IRON.

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ILLUSTRATED ARTICLES.

IRON.

No. 495.

LONDON, FRIDAY, JULY 7, 1882.

THE RATING OF MINES.

IF the British taxpayer often grumbles very loudly, it must be admitted that he has frequently good cause for doing so. It is not the imperial taxes against which his complaints are generally directed, although they do not escape, but the special grievance of the ratepayer are the local burdens; and in proportion to the bitterness of his cry against them, it will be allowed, are their inequality and extravagance. Perhaps it would be difficult to find more forcible examples of disproportion between an end gained and the means employed than are to be met with almost any day in the administration of parochial matters. Most of us have had, unfortunately, personal experience of the heavy incidence of local imposts—an experience which has not been rendered more agreeable by the sight of the vast expenditure of force which takes place compared with the unsatisfactory result shown—and must have been struck with the conviction that there is something wrong either in the manner in which parish matters are conducted or in the system which commits such extensive and arbitrary powers into the hands of men who may not have the capacity or the will to wield their authority properly. In all probability, the annals of mining taxation furnish as glaring instances as could be found anywhere of the manner in which the weak are made to suffer for the strong, or the just for the unjust. Mr. T. F. Hedley, of Birmingham, has recently published an able pamphlet upon the rating of ground rents and mineral rents, in which he mentions the case of some six mines in the county of Durham in which the collieries had been underrated to the extent of £120,000 through the influence brought to bear on the assessment committees by the colliery officials. The result of this was that the other ratepayers had been mulcted in the sum of £18,000 a year in rates which ought to have come out of the pockets of the colliery proprietors. Instances of this nature might be multiplied, but it is unnecessary to do so. Even, however, where the very best intentions exist on the part of the parochial authorities, there are considerable difficulties in the way of their being able to assess mining property accurately. This arises from the fact that neither the overseers nor the assessment committees have the power to require the owners or lessees of mines to furnish the particulars necessary for making the valuation. This power rests only with the county rate committees, who are often unwilling to exert their authority to assist the assessment committees, to whom the only course left open in such a case is to assess the property at a figure much beyond its value, and thus force the proprietors to give the desired information on appeal to the Quarter sessions.

There can be little doubt that, whilst large sums are in this manner lost to the rates, or are unjustly made up out of the pockets of the other ratepayers, much money is also not secured through the ignorance of the overseers and the want of a proper control or supervision over local assessments. The law, however, relating to the taxation of mines is sufficiently clear on the matter, if it is a little intricate. Until the passing of the Rating Act of 1874 the principles on which assessment committees had to proceed were not so well defined as they are now, since, under the statute of Queen Elizabeth's reign, only coal-mines were embraced, and therefore the occupiers of all other mines, where the royalties were payable otherwise than in the form of parts or shares of the produce, were exempt from ratability. But by the Act of 1874 alluded to, the occupiers of all mines, with the exception only of copper, lead, and tin mines, are placed on the same footing as the proprietors of coal-mines, and are ratable for the mineral rents and for the surface lands, buildings, and plant connected with the mines. In the case, however, of copper, lead, and tin mines, where the rent is paid in the shape of a certain proportion of the yield of the mines, the owner is held to be liable in respect of the minerals, and the occupier only so far as the surface lands, &c., are concerned. The principle which would seem to be acted on in these cases is that by the terms under which the owner of the property leases the mine to the occupiers he is virtually a partner in the concern. The miners might be described as the working partners, and the owner as the sleeping one. It is only when mines are productive that they are ratable; when they cease to be so to the occupiers, they are exempt, even although, in terms of the leases under which they are held, the owners may still derive some benefit from them. On the other hand, however, mines still continue subject to assessment for local rates even if they are not profitable to the occupier. Where improvements have been made in a mine, which will generally be with the object of making it more productive directly or indirectly, the mine is ratable at the enhanced value, and the occupier is liable for the increased assessment, whether the improvements have been carried out at his expense or at that of the owner. Besides the strictly mineral rents or royalties which the lessee of a mine may pay in respect of the produce which he takes out of it, he has often to pay other rents on account of money which may have been sunk by the owner in developing or improving the property; and, in addition, it often happens that he has the use of "outstroke" and shafts in adjoining lands, that is, underground ways and shafts for the purpose of bringing the minerals to the surface more readily, and for which large sums are paid as rent. These passages and shafts are considered subject to rating, at least to the extent of the rent paid for the use of them, which may be taken as the measure of the increased value which they give to the mine. Royalties are held not to be subject to any deduction, for the purpose of rating, on account of repairs, insurance, &c., nor in respect of the using up of what is termed the *corpus* of the estate, although an allowance on this latter score has been recommended by a select committee of the House of Commons.

In the extension of the workings of a mine it is often the case that the galleries get carried under the lands of another union. When this occurs, the minerals which are won from these parts are ratable by the union from under whose lands they were taken. This law is a fruitful source of difficulties between mine-owners and overseers, owing to the impossibility of obtaining accurate information as to the quantities taken from particular points. It is different, however, so far as minerals worked from under the sea below low-water mark are concerned, such being by decision of the higher courts exempt from rating; but the underground passages used for the conveyance of these minerals to the surface are ratable. Although the law relating to these matters may be clear enough, it is perhaps too much to expect that overseers and assessment committees, at least during the continuance of the present system of local government, will be thoroughly versed in all its minutiæ; and there is, therefore, all the more reason that something should be done to improve the method of its administration.

IRON TRADE SUMMARY.

THE English iron market has been firm during the week, notwithstanding disquieting political rumours. A fair business has been done in pig-iron. Tuesday market at Middlesbrough was quiet, but steady, and prices were unchanged. Manufacturers were maintaining their quotation of 43s. 6d. for No. 3 prompt, and dealers were quoting the same, with but few exceptions. The returns for June, published after the close of the market, are more favourable than was expected, showing a decline of 8376 tons in stocks, and will, no doubt, have an enlivening effect on business. A good tone prevails in the Glasgow warrant market, the demand continuing on an extensive scale, and shipments large. Quotations have been steadily advancing during the week, and closed on Wednesday at 49s. 4d. cash and 49s. 6d. a month for buyers; sellers ½d. per ton more. Makers are well sold, and very firm in their quotations at an advance of 1s. per ton; their stocks are being considerably reduced. Pig-iron has been steady on the Tyne, exports being satisfactory. There has been no change in prices, Cleveland No. 3 being still sold at 45s. 9d. Lancashire makers of pig-iron are doing a steady trade at advanced prices, which, it will be remembered, have been raised at from 1s. 6d. to 2s. 6d. a ton. A cheerful tone prevails in the hematite iron market, and prices are well maintained, quotations being the same as a week ago—57s. for No. 1, 56s. for No. 2, and 55s. for No. 3, nett, at works or f.o.b west coast ports. Quotations for pig-metal are somewhat stronger in the Forest of Dean. A better inquiry appears to be springing up for manufactured iron, and prices, in consequence, are stronger. As much as £7 has been paid for ship plates at Middlesborough, prompt delivery; but the ruling quotations are £6 12s. 6d. to £6 15s. for plates, and £6 2s. 6d. to £6 5s. for angles and bars. At Newcastle, ship plates make £6 17s. 6d. to £7, delivered promptly to the Tyne yards; bars sell at £6 5s., angle iron at £6 7s. 6d., and boiler plates at £7 17s. 6d. to £8. In Staffordshire prices are rising a little. Best bars are £9 10s., second class £7, and common sorts £6 10s. to £6 5s. In Lancashire, bars are held firmly at £6 7s. 6d. to £6 10s. There is still a steady demand for best Yorkshire iron, principally plates. The tinplate market is dull again, coke plates selling at Liverpool at 16s., and charcoals at from 19s. to 21s. The hardware trade is without change, and prices are unaltered. The Sheffield trades are more cheerful in tone, and some heavy transactions have taken place this week. Bessemer is stiffer in price. The greatest activity prevails in the armour-plate mills. There is no change to note in the steel rail trade in Wales. Makers are very busy, and in most cases are full of work for the next two or three months. In North Lancashire and West Cumberland steel rails are in very good request, at about £5 15s. per ton. In Cleveland also prospects are said to be brightening, but rates are as yet very low. Shipbuilding is still carried on briskly, but orders are becoming scarcer at east coast ports and on the Tyne. Engine manufacturers have plenty of work on hand; most of them for marine engines, but electric lighting machinery also forms a large share of new orders. Makers of other classes of machinery are also well, if not briskly, employed. Forges and foundries are fairly busy. The firmness in the London coal market has had a good effect upon local markets for house coals; both the household fuel branch is still very quiet in Yorkshire. Steam coals are being shipped in large quantities both from the Tyne and South Wales ports.

The iron markets of the Continent continue to display great activity. The advices from Austria are of a decidedly favourable nature. Much greater animation prevails in the iron market, and great hopes are expressed of an active autumn business, in view of the cheering prospects of the coming harvest. In the Belgian market, the previous firmness increases with the arrival of new orders, which keep coming in at a steady rate. The general price of bar iron is 140 fr. A good tone continues in the French iron market, this tendency being strengthened by the improvement which is taking place in foreign markets. In Germany, prices are rising both for pig and finished iron. The production of pig-iron in the German Empire (including Luxemburg), during the first five months of the present year was 1,265,745 tons, against 1,118,283 tons in 1881. Great activity also prevails in the coal markets of the Continent, values advancing at the same time. The American iron market is quiet, but firm. Quotations of Scotch pig-iron have been steady during the week. The strikers are gradually resuming work on the employers' terms.

BOYLE'S SYSTEM OF SHIP VENTILATION.

IN recording the advances of sanitary science in connection with that important branch ventilation, we have occasionally, to notice the practical progress made by Messrs. Robert Boyle and Son, the well known ventilating engineers of Holborn Viaduct, London, and Glasgow, in this direction, and to record the victories gained by them over the spirits of the air, *i.e.* of foul air. Our most recent notice related to ship ventilation, and in it we briefly explained the system invented and applied by this firm, and for which they obtained in competition the Bu[illegible] prize of £50, offered for the best system of ventila[illegible] tion for ships at the Shipw[illegible] Exhibiti[illegible] in Fishmongers' Hall in May last. Seeing [illegible] the im[illegible] portance of ventilation in connection with [illegible] ships, and seeing moreover the systematic way in which it appears to be neglected, we now propose to give [illegible] subject the attention it so fully merits, and to plac[e] before our readers all particulars relating to Messrs. Boyle's system. Before doing this, however, it wi[ll] be but just to give credit where credit is due, and to state that many ships are provided with what ar[e] supposed to be efficient means of ventilation, bu[t] which, whatever they may be in theory, are not [illegible] in fact. Of course shipowners are not wholly to blame. Deficient in special scientific knowledge they can only adopt what their advisers in suc[h] matters suggest to them. This usually consists of a pipe and bell-mouth, or trumpet-shaped, head, which may be useful under certain conditions for driving down air, but is of little or no use as an extractor of the foul air, which, after all, is reall[y] what is required if the ventilation is to be satisfactory and safe. But this satisfaction and this safe[ty] are often unattained through something else th[an] technical ignorance, and that something is a sho[rt]-sighted economy, which, regardless of the risks to li[fe] and health, attempts to keep down expenses b[y] adhering to the old-fashioned, unscientific, and in[-] effective ventilating appliances which are usuall[y] found on board ship. Now the most common of the appliances is, as we have stated, the bell-mout[h] ventilator, and its special disadvantages are that [it] requires trimming to suit the direction of the wi[nd] and this necessitates a certain amount of attent[ion] that is not always given. Owing to the dow[n] draught which it causes when applied to passenge[r] or the crew's quarters, it is in cold weather genera[lly] stopped up, clandestinely or otherwise, as the ca[se] may be, when any ventilation it might have affor[ded] is of course at an end, and partial asphixiation ens[ues] with all its attendant miseries and dangers. W[hen] applied to holds for the ventilation of cargoes results are, if possible, still more serious, [illegible] the e[va]poration of moisture and exhalations of gas[es] wh[ich] are generated and thrown off from most cargoes precipitated and pressed down by the rush of c[old] air through the ventilator, and made to resatu[rate] and charge the cargo with those deleteriou[s] dangerous bodies to such an extent as to not [only] deteriorate the quality of the goods, but pro[ve a] positive source of danger through the collect[ion of] compressed moisture and gases, often result[ing in] spontaneous combustion. Grain and fruit ca[rgoes] are specially liable to suffer through defectiv[e ven]tilation, and coal-laden ships come under the c[lassi]fication of dangerous, where proper provision [is not] made for the free escape of the gases evolved [and] a free circulation of air through the whole ca[rgo]

BOYLE'S SYSTEM OF SHIP VENTILATION.

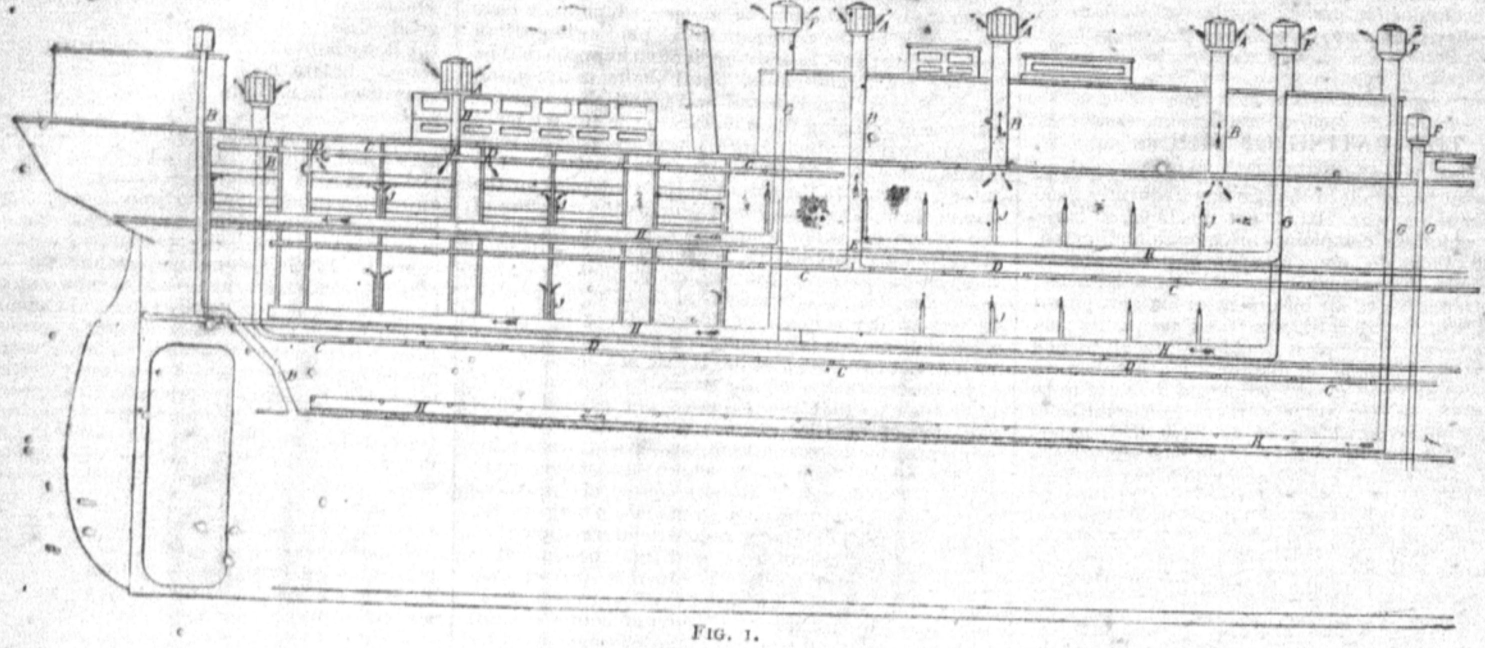


Fig. 1.

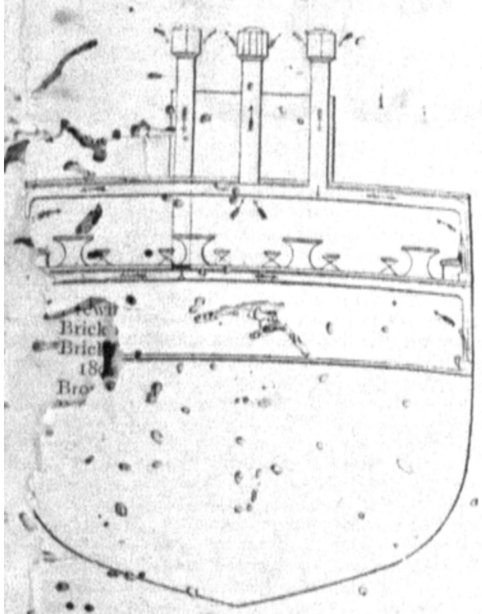


Fig. 2.

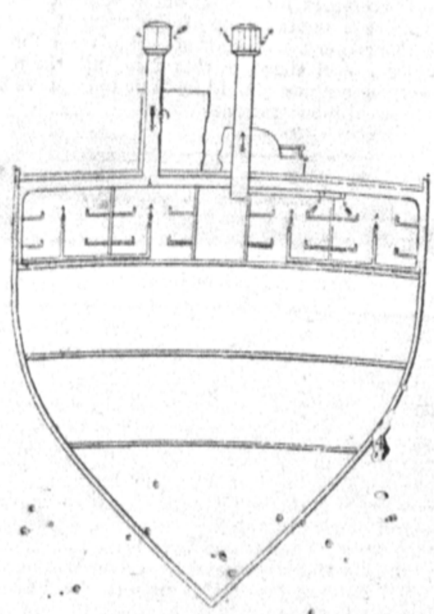


Fig. 3.

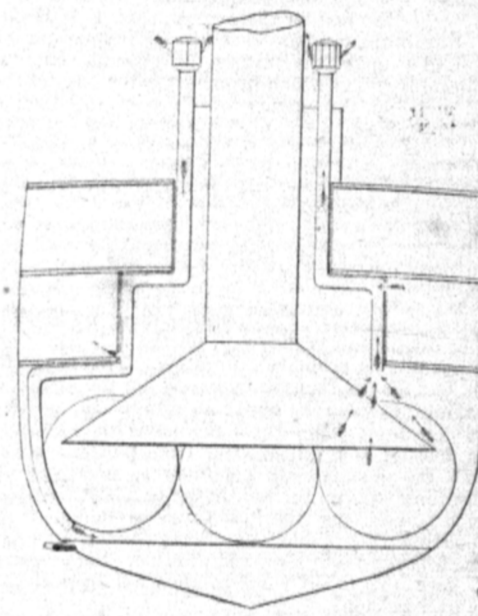
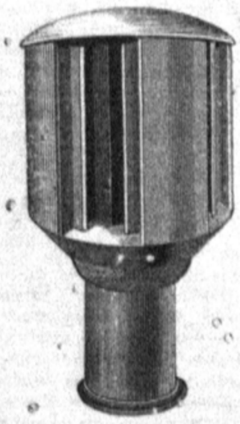


Fig. 4.



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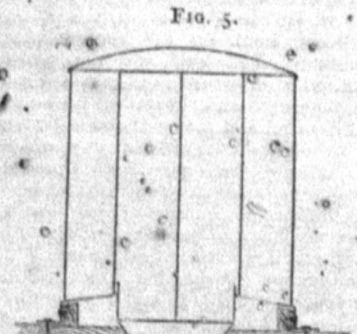


Fig. 6.

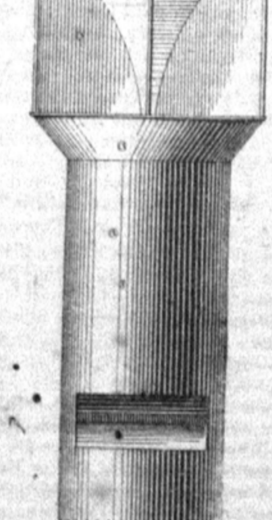


Fig. 7.

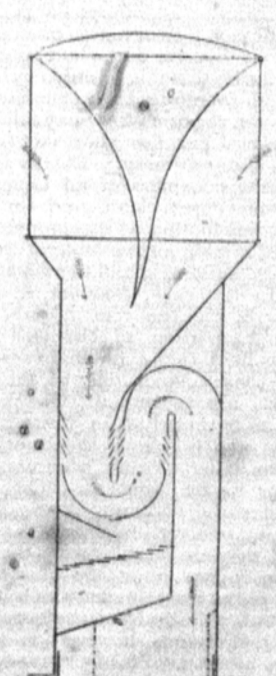


Fig. 8.

is, however, to be hoped that the Royal Commission which is now examining into the question of the ventilation of ships will so deal with the matter that a radical change will be made in this important respect. Our columns have from time to time testified to the fact that there are means of accomplishing perfect ventilation on shipboard, and they once more bear witness to the fact, as evidenced by Messrs. Boyle's system, which we will next proceed to explain.

The main conditions which a system of ship ventilation, capable of universal application, should embody, are that it should not be liable to derangement; that it should be independent of any special attention; that it should be automatic; and, that it should always be in action, whether the vessel be on a voyage or in port. These conditions Messrs. Boyle's system appears to fulfil, and we think our readers will go with us in our conclusion by the time they have read the present notice. The system is represented in the engravings on page 2, from which it will be seen that it is somewhat similar to that so successfully applied by Messrs. Boyle to dwelling houses and public buildings, and consists of upcast and downcast ventilators. The upcast ventilator or air-pump, which has already been described in IRON, is so constructed that no matter from what direction the wind may impinge upon it, an up-draught is the result, there being no down-draught. It is a fixture, which has no movable parts to get out of order, and which never requires trimming, so that the ventilation cannot suffer through want of attention. It has also the merit of being perfectly water-tight, Messrs. Boyle having recently effected an improvement which prevents a drop of water passing through it, even though a heavy sea broke over it. It is fixed on deck in a similar manner to the ordinary ventilator. The downcast ventilator is a very simple and ingenious contrivance, as it is made to send an abundant supply of fresh air below and at the same time no water can pass down the shaft. It consists of four openings or mouths, something similar to the bell-mouth, but contracted at the top of the shaft where they converge into one, so arranged that they catch the wind from every quarter without the necessity of the ventilator being trimmed, as, like the air-pump ventilator, it is a fixture. Inside and about one-third the length of the pipe above deck an oblong tube is fixed at the bottom of the bend, and round the sides a series of louvres are arranged so as to allow any water which may pass in at the mouths of the ventilator to escape into the outside pipe and thence through an opening on to the deck. It will thus be seen that with these appliances it is possible to have the ventilation going on between decks without any interruption or stoppage when there is a storm blowing with the seas sweeping the decks, whereas under ordinary conditions, in similar weather, everything would be battened down and the ventilation entirely stopped.

Turning to our engravings, fig. 1 is a longitudinal section of a steamship showing the arrangement of the pipes for distributing the fresh air and extracting the foul air from the different parts of the ship. A is the air-pump extraction ventilators; B, main extracting shafts; C, branch extraction pipes led under the ceiling through the different cabins into which run other smaller pipes from other cabins; D, foul air exit openings into extraction pipes from cabins; E, partition plates to prevent currents in branch pipes meeting and creating an eddy, and also to deflect the currents up the main shafts; F, downcast ventilators; G, main supply pipes; H, branch supply pipes to cabins, saloons, &c.; I, small vertical tubes to admit the air in an upward direction and so avoid draughts. These tubes are fitted with regulating valves, so that the air supply is completely under control; when it is desired, the air supply may be warmed by having small steam pipes led along inside the branch pipes and connected with the boilers. The air can also be cooled by means of ice-boxes, placed in different positions in the shafts, so that in winter the air can be had of a genial warmth, and in the summer of a refreshing coolness. Figs. 2 and 3 are transverse sections of saloon and cabins showing cross pipes.

Fig. 4 shows the application of the system to the stoke-hole, and involves an entire revolution in the present mode of ventilating that part of the ship which is not only most unscientific, but is found to act the reverse of what is intended, and proves more of a nuisance than a benefit to the men below. We refer to the open gratings placed over the stoke-hole, which, instead of allowing the free exit of the heated air, permits the cold external air to pass through and press down the hot air to the lower level occupied by the men, who are thus constantly kept, as it were, in a reservoir of compressed hot air. Messrs. Boyle propose to do away with these gratings and have everything tight at the top, except where the ventilating shafts penetrate. On one side of the stokehole is fixed one of the new downcast ventilators, which has a shaft carried down to about two feet from the floor, where the air is discharged. On the other side of the stokehole is fixed an air-pump upcast ventilator, with the shaft just penetrating through, and no more. This ventilator sucks away the hot air from the highest level to where it naturally ascends, and, owing to the suction power of the ventilator, and there being no downward pressure of cold air from the top, it is drawn away with great rapidity, being replaced by cool, fresh air at the floor-level, just where the men most want it. Any number and size of ventilators may be applied that may be required. The furnaces would also draw their supply of air from the downcast. By dispensing with the gratings, and having everything tight above, water is also prevented from passing below, which is another important point. It will be observed that the bunkers are also ventilated with the same shafts that are used for the stokehole. Figs. 5 and 6 show the air-pump extraction ventilator for fixing on the deck or on the top of a deckhouse. Figs. 7 and 8 represent an elevation and a section of the downcast ventilator, showing the arrangement for preventing water passing below. The whole system as above described can, of course, be applied equally as well to yachts as to ships.

It will thus be seen that we have here a practical system of perfect ventilation, which meets all the requirements of the case, and one that can easily be adopted without causing an inordinate addition to the cost of a vessel. If the parsimony of shipowners or the obtuseness of shipbuilders still be proof against its manifold advantages, it is to be hoped that passengers and shippers who may become aware of its merits will, in their own interests, raise such a clamour as may lead to their health and their goods being no longer jeopardised. We should add that the air-pump ventilator is used in the Royal Navy, and has been applied to over twenty of the leading Lines, including the P. and O. Line, Anchor Line, Allan Line, State Line, Clan Line, Glen Line, and White Star Line.

A NEW GAS ANALYSIS APPARATUS.

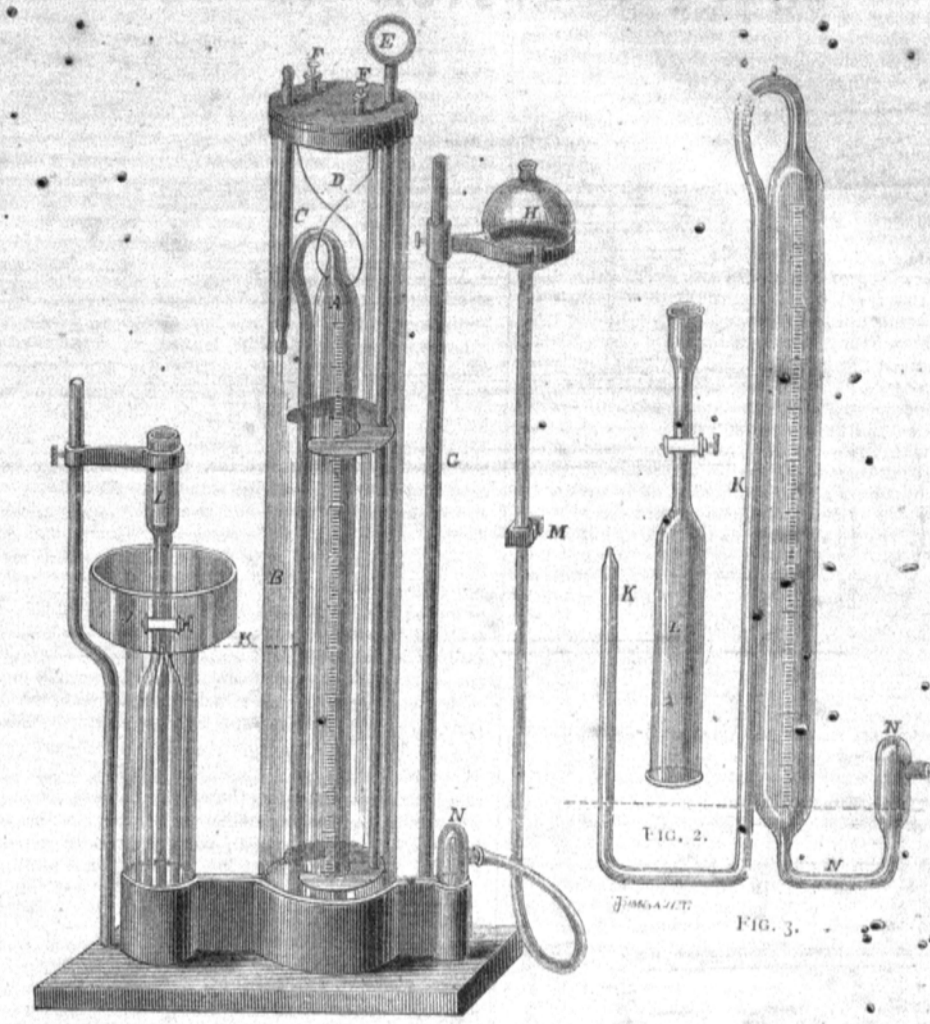


FIG. 1. FIG. 2. FIG. 3.

ANY one who has worked with the various forms of gas apparatus hitherto invented will be able to appreciate the advantage of an arrangement which possesses no fragile joint, and no capillary tube to get stopped up. The want of an apparatus, simple to work, requiring only a small amount of mercury, and capable of yielding accurate results with some rapidity, has been widely felt, and it is hardly too much to say that none of those hitherto in use have proved themselves entirely satisfactory. In ironworks laboratories especially, there are many investigations which would no doubt be carried out if means were at hand of making gas analyses rapidly and yet accurately. That gas analyses are capable of yielding results of great accuracy has been shown by the determination of the atomic weights of nickel and cobalt by Russel, and of aluminium by Mallet, from the volume of hydrogen liberated by solution of the metal in an acid. Metallurgists as yet know nothing, except from a few isolated experiments, as to the composition of the blast-furnace gases as affected by changes in the burden and temperature, or of the gases evolved in the Bessemer converter, whereas the employment of such a form of gas-analysis apparatus as that devised by Sokoloff, and described in the last part of the *Berichte der deutschen chemischen Gesellschaft*, No. 8, 1882, would facilitate the prosecution of such researches in iron works laboratories, and would doubtless add greatly to our knowledge of the processes of iron manufacture.

Fig. 1 shows the arrangement of the parts; figs. 2 and 3, the absorption vessel, or bell-jar, and the eudiometer respectively. The eudiometer, A, is drawn out at both ends, the lower end being bent twice at right angles and terminating in a bulb, N, with side tube attached. This side-piece is connected by means of a strong caoutchouc tube with the globe H, and can be closed at will by the screw pinch-cock, M. The upper end of the eudiometer is fused to a narrow delivery tube, bent as in fig. 3, drawn out at its termination to a small hole. The height of the vertical limb of the delivery tube should be about 8½ inches, and a mark is made on the tube K, level with this opening. The eudiometer, A, is surrounded by a wide cylinder cemented below into a cast iron stand; into this cylinder water can be introduced through the hollow stirrer, E. The cover of the cylinder also is provided with an opening for a thermometer, and with two binding screws, which can be connected with the platinum wires of the eudiometer. The cast-iron base supports the horizontal portion of the delivery tubes, as well as a cylindrical mercury trough, which encloses the free end of the delivery tube, K. Into this trough, and covering the tube K, is inserted a bell-jar, L (fig. 2), provided with a funnel and stopcock, serving for the purpose of submitting the gas to the action of liquid reagents. This receiver is of such a length that when pressed on the bottom of the trough the delivery tube just reaches to the stopcock. The stand has two uprights, one for holding the bell-jar, the other, G, for holding the globe, which can be raised or lowered at will. The mode of filling is as follows:—The stopcock, M, being closed, mercury is poured into H; the apparatus is then inverted and the stopcock opened; in this way air is driven out of the tube and the bulb N, after which the whole is brought into the proper position once more; and the mercury then rises in the eudiometer, expels the air from the tube, and finally overflows at the opening of the tube K.

The calibration of the eudiometer may be effected by filling with water to the lowest mark, and forcing the water out slowly by raising the globe, and measuring the volume of water expelled which corresponds to an observed rise in the height of the mercury. Herr Sokoloff finds that the calibration in this way gives as exact results as the usual method of calibrating with mercury.

To carry out an analysis the trough is filled with mercury till it stands about half an inch above the opening of the delivery tube, then the bell-jar containing the gas is brought to the trough, pressed down, and sufficient mercury run out of the trough to allow the point of the delivery tube to be seen. The globe H is next lowered, the stop-cock opened, and the gas thus drawn over into the eudiometer; the level of the mercury in which, and in the globe being made to coincide, that in the two portions of the delivery-tube will balance each other, and the volume of the gas from the mark on the tube K is thus read off without any calculation for difference of pressure. After measurement the globe H is raised, the gas being thus forced over into the bell jar into which the proper reagent is introduced by cautiously opening the stopcock. After absorption, the gas is again drawn over into the eudiometer in the same manner as described above, and its volume measured. During an explosion the stopcock, M, is left open, and the apparatus will then sustain the shock without danger of breakage. After the explosion the gas may be rapidly cooled down by moving the stirrer up and down a few times.

A series of analyses of air showed the author that ten minutes sufficed for one analysis. The following example is given by Herr Sokoloff of the analysis of a mixture of CO and CO_2.

1°. By absorption of the carbonic acid by means of caustic potash.

2°. By absorption of the carbonic oxide by means of a solution of cuprous chloride, Cu_2Cl_2.

1°. Volume of gas used = 23·8 c.c.; after absorption = 11·9 c.c.

∴ In 100 volumes CO = 50·0
CO_2 = 50·0
100·0

2°. Volume of gas used = 26·4 c.c.; after absorption = 13·25 c.c.

∴ In 100 volumes CO = 49·82
CO_2 = 50·18
100·00

To remove the reagent from the bell-jar, mercury is poured into the trough as at first, the bell pressed down and the stopcock opened, when the liquid rises into the funnel and may be drawn off by means of a pipette and replaced by a fresh solution.

Although they might add to the complexity of the apparatus above described two additions may be suggested. The first is a stopcock near the bottom of the mercury trough for the purpose of lowering the level of the mercury; the second is the attachment of a vertical tube (open above) to the horizontal part of the tube N. This should be brought close to the eudiometer tube, and is for the purpose of enabling the experimenter to bring the level of the mercury in the globe and the eudiometer more accurately to the same height.

OCCASIONAL NOTES.

A SHIPBUILDING PROBLEM.

THE American correspondent of a daily contemporary wires that the Senate Naval Committee has introduced a bill voting 10,000,000 dollars for building six steel cruisers of from 4300 to 6000 tons, one steel ram of 2000 tons, four steam cruising-boats, and four torpedo-boats. He adds: "The bill provides that the steel shall be American, and that half the vessels shall be built in private yards." If "our own correspondent" is correct, it appears to us that a small difficulty will arise in carrying out the provisions of this bill. There are in all fifteen vessels to be built, so that the government and the private builders will have to construct seven and a half each! We should like to know how this is going to be done. Will some of the parties go odd man for the fifteenth ship, or will the government stick to the text of the bill and build half a vessel and a private firm the other half, each half being fitted with a bulkhead, and the two halves being floated out and united in one after launching? We will leave our clever cousins to settle this point; but inasmuch as a coach and horses can always be driven through an Act of Parliament, we doubt not a ship of moderate dimensions can be sailed or steamed through an Act of Congress.

