially as and for the purpose described. (4) The combination, with a lever and its notched quadrant, of two or more latches, all operated by the same handle, the notches and latches being so arranged that only one latch is in engagement with

348,681



the quadrant at the same time, substantially as and for the purpose set forth. (5) The combination, with lever A and quadrant B, having notches *b b*, of handle D, links E E, pin F, and latches H I, having slots *a g*, said slots being equal in length to the depth of a notch plus the diameter of pin F, substantially as and for the purpose set forth. (6) The combination of lever A, quadrant B, having notches *b b*, handle D, links E E, pin F, bolt G, main latch H, having slots *a h* and lug *e*, and auxiliary latch I, having lugs *f f* and slots *c*, *d*, and *g*, substantially as and for the purpose set forth. (7) The combination of lever A, having lug M, quadrant B, having notches *b b*, handle D, links E E, pin F, bolt G, latches H and I, rods K K¹, and springs L L¹, substantially as and for the purpose set forth.

348,709. Revolving Mould for Casting Tubes, G. *Adams, Waterbury, Conn.—Filed June 30th*, 1886.

Claim.—(1) In a revolving mould for casting seamless tubes of copper, &c., the combination, with the mould A, of the rotating horizontal wheel H, centreing and carrying said mould, and provided with a lower centre stud *c*, the base or stand I, having a sleeve-bearing *d*, for said stud, and the circular series of balls or rollers *e*, interposed between said wheel H and stand I, and fitted to freely run within tracks therein, substantially as specified. (2) The combination of the detachable upright mould A and its bowl B, the horizontal mould centreing and carrying gear H, provided with a centre stud *c*, and grooved circular track *f* on its under side or face, the base or stand I, having a central aperture or sleeve-bearing *d*, for the stud and a grooved circular track *f*¹, in is upper face, the circular series of balls or rollers *e*, the driving shaft K, and th driving. wheel or pinion J, fitted to engage and disengage with said shaft, essentially as shown and described, and for the purposes herein set forth. (3) In a revolving mould for casting tubes, the combination, with a stand having a central aperture and an

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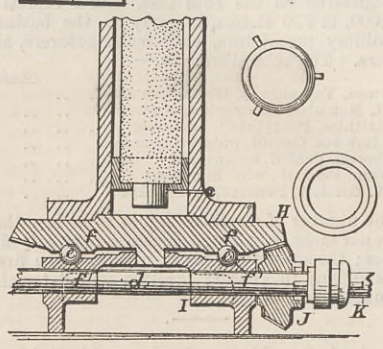
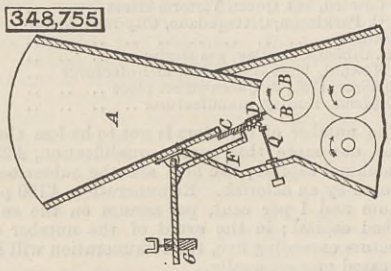


annular groove, of a gear fitted upon one side for carrying a mould and having upon its opposite side a central stud fitting the aperture of the stand and an annular groove co-incident with the groove in the stand, and a series of balls adapted to the grooves in the stand and gear, substantially as shown and described.

348,755. Feed Regulator for Roller Mills, *David Mackey, Batavia, N.Y.—Filed May 11th*, 1886.

Claim.—The combination of the hopper A, roller B,

348,755

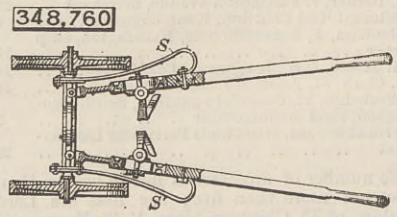


and hinged slotted board C with the adjustable plate D, lever F, weight G, and the set screw Q, which is passed through the side of the hopper to regulate the distance the board C shall move backward, substantially as described.

348,760. Wheel Cultivator, *James McGee, Scott County, Iowa.—Filed May 3rd*, 1886.

Claim.—In combination with a two-wheeled hand cultivator having an arched axle, two rear laterally-moving beams with shovels or knives and handles for propelling or guiding connected therewith, the curved springs S S, each attached at one end to the axle

348,760

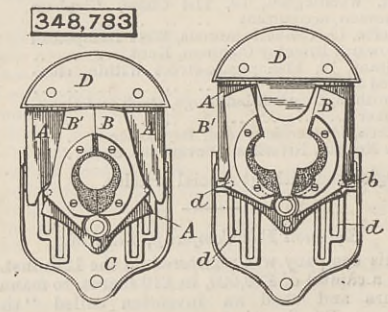


between the wheel and beam and at the opposite end of the handle, so as to exert a force to move the beam outwardly toward the wheel and act as a brace between the axle and rear laterally moving beam, substantially as described.

348,783. Faucet Inclosing Fixture for Refrigerator Boxes, *Charles Scheef, Chicago, Ill.—Filed February 9th*, 1886.

Claim.—(1) A fixture for refrigerator boxes arranged with wing-plates embracing the faucet, and with a plate sliding upon the refrigerator box for operating such wing plates, and for entirely closing the faucet openings of such boxes, substantially as and for the purpose set forth. (2) In a fixture for refrigerator boxes, the combination, with the crown plate secured to the door thereof, of a stationary plate secured to the box and over the faucet opening thereof, of wing plates pivotted to such stationary plate and adapted to embrace the shank of the barrel faucet, and of a sliding plate arranged to operate the wing plates and

348,783



adapted to shut the faucet opening, all substantially as described, to operate as specified. (3) In a fixture for refrigerator boxes, the combination of stationary plate A, wing plates B B¹, pivotted thereto and having studs *b*, and vertically sliding plate C, having L-shaped grooves, all substantially as described, to operate as specified. (4) In a fixture for refrigerator boxes, the combination, with stationary plate A, having screw studs with springs *l* and nuts *m*, of wing plates B B¹, pivotally secured to plate A and having studs *b*, of plate C, having slots *o*, and L-shaped grooves *d*, and of crown plate D, the whole being constructed and arranged to operate substantially as described, for the purpose specified.

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