GERMAN TRADE WITH SPAIN.

It appears from a consular report published in the *Deutsche Handelsarchiv* that the trade of Germany with Spain is considerably on the increase. The growth of imports of German manufactures of iron and steel into Spain especially is noteworthy. German makers now supply about eight-tenths of the requirements of that country of steel rails, tires, axles, locomotives, carriages, machine tools, &c. Amongst other contracts which German manufacturers have secured during the past year, there is to be noted that for a new railway, for which the whole of the permanent way and rolling stock has been supplied from Germany. In the Spanish arsenals and shipyards, it is stated, the two well-known manufactories of machine tools of Chemnitz have entirely superseded English makers. German iron and steel wire, Solingen cutlery, Aachen needles, and the better descriptions of small iron and steel wares of Remscheid are selling as largely as ever. We have always held that English manufacturers have very much neglected the Spanish market, and the above report—which, it must not be forgotten, is official and perfectly trustworthy—proves our assertion to be true.

A SUBMARINE DETECTOR.

A new instrument, which promises to be of great value in searching for torpedoes, and in other submarine work, has been invented by Captain McEvoy, of No. 18, Adam Street, Adelphi, a gentleman well known in connection with torpedoes and submarine engineering. The detector has for its object the discovery of metallic bodies in the water, thereby facilitating their recovery when desired. The apparatus consists of a small mahogany box, in which there are a pair of coils or bobbins, a vibrator similar to that employed in electric bells for making and breaking contact, and a telephone. To the box is attached a given length of flexible cable with four conducting wires in it. At the other end of this cable is fixed a flat wooden case, in which there are two coils. This wooden case is weighted so that it may readily sink when placed in the water. There are also terminals on the box for attaching battery wires, and an arrangement for putting on and cutting off the current. There are two complete circuits through the box, cable, and wooden case: one primary and the other secondary. The battery, vibrator—one coil in the box and one coil in the wooden case—are in the primary circuit. When the battery is on, the coils in the box are adjusted so that little or no noise from the make and break action of the vibrator is heard in the telephone. When so adjusted, the instrument is ready for work, and if the wooden case is then brought near a metallic body, a loud noise is heard in the telephone, thus indicating the proximity and locality of such body. The principle on which this invention is constructed is that of the induction balance of Professor Hughes. In this case the application of the principle to the uses referred to has been worked out in a very practical manner, and the apparatus, which we have seen in operation, cannot fail to be of importance in discovering and locating the position of torpedoes, submarine electric cables, lost anchors, chains, sunken vessels, treasures, &c., and in assisting the operations of divers.

DOVER HARBOUR.

It is proposed to make a considerable addition to the area of Dover harbour, which is at present not very roomy, and liable to being silted up. The bill which the Dover Harbour Board are endeavouring to obtain during the present session of Parliament for the construction of a deep-sea harbour at Dover is very comprehensive in its character, and practically aims at carrying out the scheme reported upon and approved by a parliamentary committee some six years ago. The Admiralty Pier will form the western arm of the harbour, and, according to the plans, it is intended to lengthen this by extending it eastwards for a distance of 550 feet. The eastward limit of the harbour will be formed by a pier or breakwater running out from under the cliffs beyond the castle to a distance extending in a southward direction for about 1000 feet, the space between the two piers being thus about a mile. Both these pier will converge slightly, and between them, marking off the entire limits of the harbour, will be a large breakwater. This breakwater will begin in the bed of the sea about 800 feet from the termination of the eastern arm of the harbour, and extend in a southerly direction for about 1200 feet, continuing in a south-westerly direction for about 2100 feet to within 600 feet of the western arm. Provision is therefore made for two outlets of 600 and 800 feet respectively. The harbour will thus enclose nearly the whole of the bay which is sheltered by the cliffs, and is overlooked by the fortifications at the heights and the the castle. The additional accommodation provided for the anchorage of vessels of the mercantile marine and the Royal Navy has, of course, long been required; but it is not too much to say that the enlargement of Dover harbour, which has been rather looked down upon by foreign critics as a port of only secondary importance, will tend to modify that view.

AMERICAN RAILWAY COMPETITION.

The remarkable effects of too much competition are well illustrated in an official report on the war of tariffs among the American railways, which, our readers will remember, extended over four months of the summer and autumn of last year. Through passenger fares on the great competing lines running east and west, according to the report, were reduced to about one-fourth the usual rate. Freights were also greatly lowered, though not in a corresponding degree, the cost of bringing wheat from Chicago to New York, for example, being reduced just one-half. A corresponding fall took place in the lake and canal rates on the transport of grain. The results of this severe struggle, unparalleled in the history of railways, are now seen in the depreciation of American railway securities, the bankruptcy of not a few lines, and the suspension of many new works. The partial stoppage of railway constructing operations in the United States has likewise been felt by the iron trade of this country in the gradual falling-off of American orders since the early part of this year.

THE LIVERPOOL AND MANCHESTER CANAL.

The practicability of constructing a tidal water way for ocean going steamers between Liverpool and Manchester was considered at a meeting held last week at the residence of Mr. Daniel Adamson, The Towers, Didsbury. It was stated at the meeting that there were no engineering difficulties to overcome in constructing the proposed waterway. There was an enormous depth of water outside Liverpool, except at the bar, which constituted a serious interruption to the navigation of the Mersey. If the contemplated waterway were made, it was probable that the additional scour would remove the bar, which would be a great advantage to Liverpool. The wisest thing, it was thought, would be to have a system of locks between Liverpool and Manchester; but it was also believed that, if the canal was to be a success, it must be made free from any interruptions—so free that a steamer could come to Manchester, whatever the condition of the tide, and go away at any time, night or day. To effect this, a depth of 22 feet would be required, compared with the 26 feet of the Suez Canal. The above views were supported by Mr. H. H. Fulton, C.E., the author of the scheme, who went some length into its details; and Mr. George Hicks gave statistics to show that it would be a financial success. We never heard of any new undertaking that was not pronounced a mine of wealth by its promoters; but in this case, although estimates for works of this nature are generally below the actual cost, we believe that a fair dividend may be expected upon the outlay. At any rate, the proposal deserves serious consideration, especially from the point of view of the immense advantages it would offer to Manchester.

A NEW DIRECT PROCESS.

A new process has been patented by Mr. J. C. Bromfield, of Brighton, for making iron and steel direct from the ore, and which, we are assured, has been spoken favourably of by no less an authority than Sir Henry Bessemer. Besides the main feature of the direct transition from the ore to a high class of metal, either iron or steel, the sub-products, notably the furnace gases, are, by this process, saved and utilised. Mr. Bromfield grinds to powder coal or coal dust and iron ore or "blue billy," in proportions varying in the nature of the materials; and, when much silica is present in the ore, he adds alumina with or without calcium oxide or carbonate of lime. At the same time he extracts a mucilage by hydraulic pressure from seaweed steamed in a close-jacketed boiler. The powder and mucilage are internately mixed with Portland cement, carbonate of lime, magnesia lime or calcium oxide, in proportions varying with the nature of the ore; and this mixture is formed into bricks by a powerful press. When dry, the bricks are coked in a retort, whereby their sulphur and phosphorus are driven off. The gases are led through an hydraulic main and utilised, either for maintaining the combustion or for illuminating purposes, in which case the by-products are also turned to account. After coking, the bricks are ready for the smelting furnace, and, as it is claimed, produce a high class of metal, from which practically the whole of the phosphorus and other injurious elements of the raw materials have been expelled.

THE SOCIETY OF ENGINEERS.

ON Wednesday last, July 5, the members and associates of the Society of Engineers made the first of their vacation visits for the present year. The place visited was Chatham Dockyard, permission for an inspection having been given by the Lords of the Admiralty. The members and their friends, to the number of more than a hundred, went down by special steamer. Amongst the company were Mr. Jabez Church, president; Messrs. C. Horsley, Berridge, Spice, Gandon, Walmisley, Rigg, Baldwin, Latham, and S. Cutler, members of the Council; Mr. A. Williams, honorary secretary and treasurer; and Mr. B. Reed, secretary. On landing the visitors were, at the request of Admiral Superintendent Watson, conducted through the works by Mr. E. A. Bernays, the superintendent civil engineer, and Mr. Penny. Upon the first slip visited was being built the armour-plated cruiser, *Warspite*, 315 feet long, 61 feet broad, 23 feet 10 inches deep, and of 7390 tons displacement. She will carry four 18-ton guns *en barbette*, six six-inch rifled breechloaders, and twelve torpedoes. This vessel's thickest armour is ten inches, and she is to make sixteen knots an hour. Next came the *Calypso*, a single-screw corvette of 2765 tons, and carrying ten six-inch guns. She was commenced last year. The *Rodney*, which is the biggest vessel in the yard, was laid down in February last, and is the latest development of the barbette principle. Her armour is 18 inches thick, one-fourth being steel. The length of this ship is 325 feet, breadth 68 feet, depth 26½ feet, tonnage 9150, and she will carry four 60 ton and six six-inch guns. The *Polyphemus* was no stranger to the visitors, most of them having last year paid her a special visit of inspection. At present she is in dock. The sister ships *Agamemnon* and *Ajax* are being made ready for immediate service. They are double-turreted ironclads, carrying four 38-ton guns, two six-inch guns, two seven pounders, four mitrailleuses, ten Nordenfelts, and twelve torpedoes. They have 18-inch armour plates, are 280 feet long, 66 feet broad, 22 feet 7 inches deep, and of 8490 tons displacement. The *Rover*, which is also fitting out, is a corvette, carrying fourteen six-inch guns, several machine guns, and half a dozen torpedoes. The *Constance* is somewhat lighter in form and equipment, but carries the same number of torpedoes. She also is being fitted up with all speed. The *Conqueror*, next visited, is pushing on to completion. She is partly barbette and partly turret, and will carry 24 torpedoes, a couple of 43-ton guns, and others of better calibre. Alongside lay the *Jumna*, Indian troopship, under refitment. Having inspected the ships and run through the workshops, the visitors were conveyed by dockyard express train to the extension works, where three new basins have been constructed by convict labour, each basin representing an area of 34 acres. The new works are for the departments of the factory, repairs, and fitting out, and have been fully described by us in connection with a previous visit of the society.

MARBLE QUARRYING MACHINERY.

SOME time ago a Greek company (La Cie. Hellenique des Marbres de Paros) purchased the rights of the celebrated marble quarries of Paros, which provided the sculptors of ancient Greece with the blocks which they chiselled into such exquisite forms. To facilitate the despatch of the stone when quarried, a line of railway has been laid from the pit to the shore, a distance of nearly seven miles, and the company have purchased through their London representatives, Messrs. H. Stopes and Co., of 24A, Southwark Street, a steamer. This vessel has since brought over a cargo of statuary and building marbles, and Messrs. Stopes and Co. are now sending her back with an important consignment of machinery to be fixed at Paros. This consists of a complete set of air-compressors and rock drills for thirty-six drills. The air-compressor and engine are designed and made by Messrs. R. Schram and Co., and have been illustrated in IRON. The air-compressor and steam-cylinders are both 22 inches diameter, having a stroke of 30 inches, and are arranged side by side on a single massive bedplate. With a view to economise fuel the steam cylinder is fitted with an expansive cut-off valve, so arranged that steam can be regulated at all times. A 12-inch condenser is placed immediately behind, and in a line with the steam-cylinder working from the same piston rod. The air cylinder is enclosed in a cast-iron water tank, and is fitted with Schram's patent inlet and outlet valves. The engine is entirely self-contained, and is of the most substantial construction, all the working parts having large bearing surfaces, the cost of fixing being carefully considered. Two sets of drills are being sent out, after lengthened careful trials by Messrs. Stopes in this country, and the two selected makers, Schram and Hathorn, will now have the merits of their drills tested by actual work side by side. All the drills are arranged to be mounted on two kinds of tripod stands, one for drilling vertical the other horizontal holes. The air-receivers for the storage of compressed air are four in number, each 4 feet in diameter and 12 feet long, and are fitted with safety valves, &c. The air is conveyed to these receivers through 3-inch wrought-iron pipes, and will be distributed to distances of in some cases over half a mile. The revival of so famous an industry in Greece after a lapse of 2000 years is creditable to the little kingdom of the Hellenes, and it is gratifying to find that the demand for this marble is already sufficient in the East to ensure success to the enterprise.

MANGANESE BRONZE.

IT is now some time since we first had to notice the introduction of the manganese bronze and the white brass of Mr. P. M. Parsons. These now well-known metals have since then, by virtue of their own merits, found their way into extensive use with engineering and shipbuilding firms. So great has become the demand for them that a company, having offices at No. 8, Walbrook, London, has been formed for the purpose of taking over the business and erecting enlarged works, with additional plant and machinery, so as to extend the business and open out important branches of it, which have as yet remained undeveloped. We need hardly remind our readers that the manganese bronze (which has aptly been termed the steel of the bronze alloys) possesses extraordinary strength, together with toughness, hardness, durability and freedom from corrosion. It can be made into castings of all kinds, and can be forged, stamped, pressed and rolled into rods, plates, sheets and sheathing, as well as worked cold and drawn into tubes and wire. Manganese bronze has been subjected to numerous tests in order to ascertain its transverse and tensile strength, toughness, and other qualities, under the direction of the Admiralty, and at the Royal Arsenal, Woolwich, as well as by several private firms, and the results show that the transverse strength and toughness of cast bars is double that of the best gun metal, and considerably above that of wrought iron, while the tensile strength and toughness of rolled and forged bars, plates, &c., is equal to that of mild steel. The white brass is manufactured in two qualities, one for small solid bearings and bushes, and the other for lining large bearings. It is in use in a number of the largest steamships afloat, and in various kinds of engines, machines, railway carriages, &c., and has proved to be highly successful in preventing heating, and in reducing wear and friction to a minimum.

THE MECHANICAL VENTILATION OF MINES.

AT the closing meeting of the session in connection with the Manchester Geological Society, held at Wigan, on June 30, the whole of the programme was devoted to subjects specially interesting to mining engineers, of whom there was a large number present. Amongst other subjects was a paper by Mr. Charles Cookson on the relative efficiency and useful effect of centrifugal fans for mine ventilation. The great majority of mining engineers, he said, had become convinced, on the ground of safety and efficiency, that mechanical was greatly superior to furnace ventilation, and the point now chiefly at issue was the relative superiority of the various systems of mechanical ventilators. These might be divided into two classes: the first consisting of the Waddle, the Guibal, and the Schiele, which were centrifugal ventilators; and the second consisting of those machines which were known as varying capacity ventilators. The latter class, however, in his opinion, were not at all suited for the enormous volumes of air which were required at the present day for the ventilation of coal mines, and very few comparatively were at work in this country, whilst on the Continent, where all types of mechanical ventilators had been more fully tried than here, the centrifugal fan was being put up practically to the exclusion of all others. It was therefore only necessary to consider the relative merits of this class of ventilator. In the absence of any fair means of comparison obtainable with present experiments as to the useful effects and results, he had turned his attention to one or two other points, which, in his opinion, were quite as important as the question of the percentage of steam utilised. The work of a fan was, primarily, to produce a ventilating current in the mine, and they could calculate what ventilating pressure could be produced by a fan running at any speed. Since the quantity of air in a mine depended upon the ventilating pressure or water-gauge that a fan could produce, the question as to which type of fan was able to produce the greatest water-gauge was one of great importance, as it might be said that the fan which at a certain speed could produce the greatest water-gauge was the most efficient ventilator. As a basis on which to test this class of ventilator, they might consider that in all centrifugal fans the air travelled the fan at the speed at which the tips of the fan were travelling. In open running fans the work which was stored up in the air when travelling was nearly all lost, and if they could utilise any of this stored up work by lessening the velocity of the air before discharging it into the atmosphere, they would increase the useful effect of the fan. If all this stored up work could be utilised, and the fan caused no friction to the air in passing through it, they would arrive at what a perfect fan could produce. In order to get at a fair average of results, he had worked out the percentage of efficiency in this respect of some six Guibals, three Waddles and five Schieles, of whose working he had particulars, and averaging the results he found that they gave the following comparison :—

Guibals	..	64·5	of efficiency with regard to water-guage produced.
Waddles	..	44·78	
Schiele	..	34·54	

Taking this as a fair basis for calculation, they could find out approximately what each of the three types of fans would do at the same or different speeds, and taking 9000 feet per minute of periphery speed as being about the limit of safe working speed of fans of such dimensions as would pass large volumes of air, they found that at this same speed they would give the following results :—

	Water-guage.		Air per minute.
Guibals	6·61 inches	..	200,000 cubic feet.
Waddles	4·59 ,,	..	166,780 ,,
Schiele	3·53 ,,	..	146,160 ,,

This showed that if the fans were all working under similar conditions and at the same speed of periphery, the Waddle would give 16·6 per cent, and the Schiele 26·9 per cent. less air than the Guibal, or putting it in another form, they found that to produce the same amount of air the Waddle would have to run at 20 per cent. and the Schiele at 36·6 per cent. greater speed than the Guibal, so that whatever the result as to the useful effect calculations, they might say that as a matter of efficiency with regard to the speed of the fan the Guibal was the most efficient. In the course of a discussion on the paper, Mr. Wm. Bryham, a well-known mining engineer in the Wigan district, said that although he was prepared to admit that the time was coming when mechanical ventilation would be more applied than it had been before, he scarcely thought the time had yet come when it could be said that under some conditions it was altogether superior to furnace ventilation. Mr. Cookson replied that no doubt at certain depths furnace ventilation was found to be more economical than mechanical ventilation, but another point to be considered was the question of safety.

THE IRON TRADES EMPLOYERS' ASSOCIATION.

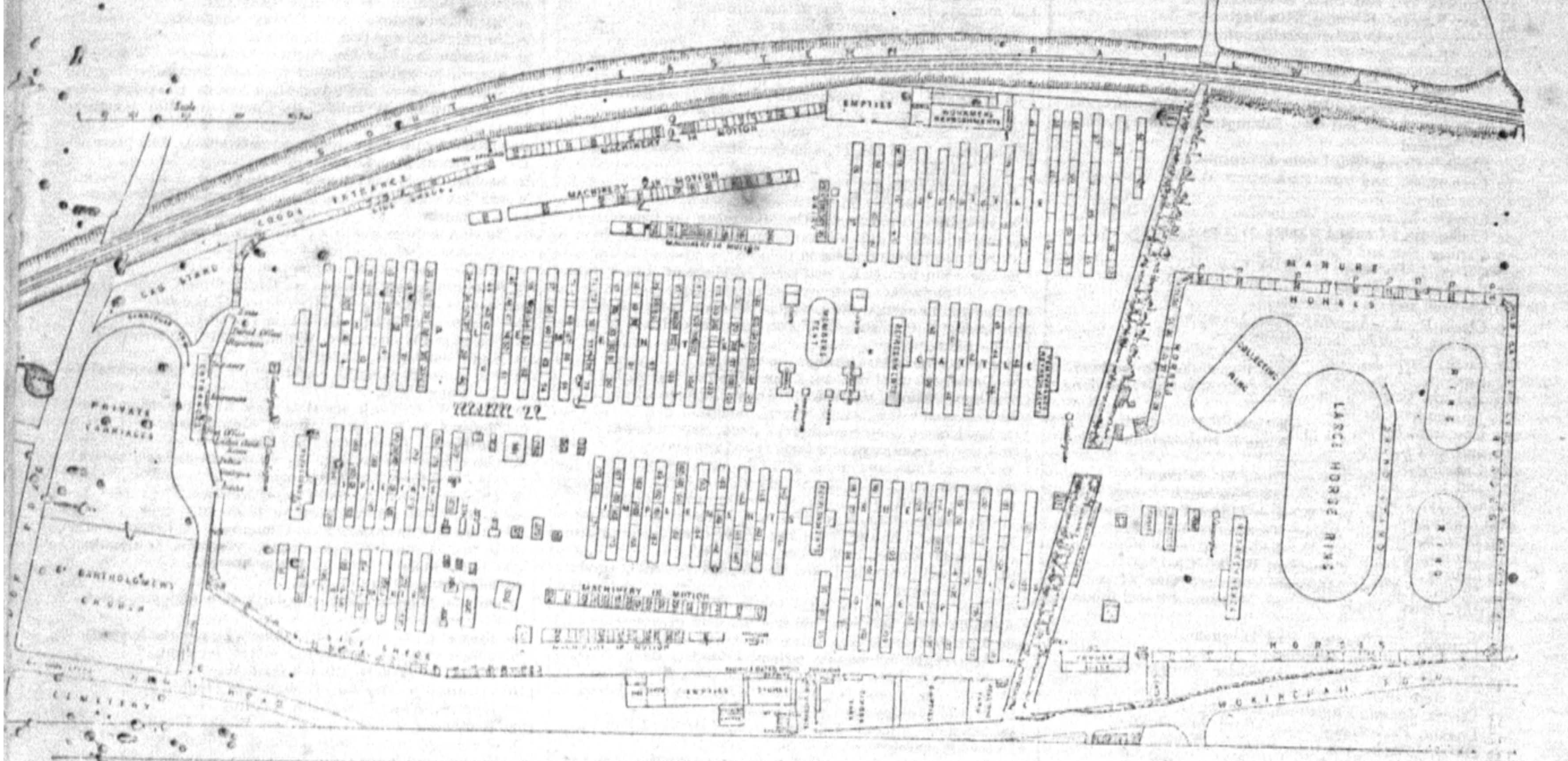
THE annual meeting of the Iron Trades' Employers' Association was held on June 29, at Huddersfield, Mr. David Greig, Leeds, in the chair. The general committee of management, in presenting their report, congratulated the members upon the revival of trade, which, though slow in many departments, seemed to be progressing, and it was hoped would be lasting in every district. In so far, however, as the improvement in trade had influenced the labour market, the committee had to remark that in every branch where skilled labour was requisite in the engineering and iron trades, the workmen had been the first to reap the benefit, long before any corresponding advantage had been felt by employers; for though it was frankly admitted that orders had been greatly increased, it was nevertheless necessary to state that prices did not improve to the extent desirable, and that until competition became less eager, the pecuniary results to employers could not be satisfactory. At the present time wages in every department of the engineering trades had returned to, and in some cases had advanced upon, the rates in force during the period of activity preceding the depressions in 1878-9. Thus there was scarcely any industrial district in the kingdom in which advances had not been given by employers as a natural consequence of increasing activity, and it was gratifying to know that this result had been generally effected without the intervention of strikes or difficulties of that kind. The secretary had been instructed to collect the fullest information as to wages paid at the present time in every branch of the engineering and iron trades for the guidance of members in meeting claims which might be made upon them. The paramount importance of piecework, in every department where it could be introduced, had been kept constantly before the members, and it was making way in the country. It was known that the leaders of some trade unions in the engineering and iron industries were increasing in their efforts to prevent its extension, and even to limit its application in shops where it had long been in operation, but where it had once been fairly established it remained unshaken. The matter of the greatest interest during the year had been the experiment made by the members in regard to the establishment of a system of mutual insurance against claims for personal injuries made upon employers by their workmen under the Employers' Liability Act, 188[illegible]. The results of this experiment had so far abundantly confirmed the steps taken by the promoters of the system as an integral part of the work of the association. Every claim made upon the committee had been met with all possible dispatch, and the entire amount expended upon claims made for compensation had not exceeded twelve per cent. of the gross sum received as premiums, so that a large amount would be carried over to a credit balance for the ensuing year. The result was, do doubt, due mainly to the economical administration of the fund, as both the legal expenses and the cost of management had been very moderate indeed. The final statement as to income and expenditure in the insurance section could not be made public till after the end of July, when all the members who had insured would be called together to hear the treasurer's report, with the statement of the committee, and to consider whether, at a not very remote date, it might not be possible, under some modified form of subscription, to merge into one, the general and the insurance funds to make one payment cover the privileges of membership, and the insurance against claims for compensation under the Act as it now stood. In any case, it was satisfactory to know that the investigation into the question of risks in the engineering and iron trades, and the classified ratio of such risks which was undertaken and completed about two years ago by order of the general committee of management of the association, had led to conclusions which had been shown to be sound, and by establishing a very moderate scale of premiums to cover such risks, the association had saved its members and all employers in the engineering trades of the country from a large annual contribution, which it was once feared would have to be paid, and would have become an additional and a serious tax upon industrial enterprise. The committee had organised an active opposition to the proposed amendment of the Employers Liability Act; which had in view the making illegal any martial contracting out of the provisions of the act, and which would thus destroy all freedom of contract between employers and employed. Communications with regard to the matter had also been opened up with Sir Joseph Pease, and the secretary had been instructed to act upon any suggestion he might give, by which to strengthen his hands against this objectionable Bill when it was again before the House of Commons. In conclusion, the committee urged upon members in every district the duty of taking steps for widening the area of the association. In view of the position taken by trades unionists all over the world, it was clear that the organisation of employers for defence and mutual support was each year growing more necessary. The past year had been one of unusual quiet, but it would be contrary to all experience to hope that such quietness would continue without some interruption. The vicissitudes of trade and the changing condition of the labour question, caused by immigration, and the sudden call for labour in special industries, such for instance as the one now going on in the iron shipbuilding trade, might at any time become a source of disturbance, and it was a satisfaction to know that employers who were members of that association could at once call to their aid an organisation which had branches all over the kingdom, and would thus be made useful whenever and wherein it was required. The President having delivered an address, reviewing the chief topics which had occupied the attention of the society during the year, moved the adoption of the report, which was seconded by Mr. J. Robinson, of Manchester, and agreed to. The usual votes of thanks were then passed, after which it was resolved that the next annual meeting of the society should be held in Keighley, Yorkshire, and Mr. David Greig was re-elected president for the ensuing year. In addition to the ordinary business a resolution was passed, recommending the general management committee to revise the rates of subscription with the view to widening the basis of the association, and this closed the proceedings.

EASTBOURNE EXHIBITION OF FINE ARTS, SANITARY APPLIANCES, &C.—It is intended to erect a structure at Easrbourne, in which to carry on a series of annual exhibitions, varied in character, scope, and object, as a permanent institution, to which shall be attached an association, having for its object the diffusion of knowledge of a technical and scientific character, and known as "The Eastbourne Arts, Science, and Sanitary Association."

EXHIBITION OF LIFE-SAVING APPLIANCES.—The exhibition of means and appliances for the protection and preservation of human life, which is now being held at the Alexandra Palace, was officially opened on Saturday last. Various railway companies have contributed to the department of railway safety appliances. To a section devoted to apparatus for marine emergencies the Board of Trade and Trinity House contribute, together with the Royal National Lifeboat Institution, the Royal Humane Society, the Shipwrecked Mariner's Society and the Marine Life Protection Association. The ambulances and appliances of the War Office and St. John's Ambulance Association are shown in the Sanitary and surgical department. The means of extinguishing fire are shown by the Fire Brigades' Association and by the Metropolitan Fire Brigade. Precautions which may be taken against the loss of life in mining are illustrated in a mining section, to which the Royal School of Mines has contributed; and under the head of "engineering and miscellaneous safety appliances" there is room for no end of articles claiming to serve some purpose connected with the protection and preservation of human life. We shall give a full notice of the exhibition in an early issue.

THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

PLAN OF THE SHOW YARD, READING, 1882.



THE ROYAL AGRICULTURAL SHOW AT READING.

TO-MORROW—Saturday—the forty fourth annual show of the Royal Agricultural Society of England will commence by the admission of the public to the implement department, and on the following Monday the whole show will be thrown open. The show-ground is conveniently situated on the London Road, and is bounded on the north-east by the South-Eastern Railway. In the annexed engraving we give a plan of the show-yard from which the general arrangement of the exhibits will be seen. The area of the ground is somewhat in excess of that of the ground at Derby last year, and the number of exhibitors is also greater. In fact, the entries in all departments are in excess of the last few years, 13,017 feet run of shedding having been taken by 358 exhibitors, who will occupy 391 stands. In the following statement we give the space allotted in the three general divisions of the implement yard at Carlisle, Derby, and Reading respectively, from which the gradual increase will be seen:—

Description of Shedding.	Carlisle, 1880.	Derby, 1881.	Reading, 1882.
	Feet.	Feet.	Feet.
Ordinary	6,662	9,138	9 326
Machinery in motion ..	2 060	2,102	2,289
Side sheds	1,059	1,511	1,402
Total	2,781	12,751	13 017
Number of stands ..	270	377	391

The Reading Meeting is for the district comprising Berkshire, Cornwall, Devonshire, Dorsetshire, Hampshire, Kent, Somersetshire, Surrey, Sussex, and Wiltshire. As stated by us last week, the prizes offered this year are for (class 1) the most efficient and economical apparatus for excavating field drains; (class 2) the best cream separator driven by mechanical power; and (class 3) the best cream separator driven by manual or horse power. For each of these the Society's gold medal is offered. Money prizes of the values of £50, £25, and £105, are offered respectively for (class 4) the best milking machine, to be tested during six consecutive months of the spring, and summer of 1883; (class 5) the most efficient portable straw-compressing and binding machine, to be worked in conjunction with a thrashing machine; and (class 6) the most efficient and economical method of drying hay or corn crops artificially, either before or after being stacked. The prize of one hundred guineas for the best system of hay and corn drying is offered by Mr. Martin J. Sutton, of Reading, and is being keenly competed for during the present week, several competitors having entered the field. In class 1 there were two entries, but which were afterwards withdrawn. In classes 2 and 3 ten machines were entered by three exhibitors, two of which were withdrawn. Classes 4 and 5 have each one entry. The chief interest centres in class 6, and which interest was recently re-awakened at the Bath and West of England Show at Cardiff. In this class twelve systems of hay and corn drying have been entered by nine competitors, and these systems are being tried during the present week at Reading near the Whitley Manor Farm, where 97 acres of meadow grass were reserved for the trials, besides several acres of rye-grass. Most of the inventions under trial are based upon the Neilson system, which we recently described in connection with the Bath Show. The general view of the matter is that the Neilson system, pure and simple, is too expensive for general adoption, and the aim of the various inventors and adapters is so to modify the apparatus that the system of harvesting in the stack may be carried out cheaply. The Agricultural and Horticultural Association make two entries, one being a portable and the other a fixed system of drying in the stack. These systems are based upon Neilson's invention, the improvements effected having been patented by Mr. E. O. Greening and Mr. Barker, whose object has been to produce a system capable of being adopted by agriculturists, whether farming on a large or small scale. In the fan all straps and nearly all spur wheels are dispensed with, thus enabling the whole to be turned by a single shaft carrying one large driving wheel, by which the fan is rotated at a very high velocity by small friction pulleys. The driving wheel itself revolves at a very rapid rate, being impelled by a modification of the sun-and-planet motion, and the result of the combination is to obtain for the small fan a velocity equal to between 2000 and 3000 revolutions per minute, while the handles have only to be turned at the rate of 50 revolutions per minute. The system is provided with a thermometer marked with the points where the fan must be used for hay and for corn-drying respectively, and especially where danger of fire threatens. The fixed system is similar to the portable one, except that the fan is smaller. The Royal Agricultural Society are themselves the exhibitors of Mr. Neilson's fan. Messrs. R. A. Lister and Co., of Dursley, have their new exhaust fan, which is also on the Neilson system. It can be worked by two men, or is suitable for driving with horse-gear or steam or water power. The fan is composed wholly of iron, is mounted on four wheels and can be easily drawn about. Mr. James Coultas, of Spittlegate, Grantham, is also one of the competitors, with his apparatus for drying in the stack. It is mounted on travelling wheels, and has shafts suitable for moving from stack to stack. The system consists of a powerful exhaust fan driven at a high rate of speed by steam, horse-gear, or hand-power. Mr. W. A. Gibb's hay-drying apparatus, which we recently described, has been entered by Mr. W. W. Champion, the manager of the Reading sewage farm, who has had it under trial for some time past. Mr. Gibbs himself has entered two stack-drying fans, one for hand and the other for steam power. The other competitors are Mr. C. D. Phillips, of Newport; Mr. Bamlett, of Thirsk; Messrs. Robey and Co., of Lincoln; and Messrs. C. Kite and Co., of Charlton Street, Euston Road, all of whose systems will be described, and some of them illustrated by us next week. The trials of the cream separators are of interest, a considerable amount of ingenuity having been brought to bear on the question of separating the cream from the milk, and some very perfect machines having been brought out of late years. The duration of each trial was fixed at one hour. The separators in each class were tested simultaneously. They were all worked by the same shaft, the speed of which was kept as nearly as possible at 150 revolutions per minute, the exact speed being indicated by a speed indicator, and duly noted at regular intervals during the trials. In concluding this preliminary notice of the Reading Show, we append a list of the exhibitors of implements and machinery, reference being made to the numbers of their stands.

Stand. EXHIBITORS.

74 Anglo-American Tin Stamping Co., Mitton Stourport.
128 Atmospheric Churn Co., 119, New Bond Street, W.
195 Aveling and Porter, Rochester.
266 and 342 Agricultural and Horticultural Association, 3, Agar Strand, W.C.
151 Allan, J. D. and Sons, Dunkeld, N.B.
369 Ackerman, S. and Co., 131, King's Road, Reading.
165 Alexanders and Loveridge, Lion Works, Leominster.
228 Agricultural and General Engineering Co., 2, Walbrook, E.C.
221 Andrew, J. E. H. and Co., Stockport.
135 Alway, W. and Sons, 74, White Lion Street, Pentonville, N.
137 Arnold, Miss May, Launcelanl Wood, Brookwood, Surrey.
106 Aylesbury Dairy Co., 31, St. Petersburg Place W.
143 Appleby and Co., Renishaw Ironworks, Chesterfield.
162 and 231 Albion Ironworks Co., Rugeley.
38 Atkinson and Philipson, 27, Pilgrim Street, Newcastle-on-Tyne.
293 Ashby, Thomas and Sons, Aswell Ironworks, Louth.
77 Avery, W. and T., Digbeth, Birmingham.
96 and 251 Bradford, T. and Co., Crescent Ironworks, Salford, Manchester.
95 Bigg, Thomas, Leicester House, Great Dover Street, Borough, S.E.
286 Barrows and Stewart, Banbury.
205 Bamford, H. and Sons, Leighton Ironworks, Uttoxeter.
83 Baker, J., Falcon Works, Wisbech.
84 Bennett, Herbert George, Bracknell.
03 Bedford Ironworks Co., Bedford.
141 and 379 Baker, Thos. and Son, Compton, Berks.
35 Brown and May, North Wilts Foundry, Devizes.
106 Boby, Robt., St. Andrew's Works, Bury St. Edmund's.
97 and 219 Bellamy, J., Byng Street, Millwall, E.
270 Bruce, A. K., 7, Catherine Street, Strand, W.C.
214 Bristol Wagon Works Co., Bristol.
246 Bailey, W. H. and Co., Albion Iron Works, Salford, Manchester.
169 Barbidge, Thos. and Co., Union Foundry, Melksham, Wilts.
85 Balderstone, Wm. Hy., Radcliffe-on-Trent, Nottingham.
172 Bird, Fredk., and Co., 11, Great Castle Street, Regent Street, W.
58 Burney and Co., Millwall Docks, E.
197 and 224 Burrell, Chas. and Sons, St. Nicholas Works, Thetford.
27 Bligh, James and Son, Ramsgate.
26 Benison, Bros, Bedford Street, Leamington.
155 Bentall, E. H. and Co., Heybridge, Maldon, Essex.
278 Bartin, E. P. and Co., West Drayton, Uxbridge.
10 Ball, George, North Kilworth, Rugby.
32 Bligh, Bros., Canterbury.
157 Baker, Wm. B., Well Street Ironworks, Bedford.
311 Burca, Wm., Covent Garden Warehouses, James Street, W.C.
208 Bayliss, Jones, and Bayliss, Monmore Green, Wolverhampton.
148 and 236 Barford and Perkins, Peterborough.
187 Bamlett, A. C., Thirsk, Yorks.
263 Bagnall, W. G., Castle Engine Works, Stafford.
361 Bruce and Batho, 9, Victoria Chambers, Westminster.
214 Bateman, A. H., and Co., East Greenwich, S.E.
185 Brenton, Wm., Polbathic, St. Germans.

Stand. EXHIBITORS.

138 Bull, Alfd., 25, High Street, Guildford.
19 Ball, W., and Son, Rothwell, Kettering.
198 Clayton and Shuttleworth, Lincoln.
90 Cooch, Hy., Harlestone, Northampton.
12 Clay, Chas., the Standard Works, Wakefield.
144 Coleman and Morton, Chelmsford.
13 Croskill, W., and Sons, Beverley.
33 Cox, Edward, Sonning, Reading.
390 Centritugenbau-Actiengesellschaft, Steindamm, 2, Hamburg.
5 Cradock, George, and Co., Patent Wire Works, Wakefield.
140 Carson and Toone, Wiltshire Foundry, Warminster.
114 and 243 Cottrell and Co., Eddington Ironworks, Hungerford.
244 Clarke's Crank Co., Limited, Lincoln.
230 Corbett, S., and Son, Park Street Works, Wellington, Salop.
69 Cowley, J., and Son, Wednesbury Road, Walsall.
204 Cooke, jun., Lindum Plough Works, Lincoln.
56 Carling, Gill and Carling, High Street, Guildford.
296 Carter, J. Harrison, 82, Mark Lane, E.C.
281 Constantine, Thos. J., 61, Fleet Street, E.C.
260 Cochran and Co., Birkenhead.
150 Clark, R. A., Aigburth Vale, Liverpool.
113 and 245 Coultas, James, Grantham.
111 Cook, David J., High Street, Reading.
87 Corbett, Thos., Perseverance Ironworks, Shrewsbury.
163 and 229 Crowley, jun., and Co., Meadow Hall Ironworks, Sheffield.
294 Corcoran, Bryan, 31, Mark Lane, E.C.
62 and 382, Crump, H. S., Aloin Ironwoks, Gloucester.
223 Crossley Bros., Manchester.
176 and 377 Cornish, George, Bury St. Edmund's
124 Christy, Thos., and Co., 155, Fenchurch Street, E.C.
386a Champion, W. W., Whitley Manor Farm, Reading.
273 Deacon, Simeon, Kennet Ironworks, Reading.
207 Dennis, W. F., 101, Leodenhall Street, E.C.
163 Dening and Co., Crimchard Works, Chard.
262 Dodman, Alfred, Highgate Foundry, King's Lynn.
123 387 Dairy Supply Co., 28, Museum Street, Bloomsbury.
164 Doughty and Bradley, East Dereham.
108 Doulton and Co., Lambeth.
146 Davey, Sleep and Co., Excelsior Plough Works, St. Germans.
53 Davies, Jenkin, Englefield, Reading.
247 Deakin, Parker, and Co., Salford, Manchester.
333 Davis, Joseph, and Co., Fitzroy Works, Kennington Park Road, S.E.
44 Denton Henry, St. Peter's Works, Wolverhampton.
15 Decauville, Mons. 7, Idol Lane, Great Tower Street, E.C.
178 and 375 East Yorkshire Cart and Waggon Company, Beverley.
258 Eddington, W. S. and Co., 60, Queen Victoria Street, E.C.
134 Eddington, Benjamin, 2, Duke Street, London Bridge, S.E.
73 Fairbanks and Co., 108 Upper Thames Street, E.C.
102 Fison, C. O., Stowmarket.
1 Fowler, J., and Co., Leeds.
36 Fuller, S. and A., Kingsmead Street, Bath.
277 Fawcett, T. C., Burmantofts Foundry, Leeds.
257 Foster, Wm. and Co., Wellington Foundry, Leeds
304 Farrer, J. and Son, 52, Old Kent Road, S.E.
46 Follows and Bate, Dutton Street Works, Manchester.
47 Fussell, James, J. and J. Frome, Somerset.
256 Gibbons and Robinson, Wantage.
264 Gilkes, Gilbert and Co., Canal Iron Works, Kendal.
64 Gower, A. W. and Son, Hook Foundry, Winchfield, Hants.
59 Gibbons, Hy., Kenet Ironworks, Hungerford.
74 Gibbs, Wm. Alfd., Gillwell Park, Chingford.
106 Garrett, Richard, and Sons, Leiston Works, Suffolk.
295 Gardner, W., Gloucester.
45 Gilbert, W. Shippon, Abingdon
37 Gold, Hy., 82, Long Acre, W.C.
50 Gower, A. W., and Son, Britannia Works, Market Drayton.
127 Gee and Co., Gloucester.
25 Gold Bros., Windsor.
4 Glover, W., and Sons, Eagle Works Warwick.
192 Handyside, Andrew, and Co., Limited, Britannia Ironworks, Derby.
189 Hunt and Tawell, Earl's Colne, Halstead.
269 Humphries, Edward, Pershore.
370 Humphreys, J. C., 32, Albert Gate, S.W.
23 Hart, Samuel, 79, New Bond Street, W.
203 Hunter, Thos., Maybole, N.B.
385 Henson and Co., Brookside Ironworks, Derby.
388 Hald, D., and Co., 24, Great Winchester Street, E.C.
125 Hathaway, George, Chippenham.
177 and 376 Hill and Smith, Brierly Hill, Staffs.
248 Hayward, Tyler, and Co., 84, Upper Whitecross Street, E.C
355 Hepburn and Gale, 239, Long Lane, Southwark, S.E.
11 Hailstone, Cornelius, Reading Road, Basingstoke.
366 Horley, M. E. and E., Toddington, Dunstable.
21 Hayes and Sons, Stamford.
290 Hopkinson, Charles, Beehive Works, Retford.
91 Harrison, McGregor, and Co., Albion Ironworks, Leigh, Lancashire.
161 Holyoak, L., and Sons, Cosley, Leicester.
268 Hindley, E. S., Bourton, Dorset.
193 Holmes and Sons, Prospect Place Works, Norwich.
272 Hall, Charles Edward, engineer, Sheffield.
76 Hart, David, and Co., Wenlock Road, City Road, N.
276 Hempsted and Co., Phœnix Works, Grantham.
70 Hodd, R., and Son, 30, Hatton Garden, E.C.
3 Howard, J. and F., Brittannia Works, Bedford.
373 Howorth, James, Victoria Works, Farnworth, Bolton.
253 Hornsby, R., and Sons (Limited), Spittlegate Works, Grantham.
36 Howes and Sons, Chapel Field, Norwich.
129 Harrison, W. J., 208, Waterloo Road, Lambeth, S.E.
356 Harbord, Henry, Dockhead, S.E.
15 Hardy and Brittian, 54, Glover Street, Birmingham.
136 Hetley, Alfred, Sand Road Ironworks, Ampthill, Beds.

Stand. EXHIBITORS.

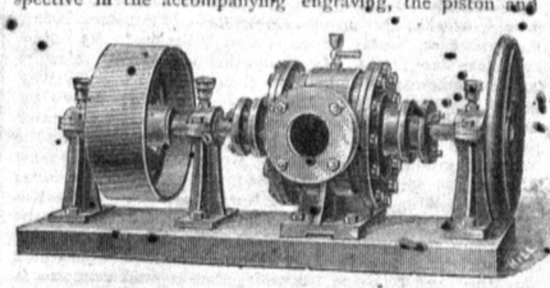
367 Helliwell, T. W., 8, Victoria Chambers, Westminster, S.W.
292 Herbert and Law, Heriotfield Works, Edinburgh.
383 Inman, Henry, Stretford, Manchester.
7 James, J., and Sons, Tivoli Works, Cheltenham.
202 Jack, Alexander, and Sons, Maybole, N.B.
186 Johnston Harvester Co., 1, Chiswell Street, E.C.
154 and 233 Jeffrey and Blackstone, Stamford.
35 King, Wm., Leighton Buzzard.
49 Kirkstall Forge Co., Kirkstall Forge, Leeds.
191 Keyworth, J. and H., and Co., 35, Tarleton Street, Liverpool.
182 King, W. and H., Newmarket, Stroud, Gloucestershire.
55 Knapp, Leonard R., Clanfield, Faringdon.
51 Kell, Meats, and Co., Gloucester.
184 Kite, C., and Co, 11, Charlton Street, Euston Road, N.W.
64 King and Co., 75, King's Road, Reading.
29 Kiddle, J. and J. T., Donhead St. Mary, Salisbury.
180 Kingsford Fairless and Co., Kingston-on-Thames.
93 Knight, E. M., 3, Victoria Street, Liverpool.
199 Kearsley, George, Ripon.
79 Larksworthy, J. L. and Co., Lowesmoor Ironworks, Worcester.
121 Lloyd, Lawrence and Co., 34, Worship Street, E.C.
267 Ladd, J. H., and Co., 116, Queen Victoria Street, E.C.
8 Loft, Thos., Meopham, Gravesend.
181 Lankester and Co., 228, Upper Thames Street, E.C.
117 Lyon, Arshur, 32, Windmill Street, Finsbury, E.C.
384 Lovegrove Hy., High Street, Slough.
112 Langley, T., and Son, King Street, King's Lynn.
120 Llewellyn, George and Son, Haverfordwest.
86 Lloyd, Thos. and Sons, 327, Old Street, E.C.
148 Lawrence and Co., 22, St. Mary Axe, E.C.
31 Lister, R. A. and Co., Victoria Ironworks, Dursley.
371 Matthews, John, Royal Pottery, Weston-super-Mare.
30 Marston, John, and Co., Bradford Street, Birmingham
34 Morgan and Co., 128, Long Acre, W.C.
240 Marshall, Sons, and Co., Britannia Ironwcrks, Gainsborough.
386 Main, A. J. and Co., 108, Queen Victoria Street, E.C.
19 Milford, T. and Son, Thorverton, Cullompton
265 Mather, George R., Albion Foundry, Wellingborough.
152 Murray, G. W. and Co., Banff Foundry, Banff, N.B.
259 Maynard, Robert, Whittlesford Works, Cambridge.
261 McLaren, J. and H., Midland Engine Works, Leeds.
145 Maldon Ironworks Co., Maldon.
41 Mackie, J. and J., and Co., Berks Ironworks, Reading.
158 Murton and Turner, Giltcross Ironworks, Kennington Hall, Thetford.
372 Major, H. J. and C., West Quay, Bridgwater.
299 Morris and Griffin, Wolverhampton.
100 Margrett, Edward, King Street, Reading.
271 Marsden, R. H., Leeds.
99 Moule's Patent Earth Closet Co., 5a, Garrick Street, Covent Garden, W.C.
209 and 365 Morton, Francis, and Co., Naylor Street Ironworks, Liverpool.
222 Muller, H. L., 22, Mary Anne Street, Birmingham.
288 McKenzie and Sons, Camden Quay, Cork.
67 Messer and Co., Reading.
282 Newton, Chambers and Co
357 Norris, S. E., and Co., Shadwell, E.
234 Nalder and Nalder, Challon Ironworks, Wantage.
155 and 232 Nicholson, W. N., and Son, Trent Ironworks, Newark-on-Trent.
60 Nottingham Malleable Iron Co., Kirke White Street, Nottingham.
331 Neighbour, G., and Son's, 149, Regent Street, W.
136 Nyrop, J. E., Blegdamsveien, No. 14, Copenhagen.
20 Osmond, Stephen Thomas, Newtown Foundry, Ramsbury, Wilts.
287 Oldham and Booth, 14, Trippett, Kingston-upon-Hull.
173 Penney and Co., Limited, 6, Broad Gate, Lincoln.
98 Plimpton, J. C., and Co., 55, South John Street, Liverpool.
132 Piggott Brothers, Bishopgate Without, E.C.
227 Proctor and Co., Stevenage.
114 and 242 Perkins, Paternoster, and Burlinghani, Hitchin.
275 Pinfold, J. D., Rugby.
159 Page, E., and Co., Victoria Ironworks, Bedford.
131 and 241 Picksley, Sims and Co., Bedford Foundry, Leigh, Lancashire.
57 Powell, Bros., and Whitaker, Cambrian Ironworks, Wrexham.
216 Powis, Charles and Co., 60, Gracechurch Street, E.C.
283 Phillips, Chas. D., Newport, Mon.
110 Purser, G. and W., Trafalgar Works, Birmingham.
368 Priestman Bros., Holderness Foundry, Hull.
359 Prellers Leather Co., 57, Lant Street, Southwark, S.E.
133 Peck, J. H., and Co., Wigan.
107 Pierce, A. E., 63, New Oxford Street, W.
175 and 375 Perkins and Bellamy, Ross, Herefordshire.
170 and 226 Richmond and Chandler, Manchester.
81 Riches and Watts, Norwich.
364 Rendle, W. E., and Co., 3, Westminster Chambers, Victoria Street, S.W.
72 Rollins, J. G., and Co., Old Swan Wharf, London Bridge, E.C.
254 Robey and Co., Globe Works, Lincoln.
2 Ruston, Proctor and Co., Sheaf Ironworks, Lincoln.
362 Richardson, W., and Co., Darlington.
78 Robinson, John, King Charles Croft, Leeds,
52 Reeves, R. and J., and Son, Bratton Ironworks, Westbury, Wilts.
126 Richardson, Edmund, High Gate, Kendal.
71 Reid, Ben and Co., Bon Accord Works, Aberdeen.
279 Reynolds, F. W., and Co., Acorn Works, Edward Street, Blackfriars Road, S.E.
285 Rhodes, J., and Sons, Grove Ironworks, Wakefield.
144 and 239 Reading Ironworks Co., Reading.
190 Ransome, S. and E., and Co., 10, Essex Street, Strand, W.C.
104 Roberts, Chas Gay, Collards, Haselmere.
28 Roberts, John and Sons, Bridgwater.

Stand. EXHIBITORS.

119 Robinson, Edmund, 17, King Street, Penrith.
68 Ridley, Wm. and Sons, Reading.
6 Randell, F. and H., St. Nicholas Works, North Walsham.
194 Ransomes, Head, and Jefferies, Orwell Works, Ipswich.
66 Rainforth, W. and Sons, Brittania Ironworks, Lincoln.
391 Royal Agricultural Society of England.
54 Spear and Jackson, Etna Works, Sheffield.
168 Smith, Wm, and Son, Kettering.
116 Sharman and Ladbury, Melton Mowbray.
200 Smyth, James, and Sons, Peasenhall, Suffolk.
160 Stacey, George, and Sons, High Street, Uxbridge.
88 Summerscales, W., and Sons, Couly Lane Mills, Keighley.
297 Schaffer and Budenberg, 1, Southgate, St. Mary's Street, Manchester.
84 Stubbs, W. B., Hawksworth, Bingham.
171 and 225 Samuelson and Co., Britannia Works, Banbury.
183 Skurray's Edge Tool Co., Railway Works, Chippenham.
101 Stenson and Co., Northampton.
213 Standard Emery Wheel Co., Greek Street, Soho, W.
353 Staynes and Sons, 60, High Street, Leicester.
266 Spencer and Gillett, Melksham Foundry, Wilts.
82 Shield and Crokett, 25, Wollaton Street, Nottingham.
201 Smith and Grace, Thrapston.
218 Sun Auto-Pneumatic Lighting Co., 115, Southwark Street, S.E.
18 Stone, J. S., Dack Street Works, Newport, Mon.
11 Sherwin, G. E., Alma Street, Birmingham.
220 Turner Gas Engine Co., St. Alban's.
219 Thompson, Sterne and Co., Crown Ironworks, North Woodside Road, Glasgow.
22 Thorn, Charles, St. Giles Gate, Norwich.
215 Taylor, Richard W., Bury St. Edmund's.
149 Thomas, Edward and Co., Oswestry.
147 and 237 Tasker, W., and Sons, Waterloo Ironworks, Andover.
255 Tuxford and Sons, Boston.
130 and 389 Thomas and Taylor, 89, Lower Hillgate, Stockport.
80 Turner, E. R. and F., St. Peter's Ironworks Ipswich.
75 Turner and Son, 49A, Friar Street, Reading.
106 Vipan and Headly, Church Gate Works Leicester.
250 Victoria Foundry Co., Newark-on-Trent.
17 Vincent, Wm., Arborfield, Reading.
274 Whitehead, J. and Co., Albert Works Preston.
358 Webb and Son, Combo Tannery, Stowmarket.
284 Watson and Haig, Acre Ironworks, Andover.
188 Wood, Walter A. 36, Workship Street, E.C.
142 and 238 Wallis and Stevens, North Hants Ironworks, Basingstoke.
217 Wurr, H. and Co., 8, Blomfield Street, London Wall, E.C.
354 Wilcox, W. H. and Co., 36, Southwark Street, S.E.
298 Wilkinson, Heywood, and Clark, 7, Caledonian Road, N.
122 Waide Wm., 3, South Brook Street, Hounslow Lane, Leeds.
40 Windover, C. S., and Co., 32, Long Acre, W.C.
92 Wilder, John, Yield Hall Foundry, Reading.
280 Williams, T. C., and Sons, London Street, Reading.
42 and 380 Wilder, R. J. and H., Wallingford.
289 Woods and Long, Stowmarket.
352 White, Joseph, and Co., 95, Trinity Square, Southwark, S.E.
43 Walker, Francis, Tithby, Bingham.
167 Williams, John and Son, Rhuddlan, Rhyl.
109 Warmsley and Co., Bangor Wharf, Kings Road, Reading.
89 Whalley, Smith and Paget, Parker Street Ironworks, Keighley.
252 Walworth, James, and Co., Lister Mills, Bradford.
303 Wright and Holmes, 333, Moseley Road, Birmingham.
9 Woolnough, W. C., and Co., Ceres Ironworks, Kingston-on-Thames.
291 Welman, James, East Street, Poole, Dorset.

MARTIN'S ROTARY PUMP.

IN our notice of the Bath Show at Cardiff we referred to an ingenious and effective rotary combined pump and engine, the invention of Mr. J. R. Martin which we found at the stand of Mr. James Sinclair, of 104, Leadenhall Street, London. In this pump, which we illustrate in perspective in the accompanying engraving, the piston and



cylinder have no eccentric or cam motion whatever, all the working parts run round a centre of their own and are not guided by any stud or groove in the cam or cover. The elastic bearing of the piston is maintained entirely by the elasticity of two steel rings which are in the body of the piston, just as they are in the ordinary piston of the steam engine. The difference is that the rings are made to revolve in the cylinder of the pump and engine, and to maintain the elastic bearing against the cylinder instead of pushing the piston from one end of the cylinder to the other, as in the steam engine. At the same time the rings do not bear against the cylinder, and they can be taken out and expanded and replaced in a few minutes; and the engine or pump can be started, stopped and reversed instantly. It will be seen that the pump is of very simple construction, there being no cams or irregular parts to produce unnecessary wear and friction, whilst of its efficiency we had ample proof at the Cardiff Show. We may add that the pump is already in use for a variety of purposes, and is very well spoken of by users.

THE CONSUMPTION AND ECONOMY OF FUEL IN THE IRON AND STEEL MANUFACTURE.*

By Mr. J. S. Jeans, London.

(*Concluded from page* 492, Vol. xix.)

III. Bessemer and Open-hearth Steel.—It is now a matter of common knowledge that the introduction of the Bessemer and Siemens processes of steel manufacture has induced a remarkable economy of fuel. When our esteemed past president, Sir Henry Bessemer, made his first public announcement of his process in 1856, he described it as the "manufacture of iron and steel without fuel." But while the ingots are made without other fuel than that used to raise the blast, there is in this latter process, and in the subsequent treatment of the ingots, a consumption of coal which, although trifling by comparison with that which would have been required in the production of finished iron or crucible steel by the old process, is yet, in the aggregate, very considerable. Returns with which I have been favoured from a number of firms engaged in the manufacture of Bessemer steel would seem to show that the consumption of coal per ton of finished steel varies from 13 cwt. in works where the process is carried on in connection with blast-furnaces, to 16 cwt. in works where the metal has to be charged cold into the cupolas. In the United Kingdom there are now sixteen Bessemer plants in operation without auxiliary blast-furnaces, while twelve other Bessemer works are carried on alongside the furnaces that provide them with pig-iron. The latter produced during last year 954,000 tons, and the former 487,719 tons of ingots. Deducting from these quantities 10 per cent. for waste, we have:—

Tons.	Coal per ton.	Tons.
854,000	at 13 cwt. making	555,100
838,948	,, 16 ,, ,,	351,158
	Total	906,258

These figures are under rather than over the average. In many works the consumption per ton of finished steel takes a higher range than the highest of these averages. In one of the largest Bessemer works on the Continent, whence I have obtained some details, the average consumption of coal over several months' working has been—In making the ingots, 189 kilos. of coke; in raising steam in boilers, 202 kilos. of coal; in reheating the ingots, 191 kilos. of coal; in raising steam for mills, &c., 165 kilos. of coal. If we convert the coke into coal at 60 per cent., this will be just about equal to 17½ cwt. of coal per ton of finished steel. In other works that I have heard of, the average is even higher. Even in works where the iron is taken direct from the blast-furnace the consumption of coal rises to 16 and 17 cwt. per ton of finished steel. One such works I know of, producing over 100,000 tons of rails per annum, where the consumption is quite that amount, but this is owing to the fact that a large proportion of the rails made are of light section, and hence require to be cogged, while heavy rails can be rolled off direct from the ingots. If due credit is taken for this difference, a consumption of 16 cwt. of coal in rolling heavy rails may be regarded almost as the equivalent of 10 to 11 cwt. in rails of very light section. The total quantity of fuel employed in the Bessemer and open-hearth steel works of the United States in the Census year 1880 was:—

Anthracite coal	140,458 tons.
Bituminous coal	465,655 ,,
Coke (as coal)	174,966 ,,
Total	781,079 tons.

The total production of finished Bessemer and open-hearth steel for the same year was 983,039 tons, so that the average consumption of coal per ton of finished steel was 15·8 cwt. The total quantity of Bessemer and open heath steel made in the United Kingdom during 1881 was 1,779,719 tons. To have produced this by the old crucible process, assuming the moderate expenditure of four tons of coals per ton of steel, would have required a consumption of 7,118,876 tons of fuel. But the actual consumption, assuming an average of 10 cwt. of coal per ton of ingots over the whole, has only been 889,000 tons of coal, so that there has been an economy, as compared with the old process, of 6,229,000 tons. It will not be questioned that much of the expenditure of fuel now incurred in the working of Bessemer plant might be economised. Mr. Holley showed that the cost of the coal required to drive the machinery of an average American Bessemer plant averaged about 1⅓ dol. per ton of ingots, while an equally large expenditure of coal is called for in respect of the rail and blooming mills. With better steam-engines he calculated that a third of this cost could easily be saved, and such a saving would represent an economy of nearly 300,000 dols. a year on the present output. The Troy steel rail-mill engine, for example, with a 54-inch cylinder, was superseded by a 44-inch Corliss engine, and an economy of 25,000 dols. a year in fuel was the result. In the manufacture of Siemens steel the consumption of coal varies quite as much as in any of the other departments of the iron trade that we have considered already. At one works I find it to be only 12 cwt. per ton of ingots, at another 15 cwt., and at another 16½ cwt., the coal in the latter case being, however, very inferior. At one of the most important open-hearth works in England the average consumption of coal is as under:—

	Cwt.	qrs.	lbs.
Coal used per ton of ingots	12	0	15
,, ,, plates	—		
,, ,, for furnaces and producers	17	0	1
,, ,, ,, raising steam	17	0	3
Total	46	0	19

A considerable quantity of open-hearth steel is, however, worked up into rails and other manufactures, in respect of which the consumption of fuel will be less than that here shown, and probably, if the average coal used is put at 2 tons per ton of finished steel, it will not be much beyond the mark.

Crucible Steel.—The use of the Siemens regenerative gas-furnace enables a ton of crucible steel to be melted with an expenditure of only 1⅓ tons of coal, as against 2½ tons of coke in the ordinary furnace. There are no statistics of our total production of crucible steel available. A gentleman who is entitled to speak with some authority has put it at 20,000 tons. Of this quantity, however, only 3500 tons were produced by the regenerative furnace in 1881, in respect of which there would, of course, be a saving of over 9000 tons of coal, as compared with the old form of furnace. This saving is clearly not sufficient to induce many manufacturers to substitute the new system for the old, the first cost of the former, and the rearrangement of plant which it would involve, not to speak of prejudices that may be well or ill founded, leading many manufacturers to forego the advantages manifestly resulting from the adoption of the Siemens furnace, and inducing an expenditure of at least 60,000 tons of coal per annum, which is wholly uncalled for. In the manufacture of crucible steel in the United States, the total quantity of coal consumed in 1880 was 303,017 tons; and as the production of such steel was 70,319 tons, the average consumption of coal per ton of steel made was 4·2 tons. In addition to the mineral fuel here shown, 66,000 bushels of charcoal were consumed; but this is too small an item to disturb the average in any material degree.

IV. Castings, &c.—It is quite impossible to determine with anything like precision the annual production of castings in the United Kingdom, but it may be assumed to be about a million tons, this being a figure arrived at afte calculating the quantities of iron used in respect of other purposes. The quantity of fuel used for foundry work is very small by comparison with that employed in other departments of the trade. In one large foundry, of which I have obtained particulars, it is about 2 cwt. of coke per ton of good castings, with an additional 40 lb. of coal for raising steam. The average will, however, in all probability, be higher than this; and if it is put at 4 cwt. of coal per ton of castings, it will not be likely to exceed the mark. On this basis of estimation, the total consumption of coal for foundry purposes may be taken at 200,000 tons. This quantity is so relatively small—about 0·6 per cent. of the whole coal used in ironmaking—that its influence upon the question of fuel economy may be regarded as almost inappreciable.

V. Tinplates.—In the manufacture of tinplates, considered apart from that of manufactured iron proper, there is a large and increasing consumption of coal. My friend Mr. Strick informs me that the average quantity of coal consumed in heating and annealing furnaces is, as nearly as possible, 15 cwt. to the ton of tinplates. "It is not," he adds, "so easy to estimate the quantity consumed under boilers, some works—those erected within the last five or six years—being supplied with better constructed engines than the older works, and the consumption of fuel will therefore vary as much as in the proportion of two to one. Other works, again, which have forges combined with tinplate works, are so arranged as to draw a considerable supply of steam from boilers erected in conjunction with their puddling and balling furnaces. I don't, however, think you will be far wrong if you take an average of 18 cwt. of coal per ton, giving 18 + 15 = 33 cwt. coal per ton of tinplates, and assuming the present annual output to be 350,000 tons, the consumption of coal will be about 577,500 tons."

Table A.—Statement *showing the Production of Pig-iron, &c., and Coal used in its Manufacture, from* 1855 *to* 1881, *on the Basis of Computation adopted by the Royal Coal Commission.*

Year.	Pig-iron Produced.	Pig-iron left for Conversion into Rolled Iron and Steel, &c.	Coal used in the Manufacture of Pig-iron, at 3 tons per ton of Pig-iron.	Coal used in the Conversion of Pig-iron at 3 tons 7 cwt.	Total Coal used in the Iron and Steel Manufacture.
	Tons.	Tons.	Tons.	Tons.	Tons.
1855	3,218,154	2,926,378	9,654,462	9,803,366	19,457,828
1856	3,586,377	3,229,051	10,759,131	10,802,370	21,561,501
1857	3,659,447	3,237,361	10,978,341	10,845,159	21,820,500
1858	3,456,064	3,092,921	10,368,192	10,361,285	20,729,477
1859	3,712,904	3,396,528	11,138,712	11,378,368	22,517,080
1860	3,826,752	3,484,186	11,480,256	11,672,023	23,152,279
1861	3,712,390	3,324,356	11,137,170	11,137,592	22,273,762
1862	3,943,469	3,499,015	11,830,407	11,721,700	23,552,107
1863	4,510,040	4,024,765	13,530,120	13,482,962	27,013,082
1864	4,767,951	4,301,966	14,303,853	14,411,586	28,715,439
1865	4,819,254	4,276,236	14,457,762	14,325,390	28,783,052
1866	4,523,897	4,026,759	13,571,691	13,489,647	27,061,338
1867	4,761,023	4,193,704	14,283,069	14,048,908	28,331,977
1868	4,970,206	4,415,186	14,910,618	14,790,873	29,701,491
1869	5,445,757	4,734,145	16,347,371	15,859,335	32,207,706
1870	5,963,515	5,210,176	17,890,545	17,454,089	35,344,634
1871	6,627,179	5,566,175	19,881,537	18,646,686	38,528,223
1872	6,741,929	5,410,786	20,225,787	18,126,131	38,351,918
1873	6,566,451	5,424,386	19,699,353	18,171,691	34,871,044
1874	5,991,408	5,217,128	17,974,224	17,477,378	35,451,602
1875	6,365,462	5,418,235	19,096,386	18,151,087	37,247,473
1876	6,555,997	5,645,992	19,667,991	18,914,071	38,582,062
1877	6,608,664	5,727,222	19,825,992	19,186,193	39,012,185
1878	6,300,000	5,375,354	18,900,000	18,007,435	36,907,435
1879	6,009,434	4,785,998	18,028,304	16,033,093	34,061,395
1880	7,721,833	6,090,204	23,165,499	20,402,183	43,567,682
1881	8,377,364	6,897,168	25,131,992	23,105,512	48,237,504
Totals ..	143,736,921	122,931,401	428,258,763	411,805,113	836,844,776
Av. per Annum	15,286,552	4,553,014	15,861,435	15,252,041	30,994,250

Table B.—*Table showing the Relative Quantities and Percentages of Coal used in the Iron Trade of Great Britain, on Basis of Computation adopted by the Royal Coal Commission of* 1869 *and the Select Committee of* 1873.

Year.	Quantity of Coal Raised.	Pig Iron Made.	Total Coal Used in Iron Manufacture.	Total Home Consumption, deducting Exports of Coal.	Percentage of Home Consumption of Coal used in Iron Manufacture.
	Tons.	Tons.	Tons.	Tons.	
1855	64,307,459	3,218,154	19,457,828	59,330,557	32
1856	66,508,815	3,586,377	21,561,501	60,626,036	35
1857	65,274,047	3,659,447	21,823,500	58,536,329	37
1858	64,887,869	3,456,064	20,729,477	58,358,416	35
1859	71,859,465	3,712,904	22,517,080	64,852,516	34
1860	79,923,273	3,826,752	23,152,279	72,601,441	31
1861	85,512,144	3,712,390	22,273,762	77,657,029	28
1862	83,510,838	3,943,469	23,552,107	75,202,986	31
1863	88,165,465	4,510,040	27,013,082	79,890,253	33
1864	92,662,873	4,767,951	28,715,439	83,852,965	34
1865	98,150,587	4,819,254	28,783,052	88,980,110	33
1866	101,506,794	4,523,897	27,061,338	92,139,045	29
1867	104,375,480	4,761,023	28,331,977	94,614,153	29
1868	103,014,207	4,970,206	29,7[illegible]491	62,516,396	32
1869	107,299,634	5,445,757	32,207,706	97,066,499	33
1870	110,431,193	5,963,515	35,344,634	98,728,543	35
1871	117,352,026	6,627,179	38,528,223	104,604,037	36
1872	123,497,316	6,741,929	38,351,918	110,298,822	34
1873	127,016,747	6,566,451	34,871,044	114,399,181	30
1874	125,067,916	5,991,408	35,451,602	111,140,711	31
1875	131,867,105	6,365,462	37,247,473	117,322,189	31
1876	133,344,766	6,555,997	38,582,062	117,045,689	32
1877	134,610,763	6,608,664	39,012,185	119,190,713	32
1878	132,654,887	6,300,000	36,907,435	117,160,254	31
1879	134,008,228	6,009,434	34,061,395	117,565,932	28
1880	146,818,622	7,711,833	43,567,682	128,108,651	34
1881	154,184,300	8,377,364	48,237,504	134,592,702	35

* Read at the Spring Meeting of the Iron and Steel Institute, 1882.

TABLE C.—*Actual Consumption of Coal in the Pig-iron Manufacture of Great Britain from 1874 to 1881.*

Year.	Average Consumption of Coal per ton of Pig Iron.		Total Production of Pig Iron.	Total Quantity of Coal Consumed in Production of Pig Iron.	Quantity of Coal saved on the calculated Average Consumption of 1872 and Preceding Years.
	Tons.	Cwt.	Tons.	Tons.	Tons.
1874	2	14	5,991,408	16,176,796	1,797,428
1875	2	9	6,365,462	15,595,381	3,501,005
1876	2	8	6,555,997	15,734,386	3,933,605
1877	2	6	6,608,664	15,199,924	4,626,068
1878	2	4	6,300,000	13,860,000	5,040,000
1879	2	3	6,009,434	12,920,283	5,108,021
1880	2	3	7,721,833	16,682,629	6,563,559
1881	2	3	8,377,364	18,011,332	7,120,660
Totals			53,930,162	124,100,042	37,690,346
Average	2	7·2	6,741,270	15,512,505	4,711,293

TABLE D.—*Statement showing the Consumption of Coal in the Bessemer Steel Manufacture from 1872 to 1881, at 15 cwt. to the Ton of Finished Steel with Economy as Compared with Rolled Iron.*

Year.	Production of Bessemer Steel Ingots.	Quantity of Coal used at 15 cwt. to the Ton.	Quantity of Coal that would have been required to Produce the like Weight of Finished Iron at 3 Tons.	Resulting Economy of Coal.
	Tons.	Tons.	Tons.	Tons.
1872	410,000*	307,500	1,430,000	922,500
1873	496,000*	372,000	1,488,000	1,116,000
1874	540,000*	405,000	1,620,000	1,215,000
1875	620,000*	465,000	1,860,000	1,395,000
1876	700,000	525,000	2,100,000	1,575,000
1877	750,000	562,500	2,250,000	1,687,500
1878	807,527	605,643	2,422,581	1,816,938
1879	834,511	625,881	2,503,533	1,877,652
1880	1,044,382	783,285	3,133,146	2,349,861
1881	1,441,719	1,081,287	4,325,157	3,243,870
Totals	7,644,139	5,733,096	22,934,417	17,199,321
Average	764,213	573,309	2,293,241	1,719,932

* Estimated.

TABLE E.—*Details of Fuel Consumption at various Blast Furnaces, from 1820 to 1881.*

Year.	Works.	Fuel.	Consumption of Fuel per Ton of Pig Iron. Ton.	cwt.	qrs.	Nature of Iron made.	Blast.	Authority.
1820	Hartz.	Charcoal.	0	18	0	White.	Hot.	Grüner.
1850	Cleveland.	Coke.	1	15	0	Grey.	,,	,,
1857	Pouzin.	,,	1	4	0	Mottled.	,,	,,
1861	Low Moor.	,,	0	17	6	White.	,,	,,
,,	Thornaby.	,,	1	9	0	Nos. 3, 4.	,,	,,
1862	Pollonica.	Charcoal.	1	0	6	,,	,,	,,
,,	Gartsherrie.	Raw coal.	2	6	0	—	Cold.	,,
1864	South Bank.	Coke.	0	17	6	White.	Hot.	,,
1867	Ormesby.	,,	1	2	0	Grey.	,,	,,
1869	Dowlais.	Raw coal and coke.	1	18	0	,,	,,	,,
,,	Pennsylvania.	Anthracite.	1	10	0	Mottled.	,,	,,
1870	Ottange.	Coke.	1	7	0	Foundry.	,,	,,
,,	Ars-sur-Moselle.	,,	1	18	0	White.	,,	,,
1871	Heft.	,,	1	0	0	Nos. 1, 2.	,,	,,
1873	Longwy.	,,	1	7	0	White.	,,	,,
,,	Prävali.	,,	1	3	0	,,	,,	,,
1875	Vordenberg.	Charcoal.	0	13	0	,,	,,	,,
,,	Trofayach.	,,	0	13	0	,,	,,	Tunner.
,,	Hieflau.	,,	0	13	0	,,	,,	,,
,,	Neuberg.	,,	0	13	3	,,	,,	,,
,,	Treibach.	,,	1	0	0	Grey.	,,	,,
1878	St. Louis.	Coke.	0	18	0	,,	,,	,,
,,	,,	,,	*1	5	9	,,	,,	Jordan.
1880	Barrow.	,,	*1	2	0	Forge.	,,	J. T. Smith.
,,	Cleveland.	,,	1	2½	0	Hematite.	,,	E. W. Richards.
1879	Ilsede.	,,	0	19	0	,,	,,	J. Schlink.
,,	,,	,,	0	18¾	0	Manganiferous.	,,	,,
1880	Consett.	,,	0	19⅔	0	White forge.	,,	E. W. Richards.
,,	,,	,,	0	19¼	0	Hematite.	,,	,,
,,	Edgar-Thomson.	,,	1	5	0	,,	,,	Captain Jones.
,,	W. Cumberland.	,,	1	3	11.	,,	,,	G. J. Snelus.
1881	Bochum.	,,	0	19	0	,,	,,	Bochum Co.
,,	Hoerde.	,,	0	19	0	White forge.	,,	J. Massenez.
,,	,,	,,	1	6⅗	0	Grey.	,,	,,
,,	Witkowitz.	,,	1	4⅗	0	Bessemer.	,,	P. Kupelwieser.
,,	,,	,,	1	2⅓	0	Forge.	,,	,,
,,	,,	,,	1	8	0	Foundry.	,,	,,
,,	,,	,,	1	6	0	Spiegel.	,,	,,

* These are furnaces on Buttgenbach's system, as described in the *Journal*, ii., 873.

VI. FORGINGS, &c.—The production of forgings has within the last few years, in consequence of the advance in railways, shipbuilding, &c., been very greatly extended. In ordinary iron vessels, the weight of forgings required per gross 1000 tons is about 30 tons; and as the new shipping constructed last year in the United Kingdom exceeded a million tons, the total weight of the forgings required for new ships alone may be taken at 30,000 tons. This, however, is only a part of the total annual production of forgings, which, on the best data available, I should be disposed to put at 65,000 tons. In several large works that I know of, the coal used per ton of finished forgings averages about seven tons, so that the aggregate annual consumption of coal for the purpose will be about 455,000 tons.

VII. SHIPBUILDING.—In the manipulation of plates and angles, and in raising steam in our shipbuilding yards, there is a large consumption of fuel, which within recent years has been greatly on the increase. There may be a difference of opinion as to whether shipbuilding can claim to be regarded as a department of the iron trade, and therefore as to whether it ought to come within the scope of this paper; but in view of the fact that quite 80 per cent. of the coal consumed in our shipbuilding yards is used in the treatment of iron and steel, such a doubt would seem to settle itself. I am indebted to Mr. William Denny, of Dumbarton, for the following statement of the ratio consumed to the shipbuilding tonnage launched in his works during the last seven years:—

Consumption of Coal per Ton Gross Register.

Year.	Triping.	Smithy.	Total Coals.	Aggregate Gross Tonnage.	Percentage of Coals to Tonnage.
1875	3,548	1,288	4,836	17,391	28·131
1876	3,979	639	4,618	4,394	105·098
1877	4,503	1,066	5,569	10,533	52·872
1878	5,640	1,365	7,005	22,049	31·770
1879	6,356*	1,674	8,030	16,236	49·456
8880	6,831	1,417	8,248	18,112	45·533
1881	6,985	1,525	8,510	17,478	48·689
	37,342	8,974	46,816	105,993	44·169

* Includes 500 tons of dross.

It will be observed that the percentage of the coal consumed to the tonnage launched varied from 28·13 to 105·09, the mean of the whole seven years being 44·169. But it would be too much to expect that all shipbuilding yards are managed with the same efficiency and regard to economy as Mr. Denny's, and it will therefore probably be safe to take the ratio as 50 per cent., instead of 44. Applying this figure to the 1,013,208 tons of shipbuilding ascertained by the British Iron Trade Association to have been launched in 1881, we have an aggregate of 506,604 tons as the consumption of coal in shipbuilding.

VIII. MISCELLANEOUS MANUFACTURES IN IRON.—If we examine the statistics of the production of manufactured iron, as given in the Report of the British Iron Trade Association, it appears that of the 2,681,000 tons of puddled iron made in 1881, 770,000 tons took the form of rails, plates, angles and no further expenditure of coal beyond that already accounted for will take place upon this quantity. But there still remains 1,902,000 tons to undergo subsequent treatment in one way or another—sheets in the processes of corrugation, &c., nail rods in the manufacture of nails, wire rods in the production of wire, and bar iron in the multitudinous uses to which it is applied. In these various departments of the iron industry the consumption of coal must necessarily be very largely a matter of conjecture; but after considering the whole subject, I have come to the conclusion that 4,200,000 tons will be a figure not far wide of the actual truth, while in respect of the construction of boilers, engines and machinery, the work done iron will represent at least a million tons more.

RECAPITULATION.—*En resumé*, we have the following figures:—

Consumption of Coal in the Manufacture, &c., of Iron and Steel in 1881.

	Tons.
In the manufacture of pig-iron ..	18,011,000
,, ,, finished iron ..	8,443,000
,, ,, Bessemer steel	906,000
,, ,, open-hearth steel ..	276,000
,, ,, crucible steel	100,000
,, ,, foundry castings ..	200,000
,, ,, tin plates ..	577,000
,, ,, forgings ..	455,000
In the treatment of plates, &c., for shipbuilding ..	506,000
Used in the manufacture of tuyeres, axles, rivets, bolts, armour plates, wire, and other articles ..	4,200,000
In the manufacture of boilers, engines and machinery ..	1,000,000
Total ..	34,674,000

This figure represents 22 per cent. of the whole quantity of coal raised in the United Kingdom in 1881. The Royal Coal Commissioners of 1869 calculated that the total quantity of coal used in the manufacture of iron in that year was 32,207,000 tons, which was 30 per cent. of the whole quantity raised. Assuming the accuracy of these figures, it is clear that the iron trade takes 8 per cent. less of our coal output now than it did a few years ago, and that the recent astonishing progress of the coal industry has not been effected by the decreased demands of the iron trade to anything like the extent that it would have been even in 1869. We have already seen that if the consumption of coal had proceeded *pâri passu* with the production of iron since 1870 the total quantity used last year, instead of being 34,674,000 tons, would have been 48,237,000 tons. The main items of this difference may be thus stated:—

	Tons of coal.
Saved in the manufacture of pig-iron ..	7,121,000
Saved by the substitution of Bessemer steel for manufactured iron ..	4,390,000
Saved by the substitution of open-hearth steel for manufactured iron ..	338,000
Saved by the use of the use of the regenerative furnace in the manufacture of crucible steel	10,000
Total ..	11,859,000

It will, I believe, be admitted that an annual economy of twelve million tons of coal within twelve years, is not a result of which metallurgists and manufacturers have much cause to be ashamed. But it has been made abundantly clear in the course of this paper that much yet remains to be done. When we see such variations in the average consumption of coal in blast-furnaces, smelting the same ores and making the same quality of iron, it is clear that there must be unnecessary leakage somewhere. The saving of only 1 cwt. of coal per ton of iron smelted in the United Kingdom would represent an annual economy of about 420,000 tons. In the finished-iron industry, there is nearly as much avoidable waste of fuel as ever; but there is some reason to believe that this will diminish year by year owing to circumstances which manufacturers themselves will be powerless to control; and it may be interesting to some who are anticipating the ultimate adoption of steel for all purposes in respect of which puddled iron still continues to be used, to know that if this were now an accomplished fact, there would be a further economy of coal to the extent of at least 6,000,000 tons. In tables C and D in the appendix, it is shown that the saving in the consumption of coal, since 1874, in the pig-iron manufacture of this country alone, has been 37,690,000 tons, or an average of 4,711,293 tons per annum, which, if we assume an average value of only 6s. per ton, represents an economy of not less than £11,000,000. By the substitution of Bessemer steel for manufactured iron, there has been a further economy of 17,199 321 tons of coal, representing, on the same basis of value, a further sum of £5,159,000, making together a grand total of £16,159,000. It may, perhaps, be regarded as still too soon to consider with great seriousness the problem of the duration of our available supplies of fuel in relation to our ironmaking requirements. But there are districts in which that problem seems already to press for solution. In South Staffordshire the best seams of coal are very rapidly being exhausted, and the duration of the total quantity still left for use will not at the present rate of consumption exceed 200 years. In the Durham coalfield the available supplies of coking coal are being depleted at a still more alarming rate. The original area of the section of that field which yields the well-known coking coal was only about 253 square miles. Five years ago it was calculated by a member of this Institute,* who is in a position to speak with authority, that at the then rate of exhaustion—about 4½ million tons per annum—there remained sufficient for the requirements of 125 years. But since that time our production of pig-iron has increased by 28 per cent., and if the same rate of increase is continued over the next fifteen years, the duration of the available supply of Durham coke will probably be reduced to the more measurable distance of less than fifty years.

* Mr. A. L. Steavenson on "The Coke Manufacture of South Durham," *Journal*, ii. 1877.

CONTENTS.

TO READERS AND CORRESPONDENTS.

SPECIAL NOTICE.

THE ROYAL AGRICULTURAL SHOW AT READING.

ON Friday next a double number of IRON, consisting of 68 pages, will be published in connection with the Royal Agricultural Society's Show at Reading. In addition to the usual complement of professional, technical, and commercial information, it will contain an illustrated report of the leading agricultural engines, machinery, and implements exhibited at the Show, together with any novelties that may present themselves for notice.

NOTICES.

COMMUNICATIONS on literary subjects and books for review are to be forwarded to the EDITOR. Anonymous correspondence will be wholly disregarded. The return of rejected MSS. cannot be guaranteed. Correspondents are requested to write on one side of the paper only, and to mark papers sent.

All payments for Subscriptions, Advertisements and General Accounts are to be remitted to the **Office, 161, Fleet Street, E.C., London.** Cheques and Post Office Orders are to be made payable to PERRY F. NURSEY, and crossed "London and County Bank."

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THE CONTINENT.

Messrs. GALIGNANI (Baudry, Jeancourt et Cie.), 224, Rue de Rivoli, and Mr. EM. TERQUEM, 15, Boulevard St.-Martin, Paris, will supply thick or thin paper copies of IRON on application, and will receive subscriptions and advertisements.

SCIENCE AND ART.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending June 1, 1882:—On Monday, Tuesday, and Saturday (free), from 10 a.m to 10 p.m., Museum, 9359; Mercantile Marine, Building Materials, and other Collections, 4266. On Wednesday, Thursday, and Friday (admission 6d.), from 10 a.m. to 6 p.m., Museum, 2668. Mercantile Marine, Building Materials, and other Collections, 644; total, 16,937. Average of corresponding week in former years, 18,729. Total from the opening of the Museum, 21,[illegible],044.

MEETINGS FOR THE WEEK.

MONDAY, JULY 10.

ROYAL AGRICULTURAL SOCIETY.—Annual Meeting at Reading. a.m. Judging begins. Exhibition of Implements at Rest and in Motion. 2 p.m. Displays of Bee Driving. Working Dairy.

TUESDAY, JULY 11.

ROYAL AGRICULTURAL SOCIETY.—Reading Meeting. 8. a.m. Show yard. 11 a.m. Parade of Cattle. Noon. Bee Driving, 2.30 p.m. Parade of Horses, Implements and Working Dairy, 8 a.m. to 7 p.m.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—1 p.m. President's Reception at the School of Military Engineering, Chatham.

ROYAL HORTICULTURAL SOCIETY.—3 p.m.

ANTHROPOLOGICAL INSTITUTE.—8.30 p.m.

WEDNESDAY, JULY 12.

ROYAL LITERARY FUND.—3 p.m.

ROYAL AGRICULTURAL SOCIETY.—Reading Meeting. 8 a.m. to 7 p.m. Implements at Rest and in Motion, and Working Diary, 11 a.m. and 2.30 p.m. Parades. Noon, Bee Driving.

NOTTINGHAM AGRICULTURAL SOCIETY.—Show at Mansfield. Two days.

THURSDAY, JULY 13.

ROYAL AGRICULTURAL SOCIETY.—Reading Meeting, 8 a.m. to 7 p.m. Machinery 11 a.m., and 2.30 p.m. Parades. Noon, Lectures on Bee Driving and Bee Management.

SANITARY INSTITUTE.—3 p.m. Anniversary. Address by the Duke of Northumberland. At the Royal Institution.

FRIDAY, JULY 14.

ROYAL AGRICULTURAL SOCIETY.—Reading Meeting. Closing day.

QUEKETT MICROSCOPICAL CLUB.—8 p.m.

SATURDAY, JULY 15.

ZOOLOGICAL SOCIETY.—4 p.m.

METALLURGY AND MINING.

THE BASIC PROCESS LITIGATION.—The American Commissioner of Patents has affirmed the decision of the examiner-in-chief, that Jacob Reese is the prior inventor of the dephosphorising processes set forth in Reese *v.* Thomas *et al.*, "cases A and B." "This," says the *Iron Age*, "is the final action in these cases as far as the United States Patent Office is concerned."

IRON VERSUS TIMBER FOR MINES.—M. Guibal, engineer, recently submitted to the Société des Ingénieurs sortis de l'Ecole de Mines du Hainaut, Belgium, some samples of rolled iron joists of special section, which, in his opinion, would advantageously take the place of timber for supporting the roof of mine workings. A shoe of ⊤ form, on the floor of the gallery, receives uprights of double ⊤ section, provided with recesses, in which fit the projections of the shoe and of the upper longitudinal. The upper joists carry others of ⊤ section which supersede the beams of the ordinary timbering. There is no complicated jointing in this iron support, which is very simple to erect, as the joists only weigh 30 to 32 lb. the yard. They are easily moved about, and they are capable of sustaining a load of 15 cwt. in the middle without being deflected. Besides, 50 per cent. of the original cost would be realised by their sale as old iron on the workings being abandoned.

ROASTING ORES IN MEXICO.—In Mexico only the richer varieties of silver ores are smelted, the greater proportion, of course, being worked by the Patio process, while in some few of the mining districts barrel amalgamation is extensively resorted to. The ores which are to be smelted are, in some places, roasted in heaps, which is done by surrounding the mineral, broken into large lumps, with a layer of charcoal, retained in its place by an open wall of rough stone built in a circular form. The openings in this wall admit of the passage of the necessary amount of air, and the operation is completed in the course of twenty-four hours, with an expenditure of charcoal amounting to one-half the weight of ores operated on. At Nieves the ores are roasted in circular kilns 4 feet 6 inches in diameter, and of about the same height. These are formed of a bottom wall of adobe or sun-dried bricks, and are without a roof, the walls being so constructed that the area of the openings is nearly equal to that of the brickwork between them. Into each of these kilns are charged 2000 lb. of roughly broken ore intermixed with one-half its weight of dry wood. The operation requires a week for its completion, but this method of roasting can only be employed during the dry season.

THE WORLD'S PRODUCTION OF LEAD IN 1881.—Herr Landsberg, the general manager of the famous Stolberg Company, has, in an annual report to his company, given an estimate of the production of lead in Europe for 1881. This estimate deserves attention, as the painstaking care of the author and his facilities for the collection of statistics make it as close as such data can be obtained at so early a date. In many of the countries named official statistics do not appear at all, or are issued two, three, or four years too late, so that they have little value commercially. The following is Herr Landsberg's estimate for Europe :—Spain, 120,000 metric tons; Germany, 90,000; England, 67,000; France, 15,000; Italy, 10,000; Greece, 9000; Belgium, 8000; Austria, 6000; and Russia, 1500 metric tons; Total, 326,500 metric tons. The author estimates the production of the United States at 110,000 tons, which is probably very near the mark. As the output of Mexico, South America, Canada, and Australia is small, it is probably safe to assume that the world's production is about 440,000 tons of lead. This does not include China, which is a heavy consumer of lead and is not unlikely a producer of some importance, nor does it include Japan, for whose output we have no figures. It will be seen, therefore, that the United States takes second rank among the lead-producing countries of the world; and if Spain, which has declined of late years, goes on falling off this year, or we keep up our present rate of annual increase, the end of 1882 will bring the United States to the position of the greatest lead-producer in the world. We are now consuming about one-fourth of the entire world's production, and ought soon to be able to supply the wants of some of our neighbours.—*Engineering and Mining Journal.*

MANGANESE IN BESSEMER RAIL STEEL.—An interesting paper on manganese in Bessemer rail steel was read by Mr. John W. Cabot, of Johnstown, Pa., at the last meeting of the American Institute of Mining Engineers. The paper contains a series of analyses which may be of interest to Bessemer steel makers, and has been submitted as a contribution to the much-vexed discussion of manganese in Bessemer steel. The analyses were made by Mr. Cabot in the spring of 1881, at the works of the Pittsburgh Bessemer Steel Company, Limited, during a period of about eight days, part of which time the rail steel showed great variation in rolling qualities. The author says that during the first part of the time in question it rolled well; later on it began to roll worse, until finally it cracked very badly, reaching its worst stage. After this it rapidly improved until it again rolled smoothly. During this time of transition from good rolling to bad, and back to good again, the course of the manganese was followed quite closely. It is the striking correspondence between these varying manganese contents and the differences in rolling which is here presented as worthy of notice. The other ordinary elements were determined occasionally, but showed no unusual variation. The steel is likely to affect its rolling; while in the blooming mill extraordinary pains were taken with the heating and rolling. Mr. Cabot presented the following tabulated statement of the manganese percentages, with corresponding observations on the rolling qualities of the steel, and also the dates on which samples were taken:—

Date.	Manganese.	Steel rolled.
April 14 and 15 ..	0·98 ..	Well.
April 16 and 18 ..	0·89 ..	Well.
April 19 ..	0·62 ..	Medium.
April 20 ..	0·57 ..	Badly.
April 21 ..	0·46 ..	Badly.
April 21 ..	0·43 ..	Very badly.
April 22 ..	0·75 ..	Medium.
April 22 ..	1·08 ..	Well.

A diagram was also given, the ordinates of the curve being manganese percentages, and the abscissæ, days on which they were determined. For comparison with this, an approximate curve of rolling was shown, being plotted with horizontal distances as days, as before, and vertical distances representing the rolling of the steel from "well" to "very badly." In the series of results obtained, the manganese was apparently the only element, either in the chemical composition or mechanical constitution, which varied at all commeasurably with the variation in the rolling of the steel. The former appears therefore to be attributable to the rolling.

ELECTRICITY AND TELEGRAPHY.

THE PREVENTION OF FIRE RISKS FROM ELECTRIC LIGHTING.

THE following rules and regulations for the prevention of fire risks arising from electric lighting are recommended by the council of the Society of Telegraph Engineers and of Electricians in accordance with the report of the committee appointed by them on May 11, 1882, to consider the subject.

Members of the Committee.

Professor W. G. Adams, F.R.S., vice president.
Sir Charles T. Bright.
T. Russell Crampton.
R. E. Crompton.
W. Crookes, F.R.S.
Warren De la Rue, D.C.L., F.R.S.
Professor G. C. Foster, F.R.S., past president.
Edward Graves.
J. E. H. Gordon.
Dr. J. Hopkinson, F.R.S.
Professor D. E. Hughes, F.R.S., vice-president.
W. H. Preece, F.R.S., past president.
Alexander Siemens.
C. E. Spagnoletti, vice-president.
James N. Shoolbred.
Augustus Stroh.
Sir William Thomson, F.R.S., past president.
Lieut.-Colonel C. E. Webber, R.E., president.

These rules and regulations are drawn up not only for the guidance and instruction of those who have electric lighting apparatus installed on their premises, but for the reduction to a minimum of those risks of fire which are inherent to every system of artificial illumination. The chief dangers of every new application of electricity arise mainly from ignorance and inexperience on the part of those who supply and fit up the requisite plant. The difficulties that beset the electrical engineer are chiefly internal and invisible, and they can only be effectually guarded againt by "testing" or probing with electric currents. They depend chiefly on leakage, undue resistance in the conductor, and bad joints, which lead to waste of energy and the production of heat. These defects can only be detected by measuring, by means of special apparatus, the currents that are either ordinarily or for the purpose of testing, passed through the circuit. Bare or exposed conductors should always be within visual inspection, since the accidental falling on to, or the thoughtless placing of other conducting bodies upon such conductors might lead to "short circuiting" or the sudden generation of heat due to a powerful current of electricity in conductors too small to carry it. It cannot be too strongly urged that amongst the chief enemies to be guarded against are the presence of moisture and the use of "earth" as part of the circuit. Moisture leads to loss of current and to the destruction or the conductor by electrolytic corrosion, and the injudicious use of "earth" as a part of the circuit tends to magnify every other source of difficulty and danger. The chief element of safety is the employment of skilled and experienced electricians to supervise the work.

I. THE DYNAMO MACHINE.

(1) The dynamo machine should be fixed in a dry place.

(2) It should not be exposed to dust or flyings.

(3) It should be kept perfectly clean and its bearings well oiled.

(4) The insulation of its coils and conductors should be perfect.

(5) It is better, when practicable, to fix it on an insulating bed.

(6) All conductors in the dynamo room should be firmly supported, well insulated, conveniently arranged for inspection, and marked or numbered.

II. THE WIRES.

(7) Every switch or commutator used for turning the current on or off should be constructed so that when it is moved and left to itself it cannot permit of a permanent arc or of heating, and its stand should be made of slate, stoneware, or some other incombustible substance.

(8) There should be in connection with the main circuit a safety fuse constructed of easily fusible metal which would be melted if the current attain any undue magnitude, and would thus cause the circuit to be broken.

(9) Every part of the circuit should be so determined that

that the gauge of wire to be used is properly proportioned to the currents it will have to carry, and changes of circuit, from a larger to a smaller conductor, should be sufficiently protected with suitable safety fuses so that no portion of the conduction should ever be allowed to attain a temperature exceeding 150 degs. F.

N.B.—These fuses are of the very essence of safety. They should always be enclosed in incombustible cases. Even if wires become perceptibly warmed by the ordinary current, it is a proof that they are too small for the work they have to do, and that they ought to be replaced by larger wires.

(10) Under ordinary circumstances complete metallic circuits should be used, and the employment of gas or water pipes as conductors for the purpose of completing the circuit should in no case be allowed.

(11) Where bare wire out of doors rests on insulating supports it should be coated with insulating material, such as india-rubber tape or tube, for at least two feet on each side of the support.

(12) Bare wires passing over the tops of houses should never be less than seven feet clear of any part of the roof, and they should invariably be high enough, when crossing thoroughfares, to allow fire escapes to pass under them.

(13) It is most essential that the joints should be electrically and mechanically perfect. One of the best joints is that whipped round with small wire and the wire mechanically united by solder.

(14) The position of wires when underground should be efficiently indicated, and they should be laid down so as to be easily inspected and repaired.

(15) All wires used for indoor purposes should be efficiently insulated.

(16) When these wires pass through roofs, floors, walls, or partitions, or where they cross, or are liable to touch, metallic masses like iron girders or pipes, they should be thoroughly protected from abrasion with each other or with the metallic masses, by suitable additional covering; and where they are liable to abrasion from any cause, or to the depredations of rats or mice, they should be efficiently encased in some hard material.

(17) When wires are put out of sight as beneath flooring, they should be thoroughly protected from mechanical injury, and their position should be indicated.

N.B.—The value of frequently testing the wires cannot be too strongly urged. It is an operation, skill in which is easily acquired and applied. The escape of electricity cannot be detected by the sense of smell as can gas, but it can be detected by apparatus far more certain and delicate. Leakage not only means waste, but in the presence of moisture it means destruction of the conductor and its insulating covering, by electric action.

III. LAMPS.

(18) Arc lamps should always be guarded by proper lanterns to prevent danger from falling incandescent pieces of carbon, and from ascending sparks. Their globes should be protected with wire netting.

(19) The lanterns, and all parts which are to be handled, should be insulated from the circuit.

IV. DANGER TO PERSON.

(20) To secure persons from danger inside buildings, it is essential so to arrange the conductors and fittings that no one can be exposed to the shocks of alternating currents exceeding 60 volts; and that there never should be a difference of potential of more than 200 volts between any two points in the same room.

(21) If the difference of potential within any house exceeds 200 volts, whether the source of electricity be external or internal, the house should be provided outside with a "switch," so arranged that the supply of electricity can be at once cut off.

By order of the council,
F. H. WEBB, Secretary.

Offices of the Society, 4, The Sanctuary,
Westminster, June 21, 1882.

ELECTRIC LIGHT IN THE CITY.—The Corporation, pending the decision of Parliament upon the Electric Light Bill, do not propose to enter into any engagement with regard to further lighting the City, but they express themselves decidedly favourable to the houses on the line of route of the cables being supplied from the public wires, and also to undertaking the work connected with the laying down of the cables.

NAVAL ARCHITECTURE.

LAUNCHES.

ENGLISH.

Burns.—On July 1, Messrs. Edwd. Withy and Co. launched from Middleton Shipyard, West Hartlepool, this iron screw-steamer, built to the order of Messrs. Glover Brothers, of London. Her principal dimensions are:—Length, B.P., 285 feet; beam, extreme, 36 feet; depth, moulded, 25 feet 2 inches; and she is expected to carry 3000 tons deadweight. Engines of 180 nominal horse-power, will be fitted by Messrs. T. Richardson and Sons, of Hartlepool.

Crœsus.—On June 30, Messrs. Kish, Boolds and Co. launched from their yard at Pallion, Sunderland, this screw steamer, of the following dimensions:—240 feet by 34 feet by 16 feet 6 inches. Her engines, of 130 horse-power nominal, will be fitted by Messrs. Carr and Co. (Limited), Sunderland. This steamer, the first launched by the firm, has been built to the order of Mr. Thomas Kish and partners, of Sunderland, and is intended for the Bilbao trade. She is expected to carry 1750 tons on a light draught of water.

Earl of Dumfries.—On July 3, there was launched, by Messrs. S. P. Austin and Son, Wear Dockyard, Sunderland, this iron screw-steamer. She has been built to the order of Messrs. Martin and Marquand, of Cardiff, and is of the following dimensions:—Length over all, 254 feet; breadth, 36 feet; depth (moulded), 18 feet. Gross tonnage, about 1584; nett tonnage, about 970. She will be fitted with engines of 140 horse power, with large boilers, by Mr. John Dickinson.

Leander.—On June 21, Mr. W. B. Forwood's new 46-ton cutter, built by Messrs. Inman and Son, was launched from this firm's yard at Leamington. The yacht's dimensions are:—Length L.W.L., 64 feet; beam extreme, 13 feet; depth 9 feet 6 inches; tonnage, 46 T.R.A., 50 tons builder's measurement.

Lutka.—On June 29, there was launched from the shipbuilding yard of Messrs. C. S. Swan and Hunter, Wallsend-on-Tyne, this iron screw-steamer, of the following dimensions:—Length, 215 feet; breadth, 29 feet 9 inches; depth, 16 feet. Her engines are on the compound surface-condensing principle, by Messrs. Black, Hawthorn and Co., and of 110 nominal horse-power. The vessel has been built to the order of Th. Rodenacker, of Danzig, and is intended for the Mediterranean and Baltic trades.

Mount Tabor.—On June 29, there was launched from the shipbuilding yard of Mr. James Laing, Deptford, Sunderland, this iron screw steamer, of 3300 tons deadweight capacity, for Messrs. John Smith and Co., of Glasgow. The principal dimensions are:—Length, 285 feet; breadth, 38 feet; depth, 27½ feet. The engines, of 36 inches and 38 inches diameter, and 42 inches stroke, will be supplied by Mr. George Clark, of Southwick Works, Sunderland.

Newent.—On June 29, there was launched from Messrs. Short Brothers' shipbuilding yard at Pallion, Sunderland, this iron screw steamer, built to the order of a local firm, of the following dimensions:—Length, 216 feet; breadth, 30 feet 6 inches; and depth, 16 feet. Messrs. Dickinson are to supply her engines.

Oranmore.—On July 4, this new steamer, built for Messrs. Johnson and Co., of Liverpool, was launched by the Barrow Shipbuilding Company. Her dimensions are:—Length, 352 feet; breadth, 40 feet; depth of hold, 31 feet 3 inches. She will be fitted with compound inverted direct-acting surface-condensing engines, with cylinders 42 inches and 80 inches in diameter, and a stroke of 4 feet. There are two boilers, with twelve furnaces. The *Oranmore* is intended for the general cargo trade.

St. Andrew's Bay.—On July 3, there was launched from the shipbuilding yard of Messrs. Andrew Leslie and Co., of Hebburn Quay, this steamer, built to the order of Messrs. Affleck and Gray and partners, of North Shields, and intended for the Indian, American, and Black Sea trades. The dimensions of the vessel are as follows:—Length, 265 feet (between perpendiculars); breadth, 35 feet; depth, 23½ feet. The carrying capacity of the vessel is 2700 tons. Her engines, which are of 190 horse-power nominal, are built by the North-Eastern Engineering Company.

SCOTCH.

Cedric.—On July 1, there was launched from the shipbuilding yard of Messrs. Murdoch and Murray, Port-Glasgow, this screw-steamer of about 2000 tons, built to the order of Messrs. George Hood and Co., Glasgow, for their Black Sea Trade. Her engines, which are of 150 horse-power nominal, and will be supplied by Messrs. Muir and Houston of Glasgow.

Cloch and *Cumbrae.*—On July 4, these two iron screw-steamers, each of 500 tons capacity, built and engined by Messrs. W. Simon and Co., were launched complete from their works at Renfrew. They are fitted with compound engines of 100 horse-power. The steamers are the property of the Clyde Lighthouse Trust, and are intended for the deepening operations on the Clyde.

Hermes.—On June 30, Messrs. Aitken and Mansel launched from their yard at Whiteinch this screw-steamer of about 2500 tons gross, for Messrs. R. P. Houston and Co., of Liverpool, which will be employed by them in their general carrying trade. The vessel will be fitted there with her machinery by Messrs. John Jones and Sons, engineers, Liverpool.

Loch Bredan.—On July 1, Messrs. Dobie and Co. launched from the Govan Shipbuilding Yard this iron sailing barque, built for the Loch Line of Mr. Jas. Sproat, of Liverpool. This vessel, which is the seventh the builders have constructed from same model, measures about 1000 tons gross.

Normandy.—On June 29, Messrs. John Elder and Co. launched from their Fairfield Works, Govan, this steel paddle steamship, sister ship to the *Britany*, which was launched May 31, both constructed by that firm for the London, Brighton, and South Coast Railway Company, and the Western of France Railway Company. The *Normandy* is similar to, though somewhat larger than the *Victoria* and *Brighton*, built by Messrs. J. Elder and Co. for the same companies about three years ago, and which proved very successful vessels in every way. The principal dimensions of the *Normandy* are:—Length, 230 feet; breadth, 27 feet 6 inches; depth (moulded), 11 feet 8 inches; tonnage (gross), about 600 tons. The engines are of the diagonal compound type, with high-pressure cylinder of 46 inches diameter, and low-pressure cylinder of 88 inches diameter by 5 feet stroke, and the steam is supplied at a pressure of 100lb. by four steel boilers. The indicated horse-power will be above 2200, and this will give a speed of about 17½ knots per hour.

Poo-Chi.—On July 4, Messrs. Aitken and Mansel launched from their yard at Whiteinch this twin screw-steamer, of about 800 tons gross register. This vessel is constructed of Siemens steel, and has been built to the order of Messrs. George and James Weir, for the China Merchant Steam Navigation Company. The machinery will be fitted by Messrs. Lees, Anderson and Co., Clyde Street, Glasgow.

Sarnia.—On June 30, Messrs. Charles Connell and Co. launched from their shipbuilding yard at Scotstoun, this iron screw-steamer of 3850 tons, built to the order of Messrs. Flynn, Main, and Montgomery, Liverpool, for the Mississippi and Dominion Steamship Company, Limited. Her machinery is being supplied by Messrs. John and James Thomson, Finnieston Engine Works.

Wuchang.—On June 30, Messrs Scott and Co., shipbuilders, Greenock, launched from their shipbuilding yard at Cartsdyke, a twin screw steamer of 1250 tons register, and of the following dimensions:—Length 250 feet; breadth 32 feet; and depth 21 feet. The steamer has been built to the order of Messrs. Swire and Sons, shipowners, London, and is intended for the China trade. The *Wuchang* is sister steamer to the *Chung King*, recently launched by the same firm for Messrs. Swire and Sons.

Werra.—On July 4, Messrs. John Elder and Co. launched from their yard at Fairfield this fine iron screw-steamship, of 5100 tons gross register, for the North German Lloyd Company of Bremen. This vessel, which is intended for the Bremen and New York line, is of the following dimensions:—Length, 450 feet; breadth, 46 feet; depth 36 feet 6 inches. She is classed the highest grade of the Bureau Veritas, with several extras over their requirements such as iron lower and orlop decks, and additional water-tight bulkheads. The upper deck is of teak, while all the deck houses and deck work are either of teak or iron. To protect the vessel from the heavy Atlantic seas iron turtle-decks are placed at both ends of the ship. There is a promenade deck about 180 feet long, and the whole width of the vessel. Besides the ship's officers and crew, 170 in number, the vessel will carry 170 first-class, 90 second-class, and 1100 third-class passengers. The chief dining saloon is a very handsome and comfortable apartment, being about 40 feet square, and is beautifully lighted by a cupola from the promenade deck. The style of furniture, cabinet and upholstery work is of the most luxurious description. The vessel is rigged with four pole masts of iron, with yards on the fore and main masts. She is provided with steam and hand-steering gear, and all modern appliances to ensure the safety of the vessel at sea, and to facilitate the working of cargo. The vessel will be propelled by compound engines of the inverted-cylinder type, supplied by the builders, having two low-pressure cylinders 86 inches diameter, and one high-pressure cylinder of 62 inches diameter, 5 feet stroke, and working up to 95 lb. pressure. Steam is supplied by four double-ended boilers, with six furnaces in each, and it is expected that the engines will develop 6000 indicated horse power. As the vessel left the ways she was named by Miss Jessie Frost, neice of Mr. Lohmann, the managing director of the North German Lloyd Company.

TRIAL TRIPS.

Essex.—On June 29 this steamer, which has been built by Messrs. Raylton, Dixon and Co., to the order Messrs. Money Wigram and Sons (Limited), of London, for their Australian line of steamers proceeded on her trial trip from Middlesbrough. She is an iron screw steamer of the following dimensions:—Length over all, 310 feet; breadth, 40 feet; depth of hold, 25 feet 3 inches; and has a large carrying capacity of 3700 tons. Her engines of 250 horse-power nominal, by Messrs. T. Richardson and Sons, of West Hartlepool, indicating up to 1550 horse-power worked remarkably well, giving a speed of 12¾ knots.

Maipo.—On July 4, this vessel the latest addition to the fleet of steamers owned by the Compania Sud-Americana de Vapores en el Pacifico, built by Messrs. John Reid and Co., Port-Glasgow, the engines by the firm of Messrs. Rankin and Blackmore, Greenock, went on her trial trip. The *Maipo* is a four-decked vessel rigged as a three masted schooner, 350 feet long, 41 feet 6 inches in breadth, and 36 feet in depth to shade deck, her gross tonnage being 3000 tons. The engines are 280 horse-power nominal, 45 and 80, with 4 feet 8 inches stroke, having a working power equal to 2400, with 90 lb. pressure. Four of Fox's corrugated flue boilers supply the steam, which proved ample. There are besides three donkey engines in the engineroom, &c. At the trial trip the engines worked with great smoothness and minimum vibration, the speed obtained being equal to 14½ knots.

Romania.—On June 27, this new steamer, the first built to the order of the Romania Steamship Company, ran a most successful trial trip from the Tyne. The *Romania* was built by Messrs. W. Pickersgill and Sons, of Southwick, Sunderland, and engined by Mr. George Clark, of the Southwick Engine Works. Her dimensions are:—225 feet long, 33 feet 6 inches beam, 16 feet 2 inches depth of hold, 1250 tons register, and carrying capacity of 1750 tons. Her engines, which are on the compound surface-condensing principle, have cylinders 29½ inches and 55 inches diameter respectively, and a 36-inch stroke, and during the trial ran 90 revolutions, developing 960 horse-power and a mean speed of 10½ knots.

DISASTERS AT SEA.—There were 19 British and foreign actual shipwrecks reported during the past week, making a total of 786 for the present year, or a decrease of 133 as compared with the corresponding period of last year the increase for the week being six. British-owned vessels numbered 11. Three were steamers, all British, with an aggregate tonnage of 1080 tons. Total tonnage lost for the week, 9503 tons. Total number of lives lost and missing, 57. Five vessels were wrecked off the coasts of the United Kingdom, all being British owned. Three British vessels sunk by collision, off Great Britain. 999 tons of cotton were lost, also 600 tons of coal, 270 tons of petroleum, 237 tons of oats, and 400 tons of timber.

CLYDE SHIPBUILDING IN JUNE.—During the month of June, as we learn from the *Glasgow Herald*, a large amount of new tonnage has been put into the water by the various firms on the Clyde. In all twenty-one vessels, having an aggregate tonnage of 35,011, have just been launched. It has generally been the case that June furnishes more than the average monthly contribution towards the yearly output, the great activity in the later stage of shipbuilding in that month being accounted for to a certain extent by shipbuilders endeavouring to make a clearance prior to the Fair Holidays setting in. In this instance, however, the returns are unusually good. Not only is the tonnage in excess of last month, but the figures are also higher than those of the corresponding month for the last eight years, the nearest approach being June 1874, when the total reached 35 000 tons. For the purpose of comparison, we give the tonnage for the same month in former years. Last month, 31,438 tons were launched. In June 1881, the tonnage amounted to 29 000; in June 1880, to 22,528 tons; in June, 1879, to 12,074 tons; in June, 1878, to 24,500 tons; in June, 1877, to 12,400 tons; in June, 1876, to 14,072 tons; in June, 1875, to 20,700 tons; in June, 1874, to 35,000 tons. In the returns are included a number of vessels of large dimensions—viz., the Cunard liner *Pavonia*, of 5500 tons; the *City of Oxford*, 3900 tons; the *Chandernagor*, 3060 tons, etc. Messrs. Alex. Stephen and Sons and Messrs. John Elder and Co. have each contributed three vessels to the total. Despite the large output there appears to be a lot of work on hand, although it is stated that some firms are getting their orders pretty well worked up. In the lower reaches of the river the booking of new orders is still keeping pace with the output, over 6000 tons of new shipping having been contracted for during the month. In that district there are fifty-four vessels on hand, being two in excess of last month. On the whole, however, inquiries are scarce, and few new orders have been secured. Owners who intend adding to their fleets are holding back in the hope of prices becoming easier. Complaints are still being made about the irregularity of the workmen, and one shipbuilder estimates that, with proper attention on the part of a section of the men, his establishment could have turned out about 2000 tons more during the first six months of the present year. The tonnage launched during the first six months of this year, as will be seen from the subjoined table, is in excess of the corresponding period in any former year:—

			Tons.
January to June inclusive	1882	..	161,992
" "	1881	..	155,500
" "	1880	..	108,978
" "	1879	..	96,892
" "	1878	..	128,511
" "	1877	..	82,220
" "	1876	..	88,522
" "	1875	..	112,300
" "	1874	..	127,900

FIXING BOILER TUBES.—With the object of securing a high pressure of steam, combined with the utmost economy as regards space, a great innovation was introduced into the *Polyphemus* by the substitution of the locomotive type of boiler, with enclosed stokeholes and forced draught, for the ordinary marine boiler. In this respect the boiler arrangements of the torpedo ram may be said to be practically identical with the system which has been long adopted in torpedo-boats. But in the small craft an important difficulty has always existed. Owing partly to the difference in the rates of expansion between the boiler-tubes and the tube-plate, and partly to the intense heat set up, which drove the water from the points of junction, leakages occurred the moment the engines were stopped or steam was reduced. As the same defects were manifested during the preliminary steam trials of the *Polyphemus* at Chatham, the engineering department at the Admiralty resolved to prosecute an exhaustive series of experiments at Portsmouth with the object of determining the most effective means of fixing the tubes to prevent leakage. Four first-class torpedo boats were placed under the orders of Mr. J. Ellis, the chief inspector of machinery, for the purposes of the experiments, each boat having its boiler tubes fixed in the plates by a different method. These trials have extended over a number of weeks, and are now concluded, after each craft has been practically proved to death. The *Lightning's* tubes were fixed in the usual way, with the bead outside, but strengthened by eight stay tubes; No. 3 had the tubes screwed into the fire-box ends, the thread being of a peculiar kind; No. 11 had the tubes expanded into a groove in the middle of the tube plate and ferruled; while No. 12 had the tubes expanded through the plate and strengthened by long steel ferrules. No. 3 was also fitted with circulating tubes for the purpose of bringing the water from the cooler parts of the boiler to the furnace end, where the leakages occurred. The conditions of trial were that the boilers were to be pressed under way at 120 lb. to the square inch for twenty minutes, the pressure in the the closed stokeholes to be equal to five inches of water, which is equal to about half a pound to the square inch, *plus* the atmosphere. Steam was then to be reduced in less than twenty minutes to 20 lb. for the purpose of testing the results of the contraction. The trials were continued over six days in the Solent, steam being pressed and reduced three times successively during each trial. No. 11 gave out the first day. After having her tubes re-expanded, she entered a second time into the competition, but was again placed *hors de combat*. It was then determined to take her out of the running; but, in accordance with instructions from the Admiralty, she was subsequently fitted with circulating tubes, and underwent a third trial. As the results were not satisfactory she was then withdrawn. On the third day the *Lightning* had a mishap to her steering gear, while No. 3 sustained an accident to the slides of her fan engine. The *Lightning* was next put out of the competition, and the trials were limited to Nos. 3 and 12, the ultimate victory remaining with the former and the screwed tubes. She passed through the whole of the six ordeals satisfactory, the others requiring their tubes to be re-expanded and attended to after each day's run.—*Times*.

OBITUARY.

GUPPY.—Mr. Thomas Richard Guppy, formerly of Bristol, and whose name is associated with the construction of the *Great Western*, died at Portici, Naples, on June 28, aged 87. Though an Englishman, the Neapolitans regarded him as a fellow citizen, for he had spent nearly half his life among them, improving their metallurgical industry, which he may be said to have introduced there. Founder of one of the largest mechanical establishments in Naples, which gives the means of existence to upwards of 600 families, by persistent and intelligent care he raised the industry of metallic construction to so high a degree as to compete with foreign works, so that the Italian government lately commissioned him to build one of the torpedo boats of their fleet.

HANSOM.—Mr. Joseph Aloysius Hansom, the well-known architect and inventor of the Hansom cab, died at his residence, Fulham Road, London, on June 29, aged 78. Mr. Hansom, who came from an old Catholic Yorkshire family, first came into prominent notice in 1833, as the successful competitor for the Birmingham Town Hall, the erection of which was entrusted to him and his then partner, Mr. A. Elch. The contract proved an unfortunate one for the architect and builder, and resulted in his bankruptcy. Shortly afterwards he partially retrieved his fortunes by the invention of the patent safety cab, which still bears his name. His next important venture, in December 1842, was in periodical literature, as the founder of the *Illustrated Weekly Journal*. His practice as an architect had in the meantime become extensive, and examples of his taste and skill are to be seen in all parts of the kingdom. Churches from his designs were erected at, among other places, Ryde, Preston, Dalkeith, Leeds, Ripon Boulogne, Maryechurch, Oxford, Manchester and Arundel, and he was the architect of various structures, or portions of structures, for the colleges of Ampleforth, Ushaw, St. Beuno's, Beaumont, and Fort Augustus. Among his latest and finest works, executed in partnership with his son, Mr. Joseph Hansom, may be mentioned the Church of the Holy Name, at Manchester, remarkable for its tower and an extensive application of terra cotta, and the noble Church of St. Philip, at Arundel, which he designed for the Duke of Norfolk.

SMITH.—Mr. Erastus W. Smith, one of the most distinguished and efficient, yet most modest, mechanical engineer of the United States, died on June 12 at New York. He was about sixty years of age, and had been ailing for some six months. Mr. Smith was a native of Mansfield, Connecticut. When a boy he worked as a carpenter, and served for some time in a steam-engine factory in Ohio. On coming to New York, he entered the Allaire Iron Works, and left the works temporarily to study physics and mechanics in the University of New York, whence in 1844 he was graduated. After this he returned to the Allaire Iron Works and laboured there for six years, having the principle charge of some of the vessels being then built. Of late years Mr. Smith has been one of the most prominent consulting and superintending engineers. In 1866, the degree Doctor of Physical Arts was conferred upon him by the City of New York University. Mr. Smith designed and constructed the waterworks of the city of New Orleans, and was also connected with the Cleveland Waterworks. He was engineer-in-chief of the Harlem Bridge, at the head of Third Avenue, New York, and was a trustee of the East River Suspension Bridge at the time of his death.

THOMAS.—David Thomas, a pioneer in iron manufacture in the United States, died of pneumonia, at Catasaqua, Pennsylvania, on June 20, in his 88th year. He was born in Wales in 1794, and entered the iron business in his native country early in life. Mr. Thomas, with Mr. George Crane, succeeded, by the use of the hot blast, in running a furnace at Yniscedwyn, Wales, with anthracite. Later, he was induced by Mr. Erskine Hasard to go to the United States to build a similar furnace in the Lehigh Valley. He made his first cast of anthracite pig at the Pioneer Furnace, Pottsville, Pennsylvania, and on July 3 blew in the first stack of the Crane Iron Company, with which he has ever since been prominently connected. Mr. Thomas met many obstacles during the introduction of anthracite as a blast-furnace fuel, but he overcame them by his untiring energy. The name of Mr. Thomas will always hold a high position in the history of the American iron trade.

LEGAL INTELLIGENCE.

June 23.

SUPREME COURT OF JUDICATURE.

COURT OF APPEAL.

(*Sittings at Westminster, before the* MASTER OF THE ROLLS *and* LORDS JUSTICES BRETT *and* COTTON.)

SAXBY *v.* THE GLOUCESTER WAGON COMPANY (LIMITED).

This was an action for infringement of a patent.

It appeared that early in 1874 the plaintiff, John Saxby, obtained a patent for certain improvements in interlocking apparatus for railway points and signals. Patents had been previously obtained in 1870 and 1871 for inventions of apparatus for similar purposes. In an action for infringement of the plaintiff's patent of 1874 by the defendants, it was admitted by the plaintiff's witnesses that, taking the two inventions of 1870 and 1871 together, and discarding all superfluous parts, every element of the patent of 1874 was to be found in one or other of those inventions, and that no new result was obtained by the combination in the patent of 1874 different from that which had been obtained by the previous inventions; but it was contended for the plaintiff that the combination of the two inventions of 1870 and 1871, effected by the plaintiff's invention of 1874, required such an exercise of skill and ingenuity as to constitute the subject of a valid patent. There was, however, evidence, with which the Court was satisfied, to show that any person of ordinary skill and knowledge of the subject, placing the two inventions of 1870 and 1871 side by side, could effect the combination of the two in a manner similar to that of the plaintiff's invention without making any further experiments or obtaining any further information. A Divisional Court, before whom the case was brought upon motion by the plaintiff to set aside or remit to the official referee (to whom the issues, in fact, had been referred) his report, or to enter judgment for the plaintiff, and also by the defendants to enter judgment in their favour, held that the plaintiff's invention was not of sufficient novelty to constitute the subject of a valid patent. Judgment was given for the defendants and the plaintiff appealed.

Mr. Aston, Q.C., Mr. Benjamin, Q.C., and Mr. Macrory appeared for the plaintiff; Mr. Webster, Q.C., Mr. Lawson, and Mr. R. S. Wright for the defendants were not called upon to argue.

Their lordships were of opinion that the Court below was right, and that the decision of the official referee was not against the weight of evidence. The evidence of the experts in favour of the defendants preponderated over that in favour of the plaintiff in the point that the combination could be effected without invention. The result of the evidence was that the combination could be effected by a workman of ordinary skill and knowledge, and therefore it was not a sufficient invention to support a patent. Further the plaintiff was not the first inventor, inasmuch as assuming it to be an invention it had been anticipated and published by another person.

The appeal was accordingly dismissed.

GENERAL NOTES.

THE TIN STANDARDS.—On June 4, Cornish smelters advanced tin standards 2s. per cwt., making present prices 95s. and 96s.

MESSRS. NASMYTH AND CO.—The old established firm of Messrs. Nasmyth, Wilson and Co., engineers, Patricroft, near Manchester, is being formed into a limited company. The shares have been taken up privately, chiefly by the members of the concern, and have not been thrown open to the public.

EPPING FOREST TRAMWAYS.—The directors of the Epping Forest tramways are using every endeavour to open the line by Bank Holiday, August 7. The cars are ordered of Messrs. Merryweather and Sons, of Greenwich. At present the line is to be worked by horses, but it is expected that steam motors will be used within twelve months.

GAS STOVE EXHIBITION.—A public exhibition of gas heating appliances, free alike to exhibitors and the public, is to be opened on 1st August, near the Halles Centrales, Brussels. It is arranged by the municipality and the gas authorities, and prizes will be granted to succesful competitors. Gas engines are also eligible for admission, but not to compete for prizes; they will be worked gratuitously by the committee, though at the owner's risk. Further information may be obtained from the president of the committee, who is also manager of the gas works, M. Aerts, 317, Rue du Progrès, Brussels.

TRADE MARKS REGISTRATION.—A notice has been issued from the Trades Marks Registry stating that in substitution of Rules 5 and 11, made in August, 1876, the following rules were made by the Lord Chancellor on the 24th June, 1882:—Rule 5. "A person, whether a British subject or an alien, desiring to register a trade mark, shall apply to the Registrar by sending to him a statement prepared in accordance with rules 6, 7, and 8, and the prescribed fee, with the addition, in the case of a trade mark which has been used before the 13th August, 1875, but not otherwise, of a declaration prepared in accordance with Rules 9, 10, 11, 64, 65, 66, and 67." Rule 11. "Where an application for the registry of a trade mark is made by or on behalf of any firm or partnership, the statement and declaration shall be made by one member only of such firm or partnership, or by any person duly authorised by such firm or partnership; and the Registrar may require such proof as he thinks fit that the application made is duly authorised by such firm or partnership."

LARGE CASTING.—A large piece of machinery was recently cast at Messrs. Daglish's Engineering Works, St. Helens. The casting was a portion of the frame of a pair of horizontal engines, the extreme dimensions being 13 feet in length, 9 feet in breadth, and 6 feet 5 inches in depth. It was a duplicate of one cast at the same works about a month ago, and, like that one, will weigh 26 tons. In order that there should be no lack of metal for the purpose, about thirty tons were melted. The pouring of the metal into the mould was the work of only a few minutes, and it was happily accomplished without mishap of any kind, and in a way which ensured confidence in the final result. There was first brought into use a pot containing 10 tons of metal, and after this had been poured in a further supply of 12 tons, and another of about 8 tons, were run from a furnace in the side of the building. Although so quickly "run into" the mould, the metal took four hours to melt, and six weeks have been consumed in the preparation of the mould. The latter involved many details requiring nicety of execution. The engines, of which this casting constituted part of the frame, are for shipment abroad. They are stationary engines intended for the driving of very extensive cotton mills.

SAINT-QUENTIN EXHIBITION.—One of the *concours régionaux* of France was held this year at Saint-Quentin, in the department of Aisne; and at its close on 5th June, M. Leon Say distributed the prizes to the successful competitors. Agricultural implements were shown by the firms of Albaret, Bajac-Delahaye, Beaume, Boulet et Cie, of Paris (late Hermann-Lachapelle), Broquet, Decanville Ainé, of Petit Bourg, Decker et Mot, De Corbeil, De Nevers, De Niort, Dumont, Clert, Guitton, and Pecard, most of whose productions we have noticed in connection with the Paris Agricultural Show. Indeed, it must be admitted that there was no great novelty, M. Brasseur Ainé, of Berry-au-Bac, however, showed a yoke for three oxen. The industrial exhibition organised by the Mayor, M. Mariolle, remained open until the end of the month. The Forge de Saint Rock, Amiens, made a good display of wrought iron axles, and M. Denys, of Paris, showed a fine collection of perforated and stamped-out sheet iron. Two portable engines and a water tube boiler were sent by M. M. Meunier, of Lille; and M. Havequez, of Saint-Quentin, a vertical direct-acting engine, driving a small brick machine. M. M. Mariolle, Freres, of the same town, showed a Zimmermann-Valde engine; and the Maison Lecointe a Sulzer engine running. M. V. Daix, had in view some gas engines, and M. Boivin, of Lille, an improved pulsometer. There was also on view a good deal of sugar machinery.

LEEDS FIRE BRIGADE.—The following is a report of the testing by the Leeds Fire Brigade, without assistance from the makers, of one of Shand, Mason, and Co.'s improved No. 4 equilibrium steam fire engines, supplied to the Corporation in April, 1882, a similar engine having been supplied in 1876.—"Leeds Constabulary, 'E' Division, Central Station, June 30, 1882.—From Superintendent Baker, to the Chief Constable.—Sir, I beg to report that at 10.25 a.m. this date I received by telegram from the Chief Clerk's office, 'Fire at the Town Hall.' The tender was at once dispatched, and the new steamer followed, both being accompanied by a number of firemen. On arrival at the Town Hall, the Mayor, Alderman Addyman (chairman of the Fire Brigade Committee), the members of the Watch Committee, and the Chief Constable (A. B. Nott-Bower, Esq.), were waiting my arrival. The engine arrived at the Town Hall in 2 minutes and 20 seconds after receiving the order to turn out. I received instructions to get to work from the fountain with the view of ascertaining the height the steamer could throw the water. Steam was got up in 8 minutes, and in 9 minutes water was thrown through a $1\frac{1}{4}$ inch jet 40 or 50 feet above the spire of the Town Hall from the parapet under the clock. Subsequently a $1\frac{1}{8}$ inch jet was worked from the ground in front of the Town Hall, and water was sent on the dome above the clock, which is 225 feet from the ground. Four ⅝ inch jets were then brought into action, and water was thrown above the clock face. In each of the above trials the steamer worked with the greatest steadiness and regularity, ample steam being maintained throughout. The committee expressed themselves highly satisfied with the performance of the steamer. A number of bystanders witnessed the proceedings, and frequently remarked that water was never thrown to such a height in Leeds before.—I am, &c., H. M. BAKER, superintendent."

LILLE INDUSTRIAL EXHIBITION.—A small, but well-arranged exhibition is being held in the Palais Rameau, Lille, under the auspices of a committee of which the Maire is president. Though it is international, the exhibits are for the most part French or Belgian. The first object that meets the eye on entry is a monument dedicated to "La Forge," executed in wrought iron, without the aid of either stamping or files, by Prosper Schryvers, Rue du Métal, Brussels. Comprising all the styles of the Middle Ages and of the Renaissance, this highly artistic work calls to mind Quentin Matsys' famous well at Antwerp. The figures of a pitman, a French rolling-mill hand in his iron boots, an armourer with sword, and a mechanician with his tools, are surmounted by a typical smith, while supporting the scrollwork canopy above are the celebrated smiths of the four principal countries of the Continent. Bovino di Campilione, who flourished in the fourteenth century, represents Italy; Quentin Matsys, fifteenth century, Belgium; Machenod, sixteenth century, Germany; and Jean Lamour, eighteenth century, France. All these are executed in iron with the hammer alone, and produce a marvellous effect. This *chef-d'œuvre* is worthily flanked by a monumental staircase, by Wauters-Koeckx, Brussels, of black iron relieved by bright steel and copper, in which flowers, grapes and oak-leaves are interspersed with elaborate scroll work. The same exhibitor sends a handsome lustre and pair of candelabra, in which nickel ornaments relieve the iron, and a jardinière with delicately wrought china asters. M. Leion, Brussels, shews two street lamps with Renaissance brackets in forged iron, and M. Tellier, of Lille, a wrought-iron bracket, part black and part bright, to the design of M. Cordonnier, architect. To complete our list of this kind of work, M. Jos. Verhoogen, Brussels, shows a magnificent wrought-iron gate for château, with accessories; and M. Goyers, of Louvain, a portrait of M. Gambetta, beaten out of a sheet of iron with the hand-hammer alone. Some iron trestles jointed, so as to fold in a small space, are shown by M. Acolet, of Compiègne, and a hollow cast-iron cill for casement windows, acting as a gutter to take off rain and the condensed breath, by M. M. Seidel et Decroix, of Calais. Charles Havez, of Douchy, who is probably a miner, contributes a clock-case made up of various ores, with models of the miner's tools, and also specimens of iron ore from Bone, Escambrera, Bilbao, Vera, Carbonera, and Rubio. A small erection in the garden is roofed with the "metallised cloth" of M. J. Hautrive, which, intended principally for roofing purposes, is also claimed to be useful for damp walls and for steam joints. It is really a textile fabric, coated with some bituminous substance impregnated with lead, very light and flexible, yet strong, and produced at half-a-crown the square yard. It is fixed by nailing, but joints are made watertight with liquid cement. It is claimed to be the lightest, cheapest and best looking roofing substance, while it is also impermeable by water and non-inflammable. M. Jardez, of Lille, had on view a collection of his drawing boards in which a panel for stretching the paper is held fast by iron rods, and also his simplified pantagraphs and other drawing instruments.

THE HOME IRON AND COAL TRADE.

BARNSLEY AND SOUTH YORKSHIRE.—The finished iron trade carried on in this district seems to be rather better so far as regards the district foundries and the machine shops, both of which have more orders on hand. The make of pig-iron is fully up to the average. There is no change to note with respect to the number of furnaces in blast, nearly all of which are fed with North Lincolnshire ironstone, which of late has not altered in price. The coal trade is subject to no improvement whatever; many of the house-coal pits are only working two and three days per week, yet the output, even at that limited rate of working, more than covers the demand. Prices are very low and list quotations are, in very few instances, adhered to, sales being very difficult to effect. The demand for both Silkstones and Barnsley house-coal for the metropolis is very moderate indeed, as is evidenced by the railway traffic. Business with nearly all the home and other markets is very quiet indeed, with no prospect of a change for the better for some time to come. There has, during the past week, been rather more doing in steam-coal for exportation from the Humber ports, where an unusual large tonnage has, during the season, been despatched. Most of the gas contracts have been placed, and coal owners are looking forward with interest to the opening of the season, when supplies will be wanted. Owing to the fair state of trade in the woollen manufacturing districts, engine fuel and slack is good to sell, and rather more money is being asked. There is a very good general demand for coke, the best qualities being very largely sent to North Lincolnshire daily. Prices of really good coke keep well up, but inferior samples are not at all good to sell. The officials of the Yorkshire Miners Association state that there is a large amount of confiscation going on at some of the district collieries, which causes the men to be greatly dissatisfied. Several small collieries are being discontinued, the lessees not being able, in the present state of the coal trade, to work them to a profit.

BARROW - IN - FURNESS AND NORTH LANCASHIRE.—There is a very steady trade in all qualities of hematite pig-iron, and makers are fully employed so far as the number of furnaces in band are concerned. The demand on makers is, for the moment, greater than they can cope with, and it is noteworthy that from all the yards the deliveries are quite up and, in many cases, beyond the production of the furnaces. Stocks, in consequence of this, are beginning to decline, and as large cargoes of metal are being arranged for shipment from local ports, it is expected there will be a further reduction in the amount of pig-iron in hand. The demand for Bessemer is mainly upheld by reason of the large and constantly increasing requirements of steel makers. Forge iron is also in good request for general use. Prices are very well maintained, No. 1 Bessemer at 57s. per ton nett. at works; No. 2, 56s., and No. 3, 55s. per ton, deliveries extending over the next three months. Steel rails are in very good request at about £5 15s. per ton. The mills are regularly employed, and orders have been booked to a very large extent. The output of steel rails is very heavy, and a great proportion of the orders in hand are on foreign account. The plate mills are busy, and there is, generally speaking, a very large output of merchant qualities. Iron ore is still in very full demand, and prices show no variation from last week; 13s. 6d. to 16s. are still the quotations for ordinary and best samples, and as several raisers are largely sold forward, there is some difficulty in placing large orders for early delivery. Shipbuilders are not so well employed as of late. Coal and coke steady. Shipping very fairly employed.

CARDIFF.—The iron and steel trades of the district seem to have improved since last report, and prospects are brightening. The quantity sent away since last report has been 5609 tons, while iron ore has been received to the extent of 4688 tons from Bilbao, and 9798 from other sources. Campanil Somorrostro is quoted at 15s. 3d. c.i.f.; good Rubio, 15s. c.i.f.; Carthageno manganiferous ores maintain their former position. Tin plates, which took an upward turn as regards prices, have slightly declined. Good cokemades are now quoted at 16s. at Liverpool, while charcoals are from 20s. to 21s. The needy manufacturers are again flooding the market, and preventing prices rising to a paying point. In the steam coal trade the amount shipped, 124,863 tons foreign and 10,052 coastwise, shows that there is no cause to complain. The patent fuel trade is also good, 5346 tons having been sent away. The price of double-screened is about 11s., with a firm tendency, but no probability of an advance at present. There are 800 men out on strike at Fernhill, at Blaenrhondda. The freighters have subscribed £500,000 for a new dock, which will be supplemented by £150,000 from Lord Windsor, and £100,000 from the Great Western Railway Company upon certain conditions. Mr. Abernethy, C.E., has been asked to report upon the best site. It is thus probable that we shall have two new docks instead of one.

CLEVELAND.—The attendance at the iron market at Middlesbrough on Tuesday was rather thin, and business was quiet, people evidently being disposed to wait until the result of the ironmasters' June returns were known, and they were not issued until the close of the market. There was great uncertainty about the balance of trade for last month, owing to the great falling-off in the demand for Scotland, though this was more than made up for by the increase on continental account. It was expected that stocks would show a decrease, but few would look for a decline of 8376 tons. This satisfactory intelligence will doubtless have a good effect on business. A fair amount of selling has been done by the makers, who, however, have again resolved not to alter their quotations, which still remain on the basis of 43s. 6d for prompt f.o.b. deliveries of No. 3 G.M.B. Below this it is a matter of much difficulty to buy, and some of the middlemen have been quoting 43s. 7½d. for No. 3. For forward delivery merchants are quoting 43s. from August to December. As makers are transacting nearly the whole of the business there is little room for merchants, and iron in second hands is now stated to be almost practically nil, and makers have the value in their own hands. For warrants buyers were offering 43s. 3d.; a few lots were, however, sold at 43s. 4½d. per ton; but the general price asked by holders was 43s. 6d. per ton. The stock in Messrs. Connal and Co.'s stores on Tuesday night was 122,439 tons, as compared with with 124,724 tons last week, being a decrease of 2285 tons on the week. In Glasgow, the firm holds 636,342 tons. Forge iron is quoted at 42s. 6d. per ton. Considerable sales are reported in hematite iron, and inquiries are both numerous here, and on the west coast. The prospects are so good that better prices have been asked and realised, and this appears to be bringing out consumers more readily. There is a slight spurt noticeable in the manufactured-iron trade, prices being slightly higher, and orders are reported to be less difficult to secure. For ship-plates the sum of £7 per ton was actually paid for prompt delivery, but for forward delivery prices range from £6 12s. 6d. to £6 15s. Angles and bars are £6 2s. 6d. to £6 5s., less 2½ per cent. The foundry trade is slightly improved, and lately orders have been calculated, which apparently are evidently intended for Scotland, on account of the very high tests which are required. The only works which are full of orders are the Anderston Foundry at Port Clarence, and they are fed with Scotch orders obtained at Glasgow. The prospects of the steel trade are said to be brightening. Cleveland iron ore is quoted at 4s. 5d. per ton. Spanish iron ore is:—Brown Bilbao, 16s., and Campanil Somorrostro, 16s. 6d.; the price of Spanish manganiferious ore is 23s. 6d. per ton, delivered "Tees." Cumberland hematite ore, delivered in Middlesbrough, ranges from 20s. to 22s. 6d. per ton, according to quality. The coal trade is improving in about all departments, especially where shipments are concerned. The firmness in the London market has a good effect upon our home coal business, and manufacturing qualities have seldom been so well inquired after. The sales of coke are numerous, and at better prices, as the demand is in excess of the supply. The Cleveland ironmasters' returns for the month of June were issued on Tuesday afternoon. They show that 119 were blowing, as compared with 118 in the corresponding month of last year, seventy-nine of which were employed on Cleveland iron and forty on hematite. The make of Cleveland pig iron amounted to 141,650 tons, or 7835 tons less than in May; whilst the make of other kinds of iron, including hematite, spiegel, and basic pig-iron, amounted to 75,374 tons, or a decrease of 6592 tons in May. The total make of all kinds of iron was 217,025 tons, a decrease on May of 14,427 tons. The total stocks of pig-iron on June 30 were 338,571 tons, or a decrease of 8376 tons on May. Of these stocks the makers hold 145,815 tons, or an increase of 6813 tons on the previous month; while Messrs. Connal and Co.'s Cleveland stores have decreased 12,955 tons during June. The quantity of pig-iron shipped foreign was 42,917 tons, or 42 tons more than in May, but coastwise shipments only reached a total of 25,456 tons, or 3074 less than during the previous month. The total shipments were 68,373, as against 71,405 in May, and 21,664 in June, 1881; being a decrease on June, 1881, of 23,204 tons, of which 21,664 tons went coastwise.

DERBYSHIRE.—There seems to be but little change to note with respect to the iron trade carried on in this district. Operatives are fairly employed, and fully an average output of pig-iron is being made daily. Castings are not in over good request neither as regards building or general requirements. Complaints are almost everywhere rife with respect to the business doing in coal. Many of the pits in the district raise only house coal, so that short time is the rule rather than the exception. There is a limited tonnage passing from the collieries over the Midland to the metropolis, and this is mostly sent on account of contracts. What may be termed the legitimate trade is very quiet. Prices scarcely were ever lower than they are at the present time. A good deal of interest is being taken in the investigation and report of a committee of South Yorkshire coal owners with respect to the tonnage rates. A meeting of the committee is fixed for Monday, but it is not expected that anything like a concession will be made to the Yorkshire district, because in the event of that being done the rate from Derbyshire, which is over 1s. per ton lower, would also have to be reduced, the collieries being so much nearer London. Very little steam-coal is being disposed of, and there is but a limited output of coke, most of the supplies required being obtained from South Yorkshire makers.

DURHAM.—The pig-iron trade has been very steady. The returns of stocks, giving a decrease of over 8000 tons, has not affected the market either way, the result being previously discounted, and makers remaining firm at their late quotation of 43s. 6d. No. 3, the middle men who have any iron for sale being at the same rate for prompt delivery. For forward account merchants are offering to sell iron which they have yet to purchase at 43s. No. 3, but the quotation is largely a nominal one, as there are practically no buyers at the figure. The shipments of pig-iron last month were small, but owing to purchases for Russia, to which country increased quantities are likely to be sent as extra import duties are to be imposed, it is hoped that they will show a speedy improvement. There has been a good deal of iron lately disposed of; consumers who had been holding back while the battle of the "bulls" and the "bears" was in progress are now coming forward, believing that there is not likely to be any reduction in price, while there is a possibility of some rise taking place. The general opinion is, however, that the makers will do well not to be seduced into raising their rates, but to let the Scotch market rise, if it will do so, to a considerable extent. The effect of the pig-iron of the North of England being so much higher than Scotch and other iron in proportion, was shown last month by the small deliveries to Scotland, amounting to 12,691 tons only —not half the usual quantity—and to South Wales 6410 tons. The business doing in manufactured iron has improved somewhat. There has been an increase of demand, and prices have been steadier. There has been no actual advance of prices, but there has been rather a rally from the drooping tendency which lately appeared, and manufacturers are consequently firmer than they were, having no no need to accept prices which undersell the ordinarily quoted figures. The general prices are about:—Bars, £6 2s. 6d. to £6 5s.; angles, £6 5s.; ship plates, £6 15s.; boiler plates, £7 15s.; sheets, £8, less 2½ per cent. Ship plates, where there is urgent demand for present delivery, are £7 per ton. The figure for puddled bars is about £4 nett. The steel rail trade keeps quiet, owing to the strength of competition for what orders appear. The prices are run down, therefore, until £5 and even less has, it is said, been taken for ordinary heavy steel rails. Figures like this will greatly minimise the profits of steel-rail producers. There is a better demand appearing for hematite iron, and the prices are firmer. The household coal trade is showing rather more activity for shipment, but otherwise it is extremely slack, and collieries have been taking lower prices. Coke is firm at late rates, 10s. to 10s. 6d. for furnace sorts at the ovens, and foundry coke 1s. to 2s. more, according to brand. The steam-coal trade, which was lately interrupted by the holidays taken by workmen, is now pretty steady, with a fair demand.

EAST WORCESTERSHIRE.—The number of furnaces now in blast in the southern and eastern portions of the twin counties is 48, as against 49 at the commencement of June, one having been blown out for repairs. Stocks of pigs in makers' hands are less by one or two thousand tons than they were on June 1. All-mine pigs (hot air) are quoted at £3 7s. 6d. to £3 10s.; part-mine, £2 7s. 6d. to £2 10s.; common iron selle at about £2 to £2 2s. 6d. In the finished-iron industry the tendency in this district seems most decidedly towards better times. We can report things as looking more cheerful, and the existence of an improvement in the various departments of manufacture. The only drawback is the unsettled weather, but this has been somewhat local. With a good harvest we are sure to have a very brisk demand. The large strike of ironworkers which has raged in America during last month does not seem to re-act upon us much, although there have been several lots of iron sent over the water that would never have been asked for if there had been no strike in the States. Marked bars are firm at £7 10s.; and unmarked iron is inquired for; and several large lots have changed hands. Oolite ironstone is in demand as a mixture with better ones, but the supply is so great that we cannot report any increase in price. Coal does not sell very readily. Forge and manufacturing fuel is in most request; the demand is dull for household sorts. The collieries of this district are only working limited time. Makers are pushing sales of oven coke, which is in most abundant supply. It can be bought at quite 1s. per ton less than it could some two months ago.

FOREST OF DEAN.—The iron trade of the Forest continues without material alteration. Stocks of pig metal have undergone considerable reduction, and, as prospects are somewhat brighter, there may be expected a hardening of prices. Local quotations are already strenthened, and, having regard to the absence of stocks, the probabilities are favourable to the condition indicated. Tracing the reference last week on the subject of a couple of reported orders which had reached the Forest for manufactured iron, it appears that the numerical element was incorrect, inasmuch as, instead of 2, the figure 1 was the more precise quality. It will therefore be necessary, in making the correction, to say that a Forest firm have received an order (American) for manufactured iron, which is now in hand. Tinplates are slightly in improved request, but, as prices remain inconsistent with the idea of profit, it is not a very encouraging position of affairs. Having regard, however, to the substantial stocks of raw material, makers hold it only requires improvement of demand and enlarged prices in order to enable manufacturers to recover lost ground. The iron ore trade is not improved, and there is little prospect in that direction. Quotations range from 7s. to 11s. per ton at the mines. The coal trade is fully up to the average of previous years, and now that the half-yearly settlement time has passed, there are already evidences of an expansion of orders. The month was begun on Monday with actual animation at Lydney, in which the majority of shippers participated. This, in a measure, arises from the high tides of the Severn enabling the vessels engaged in the carriage of fuel to make expeditious trips. Some cargoes of Forest coal have been shipped this week for Ireland. The announcement a few days ago as to the forfeiture of galees in the Forest of Dean coal and iron ore is not an alarming matter, although it carried that construction. The forfeiture ordered by the Commission of Woods and Forests refers more especially to unworked properties, and has been brought about by failure either to pay royalty due to the Crown or neglect to develop the properties as required under more recent rules as applying to the Crown and their Forest galees.

GLASGOW.—A good tone continues to be maintained in the warrant market, and the scope of the "bears" that a smart reaction would suddenly send the price under 48s. again, seems less likely than ever to be realised, and there are many of those in the trade who say the price is bound to go over 50s. per ton, as the demand continues on an extensive scale, and that even 50s. is a comparatively low price for iron. The makers are well sold and busy with deliveries, many of the special brands, and of No. 3 ordinary brand, are scarce and difficult to be got promptly. Makers say their stocks are constantly being reduced, and they are very firm in their quotations at an advance of 1s. per ton, and as their prices are now high in comparison with warrants, it is expected that an inroad will be made in the large stock of iron in Connal and Co.'s store. The shipments for abroad are keeping well up, notwithstanding that high freights prevent any considerable quantity being sent up either the United States or Canada. The home consumption is still on a large scale, though more iron is now coming in from Middlesbrough, the lessened difference in prices permitting this to be done at a small profit where consumers are favourably situated for deliveries. In warrants a large business has been done daily, and it would seem as if the public were now operating more freely, though the bulk of the business is done on behalf of the regular dealers. On Thursday from 48s. 9d. to 49s. 3½d. cash, and 48s. 11½d. to 49s. 5½d. a month was paid; next day there was a reaction from 49s. 2½d. to 48s. 8d. cash and 49s. 4½d. to 48s. 11d. a month. On Monday from 48s. 8½d. to 49s. 0½d. cash and 48s. 11½d. to 49s. 3d. a month was paid. On Tuesday sales were made down to 48s. 9d. cash, but in the afternoon there was eager buying up to 49s. 4½d. cash and 49s. 7d. a month. On Wednesday the market opened strong at 49s. 6d. cash and 49s. 7½d. a month, but on some adverse news from Egypt, the price dropped at once to 49s. 2d. cash, afterwards rallying to 49s. 5d. cash and 49s. 7d. a month. Closing, buyers 49s. 4d. cash and 49s. 6d. one month, sellers ½d. per ton more. There are still 108 furnaces in blast. The shipments of pig-iron from Scotland last week were—foreign 11,414 tons, coastwise 3910 tons, total 15,324 tons, against 13,095 tons in the corresponding period of last year. The total increase in shipment since Christmas now amounts to 38,642 tons. The imports of Middlesbrough pig-iron into Grangemouth last week were 3330 tons, against 6061 tons in the similar period of last year. The total imports till July 1, 1882, are 109,922 tons, against 152,834 tons, being a decrease since Christmas of 42,912 tons. The stock of pig-iron in Connal and Co.'s store now amounts to 635,717 tons, being a decrease for the week of 983 tons. There is more doing in manufactured iron, and inquiries are more numerous. Most of the works are going steadily, though it is difficult to get any advance in prices. The exports of manufactured goods were again large, the chief items being locomotive machinery valued at £16,335, and sewing machines valued at £9298. The shipbuilders and engineers are very brisk, and most of the ironfounders have no cause for complaint. On Thursday of next week the annual Glasgow Fair holidays begin, when business generally will be at a stand for about a week. The imports of iron ore for the last week were small, but a number of arrivals were daily expected; the price of Spanish ore is steady, though English qualities are firmer. The coal trade shows an improving tendency, and a large volume of business is being done. The east coast exports are again very large, and stocks are diminishing in Fifeshire. The miners everywhere are working steadily. Prices show no change as yet, as the competition is still too keen.

LANCASHIRE.—Somewhat of a lull has come over business in the iron trade of this district, but prices generally remain firm, the orders booked recently enabling makers, as a rule, to be indifferent about pressing further sales at present. Lancashire makers of pig-iron have done a moderate business at their full rates, and are firm at 45s. to 46s. less 2½ for delivery equal to Manchester. Outside brands are still quoted at as high as 46s. to 47s. 6d. for Lincolnshire, and 48s. to 49s. for Derbyshire less 2½ per cent. delivered here, with transactions to a fair extent reported at under the top figures, although there are sellers in the market at less money. Occasional sales of Middlesbrough iron are made on the basis of 52s. per ton net cash for foundry qualities delivered equal to Manchester. Manufactured iron makers are generally in a better position. There are fair inquiries in the market, and orders have been secured which are keeping forge proprietors going. In bar iron prices show no tendency to stiffen, and sellers are firm at £6 7s. 6d. to £6 10s. per ton for delivery into the Manchester district, but for hoops, in which trade is only quiet, quotations are being made at as low as £6 5s. to £6 10s. per ton. The engineering trades are kept well employed both on special and general work, the former including a considerable inquiry for machinery connected with electric lighting. There is a good export trade being done in the general class of machine tools, especially to France, and cotton machinists are fairly busy, a good deal of this work being at present sent to the United States. In the coal trade business continues very dull, but this is due more to the enormous extent of the output than to the absence of consumption, as the coal-using branches of industry are generally busy, and apart from the house-fire coal trade, which is, of course, affected by the season of the year, requirements may be said to be fully up to an average. The large supplies coming into the market, however, far more than cover all the demand, and the pressure of accumulating stocks keeps prices. This is bringing about the consideration of the wages question, and the steps which are being taken by the largest coalowning firm in Lancashire for reducing wages to the point at which they stood prior to the advance at the close of last year are likely to lead to a serious strike in the St. Helen's district, which may be followed by a more extended struggle between the employers and the men. At the pit mouth the average prices are about as under:—Best coals, 8s. to 8s. 6d.; seconds, 6s. to 6s. 6d.; common, 4s. 9d. to 5s. 3d.; burgy, 4s. 3d. to 4s. 6d.; best slack, 3s. 6d. to 4s.; and common, 2s. 9d. to 3s. 3d. per ton.

LEEDS AND WEST YORKSHIRE.—Since our last report business has gone on steadily at the forges making best Yorkshire iron. No new requirements of any importance have been made known, and the output is principally plates, the unexhausted old orders for which will suffice to keep all hands in nearly full work for a considerable time yet to come. Nothing decisive has occurred with respect to a good market for best bar-iron opening shortly in the United States. The manufacture of common iron in this district still keeps within limited dimensions, and prices are unchanged, and likely to remain so. Makers of all kinds of locomotive engines keep well employed. There is more than an average of orders on hand for both railway and colliery tank engines and for road traction engines. Special tool makers are working on specialities rather than on orders connected with the large engineering shops of the country. The textile machinery trade is rather at a low ebb—at all events, so far as regards new orders accruing. Boiler-makers are at present fairly employed, but there are general complaints as to the prices obtained, which, it is alleged, do not admit of any recognition of the delay, anxiety, and red-tapeism which attends the adopted system of test and inspection. Agricultural machinery is not so brisk a branch as it was at the beginning of the spring. In consequence of the changeable weather of late some orders have been suspended or cancelled. The shovel and fender makers keep doing a steady trade, both home and foreign. One Leeds firm is expecting a large Government order for shovels immediately. Nut and bolt makers find business rather slacker, after a fairly good run of three or four months' duration. The cut-nail trade keeps at only a moderate level, but two of the leading firms continue to make improvements by the introduction of new machinery (both home and foreign patents). Throughout West Yorkshire three or four days a week is the stint of work at the collieries. There is no change in prices.

LIVERPOOL.—A still growing demand characterises the present market. After the torpor of buyers for the first four or five months of the year another period of activity was to be expected. This seems to be now well on the way, and autumn prospects, especially after the favourable weather of the last week, begin to look well assured. It would appear, in fact as if the same influences which brought about the revivals of trade which marked the autumns of the last three years are again at work, and that, unless marred by greatly unfavourable weather and political dangers, the last half of this year will be no exception to its predecessors. Pig-iron maintains its firmness, but has not brought out any save speculative buying here. American orders for pig are conspicuously absent. People do not yet seem to have realised the remarkably favourable statistics of pig-iron for the first half of the year, which show, both at Middlesbrough and Glasgow, decreases of stocks and decreases of production, with consequent increases of exports and increases of home deliveries, as compared with the similar period of 1881. The tinplate trade hardly moves, as might have been expected, seeing that there is a stiff advance in the prices of tin, and sheet iron is also dearer. American requirements in this article are singularly late this year, and have been much upset by the weather there and the labour troubles. Prices here do not advance therefore, and cokes are steady at 16s., charcoals at 19s. per box. Sheet iron is in very active demand, partly on American account, and some makers now ask substantial advances. Other classes of iron partake in the improvement, though to a lesser extent. Indian buying is again becoming of a pronounced character, and Australian is also looking up. In the United States, however, everything is upset, but there are some here who count on an autumn demand. This is largely a question of harvests, however, and as the balance of trade has been heavy against America for nearly nine months, a large demand cannot be looked for. No country, not being a carrying one, can continue to import in excess of its exports.

LONDON.—The metal market is better here. There seems more disposition to place orders, and in some departments makers are fully booked ahead. Iron pigs remain very firm. Scotch warrants have fluctuated since our last between 48s 7d. and 49s. 6d., closing 49s. 5d. Manufactured iron better. Copper has remained steady. Chili bars, £66 15s. English ingots, £71 to £72. Tin: There is a very strong market, and but little tin to be obtained. Shipments are very light, and consumption continues heavy. There is a large demand for English tin for the Continent. Fine foreign classes strong at £99 15s. Present price in the Straits is cabled £105 laid down here. Tinplates very firm; makers full of orders, cokes 1*s.

NEWCASTLE AND THE TYNE DISTRICT.—The crude iron trade of our district has maintained the steady character reported last week. Satisfactory exports are going away, and the market seems to be quite settled down into a steady groove. No change has taken place in prices, Cleveland No. 3 being still sold at 45s. 9d. for prompt delivery, whilst forward business can be done at 6d. less. No. 4 forge quality is quoted 44s. 9d., delivered in the Tyne. A better feeling has come over the manufactured iron, sales being more readily effected and in greater quantity than for some weeks past, shipbuilders having been extensive buyers. Prices, however, are not much changed. Ship plates make £6 17s. 6d. to £7, delivered to the Tyne yards, and for delivery in three months, £6 15s. to £6 17s. 6d. is the quotation; bars sell at £6 5s., angle iron at £6 7s. 6d., and boiler plates at £7 17s. 6d. to £8 less the usual commission. Iron shipbuilding is still briskly pushed forward on the Tyne, and would be on the Wear also were it not for the wages disputes that every now and again crop up. Inquiries as to new contracts are few and far between, and, and unless some improvement is seen in the rates of freight before the closing months of the year, this important industry will again become depressed. Engine manufacturers have plenty of orders on hand, and are getting them worked off as quickly as possible; but most of these orders are for marine engines, a branch of the trade that, of course, goes hand in hand with shipbuilding, and any dulness in the shipyards will quickly be felt by the engine makers. Forge work of a heavy class is readily obtained by forge owners, and foundries also are fairly busy. In bolts and rivets a steady business is done, and chain and anchor smiths are also kept pretty well employed. Business in Bilbao red ore is rather flat; the price is only 6s. 6d. f.o.b. at Bilbao, and the freight to the Tyne is not over 9s. per ton. Steam-coals are being shipped in great quantity for the Baltic and Mediterranean, and also to the Suez coaling stations and the East Indies. For the West Coast of South America large orders have recently been received for best steam-coals, the price of which is firm at 9s. per ton less 2½ per cent.; second-class sorts go away freely at 7s. 6d. to 8s. per ton, mostly for locomotive use. Gas, manufacturing and smithy coals are all steady and unaltered in value. Household kinds are dull, and prices irregular, export orders being scarce. The coke trade is brisk, foundry descriptions fetching 14s. per ton shipped, and blast-furnace sorts about 10s. at the ovens. Chemicals have considerably improved; soda crystals are quoted £2 13s. 9d. prompt and £2 14s. 6d. to £2 15s. delivery in a month; and soda ash 1¼d. less 4 per cent. Firebricks have a steady sale on former terms. Cement is shipped off as quickly as it can be made, and prices remain firm.

NEWPORT.—Activity in the make is one of the chief features visible in the iron and steel trades of the district, and the whole of the works continue to receive a good share of orders. There is at the present time a considerable quantity of railway material lying at the Alexandra Dock line awaiting shipment, and it is with difficulty that room is found for the quantity which arrives daily. In iron-ore transactions we have again no change to report. There are good stocks, and little is being done outside of contracts. We notice this week the arrivals of this article have been small. Pig-iron remains firm at 49s. 6d. to 53s. 6d. for foundry qualities of Middlesbrough pigs delivered ex-ship at Newport, and 47s. 6d. to 49s. for other qualities. At the above prices one or two contracts have been made for delivery over the next two months. For steel rails, blooms, and all kinds of finished iron, the demand is kept up, and orders continue to arrive in good number. Buyers are now sending in their orders, fearing a rise in the market. The quantity of iron, &c., shipped is below the average, but we expect an improvement in next week's returns. There is nothing new to report with respect to the tinplate trade, which still shows signs of a slight improvement. Prices remain firm at recent quotations. Steam coal shipments continue brisk, and prices are well maintained. There are no immediate appearances of any important movement. The demand, while not excessive, enables shippers to sustain a good stem, and also to refuse any reduction in price that may be offered. Several orders are in the market for Brazil, while there are a fair amount of inquiries for other parts of South America. House coals and coke are in steady request, and prices are firm for best qualities. In pitwood, although stocks are large, there is good enquiry, and prices are well maintained. During the week 23,958 tons of coal have been shipped, as compared with our last return of 27,039 tons. Of iron only 1940 tons were cleared, 1140 tons going to Montreal, and 800 tons to Genoa. 200 tons of coke also left the port. The imports comprised 5120 tons of iron ore from Bilbao, and 1060 from other directions. 1055 tons of pitwood also came to hand.

NORTH STAFFORDSHIRE.—The slight improvements noticed last week in the condition of the finished iron trade of this district is maintained, and the generally successful gathering in of the hay harvest tends to heighten the more cheerful tone which has lately set in. Although there is no strong influx of orders they are coming in steadily, and most of the works are kept going a good average time. The home market is assuming a healthier character, and specifications are being placed more regularly by merchants. Nothing is yet doing with United States, but the opinion prevails that demands form that quater will arrive before long, and that they will be arranged on terms more favourable to the seller than those which have recently ruled. Russia is sending scarcely anything to this country, but the colonial trade keeps pretty active. Prices are firmer, without any advance on the old list. If makers would accept contracts for forward delivery at present rates a good many could be secured, but they fight shy of committing themselves under the circumstances. There is a tolerabley brisk demand for the various classes of merchant iron, and a good business is doing in heavy sections—such as are used in building, &c. Plates continue to give the mills in their department nearly regular work, and a fair trade is going on in hoops. There is no change either in regard to pig-iron or ironstone. The latter is selling at from 8s. 9d. upwards. Coal continues to have a very limited sale, and the old complaint of profitless rates is still prevalent.

SHEFFIELD.—Throughout the whole of the heavy iron and steel trades there is a more cheerful tone noticeable, and some heavy transactions have taken place this week. Yorkshire made pig is in full request, at advancing rates over the closing prices of last quarter. The ironworks here are doing a really good business, and at remunerative prices. In the steel trade also there is very much steadier business than was the case before the close of last quarter. Bessemer is stiffer in price, and the leading makers are refusing to commit themselves to certain forward deliveries. Best Sawn Ends Bessemer billets are fetching £6 5s. per ton; super, for special purposes, £9 10s.; with extra admixture of foreign iron for tool purposes £12 to £13 10s. per ton. The latter special makers are selling freely. We notice that at one or two of the leading mills a large number of extra ironworkers have been put on; in one case upwards of 200. Sheet and plate mills are doing a tremendous trade, and at the present time the prospects for the autumn are really good. In the armour plate mills there is the greatest activity, and no doubt this department will be brisk for a considerable time to come—even on existing contracts, but others are no doubt following both on account of the home and foreign Governments. Swedish and Russian irons are stiffer in price, and agents here report a more extensive business. This is partly occasioned by the improved condition of the saw and file trades. Men engaged in those branches are obtaining fuller employment, and not many hands are left on the union funds. This is a good omen, especially in the summer months. It will have been noticed from the mail news that heavy mails and a considerable amount of specie are coming up from the ports on the West Coast of South America. This trade is very rapidly reviving, and Sheffield houses in this connection are obtaining good lines. These markets have been stagnant for at least ten years, but now that they are reviving a great improvement in the old staple branches must take place. It may be said with truth that ten or twelve years ago one-third of the cutlery made in Sheffield was shipped to the South American markets. Spanish buyers are coming up more freely, and the West Coast of Africa traders are again sending in good reports, and produce is following. This latter fact has caused a fall in the price of ebony. Ivory will advance in value, as supplies are shorter than ever. The the trade prospects of Sheffield are at present good, notwithstanding the falling-off in the rail trade. The railway companies have not yet decided on lowering their tariffs, which so seriously affect the commercial portion here.

SHROPSHIRE.—This has been a week of idleness pretty generally among local firms in the iron trade, who have been stock-taking and repairing. Finished iron manufacturers report that a few more inquiries continue to come to hand for the best qualities of iron; and although the trade is disturbed in anticipation of the approaching local quarterly meetings, the opinion gains ground that the current demand will exhibit an increase when these have taken place. It is also believed that present prices will be confirmed, as there are no circumstances that would warrant either a rise or decline. The pig iron trade of the district exhibits no reaction from previous reports, and prices continue the same.

SOUTH STAFFORDSHIRE.—It is no more than was to be expected, remembering that the quarterly meetings are to be held next week, that the iron trade should this week be quiet in the matter of new business. Nearly all the mills and forges, however, have enough orders to keep them fully going, and the only complaining is on the score of prices. In this particular every one would be glad to see a decided improvement. Still it is satisfactory that prices are rising a little, and that the prospects are favourable to further advances. Sheets and common bars show the most improvement in this regard; £8 might now be almost considered a low price for sheets (singles), and £8 10s. is the minimum for doubles. Best bars are £9 10s., second class £7, and common sorts £6 10s. £6 5s. Plates are easy at £8 5s. for ordinary sorts, and superior sorts are £9. Hoops are going to the colonies, and abroad in large quantities at £6 17s. 6d. to £7 per ton. Bedstead strips are £6 15s. All-mine pigs are 65s. to 70s. per ton, and this figure is likely to be redeclared at the quarterly meetings. Cinder pigs are 37s. 6d. to 40s. On 'Change in Wolverhampton on Wednesday there was a report current that some of the specimens of basic steel made from local pigs, which had been worked up by the chain and cable makers, had proved deficient in tensile strain, although the metal had welded well. More definite information on the point will be shortly forthcoming. The hardware trades are without much change. The half yearly stocktakings are interfering with business, and the unfavourable weather is checking orders from the agricultural centres. The advance in wrought iron tubes announced by Jno. Russell and Co., of Walsall, is a satisfactory indication of business.

SWANSEA.—Last week's import and export trades have been of a full average; the iron works are well employed, and fresh enterprises are contemplated. The tinplate trade is most depressed at the adjoining town of Neath. The new harbour works are being pushed forward, and will be completed in another eighteen months. At Llanelly, too, there is much activity apparent, several disputes, from which serious consequences were apprehended, have been satisfactorily settled.

WEST CUMBERLAND.—There is still a very cheerful tone in the hematite iron trade of West Cumberland, and the business doing is considerable. New orders are coming to hand from foreign consumers, and America and the Continent are still playing a very important part in the purchase of crude iron and manufactured steel. The disposition is in the direction of a still better state of things, and on all hands confidence is shown that in the immediate future business will be good, and that makers of iron and steel will have plenty of work. The furnaces are producing more iron, owing to the blowing-in of some, which for a long time have been idle. Stocks are smaller than they were, and at present may be considered not too large for the extent of business which is being done. Shipping is busily employed, and large consignments of metal are being exported to America, the Continent, and elsewhere. The orders which makers hold at present are to a large extent for the foreign market, and it is therefore probable that, at any rate up to the end of October, there will be a continual draw on the resources of producers; and it is therefore probable that a further increase in the output will be necessitated. No. 1 Bessemer is quoted at 57s.; No. 2, 56s.; No. 3, 55s. per ton nett, delivery at three months. The various steel works throughout the district are very well-off for orders, and are working full time. The sales of rails and other railway material have been large lately, and several very heavy contracts are still pending. A good trade is being done in merchant qualities of steel, but the finished iron trade, which at one time was one of the industrial features of the district, has almost entirely lapsed. Shipbuilders are very well employed, and are expecting new orders. Iron ore is in steady request at unchanged prices, 13s. 6d. to 16s. representing the margin of values between average and best qualities. The coal and coke trades are well employed, and native qualities find a good market. The shipping trade is brisk, and there is a large export of iron and steel, together with a fair import of foreign ores, which are consumed for mixing purposes by the furnaces in the district.

CLEVELAND PIG-IRON SHIPMENTS.

The following table contains comparative statements of the weekly shipments of Cleveland pig-iron from the beginning of this year and the years 1881 and 1880, up to last week, as well as the monthly shipments from January to June of 1882 and the previous four years:—

WEEKLY SHIPMENTS.

Week ending		1882. Tons.	1881. Tons.	1880. Tons.	1879. Tons.	1878. Tons.
Jan.	7	14,992	12,331	14,347	—	—
	14	18,128	13,454	21,712	—	—
	21	16,125	10,246	19,384	—	—
	28	18,648	6,893	15,315	—	—
Feb.	4	14,990	9,761	11,988	—	—
	11	15,591	15,035	18,082	—	—
	18	14,929	14,681	15,725	—	—
	25	16,941	16,116	21,055	—	—
Mar.	4	25,669	19,115	28,546	—	—
	11	21,245	13,474	14,322	—	—
	18	19,400	17,464	18,295	—	—
	25	15,433	19,370	24,241	—	—
April	1	19,850	20,498	12,138	—	—
	8	17,530	13,154	22,145	—	—
	15	14,934	19,390	18,835	—	—
	22	16,406	19,221	17,111	—	—
	29	16,286	22,946	20,878	—	—
May	6	14,000	15,537	20,509	—	—
	13	16,841	15,395	19,239	—	—
	20	17,609	16,480	16,471	—	—
	27	16,801	21,426	21,648	—	—
June	3	8,943	17,568	22,400	—	—
	10	17,678	19,796	18,368	—	—
	17	15,596	21,834	17,078	—	—
	24	15,715	21,827	12,312	—	—
July	1	23,803	22,802	24,117	—	—
Totals		441,083	435,831	486,261	—	—

MONTHLY SHIPMENTS.

	1882.	1881.	1880.	1879.	1878.
Jan. 31	71,458	47,890	78,941	39,751	47,932
Feb. 28	66,893	58,370	71,573	57,458	51,697
Mar. 31	89,837	81,603	84,375	73,105	61,386
April 30	68,909	78,894	88,018	65,250	69,256
May 31	71,405	75,729	81,829	71,456	74,043
June 30	68,373	91,577	82,186	60,808	68,808
Totals	436,875	434,069	486,922	367,828	373,122

SCOTCH PIG-IRON SHIPMENTS.

The table below (copied from the *Public Ledger*) is a comparative statement of the weekly shipments of Scotch pig-iron from the beginning of this year and the corresponding weeks of the previous four years, up to last week. The shipments were:—

Week ending		1882. Tons.	1881. Tons.	1880. Tons.	1879. Tons.	1878. Tons.
Jan.	7	3,389	6,181	6,689	6,069	6,085
	14	5,767	6,677	12,288	6,291	4,532
	21	7,742	4,608	7,566	6,331	6,170
	28	8,041	8,906	13,383	4,969	6,550
Feb.	4	12,236	7,226	14,190	6,130	5,637
	11	10,786	10,072	10,612	7,272	5,722
	18	10,528	7,405	15,152	8,996	5,124
	25	10,739	11,266	12,603	8,318	7,836
March	4	12,600	9,900	17,968	13,910	6,816
	11	13,287	8,261	23,985	10,743	8,662
	18	17,544	7,893	20,987	11,167	7,725
	25	12,375	12,262	23,598	9,463	11,499
April	1	10,107	10,421	15,822	15,653	7,448
	8	12,662	10,647	18,309	12,913	9,441
	15	11,694	13,736	15,784	13,228	9,513
	22	14,170	11,492	16,279	11,705	8,382
	29	18,056	13,147	17,749	12,923	8,853
May	6	11,387	9,461	14,799	13,135	9,248
	13	14,982	10,718	13,123	9,919	7,820
	20	12,122	9,532	11,036	11,415	10,742
	27	9,760	11,943	12,819	15,434	7,362
June	3	9,867	14,509	13,198	8,402	7,008
	10	14,270	12,331	11,860	6,156	10,310
	17	15,308	13,537	9,502	7,278	6,326
	24	10,147	10,977	11,514	7,074	7,185
July	2	15,324	13,095	12,527	8,252	7,416
Totals		304,890	266,204	373,342	253,236	202,502

THE CONTINENTAL IRON AND COAL TRADE.

BELGIUM.—The firmness of the Belgian iron market increases with the greater demand for all descriptions of iron. Pig-iron is steady. Luxemburg pig makes 50 fr. The base price of manufactured iron is now 140 fr., and makers are reluctant to engage themselves for forward deliveries, reckoning upon an early advance. Rail mills are very full of work.

The Belgian coal market preserves its previous favourable tendency. Domestic coal remains quiet, and prices are stationary, but the quotations of other descriptions of fuel are rising, and values are now from 1 to 2 fr. above those ruling at this time last year. The latest quotations are:—

	June 17. Francs.	July 1. Francs.
"Fines"	7·50—11	8—10
"Gailleteux"	9·50	9·50—10
"Tout-venants"	11	11—11·50
"Houilles"	18	23
Coking-coal	10·50—11	10·25—10·50
Coke	17—18	17—18

FRANCE.—In the Meurthe-et-Moselle, foundry pig is very active, the Longwy district feeling the effects, to a great extent, of the improvement which has taken place in foreign markets. The weakness which existed in Belgium and Germany caused buyers in the district to hesitate; but as soon as firmness set in abroad, consumers knew that they had nothing to hope from the foreign producer, and were willing to pay the prices demanded. Quotations are at present 90 fr. for No. 1 foundry, 82 fr. for No. 3, and 72 fr. for forge pig. In the Haute-Marne, business continues animated. Prices remain without change, at 210 fr. to 230 fr. In the Nord, works maintain their quotations, which are as follows:—

	Francs.
Merchant bars	190—195
Plating iron	200—205
Angle iron	200—205
Joists	190—195
Heavy plates	220—230
Ordinary plates	250—255
Boiler plates	280—290

At Paris, values remain 205 fr. for merchant iron and 215 for joists. There is more firmness in the market, but the demand is not of such a nature as to warrant an increase in price. Old rails are offered at 120 fr. without buyers, who are unwilling to give more than 117 fr. 50 c. We mentioned in our last issue that 200,000 tons of steel rails would soon be required for the State railways. The exact quantities are 187,432 tons, the delivery of which is divided as follows:—

36,456 tons in 1883,
109,650 " " 1884,
41,326 " " 1885.

French steel rail mills, therefore, have a fair amount of work in store for them.

GERMANY.—According to the statistics published in *Stahl und Eisen* by the German Iron and Steel Institute, the production of pig-iron in the German Empire (including Luxemburg) rose in May to 243,301 tons, of which 152,383 tons were forge pig, 17,676 tons foundry pig, 57,737 tons Bessemer pig, and 12,805 tons Spiegeleisen. The production in May 1881, was 224,212 tons. During the first five months of 1882 there were produced 1,265,745 tons, against 1,118,283 tons in the preceding year.

Herr Hilgenstock, chief engineer at Hörde, at the meeting of the Association of German Blast-furnace Owners, submitted some interesting information respecting the difference in price of Thomas and Bessemer pig. According to him, it is between 22 and 23 marks per ton. Thomas iron, says Herr Hilgenstock, requires at least 400 kilogrammes of coke less per ton than Bessemer iron, which would give a difference in favour of the former of 4 to 5 marks. For ore and lime the expense is about 18 marks less. Altogether, therefore, the above estimate as to cost is correct. To this must be added that, under equal conditions, for Thomas pig the cost of labour and working expenses are lower than for Bessemer pig. The difference in the cost of production would be still greater if a rise were to take place in fuel, such as was the case in 1879-80, when the price of coke rose to 30 to 40 marks per ton.

The improvement in the German iron market continues. In Westphalia the demand for both pig and finished iron is very active. Prices have a rising tendency. Latest official quotations at Dortmund for iron and steel per 1000 kilogrammes at works (English descriptions per ton at port of shipment), are:—

	June 5. Marks.	July 3. Marks.
White-grained puddling pig	62	65
Spiegeleisen	74	76—78
German foundry pig No. 1	76	75
German foundry pig No. 2	71	70
German foundry pig No. 3	65	65
German Bessemer pig	66	66—[illegible]
English foundry pig No. 3	41	41—45
English Bessemer hematite pig	51	55
Luxemburg pig	47	47½
Bar-iron	135—140	140—145
Fine-grained iron	170	170
Angle-iron	150	150
Joists	150	150
Boiler-plates	215	215—220
Boiler-plates No. 2	200—205	200—205
Fine-grained plates	250	185
Charcoal plates	275	275
Low Moor plates	305	305
Bessemer steel rails	150½—160	155—165
Bessemer steel rails (defective)	125	125
Bessemer steel pit rails	130—140	135—143
Iron pit rails	135	135

At a recent conference of Silesian ironmasters with Silesian and Berlin iron merchants, an agreement was come to which will exercise some influence on the German iron market for some time to come. Dealers have lately been rather reserved as to orders, believing that they would be able to depress prices. The ironmasters declared at the meeting that the present state of the iron trade does not allow of reductions, and that they must adhere to their quotations. In consequence of the exchange of ideas at the meeting, merchants have shown a disposition to meet manufacturers, and have agreed to pay from 2½ to 5 marks more per ton. The result of this arrangement has been that between 20,000 and 25,000 tons of iron have since changed hands, and that the Silesian iron market has become firmer. Pig-iron is steady. Puddling iron maintains its quotations, which are from 66 to 68 marks per 1000 kilogrammes at works. The weekly production is about 7500 tons. Foundry pig sells at 71 to 72 marks. Finished iron is firm, 140 marks being the base price. Sheet iron passes off readily at 185—190 marks and 215—220 marks.

Like the iron trade, the German coal trade is flourishing. Nearly all collieries and coke ovens have engaged their output for the third quarter, and for new orders an advance is asked. A good autumn business is expected. The following are the quotations at Dortmund per 100 cwt. at the pit's mouth or at coke ovens:—

	June 5. Marks.	July 3. Marks.
Best coal (Stückkohle)	40—45	38—43
Cobbles	36	36—40
Large washed nuts	37½—40	37½—40

	June 5. Marks.	July 3. Marks.
Washed smith's coal	30	30—33
Screened coking coal	25—27½	26—28
Inferior coal	15—20	15—20
Gas coal	36	36—37
Mixed coal	27—30	27—30
Prime coke	55—60	55—62½
Patent coke	60—70	60—70
Small coke	35	35—40

SCOTCH PIG-IRON QUOTATIONS.

(From the *Glasgow Herald*.)

NEW YORK, Wednesday.

	Th.	Fri.	Sat.	Mon.	Tu.	Wed.
Gartsherrie (in yard)	25½	25½	25½	—	—	25½
Coltness (at quay) ..	26	26	26	—	—	26½
Langloan	25½	25½	25½	—	—	25½
Glengarnock	25	25	25	—	—	25
Carnbroe	25	25	25	—	—	25
Summerlee	25	26	25	—	—	26
Eglinton (at quay) ..	23	23	23	—	—	23
Shotts	26½	26	26	—	—	26
Calder	—‡	—‡	—‡	—	—	—‡
Carron	24½	24½	24½	—	—	24½
Dalmellington ..	—‡	—‡	—‡	—	—	—‡
Kinneil	—‡	—‡	—‡	—	—	—‡

‡ None here.

NEW PATENTS.

ALL the Patents are placed Alphabetically, with the official numbers attached. The New Applications range from No. 3201 to No. 3138, being the entries from June 27, to July 3, 1882.

NEW APPLICATIONS

Abstracting Gold and Silver.—*R. Barker, Seacombe, Cheshire.* [3046

Agricultural Elevators.—*R., J., and H. Wilder, all of Wallingford, Berks.* [3105

Apparatus for Heating, &c., Water.—*S. Newbold, and S. Thornley, both of Liverpool, Lancs.* [3082

Apparatus for Lifting Barrelled Beer, &c., above their Level.—*W. Wood, and W. Whitaker, both of Burnley, Lancashire.* [3117

Apparatus for Preparation of Carbon Filaments.—*A. R. Leask, and F. P. Smith, both of Holborn Viaduct, Middlesex.* [3099

Apparatus for Receiving and Collecting Waste Matter in Houses.—*F. M. Bonnefin, Leadenhall Street, Middlesex.* [3034

Apparatus for Regulating the Production of Electricity.—A communication.—*J. C. Mewburn, 169, Fleet Street, Middlesex.* [3054

Apparatus for Removing Ingots from Moulds.—*T. Hampton, Sheffield.* [3056

Apparatus for Removing Surplus Bronze from Paper, &c.—*J. Bromley, Hunslet, Leeds, Yorks.* [3112

Apparatus for Slicing Materials into Strips.—*J. B. Whitehead, Ilkley, Yorks.* [3045

Apparatus for Trapping Mica Pits.—*J. Levering, and R. Martin, both of St. Austell, Cornwall.* [3102

Apparatus for Washing Wool.—*J. Petrie, jun., and F. W. Petrie, both of Rochdale, Lancs.* [3094

Apparatus used in Manufacture of Gas.—*S. Chandler, jun., and T. Chandler, both of Newington Causeway, Surrey.* [3024

Arc Electric Lamp.—*R. H. Courtenay, Southampton Buildings, Middlesex.* [3101

Arrangement of Machines for Syringing Leaves of Plants.—*J. A. Drake, and R. Muirhead, both of Maidstone, Kent.* [3037

Artificial Stone.—*R. Searle, 93, Amhurst Road, Hackney, Middlesex.* [3049

Artificial Stone.—*G. Hodson, Loughborough, Leicester.* [3127

Blowpipe Lamp.—*J. T. Garratt, Camberwell, Surrey.* [3026

Breech Loading Firearms.—*H. A. A. Thorn, 151, New Bond Street, Middlesex.* [3089

Breech Loading Small Arms.—*T. W. Webley, and T. Brain, both of Birmingham, Warwick.* [3053

Bricks and Tiles.—*W. A. M. Valon, Ramsgate, Kent.* [3103

Bulge Barrel Hooks.—*W. Downs, Liverpool, Lancs.* [3071

Carbonate of Soda.—*C. Wigg, Liverpool, Lancs.* [3125

Cartridges.—A communication.—*H. E. Newton, 66, Chancery Lane, Middlesex.* [3055

Chucks for Turning Lathes.—A communication.—*H. H. Lake, Southampton Buildings, Middlesex.* [3057

Combined Steam and Hand Steering Apparatus.—*J. Hastie, Greenock, Renfrew.* [3124

Combing Wool, &c., Machinery.—*J. W. Bradley, and J. Wood, both of Bradford, Yorks.* [3088

Detaching Hooks.—*J. King, Pinxton, Derby.* [3021

Door Furniture.—*J. Brownrigg, Windermere, Westmoreland.* [3110

Dynamo Electric Machines.—*W. E. Ayrton, and J. Perry, Finsbury, Middlesex.* [3036

Dynamo Electric Machines.—*E. A. Sperry, Cortland, New York, U.S.A.* [3025

Electric Arc Lamps.—A communication.—*E. de Pass, 68, Fleet Street, London.* [3070

Electric Lamps.—A communication.—*J. H. Johnson, 47, Lincoln's Inn Fields, London.* [3079

Electric Logs.—*R. M. Lowne, East End, Finchley, Middlesex.* [3128

Electric Railways, &c.—*H. Binko, Queen's Road, Finsbury Park, Middlesex.* [30734

Excavating Earth for Sinking Tubing.—A communication.—*W. R. Gedge, 11, Wellington Street, Strand, London.* [3085

Fan Suitable for Exhaust or Blast Purposes.—*G. M. Capell, Passenham, Northampton.* [3130

Fitting for Horseshoes.—*J. Vernon, Newton Stewart, Scotland.* [3027

Floating Lights.—A communication.—*C. D. Abel, 28, Southampton Buildings, Middlesex.* [3030

Fluid Meters.—*J. R. and T. W. Harding, both of Leeds, Yorkshire.* [3068

Galvanic Batteries.—*C. P. Nezeraux, Paris, France.* [3039

Galvanic Batteries.—*J. H. Davies, Ipswich, Suffolk.* [3120

Generators.—*L. P. Martin, Vienna.* [3115

Generating Electricity Machines.—*T. Varley, Walthamstow, Essex, and H. B. Greenwood, Monmouth Road, Middlesex.* [3129

Glass Furnaces.—A communication.—*E. de Pass, 68, Fleet Street, London.* [3029

Glass Melting Furnaces.—*L. le Breton Mount, Melbourne, Victoria.* [3051

Grain Elevators.—A communication.—*H. E. Newton, 66, Chancery Lane, Middlesex.* [3134

Incandescent Electric Lamps.—*F. L. Willard, 85, Hooton Street, Middlesex.* [3042

Indiarubber Tyres.—*A. J. Wyley, and B. Collins, both of Manchester, Lancs.* [3022

Imitating Articles of Glass.—*C. H. Stearn, 51, Osborne Road, Newcastle-upon-Tyne.* [3114

Instrument for Drawing Corks.—*T. P. Wymond, Gresham Buildings, Basinghall Street, London.* [3043

Internal Bottle Stoppers.—*W. Frogyatt, Nottingham.* [3041

Joint for Detachable Gas Lamps.—*W. R. Wynne, 116, High Holborn, Middlesex.* [3062

Lawn Tennis Bat Handles.—*C. W. Melior, Gracechurch Street, London, and R. C. B. Moth, Tollington Park, Middlesex.* [3050

Looms.—*C. Callow, Burnley, Lancs.* [3069

Looms.—*J. Dodd, Oldham, Lancs, and W. Adam, Kidderminster, Worcester.* [3087

Machinery for Cleaning, &c., Fur.—*J. Woodrow, Stockport, Chester.* [3065

Machines for Cleaning Knives, &c.—*R. Walwork, Manchester, Lancs.* [3040

Machinery for Preparing Cotton.—*S. Lord, and J. Kabery, both of Rochdale, Lancs.* [3052

Machinery for Sewing Carpets.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [3100

Magnetic Compasses.—A communication.—*F. Belbeder, Foxley Road, Surrey.* [3061

Malt Extract.—*L. Hoff, London.* [3135

Means for Forming Temporary Partitions.—*J. W. Cook, Bury Street, Middlesex.* [3028

Mechanical Parts of Musical Instruments.—*J. M. Draper and J. B. Draper, both of Blackburn, Lancs.* [3119

Mills for Grinding Corn.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [3076

Overflows of Valve Closets.—*H. Conolly, Hampstead Road, Middlesex, and A. E. Hubert, Chelsea, Middlesex.* [3095

Pencils.—*J. D. Sprague, Beulah Hill, Upper Norwood, Surrey.* [3008

Permanent Way of Railways.—A communication.—*A. M. Clark, 53, Chancery Lane, Middlesex.* [3131

Photographic Cameras.—*G. Hare, Calthorpe Street, Gray's Inn Road, Middlesex.* [3035

Picker Arms for Power Looms.—*W. Alexander, Dundee, Forfar.* [3104

Plating Metal Surfaces with other Metals.—A communication.—*A. M. Clark, 53, Chancery Lane, Middlesex.* [3122

Ploughs.—*J. Howard, and E. T. Bousfield, both of Bedfordshire.* [3093

Preventing Explosions with Coal Dust.—A communication.—*G. W. von Nawrocki, Berlin, Germany.* [3059

Process for Manufacture of Hyposulphite of Soda.—A communication.—*G. W. von Nawrocki, Berlin, Germany.* [3072

Producing, &c., Motive Power.—*J. Jeffs, Islington, Middlesex.* [3133

Production of Certain Derivatives of Alpho Oxyhydro Chinoline, &c.—A communication.—*J. Erskine, Glasgow, Lanark.* [3044

Production of Sound Ingots.—A communication.—*A. Longsdon, New Broad Street, London.* [3064

Productions of Carbons for Incandescent Electrical Illumination.—A communication.—*F. S. Isaac, Queen's Gate Gardens, Middlesex.* [3013

Propellors.—*R. Bell, Liverpool, Lancs.* [3106

Protecting Telegraph Wires.—A communication.—*G. M. Cruikshank, Glasgow, Lanark.* [3048

Refining, &c., Saccharine.—*D. MacEachran, Greenock, Renfrew.* [3063

Rendering Peat Suitable for Litter for Horses.—*S. D. Cox, New Charlton, Kent.* [3113

Rollers used for Transferring Printing, &c.—A communication.—*E. C. Hancock, Worcester.* [3058

Root Cutting Machinery.—*S. Copeland, Beverley, Yorks.* [3084

Safety Lamps.—*W. Jenkins, and D. Morgan, both of Treorky Glamorgan.* [3032

Safety Oar.—*H. O. A. E. Grunbaum, Stratford, Essex.* [3109

Safety Valves.—*G. W. Collins, Moss Side, Manchester, Lancashire.* [3092

Secondary Batteries.—A communication.—*H. J. Haddan, Kensington, Middlesex.* [3108

Secondary Batteries.—*A. Watt, Liverpool, Lancs.* [3097

Secondary Batteries.—*C. H. Cathcart, Cressingham Grove, Sutton, Surrey.* [3107

Securing Buttons, &c., to Boots, &c.—*R. C. Barron, Whitecross Street, London.* [3060

Self-Acting Mules.—A communication.—*C. A. Barlow, Manchester, Lancs.* [3090

Scouring, &c., Hanks of Fibrous Materials.—*J. F. Kilburn, Meltham, Yorks.* [3111

Screw Propellers.—*J. Carr, Heaton, Northumberland.* [3067

Shackles.—*R. M. Ruck, Chatham, Kent.* [3136

Sharpening Saws Apparatus.—A communication.—*C. P. Martin, Southampton Row, Middlesex.* [3077

Side Saddles.—*G. T. Jenkins, Middle Temple, Middlesex.* [3126

Sporting Cartridge Cases.—A communication.—*C. D. Abel, 28, Southampton Buildings, Middlesex.* [3137

Stable Fittings.—*D. McGill, Peckham, Surrey.* [3038

Stamping Ink.—A communication.—*F. Wirth, Frankfort on the Main, Germany.* [3086

Steam Boiler Furnaces.—*W. Bell, Lancs.* [3076

Steam Boilers.—*J. T. Ward, Ossett, Yorks.* [3118

Stop Valves.—*J. A. and J. Hopkinson, both of Huddersfield, Yorks.* [3080

Swivel.—*W. Skelhorn, 32, Hatton Garden, Middlesex.* [308

Syphon for Drawing off Liquids.—*F. Sara, Plymouth, Devonshire.* [312

Telephone Receivers.—A communication.—*W. Spence, 8, Quality Court, Chancery Lane, Middlesex.* [3047

Treatment of Hops.—*W. G. Forster, Streatham Common, Surrey.* [3075

Tunnelling and Quarrying Slate.—*G. Hunter, Egham, Surrey.* [3138

Utilisation and Preparation of Certain Deposits.—*J. C. W. Stanley, Barnsdale Road, Middlesex.* [3091

Utilising Power Required to Stop Tramway Cars.—*F. J. Prince, 32, Queen's Road, Peckham, Middlesex.* [3 31

Utilising Rise and Fall of Tidal Waters.—*I. A. Timmis, 17, Great George Street, Westminster, Middlesex.* [3078

Valves.—A communication.—*A. M. Clark, 53, Chancery Lane, Middlesex.* [3132

Velocipedes.—*W. J. Lloyd, Harborne, Staffs.* [3121

Velocipedes.—*G. Moss, 46, Barbican, London.* [3023

Venetian Blinds.—*E. V. Emery, Canonbury, Middlesex.* [3116

Water Waste Preventors.—*H. Conolly, Hampstead Road, Middlesex.* [3096

Working Railway Points Apparatus.—*W. Stroudley, Brighton, Sussex.* [3066

Writing Ink.—*E. Detmold, Putney, Surrey.* [3083

ABSTRACTS OF SPECIFICATIONS RELATING TO METALS

PUBLISHED DURING THE WEEK ENDING JULY 1, 1882.

(Prepared by PHILIP M. JUSTICE, 53, Chancery Lane, W.C.)

Cast Iron.—4002 (1881).—*Haddan*, communicated by J. Chaine. Provisional Protection not allowed.—In the manufacture of pig-iron by this invention, the ores, fluxes and fuel are applied in a pulverulent state and are dried and heated before their introduction into the blast-furnace.

Malleable Iron.—5107 (1881).—*Lake*, communicated by G. Beals.—The ore or iron bearing material is coarsely pulverised and mixed with carbonaceous matter. The hearth of the furnace is then so charged that the mixture lies against both bridge walls, and slopes towards the middle of the hearth, a free space being left in said middle. When the iron on the sloping surface has come to nature, it is raked down upon the free space in the centre of the hearth, and worked into a ball.

Permanent Way.—5220 (1881).—*Browning*, communicated by B. Leslie. Provisional Protection only.—The sleeper consists of a flat plate having a central longitudinal rib on its underside. The plate after being rolled is cut out to a considerable extent at the middle part, on each side of the rib, thus forming a sleeper presenting at each end a broad flat surface for bedding firmly on the ballast.

Rings, Hooks, &c.—5227 (1881).—*J. V. Hope.*—Upon a sliding bar preferably, reciprocating vertically in guides, is fixed a central die which shapes the inside of the article. This die is fixed to a plunger on one side. For rings, a side bearing is requisite as the two ends of the rod or bar forming the ring must meet, but with horseshoe or other shaped bodies, it is desirable to make them immediately beneath the plunger, and in this case the plunger carries the central die on its end or in a fork. The various other dies required, are placed around the central one.

Separating Ores, &c.—5246 (1881).—*Glaser*, communicated by F. Büttgenbach.—In a raised position is placed a centrifugal machine of any suitable known construction, into the top of which the mixed substances to be sorted are introduced. The centrifugal machine is by preference constructed with several stages one above the other, so that as the material passes down, it is repeatedly thrown against the walls of the machine. Arrived at its lower end the material is made to pass into a screening drum.

Purification of Metals.—5257 (1881).—*Pitt*, communicated by H. Harmet.—A vertical receiver having a combustion and puifying chamber is charged from the top with solid matters, (metal and reagents), in suitable proportions. These are simultaneously melted, the fusion taking place at the lower part of the receiver. The crucible which receives all the liquid matters and at the bottom of which the metal concentrates is either fixed or movable. When necessary, a jet of air under low pressure is thrown into the crucible to agitate the contents and hasten the reaction.

Furnaces.—5285 (1881).—*J. Redgate.*—In each furnace, two or more bearing bars are employed lying in the direction of the length of the fire box or flue. The ends of these bearing bars are formed on the underside to fit the inner edge of the dead plate on one end, and the bridge bearer at the other end. And on the opposite side on the lower edge is a recessed bracket provided with a set screw for adjustment, the position of this bracket varifying according to the length of the fire bars employed in the recesses of the bearing bars. Each fire bar is formed of the requisite shape at each end to rest on the bearing surfaces.

Furnaces.—5294 (1881).—*E. Kaulbach.* Provisional Protection only.—A longitudinal opening is provided in the centre of the bottom of the furnace, which varies in size in proportion to the dimensions of the latter. Said opening wide at the mouth tapers downward somewhat funnel-shaped, and is formed partly of bars It is connected at its lower or outer extremity with a horizontal cylinder in which is a perpetual screw, which serves to force the coal into the furnace beneath the burning fuel.

Vehicle Axles.—79 (1882).—*Pieper*, communicated by J. F. Schmid.—An arm or journal passess over into a cylindrical neck somewhat smaller in diameter than the former and fitted with a flat surface, while the end of the arm is provided with a screw thread as usual. An obturating ring made of phosphor bronze and fitting tightly on the neck has on its inside a flat part serving to prevent a rotation of the ring on the axle. The above arrangement serves to prevent the egress of lubricating material from the axle.

METROPOLITAN BOARD OF WORKS.

RETURN *of the Testings made at the Gas Testing Station during the Week ending July* 4, 1882.

Company and District.	Illuminating Power.* (In standard sperm candles.) Max.	Min.	Mean.	Sulphur. (Grains in 100 cubic feet of gas.) Max.	Min.	Mean.	Ammonia. (Grains in 100 cubic feet of gas.) Max.	Min.	Mean.	Sulphuretted Hydrogen.	Pressure.†
Gas Light and Coke Company.											
Notting Hill ...	17·4	17·1	17·3	13·5	11·9	12·6	0·4	0·0	0·2	None	In excess.
Camden ...	17·6	16·6	17·0	13·0	11·0	11·8	0·2	0·0	0·1		
Dalston... ...	17·2	16·8	17·1	11·8	10·5	11·3	0·0	0·0	0·0		
Bow	17·3	16·7	17·0	16·8	11·3	13·6	2·6	1·1	1·8		
Chelsea... ...	17·0	16·6	16·8	13·8	12·2	13·0	0·2	0·0	0·0		
Kingsland Rd.	17·6	17·2	17·4	16·5	9·3	10·4	0·1	0·0	0·1		
Westminster (cannel gas)...	21·7	21·3	21·5	10·1	8·4	9·2	0·2	0·0	0·1		
South Metropolitan Gas Company.											
Peckham ...	16.8	16·4	16·6	10·1	9·0	9·7	0·4	0·0	0·1		
Commercial Gas Company.											
Old Ford ...	17·3	16·7	17·0	12·3	9·0	10.0	0·4	0·1	0·3		
St. George-in-the-East ...	17·5	16·3	17·1	11·7	9·8	10·4	0·6	0·2	0·4		

W. J. DIBDIN, F.I.C., F.C.S.

Consulting Engineer and Superintending Gas Examiner.

* The standard illuminating power for common gas in the metropolis is 16 sperm candles, and for cannel gas 20 sperm candles. Sulphur not to exceed 17 grains in the 100 cubic feet of gas. Ammonia not to exceed 4 grains in the 100 cubic feet of gas.

† Pressure between sunset and midnight to be equal to a column of one inch of water. Pressure between midnight and sunset to be equal to a column of six-tenths of an inch of water.

METAL EXPORTS FROM BRISTOL CHANNEL.

EXPORTS TO UNITED STATES AND CANADA DURING JUNE.

Destination.	Rails.	Crop Ends.	Blooms.	Wire.	Tin Plates.	Pig Iron.
	Tons.	Tons.	Tons.	Bdls.	Boxes.	Tons.
Montreal... ...	4774	—	—	—	6,417	—
New York ...	2454	—	3004	—	56,541	—
New Orleans ...	1870	—	—	—	—	—
Vera Cruz ...	248	—	—	—	—	—
San Francisco ...	—	—	503	—	—	—
Totals ...	9346	—	3507	2201	62,058	—

There were also exported to Montreal 140 tons and 840 bundles fastenings; to New York 350 tons spiegel, 654 tons old rails, and 500 casks ferro manganese; to New Orleans 136 tons fastenings; and to Vera Cruz 156 tons fastenings.

LONDON PRICE LIST OF METALS, ORES, OILS, CHEMICALS, &c.

[FOR THE PRESENT AND PAST WEEK.]

Metal Market, City, Thursday Afternoon, 4 P.M.

(*July* 6, 1882.)

METALS AND ORES.

	JUNE 29. £ s.	£ s.	JULY 6. £ s.	£ s.
COPPER (per ton)—				
Chili, for 96 per cent..........	66 10/	—	66 15/	—
Wallaroo..........................	72 0/	—	72 0/	—
Burra Burra	71 0/	—	71 0/	—
English Tough....................	71 0/	—	71 0/	—
English Ingot, best	73 0/	—	73 0/	—
Sheets sheathing and rod...	77 0/	78 0/	77 0/	78 0/
Bottoms	83 0/	—	83 0/	—
Ore per unit	—	—	—	—
PHOSPHOR BRONZE				
Special Bearing Metal (p tn)	115 0/	—	115 0/	—
Other alloys (per ton	123 0/	138 0/	123 0/	138 0/
TIN (per ton)—				
Straits (Cash).....	97 15/	—	99 15/	—
Do. for arr........................	—	—	—	—
Billiton..............................	—	—	—	—
Banca	—	—	—	—
English Ingots	102 0/	—	103 0/	—
Do. Bars	103 0/	—	104 0/	—
Do. Refined	104 0/	—	105 0/	—
Australian	92 15/	—	99 15/	—

	£ s.	£ s.	£ s.	£ s.
Tin Plates, per box, I.C. coke f.o.b. London	0 16/6	0 18/0	0 16 6	0 18/0
IX. do.	0 21/6	0 23/	0 21/6	0 23/
I.C. charcoal	0 19/	0 22/	0 19/	0 22/
I.X ,,	0 24/	0 28/	0 24/	0 28
Red lead	16 10/	—	16 10/	—
White	21 10/	—	21 10/	—
Patent shot	17 10/	18 0	17 10/	18 0
Zinc (per ton)—from No. 5 Gauge.				
Sheets, rolled	20 10/	—	20 10/	—
Do., foreign	20 5/	—	20 5/	—
Lead (per ton)—				
Soft English pig	14 5/	14 10	14 5/	14 10
Do. W.B.	—	—	—	—
Spanish soft	14 2 6	14 5/	14 2 6	14 5/
Do. with silver	—	—	—	—
Spelter (per ton)—				
Silesian, com	17 10/	—	17 10/	—
Rhenish	—	—	—	—
English	—	—	—	—
Quicksilver, bot.	6 0/	—	6 0/	—
Antimony ore (per ton)—				
Australian	—	—	—	—
Spanish	—	—	—	—
French Star	—	—	—	—
Regulus—	53 0/	55 0/	53 0/	55 0/
Crude (per cwt.)	1 14/	—	1 14/	—
Nickl (per lb.)	0 3/3	—	0 3/3	—
Brass (per lb.)—				
Sheets, 48×24	0 0/8	—	0 0/8	—
Tubes	0 0/11	0 1/	0 0/11	0 1/
Wire	0 0/8½	—	0 0/8½	—
Yellow metal	0 0/6	0 0/6	0 0/6	0 0 6
Asbestos (per lb.)	0 0/3	0 0/6	0 0/3	0 0/6
Plumbago (per cwt.)—				
Ceylon lump	1 2/	1 5/	1 2/	1 5/
Do. chip	0 10/	0 14/	0 10/	0 14/
Do. dust	0 10/	0 12/	0 10/	0 12/
Coals (per ton)—				
East Hartlepool	1 2/	—	1 2/	—
Lambton	1 4/	—	1 4/	—
Tees	1 4/	—	1 4/	—
Hartley	1 2/	—	1 2/	—
Hetton	1 4/	—	1 4/	—
Hawthorn	1 3/	—	1 3/	—
Tunstall	1 2/	—	1 2/	—

OILS, CHEMICALS, &c.

	June 29. £ s.	£ s.	July 6. £ s.	£ s.
Oils (per ton)—				
Olive, Galloli	—	—	—	—
Do. Gioja	—	—	—	—
Do. Levant	38 10/	—	37 10/	38 0/
Do. Seville	—	—	—	—
Do. Corfu	—	—	—	—
Seal, pale	35 0/	33 0/	35 0/	33 0/
Sperm head	74 0/	75 0/	74 0/	75 0/
Cod	31 0/	31 10/	31 10/	32 0/
E.I. Fish	—	—	—	—
Rape, English, brown	27 15/	28 5/	28 2/6	28 5/
Do. refined	—	—	—	—
Foreign Refined	—	—	—	—
Ground nut and Gingelly Madr.	—	—	—	—
Palm oil, fine	33 0/	33 10/	33 0/	33 10/
Palm nut oil	—	—	—	—
Linseed oil	23 17 6	24 5/	23 15/	24 2 6
Cot onseed (per ton).				
Crude	22 15/	24 0/	22 15/	25 0/
Refined	26 10	27 0/	27 5/	27 10/
Hull	25 15/	—	25 15/	—
Lard, English	60 0/	63 0/	60 0/	65 0/
Cocoanut, Cochin	35 0/	35 10/	35 10/	36 0/
Do. Ceylon pipes	27 10/	—	23 5/	—
Sydney	—	—	—	—
Oil Cake (per ton)—				
Linseed, Lndn.	8 10/	8 15/	8 10/	8 15/
American barrels	8 12 6	8 15/	8 12/6	8 15/
Do. bags	—	—	—	—
Marseilles	8 5/	—	8 5/	—
Rapeseed	5 12/6	6 0/	5 12/6	6 0/
Cottonseed	5 7/6	6 0/	5 7/6	6 0/
Tallow—PYC. old (per cwt.)	0 53 6	—	0 53 6	—
S.Americn. Beef	—	—	—	—
N. American ,,	—	—	—	—
Australian Beef (fine) (per cwt)	0 42 6	0 43/0	0 42/	0 42 10/
Do. Sheep ,, (per ton)	0 43 9	0 41 0	0 43/	0 44 0
Petroleum Oil—(per gal.)	0/57-16	0/5 7-17	0/5 7-16	0/5 ⅜
Refined coal oil				
Naphtha	0 0/6	0 7/½	0 0/6	0 0/7½
Turpentine—(per cwt.)				
French Spirits	—	—	—	—
American do.	—	—	—	—
Whalefins (per. ton)—				
Davis' Straits	0 725/	0 750/	0 725/	0 750/
Arctic	0 800/	0 750/	0 800/	0 750/
Brimstone (per ton)—				
Rough 3rds.	—	—	—	—
Roll	9 0/	9 10/	9 0/	9 10/
Acid, (per lb.)				
Acetic	0 19/	0 26/	0 19/	0 26/
Second quality (per gal.)	—	—	—	—
Citric (per lb.)	—	1/ 10½	—	2/ 0
Muriatic (sp. salts per cwt.)	0 4/6	0 7/6	0 4/6	7/6
Nordhausen 50 per cent.	0 45/	0 50/	0 45/	0 50/
Nitros	0 0/2½	0 0/4½	0 0/2½	0 0/4½
Oxalic (per lb.)	0 6½	0 7/	0 /6½	0 /7
Sulphuric, white	—	—	—	—
Do. Brown	0 0/0¾	0 0/1	0 0/0¾	0 0 1
Tartaric Crystal	0 1/8¼	0 1/8	0 1/8¼	0 1/8
Do. Powdered	—	—	—	—
Ammonia—				
Carbonate, per lb.	0 0/6¼	0 0/6¾	0 0/6¼	0 0/6¾
Sulphate, Best White (per ton)	20 5/	21 0/	20 5/	21 0/
Arsenic—White Lump (per cwt.)	0 24/6	0 25/	0 24/6	0 25/
Powdered do				
Bleaching Powder 35 %	0 10 5	0 10 6	0 10/6	0 10/9
Borax, Ref., Eng.	0 60/	0 63/	0 60/	0 63/
Copperas, green, tierces (ton)	0 45/	—	0 45/	—
Portland Cement—				
1st quality in casks 400 lb. gross, including casks, f.o.b., Thames, per cask	0 9/	—	0 9/	—
Do. in sacks, 200lb. net (per ton)				
Sacks extra, 1/6 each.	2 12/	—	2	—
Charlton White Paint (per cwt.)	1 12/	—	1 12/	—
Calley's Torbay Paint, Brown	0 30/	—	0 30/	—
Do. Red	0 34/	—	0 31/	—
Lead, Sugar, Eng., white	0 33/0	0 36/0	0 33/0	0 36/0
Brown	—	—	—	—
Red (per cwt.)				
White, ground	0 16 6	0 17/0	0 16/6	0 17/0
Litharge (pr cwt.)	0 21/	0 21/6	0 21/	0 21/6
Lime (per ton)—	0 17/6	0 19/	0 17 6	0 19/
Acetate, Brown				
Distilled	12 5/	12/ 10	12 5/	12/0
Potash—	18 0/	18 10/	18 5/	18 10/
Bichromate (lb.)				
Chlorate (pr. lb.)	0 0/5¾	6 0/	0 0/5¾	6 0/
Pruss. Red (lb.)	0 0/5¾	—	0 0/5¾	—
Do. Yel. lb.	1 10/	—	1 10/	—
Sulphate 80% (per ton)	0 10/	0 10/	0 10/	0 10/
Saltpetre (per cwt.) —	8 1/	9 10/	8 1/	9 10/
Engl. refnd. kgs.				
Do. barrels	0 26/	27 6/	0 26/	27 6/
Do. Bengal	0 27/	0 29/	0 27/	0 29/
Soda, Acetate (per cwt.)	0 10/6	1 1/6	0 10/6	1 1/6
Bicarbonate	0 30/	—	0 30/	—
Caustic 60 to 62 %	0 0/6	—	0 26/	—
Crystals grw.his ex ship (prton)	9/0	11 0/	9/0	11 0/
Nitrate	3 2/6	3 0/	3 2/6	3 2/6
	13 3/	13 9/	13 3/	13 9

PRICE LIST OF IRON AND STEEL

PREPARED BY

MESSRS. BOLLING & LOWE,

2, LAURENCE POUNTNEY HILL, LONDON, E.C.

STAFFORDSHIRE.

List Brands at Works. Per Ton

Bars—

⅝ in. to 3 in. rounds and squares £7 10 0

1 in. to 6 in. flats........ 7 10 0

Rounds and Squares.

3⅛ in., 10s. per ton extra.

4 in., 20s. ,,

4½ in., 40s. ,,

5 in., 50s. ,,

Rounds only.

5½ in., 70s. ,,

6 in., 90s. ,,

6½ in., 110s. ,,

7 in., 130s. ,,

Round and Squares,

7-16 in., 10s. ,,

⅜ in., 20s. ,,

5-16 in., 30s. ,,

¼ in., 40s. ,,

3-16 in, 70s.

Hoops—

1 in. to 6 in. wide by usual guage £8 0 0

⅞ in. wide up to 20 w. g., 20s. per ton extra.

¾ in. wide up to 20 w. g., 40s. per ton extra.

⅝ in. wide up to 20 w. g., 80s. per ton extra.

½ in. wide up to 20 w. g., 120s., per ton extra.

Plates—

To 15 feet long by 4 feet wide, not exceeding 4 cwt. £9 0 0

4 to 5 cwt., 20s, per ton extra.

5 to 6 cwt., 25s. ,,

6 to 7 cwt., 50s. ,,

7 to 8 cwt., 75s. ,,

8 to 9 cwt., 110s. ,,

9 to 10 cwt., 120s. ,,

10 to 11 cwt., 140s. ,,

15 to 20 ft. long, 20s. ,,

20 to 25 ft. long, 40s. per ton.

4 to 4½ ft. wide, 20s. ,,

4½ to 5 ft. wide, 40s. ,,

Sheets—

Singles 11 to 20 gauge..£9 0 0

Doubles, 30s. per ton extra.

Lattens, 60s.

Angles—

1 in. by 1 in. to 8 united inches £8 5 0

Tees—

1 in. by 1 in. to 8 united inches £8 10 0

For each inch above 8 united inches 10s. per ton extra.

Best, 20s. per ton extra.

Best, best, 40s.

Treble best, 60s.

STAFFORDSHIRE, MIDLAND, &c.

Ordinary Brands (at Works).

	£ s. d.		£ s. d.
Bars	6 10 0	to	7 10 0
Hoops	7 0 0	to	7 10 0
Plates	8 0 0	to	8 10 0
Sheets	8 0 0	to	8 10 0
Angles	7 0 0	to	7 10 0
Tees	7 10 0	to	8 0 0

Best, 10s. to 20s. per ton extra.

Best, best, 20s. to 30s.

Treble best, 40s. to 60s.

CLEVELAND AND NORTH OF ENGLAND BRANDS (at Works).

	£ s. d.		£ s. d.
Bars	6 2 6	to	6 5 0
Ship Plates to 8 cwt.	6 15 0	to	7 0 0
Angles	6 2 6	to	6 5 0

Best, 10s. per ton extra.

Best best, 30s.

Treble best, 50s.

SCOTCH (at Glasgow).

	£ s. d.
Bars NB crown	7 0 0
Hoops	7 0 0
Ship Plates	8 0 0
Boiler	8 10 0
Angles	8 0 0

Best, 10s. per ton extra.

Best, best, 30.

Treble best 50s.

WELSH (Newport and Cardiff).

	£ s. d.		£ s. d.
Bars	5 10 0	to	5 15 0
Plates	7 0 0	to	7 10 0

Best, 10s. per ton extra.

BELGIAN, (f.o.b. Antwerp).

	£ s. d.		£ s. d.
Bars	5 12 0	to	6 10 0
Hoops	6 10 0	to	7 5 0
Plates	7 10 0	to	8 10 0
Sheets	8 10 0	to	9 0 0
Angles	6 10 0	to	7 10 0
Nail rods	6 10 0	to	7 10 0
Iron Rolled Girders—			
Narrow flanges	6 0 0	to	7 10 0
Wide flanges	6 10 0	to	8 0 0

Steel Rolled Girders, Angles and Channels at proportionate differences.

BEST YORKSHIRE (at Works).

	£ s. d.
Bars—	
To 3½ cwt.	19 0 0
3½ to 5 cwt.	20 0 0
5 cwt. and upwards	21 0 0
Boiler Plates—	
To 2½ cwt.	22 0 0
2½ to 3 cwt.	23 0 0
3 to 3½ cwt.	25 0 0
3½ to 4 cwt.	27 0 0
4 to 5 cwt.	29 0 0
5 to 6 cwt.	33 0 0
6 to 7 cwt.	36 0 0
7 cwt. and over	40 0 0
Plates over 6 feet to 8 feet wide, 40s. per ton extra.	
Sheets	24 0 0
Angles and Tees	22 10 0
Tyres to 4 cwt.	19 0 0
4 cwt. to 5½ cwt.	23 0 0
5½ cwt. and over	26 0 0
Axles to 5 cwt	19 0 0
5 cwt. to 6 cwt.	22 0 0
6 cwt. and over	25 0 0

RAILS (at Port nearest to Works).

	£ s. d.		£ s. d
Heavy iron	5 0 0	to	5 5 0
Steel	5 9 10	to	5 10 0
Light iron	5 12 6	to	5 17 6
Steel	5 15 0	to	6 0 0

Steel Mining Rails, 10 to 15 lb. per yard, £6 to £7.

Fish Plates, heavy, 20s. per ton above rails.

Fish Plates, light, 60s. to 80s. per cwt. do.

	£ s. d.		£ s. d.
Bolts and Nuts, for fishes—			
Heavy	16 0 0	to	20 0 0
Light	26 0 0	to	28 0 0
Spikes—			
Heavy	14 0 0	to	16 0 0
Light	16 0 0	to	18 0 0

PIG-IRON.

Scotch Wrrnts (Glasgow) 49s. 5d.

Cleveland Warrants No. 3 (Middlesbrough) 43s. 6d.

Cleveland No. 1 (Tyne or Tees), G.M.B. 47s. 6d.

CASTINGS

(f.o.b. Shipping Port).

Socket Pipes (for gas or water)—	£ s. d.		£ s. d.
1½ to 2 in.	5 10 0	to	6 0 0
2 to 3 in.	5 9 10	to	5 15 0
3 to 8 in.	5 2 6	to	5 12 6
8 to 20 in.	5 0 0	to	5 10 0
20 to 48 in.	4 17 6	to	5 7 6
Chairs	4 15 0	to	5 0 0
Girders	5 15 0	to	8 0 0
Scrap—			
Old rails, D.H.	3 10 0	to	3 15 0
Do. flange	3 0 0	to	3 5 0
Engineers' heavy scrap	2 18 0	to	3 0 0
Light do.	2 0 0	to	2 5 0

WIRE.

Rolled Fencing Wire (at Works)

	£ s. d.		£ s. d
Nos. 0 to 4	7 0 0	to	8 0 0
5	7 10 0	to	8 10 0
6	8 0 0	to	9 0 0
Galvanized.			
Nos. 0 to 4	11 0 0	to	11 5 0
5	11 10 0	to	11 15 0
6	12 0 0	to	12 5 0
Drawn Fencing Wire.			
Nos. 0 to 6	9 0 0	to	9 10 0
7	9 10 0	to	10 0 0
8	10 0 0	to	10 5 0
9	10 10 0	to	11 0 0
10	11 10 0	to	12 0 0
Galvanised.			
Nos. 0 to 6	13 0 0	to	13 10 0
7	13 10 0	to	14 0 0
8	14 0 0	to	14 10 0
9	14 15 0	to	15 0 0
10	15 10 0	to	16 0 0
Drawn Bright Wire.			
Nos. 1 to 6	11 0 0	to	11 10 0
7	11 10 0	to	12 0 0
8	11 15 0	to	12 5 0
9	12 5 0	to	12 15 0
10	13 0 0	to	13 10 0
Drawn Bright Steel Wire.			
Nos. 1 to 6	12 5 0	to	12 15 0
7	12 15 0	to	13 5 0
8	13 0 0	to	13 10 0
9	13 10 0	to	14 0 0
10	14 10 0	to	15 0 0

Galvanised Fencing Strand (B.B) 7 wires.

No. 0	17 10 0	to	18
1	18 10 0	to	18.10
2	18 10 0	to	19 0
3	19 0 0	to	19 0
4	19 10 0	to	20 0
5	20 0 0	to	20 10
6	21 0 0	to	21 10
7	21 10 0	to	22 0
8	22 10 0	to	23 5
9	23 10 0	to	24 0
10	24 15 0	to	25 0

3 wires.

No. 0	16 10 0	to	17 0
1	16 15 0	to	17 5
2	17 10 0	to	18 0
3	18 0 0	to	18 5
4	18 5 0	to	18 15
5	18 10 0	to	19 0
6	19 5 0	to	19 15
7	20 0 0	to	20 10
8	21 0 0	to	21 10
9	22 10 0	to	23 0

STEEL (at Works).

Siemens-Martin or Bessemer.

	£ s. d.		£ s. d.
Plates	10 0 0	to	11 10 0
Sheets	11 0 0	to	12 10 0
Bars	9 0 0	to	10 0 0
Angles	9 10 0	to	11 0 0
Tees	10 0 0	to	11 0 0
Spring	8 10 0	to	11 0 0
Cast Steel for Tools	40 0 0	to	60 0 0

GALVANISED IRON ROOFING SHEETS

(at Liverpool).

Corrugated Sheets 5, 6, 7, or 8 feet long.

Gauges 16, 18, and 20, £14 0s. to £15 0s.

22 and 24 gauge, £15 0 to £16 0

26 gauge, £17 10 to £18 10s.

28 gauge, £19 10s. to £20 10s.

Sheets 8 to 9 feet long, 20s. per ton extra.

Sheets 9 to 10 feet long, 40s. per ton extra.

Sheets 10 to 11 feet long, 60s. per ton extra.

Sheets 11 to 12 feet long, 80s. per ton extra.

PRICES CURRENT OF MANUFACTURED GOODS

OF

BIRMINGHAM AND DISTRICT.

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The quotations given are manufacturers' average prices, dependent, of course, on terms of payment as well as the quality and quantity of goods ordered, and fluctuations in cost of raw material.

The Prices and Discounts quoted are carefully revised every week, and great pains are taken to render this List thoroughly reliable.

July 5.

Prices of manufactured hardware in this district generally are unaltered, metals and iron showing very little fluctuation. In most industries trade is still quiet, but better rates are looked forward to during the quarter, the tone in the Wolverhampton market this afternoon being more cheerful.

ABRIDGED LIST.

AMERICAN WIRE HOBS, 1 lb., 42/6; 1½ lb., 36/6; 2 lb., 3/6; 2½ lb., 31/6; 3 lb., 30/6 per cwt.

ANCHORS, common, 1 to 10 cwt. 14/ per cwt.

ANVILS (Common), 16/9 per cwt.; Best anvils, not warranted, 20/ per cwt.; Best warranted anvils (bicks tied in 1 to 5 cwt.), 21/6 per cwt.

AUGERS (shell), ⅓ inch to 2 inch, 11/ to 44/ per doz., less 55%; (screw), ⅓ inch to 2 inch, 16/ to 64/ per doz., less 55.

AXES, ship carpenters', /4½ to /5½ per lb.; Kent and house carpenters' ditto, /4 to /5; ditto, steel polished, 5 to 6, felling axes, /4¼ to /4¾; bright and blued, solid steel, /7 to /8. American felling or wedge axes, steel, polished, /11 per lb.

AXLE PULLEYS, iron, 8/ to 26/6, 1¾ inch; Brass face ditto, 26/6 to 46/6, 1¾ inch.

AXLES, 35 to 45%.

BASINS.—Bright tinned, shallow, 8 inch, 2/10; 9 inch, 2/11; 10 inch, 3/6; 11 inch, 4/3; 12 inch, 4/9; 13 inch, 5/3; 14 inch, 6/4; 16 inch, 9/ per doz.; galvanised ditto, 8 inch, 2/4; 9 inch, 2/8; 10 inch, 3/2; 11 inch, 4/; 12 inch, 4/6; 13 inch, 5/; 14 inch, 6/1; 16 inch, 8/2 per doz.

BASTARD BELLOWS, 50%; best extra nailed bastard bellows, 45%; best improved long Bristol, 40%; common smiths' bellows, 62½%; best warranted extra double nailed, 45 to 50%; ditto, with movable pipe for shipment, 52½%.

BELLS.—House brass, rough, /8¼ to /10¼ per lb.; turned edge, /8¾ to /10¾ per lb.; turned and lacquered on edge, 1/5 to 1/10 per lb.; cattle and sheep bells, with brass loops, 1/1 to 1/3 per lb.; clock bells, 1/5 to 1/6 per lb.

BELL STAPLES (fine tinned) ⅛ inch, /1½; [illegible] 3/3½; 2, /5¼; 2½, /6½ per gross.

BED SCREWS, London, black heads, 6, and 7-16, and ½ inch, 8/6 to 10/6 per gross; London heads, with bright turned collar, 6 and 7-16, and ½ inch nuts, 11/9 to 12/9; black welded heads, 8/3 to 9/3; common slit heads, 6, and ⅜, and ½ inch, 8/9 to 9/9; bright turned notched heads, 6, and 7-16, and ½ inch, 12/3 to 13/3; black notched heads, 10/ to 11/ per gross. Bedsteads, cheap stump, 6 feet by 3 feet 6 inches, 7/6 to 9/6 each; cheap French, 6 feet by 3 feet 6 inches, 8/6 to 10/6 each, rising /6 for every 6 inches.

BOLTS.—Solid end tower, 72½ to 75%; ditto, solid end barrel, 67½ to 70%; best solid tower bolts, 75%; japanned Scotch tower bolts, 55%. Bolts and nuts, black, ¼, and 5-16 to 3 inch, 2/ and 3/ per gross, ⅜ 18/, ½ 14/, ⅝ 12/, ¾ 12/6 per cwt.; bright, ¼, and 5-16 to 3 inch, 3/ and 3/6 per gross, ⅜ 20/, ½ 15/6, ⅝ 14/6, ¾ 14/ per cwt. Hexagon heads, engineers', ⅜ inch 24/6, ½ 20/, ⅝ 18/, ¾ 16/6 per cwt. Hexagon nuts, ⅜ inch 19/9, ½ 15/, ⅝ to 1 inch 14/ per cwt. Black nuts, blank, ⅜ inch 14/, ½ 13/, ⅝ to 1 inch 12/ per cwt. delivered in London.

BRASS HEAD NAILS, 57½ to 60%; star head, 50%; brass plated countersunk head, 30 to 35%; blacksmith's tongs, 23/ per cwt.; real fine wrought box irons, 20 to 25%; fine cast, 60%; middle cast, 50 to 60%; Victoria charcoal box irons, 45 to 50%; ordinary charcoal ditto, 60 to 65%; brushes, painters', 50 to 75%; best ditto, 15 to 50%; brass, rolled, 2 to 12 inches wide to 30 W.G., /7 per lb. Brass sheets, 24 and 28 inch, 8 lb. and upwards, or 27 W.G., /8 per lb.; ship and turret bells, 1/4 per lb. Battery kettles, 125/ per cwt.; brass jelly pans, with bails, /9¼ to /9¾; without bails, /10¼ to /10¾; Maslin kettles, cast, 4 to 16 inch, /9 to /9½ per lb. Brass shoe bills, /9 per lb.; brass scale pans, 1/6; brass toddy kettles, 15 to 20%.

BRASS CORNICE POLE RINGS, light, middle and strong, 45%.

BRASS WIRE, /7½ per lb. up to No. 20 W.G.; back bands, 3 lb. and larger, 16/9 per cwt.; ditto, smaller, 2/ per cwt. extra; double swivel ditto, 1/ per cwt. extra.

CART TRACES, 9 to 12 links to foot, 16/3 to 30/9 per cwt.

CHAIN, machine made, Wire, single link, "Iron," 55%; double link ditto, 55%; machine-made Wire Chain, single link, "Brass," 55%; registered ditto, 55%; close link brass chain, 55%; oval link brass chain, 55%; brass clock chain, 55%; short link tested (rigging) chain, 3-16 inch, 19/9; ¼, 17/; 5-16, 15/3; ⅜, 15/; 7-16, 13/6; ½, 12/9; ⅝, 12/; ¾, 11/6; 1 inch, 11/ per cwt.; well chain, twisted or straight link, ⅛ inch, 25/3; 3-16, 18/; ¼, 16/; 5-16, 1[illegible] per cwt. delivered.

CHAIR NAILS (brass), lacquered or gold colour, No. 1 to 12, 2/ to 7/6 per 1000; machine polished, 1/9 to 7/3 per 1000; lacquered or gold coloured, 2/ to 1/2¼ per lb.; discount per 1000, 57½%; per lb., 5%, delivered.

CHIPPING CHISELS, solid cast steel, /6 per lb.

COACH BOLTS AND NUTS, round or cheese heads, square necks and nuts, black, 3 inch and ¼, 2/6; 3½, 2/11; 4, 3/3; 4½, 3/8; 5 inch, 4/ per gross. Bright, 3 inch by ¼, 3/; 3½, 3/5; 4, 3/9; 4½, 4/2; 5 inch 4/6 per gross. Black, 3 inch by 5-16, 3/; 3½, 3/5; 4, 3/9; 4½, 4/2; 5 inch, 4/6 per gross. Bright, 3 inch by 5-16, 3/6; 3½, 3/11; 4, 4/3; 4½, 4/8; 5 inch, 5/ per gross delivered.

COACH SCREWS.—Lathe pointed coach screws, 2½ inch and under, ¼ inch, 2/6; 5-16, 3/; ⅜, 3/6; 7-16, 4/6 per gross; ⅜ inch, 21/; ½ inch, 18/; ⅝, 17/ per cwt.; 2½ to 6 inches long, ⅜ inch, 25/; 7-16, 22/; ½, 18/; ⅝, 15/; ¾, 14/ per cwt.; above 6 inch, ⅜ inch, 24/; 7-16, 22/; ½, 16/; ⅝, 13/; ¾, 12/ per cwt.; 1/ per cwt. extra for hex heads, delivered.

COACH SPRINGS, 40%.

COMPOSITION Sheathing and Slating-Nails, ¾ inch, /8½ per lb. Copper brads and bills, /9½ per lb.; round copper kettles, bare rivets, 1/7 to 1/9 per lb.; light round covered rivets, 1/6 to 1/7 per lb.; loaded 1/5 to 1/6; oval copper kettles, bare rivets, 1/10 to 1/11 per lb.; oval bare rivets, raise down, 1/11 to 2/5 per lb. Copper slating nails (cut), 1 to 1½ inch and upwards, /10 to /11 per lb.; copper scale pans, 1/9 to 1/10 per lb. Copper nails and tacks (wrought), 1 inch, 1/1½ per lb. Chair webbing, No. 9, 4/5; 10, 4/8; C9, 4/1; C10, 4/6 per gross of 66 yards. Carpet rings, 1/ to 1/4 per gross. Cornice poles, 2¼ inch, brass, best burnished, 4/6 per foot, less 45%; ¾ covered brass poles, 1/2 per foot, less 45%; 2½ inch real birch cornice poles, polished, self or mahogany colour, with ends and rings complete, /8 per foot; 2½ inch real mahogany cornice poles, with ends and rings complete, 1/7 per foot; 2¼ inch birch rings, polished, self or mahogany colour, 10/ per gross; 2¼ inch real mahogany rings, 28/ per gross net; japanned pillar chains, 1 yard, 16 by 6, 5/8 to 6/6 per doz. Japanned manger chains, 1½ yard, 16 by 6, 7/3 to 8/6; japanned rack, 1 yard, 18 by 6, 5/ to 6/; japanned dog, 1½ yard, 12 by 7, 5/6 to 6/6; 2 yards, 14 by 6, 10/ to 11/. Cowties, 6/6 to 8/6; open ring, 6/6 to 8/6; close ring, 5/6 to 6/6 per doz.; japanned watering chains, 14 by 6, 4/ to 5/; tinned ditto, 4/6 to 5/6; bullock chains, ⅜ inch hook at each end, 14/6 to 15/6; chest handles, improved japanned, 82½%; broad plate, strong and extra strong, 15 to 65%. Curtain rings (brass), 45 to 50%; square box coffee mills, 30 to 60%; common post coffee mills, 30 to 40%; best brass bushed mills, 40 to 45%; London mills, 40 to 45%.

COCKS.—Brass range cocks, ½ inch, 30/; ⅝, 42/; ¾, 53/6; 1, 64/; 1 inch 75/ per doz., less 30% discount; brass racking cocks, fast key, ½ inch, 11/; 5-16, 13/; ⅜, 15/; 7-16, 18/; ½, 23/; 0-16, 34/; ⅝, 38/; ¾, 45/; ⅞, 59/; 1 inch, 66/ per doz.; loose key, 1/ to 18/ per doz. extra; discount, 60%.

COFFIN FURNITURE, registered 50%; ditto, common, 75%.

COPPER GOAT NAILS, ½ inch to 2 inches and above, 1/7 to /11½ per lb.; copper boat roves, 3-16 to ½ inch and above, 1/7½ to 2/ per lb.; cut copper nails and tacks, ½ inch to 1 inch and above, 2/ to /9½ per lb.

COPPER WIRE, /9½ per lb. up to No. 20, W. G.

CUT NAILS.—Clasp, rose, and clout, 3 to 9 inch, 9/; 2½ and 2¾ inch, 9/6; 2 and 2¼ inch, 10/; 1¾ inch, 10/6; 1½ inch, 11/; 1¼ inch, 12/; 1 inch, 14/; ¾ inch, 16/1 per cwt.

DISH COVERS, blue japanned wire, 3/3 to 5/6 per set of 6.

DOOR SPRINGS, X, 75%; XX, 77½%; XXX, 73½%; XXXX, 65%; brass circular and iron circular, 55 to 65%; brass reliance, 10 to 70%; climax, 20%; universal, 55 to 60%; paragon, 20%; O'Connor's patent lever hinge springs, 10 to 20%. O'Connor's vertical spring hinge door spring, 15 to 25%; Gerish's spring hinges, iron, 20 to 25%; brass, 10 to 20%.

FILES, 60% the list.

FLOOR BRADS.—2 inch, 9/3; 2½ inch, 9/; 2¾ inch, 9/; 2⅞ inch and larger, 9/ per cwt.; brass head nails, 60%.

FRY PANS, 7½ inch to 17 inch, oval, bright, 12/ to 55/ per doz.; tinned, 14 to 50/ per doz.; fry pans, 5½ inch to 10 inch round, 5/6 to 10/ per doz.; tinned, 11/6 to 20/ per doz.; fry pans, 2 inch to 15 inch round, bright, 30/ to 60/ per doz.; tinned, 33/ to 64/ per doz., all fry pans 7½% and 5% delivered. Fire-irons, kitchen, in sets, /5 to /6 per lb.; tongs, 4/6 to /6; pokers, /4 and /5; fishhooks, best, 40 to 45%; common, 60 to 66%; light kitchen fenders, 5 inch, assorted, 3 feet 6 inches to 3 feet 6 inches, black fronts, 28/ to 30/ per doz.; bright fronts, 31/6 to 34/. Manchester pattern kitchen fenders, 5 feet, 1 inch top, black front, 2 feet 9 inch to 3 feet 3 inch, 37/6 to 41/ per doz.; 1 foot 3 inch to 3 feet 0 inch, 42/6 to 47/6 per doz.

GALVANISED BUCKETS, 11 inch, 38 lb. to the doz., 6/6; 11 inch, 5/6; 10 inch, 6/9; 13 inch, 7/6; 14 inch, 9; 12 inch, 42 lb., 7/3; 10 inch, 5/6; 11 inch, 6/; 14 inch, 8/; 24 inch, 9/9.

GALVANISED WASHING TUBS, oval, 22 inch, 27/; 24 inch, 30/; 26 inch, 34/.

GALVANISED WIRE NETTING, 1½ inch mesh and larger, 65%; 1½ inch mesh and smaller, 70%, delivered.

GIMP PINS.—Best black iron wire, ¼ by 18, ⅜ by 18, ½ by 18, all /5½ per lb.; 10 gauge, /1 per lb. extra; coloured, /1 extra; best bright iron panel pins in 1 lb. packets, ⅜, ½, and ¾ by 1 inch, /5½; ⅞ and 1 by 10 inch, /5½; 1½ by 15 inch, /3 per lb.; tinned, /1½ per lb. extra; brass panel pins, /9½ per lb., all sizes; copper ditto, 1/1 per lb. all sizes; brass escutcheon pins, ¾ by 16, ⅞ by 15, ⅜ by 15, ⅞ by 15, ¾ by 15, ⅝ by 11 inch, /0½ per lb.; brass gimp pins, 10 gauge, 2/ per lb.; ditto, 18 gauge, /11½ per lb.

GRID IRONS, London pattern, fluted, 70%; light ditto, 77½%; best fluted bar, 6/13; flat bar, 67½%; common flat bar, 67½%; hanging round bar, 60%; doublet, 4/6; round bar, /1½ per bar, 6/9; common gridirons, /1/13 and /2 per bar less, 65 to 75%; gimblets, 50%.

HAMMERS.—Cast steel stone breaking and quarry, 28/ per cwt.; solid cast steel engineers' hand, 1½ lb. each and above, /8 per lb.; solid cast steel boiler makers' hand hammers, 1¼ lb. each and above, /8½ per lb.; iron and steel boiler makers' sledge hammers, 6 lb. and above, 17/ per cwt.; iron and steel sledge hammers, 6 lb. and above, 18/6 per cwt.; solid cast steel sledge, 28/ per cwt. Hammers, platelayers' keying, 28/ per cwt.; holdfasts, japanned, 18/ to 20/ per cwt.; common Kent hand hammers, 35%; patent hasps and staples, 60 to 75%. Holloware, best, 45%; common, 55 and 50%; enamelled ditto, best, 30%; common, 35%. Horseshoes, fullered fore, 16/ to 18; fullered hind, 17/ to 19/; stamped fore, 16/6 to 18/9; hind, 17/6 to 19/6.

HINGES.—Patent, cast butts, 60 to 70%; patent Scotch butts, 55 to 60%; broad and narrow same discounts; patent table, bed, and back-flap hinges, 57½%; patent chest hinges, 55%; patent strap hinges, 57½%; H hinges, 55%; HL hinges, 55%; japanned and varnished hinges, double washered, light and strong, 50%; best best, London or Lancashire patent tees, 67½%; patent light japanned Scoth tees, 62½%; light patent hook hinges on plate and to drive, 30 to 35%; weighty Gothic, 20/ to 24/; scolloped edges, not japanned, 22/ to 25/; Scotch japanned tees, double washered, 20/ to 23/; Gothic Scotch japanned tees, 19/ to 22/; Gothic Scotch tees, self colour, 17/ to 21/; light "patent" broad Butts, polished joint, No. 220, 50%; ditto, No. 564, 35%; box hinges, 50%; light Parliament hinges, best strong 45%; best best ditto, 55% off list. Wrought hinges, common, 52%; best, 57½%; best best, 5 % off list. Heavy wrought hinges, common black, 13/6 per cwt.; ditto, common bright, 16/ per cwt.; tiled edges, 17/6; japanned Gothic fancy, 15/6 to 16/; common bright, broad eye, 17/ to 18/; japanned, broad eye, fancy, 18/6; best bright, 21/ to 23/; best broad eye, 21/ to 23/ per cwt.; cast hinges, polished joint, light patent wrought butts, 22/0, 50%; 33½, 42½%; steel 35%; pressed hinges, common, 65 to 70%; best, 57½ to very light, 8%. Ironfoundry, general, ash grates, 8 to 9/ per cwt.; air bricks, 7/0 to 7/6; hall stoves, 3/3 to 3/6; double, 5 6 to 6; bars and bearers, 7/6 to 9/; barrow wheels, 8/; bake pans, 8/ to 9/6; camp ovens, 7/; cooking stoves, 9/ to 10/6; cellar grating, 8/6; clock weights, 7/9; Dutch stoves, 8/6 to 10/; dumbbells, common, 7/ to 9/; best best enamelled, 15 to 17/6; furnaces up to 50 gallons, /3½ to /4; galvanised ditto, /7 to /9 per gallon; furnace doors, 9 6 to 12/; furnace pans, 8/6; heaters for box irons, 6/6 to 7/6; heaters for urns, 6/6 to 9/6; oven doors and frames, 8/6 to 10/6; three legged pots, Danish and plumbers' pots, plumb bobs, 10/6; pudding pans, 10/6 to 11/6; pump spouts, 10/6 to 13/; sash weights, 5/; ditto, with pulleys, 7/ to 8/6; shoe anvils, 8/6; Italian irons, 50%.

KNITTING PINS, iron, /4 to /4½ per lb.; steel ditto, 15 to 22; W. C., 1/6 to 2/ per lb., brass ditto, 1/4 to 1/6 per lb.; keys and blanks, 30 to 65%; extra strong plate, 30 to 37½%; extra strong Banbury pinned keys, 35 to 40%; brass shutter knobs, 55%; brass cupboard turns, 55%; brass draw knobs, 55%; brass sash screw knobs, 55%; brass range knobs, 40 to 45%; lock furniture, brass, 60%; chain lock furniture, 50%; ebony lock furniture, 2½ inch, Wilkes' spindles, 18/ per doz. sets; sham ditto, 8/ to 9/ per doz. sets; Norfolk latches, common, 62½%; Suffolk latches, 75%; best ditto, 55%.

MELTING LADLES, 2 inch to 6 inch, 9/ to 10/ per doz., less 12%; Pitch Ladles, 3 inch to 6 inch, 10/6 to 12/ per doz., less 10%.

NAILS.—Patent forged nails, "Iron or Steel." Strong Rose (flat points), 1 inch, 4 lb., 45/6; 1¼ inch, 6 lb., 38/; 1½ inch, 7 lb., 36/; 1¾ inch, 8 lb., 34/6; 2 inch, 10 lb., 32/6; 2¼ inch, 12 lb., 31/; 2½ inch, 17 lb., 28/6; 2¾ inch, 20 lb., 28/; 3 inch, 23 lb., 27/0 per cwt. Fine Rose (flat points), 1 inch, 2½ lb., 72 6; 1¼ inch, 3½ lb., 58 6; 1½ inch, 4 lb., 51 6; 1¾ inch, 5 lb., 48 6; 2 inch, 7 lb., 43/6; 2¼ inch, 8 lb., 41/6; 2½ inch, 10 lb., 37 9; 2¾ inch, 14 lb., 34/; 3 inch, 17 lb., 32/ per cwt. Coopers' Rose (sharp points), 1½ inch, 7 lb. per m., 2/4; 1¾ inch, 8 lb., 2/6; 2 inch, 10 lb., 3/; 2¼ inch, 12 lb., 3/5; 2½ inch, 17 lb., 4/5½; 2¾ inch, 20 lb., 5/1; 3 inch, 23 lb., 5/11 per m. Fine Clasp (sharp points), 1½ inch, 4 lb. per m., 2/1; 1¾ inch, 5 lb., 2/4½; 2 inch, 7 lb., 2/10; 2¼ inch, 8 lb., 3/0½; 2½ inch, 10 lb., 3/5½; 3 inch, 14 lb., 4/4½ per m. Best Canada (sharp pointed), 1½ inch, 4 lb. per m., 2/ [illegible]; 2 inch, 7 lb., 2/0; 2¼ inch, 8 lb., 3/0½; 2¾ inch, 17½ lb., 4/0½; 3 inch, 14 lb., 4/4½ per m. Pound Nails, 6dy, 2¼ inch, 28/6; 8dy, 2¾ inch, 27/; 10dy, 3½ inch, 23 6; 20dy, 4 inch, 23/ per cwt., discounts 50% off iron, 45% off steel. Nails, cast lath, 9 per cwt.; wall nails, cast, 8/6 per cwt.; cast headed bills, ⅞ by 8 oz., 12/ to 14; fine round cast bills, ⅞ inch, 11/ to 15; strong round ditto, ⅞ inch, 12 6 to 14/; cast slate pegs, 10/ to 12/; black coffin nails, 55 to 60%; white ditto, 45 to 55%; black coffin bullens, 50 to 55%; white ditto, 40 to 45%.

PICKS, iron and steel excavators', /3 to /5 per lb.

PLANES, 45% off the list.

PLOUGH TRACES, 0 to 12 links to foot, 17/3 19/9 per cwt.

RAILWAY BEATER PICKS, /3 to /5 per lb. delivered in London or Liverpool. Rakes, light garden, 50 to 60%; light solid end rakes, 47½ to 52½%; bolstered teeth garden rakes, 50%; solid end bolstered teeth garden rakes, 40 to 45%.

RATCHET BRACES, improved, 8 inch, 20/; 10 inch, 22/; 12 inch, 24/; 14 inch, 28/; 16 inch, 32/; 18 inch, 36/; 20 inch, 40; 22 inch, 44/; 24 inch, 48/ each, less 65% off list; ditto, with eccentric levers, 8 inch, 22/; 10 inch, 24/; 12 inch, 26/; 14 inch, 28/; 16 inch 30/; 18 inch, 33/; 20 inch, 36/; 22 inch, 30/; 24 inch, 42/ each; drills for above, 15 per doz., less 40% eccentric lever braces.

RIDDLES, common, ⅛ inch by 18, 21/ per doz.; ditto, foundry or gravel, ⅛ by 18, 27/ per doz., less 5%.

RIVETS.—Copper hose, ⅜ by 8 and above /10½ per lb.

RIVETS, Machine-made Wire, No. 6, 18/ per cwt.; iron boot rivets, 24/ to 25/ per cwt.; brass ditto, /8½ per lb. Ship, tank and girder Rivets, ¼ inch, 17/; ⅜, 13/6; 7-16, 13; ½ inch, 12/6 per cwt. Best Boiler Rivets, 1/ per cwt. extra. Ship scrapers, black steel blades, 50 to 55%; bright, 47½ to 52½%; cast steel black, 47½ to 52½%; bright, 42½ to 47½%; best cast steel black, 40 to 45%; bright, 35 to 40 p.c.; sash chain, copper, 55 p.c.; zinc, 55 p.c.; iron prepared ditto, 50 p.c.

SAD IRONS, common, 8/ to 11/ per cwt., delivered; best japanned, 11/6 to 13/6 per cwt.; best best japanned, 15/6 to 18/6 per cwt.

SAUCEPANS and covers, round tinned, 1 to 14 pints, 1/2 to 4/4 each; enamelled ditto, 1/4½ to 5/5 each; kettles and covers, round tinned, 3 to 16 pints, 3/ to 9/6 each; enamelled ditto, 3/3 to 9/6 each; discounts tinned, 45 to 52½%; discounts enamelled, 30 to 37½% delivered.

SCALES, copper, 72½ to 75%.

SCREWS, iron wood screws, 70%; brass ditto, 65%; copper wood screws, 35%, stove ditto, 65%; dowel ditto, 70%; brass headlock screws, 40%.

SCREW STOCKS and DIES, 57½% off list.

SHOE BILLS, in 1 and 5 lb. parcels, extra strong, and strong, 9 to 13 W.G., 11/3; middle, 14 W.G., 11/3; fine, 15 W.G., 11/3; extra fine, 16 W.G., 12/3 per cwt. Shoe heel, York, No. 1, 2/6 to 2/9; No. 2, 3/1 to 3/1; No. 3, 6/9 to 7/6 per gross net; Dundee hot turned, 4/9 to 5/3; bright edge imperial or solid Scotch, 8/3 to 8/9; bright York, 61 B, 6/9 to 7/3; bright solid, 6/3 to 6/9; toe plates, 8/3 to 8/9 per gross.

SHOVELS, common iron, round back, dust, 4 inch to 8 inch, 1/9 to 6/ per doz., less 25%; socket handles, 1/ per doz. extra; Bell mouth Shovels, 7 inch to 10 inch, 2/ to 4/ per doz., net; ditto, japanned with wood handles, 3/4 to 5/6 per doz. net. Shovels, all steel, crutch handles, No. 2, 17/; No. 3, 18/3; No. 4, 19/9 per doz.; No. 5, 20/9 per doz.; eye-handle, 1/ per doz. extra; riveted ditto, 2/ per doz extra; Spades and shovels, common, 62½%; second, 57½%; Best, 42½% discount off the list.

SIEVES, brass and iron, 55% off list; Wove wire, brass and iron, 55% off list.

SOFA SPRINGS, "Bright," 8 by 5 inch, 10/8; 8 by 6 inch, 10/9; 8 by 7 inch, 12/6; 8 by 8 inch, 13/6; 8 by 9 inch, 15/3; 8 by 10 inch, 19/ per gross, less 15 per cent. "Coppered," 1/ per gross extra up to 8 by 8; all above 1/6 per gross; coiled, /6 per gross extra.

SPLIT COTTERS, 67½% off list. American Wire Tacks, 75% off list.—**W. Gorse and Son**, Icknield Square, Birmingham.

SPOKES.—Steel bicycle and perambulator, tinned, cut to lengths, and headed, No. 6, 29/9; 7, 30/3; 8, 30/6; 9, 31/; 10, 31/6; 11, 32/; 12, 32/9 per cwt. Bright, 9/ per cwt. less.

STAIR RODS, turned ends, 82½%; ditto, solid fancy ends, 82½%.

STAPLES, Wire fencing, 1½ to 2 inch, No. 6, W.G., 12/; No. 7, 12/6; No. 8, 13/; No. 9, 13/6, diamond points; rough cut 1/ per cwt. less; kegs, 1/3 each; Galvanised staple, 7/ per cwt. extra.

STEEL TOYS, 10 to 30% off the list.

STEELYARDS, 65%.

TACKS, fine cut, in 1 and 7 lb. parcels, ¼ inch, 40/6; ⅜ inch 20/3; ½ inch, 21/3; ⅝ inch, 19/9; ¾ inch, 18/9; ⅞ inch, 17/9; 1 inch, 17/3 per cwt.—tinned, 8/ per cwt. extra; in ½ cwt. bags, 1/ per cwt. less.

TIP NAILS, in 1 and 5 lb. parcels, ¾ inch, 17/6; ⅞ inch, 15/; 1 inch, 15/; 1⅛ inch, 14/; 1¼ inch, 13/; best iron, 2/; charcoal, 2/ per cwt. extra. Tinplates, best charcoal I.C., 21/ per box; 2nd quality ditto, 20/ per box; best coke 18/; coke, 17/ per box.

TRAPS, bow spring, sham Dorset and real Dorset rabbit traps, 45 to 65%, list prices; common traps, 4 inch, 5/6 to 8/ per doz. net; run traps, 2½ inch, 5/ to 8/6 per doz.; bird traps, 3/9 to 4/ per doz.; wolf and other double flat spring, common bridge, 1/; axle bridge, 1/4 per lb., 40 to 45%; hawk or pole traps, 54 to 60%; wrought mole traps japanned, 2/6 to 3/9; galvanised, 3/0 to 4/9.

TUBES, iron gas, 70%; fittings, 75%; galvanised iron gas tubes, 55%; fittings 60%; lap welded boiler tubes, 50%, delivered; ball tube, zinc, 34/ to 36/ per cwt.; patent cased tube, 57½ to 60%, cut to lengths if required; polished and lacquered twisted brass tube, 40%; patent cased taper iron tube, 40 to 45%; patent taper iron tube, 40 to 45%; parallel iron brased tube, 40 to 45%; twisted iron parallel tube, 40%; patent cased parallel tube, 40%; Brass Tubes, plain, rough, ⅜ inch and above, /9½; other shapes /10½ to /11 per lb. Bell cop per tube, ⅜ inch and upwards, /11 to 1/ per lb.; brass ditto, 1 1 to 1/3; locomotive and marine boiler tubes, seamless, 1½ to 3½ outside diameter, to 14 W.G., /11 per lb.

VICES, best warranted, "Black" staple, solid box, 26/6 per cwt.; Best warranted, "Bright" staple, solid box vices, 30/6 per cwt.; vice boxes and pins, 26/ per cwt.

WASHERS.—Light iron, 77½%; heavy washers, 13 to 16 W.G. 10/ per cwt.; ¼ inch thick, 2/ per cwt. extra; 5-16 inch, 3/; ⅜ inch, 4/.

WIRE.—iron, bright, 0 to 6, 10/; 7, 10/6; 8, 10/9; 9, 11/3; 10, 13/0, 11/9; 11, 12/3; 12, 13/; 13, 13/6; 14, 14/; 15, 14/9; 16, 15/6; 17, 16/6; 18, 17/; 19, 18/ per cwt.; galvanised, 0 to 6, 3/3 per cwt. extra; best annealed drawn fence wire, oiled, 0 to 6, £9 5/; 7, £9 15/; 8, £10; 9, £10 10/ per ton; galvanised, 0 to 6, £12 10/; 7, £13; 8, £13 10/; 9, £14 per ton. Steel fence wire, round or oval, £2 per ton extra. Black rolled fence wire, 4 or 5, £7 per ton. Tinned bottling wire, No. 22, 31/; 23, 33/; 24, 35/ per cwt., cut in lengths and made up in 7 lb. parcels. Fine galvanised iron wire, No. 23, 4/3 per stone of 14 lb.; cast steel wire, /5 per lb.; charcoal iron wire, 4/ per cwt. extra; tinned ditto, 9/ per cwt. extra, delivered in London; 5/ per ton less in Liverpool.

WROUGHT, best countersunk clout and cone head Nails, 1 inch, 20/3; 1½ inch, 24/9; 2 inch, 22/; 2½ inch, 19/9 per cwt.; Best fine Swedish iron countersunk horse nails, stamped, 6 lb. per m. 53/3 per cwt.; 8 lb. per m. 49/; 10 lb. per m. 45/9 per cwt.; 12 lb. per m, 41/6 per cwt., or subject to 45% Derby list. Wrought rose and deck head spikes, 4 inch, 12/3; 5 inch, 11/; 6 inch, 10/3; 7 inch, 10/ per cwt.; galvanised, 4/9 per cwt. extra; Wrought rose nails, flat or sharp points, 2 inch, 21/9; 2¼, 20/9; 2½, 19/; 3, 17/6 per cwt. Wrought nails, May 1826 list, 40 to 45%; wrought Bromsgrove nails March 1878 list, 30 to 35 p.c.

NEW COMPANIES.

AFRICAN GOLD COAST SYNDICATE, LIMITED.—Upon terms of an agreement of 5th April, this company proposes to purchase from J. W. Reader, of Liverpool, a concession for minerals on the Ingstrow property, near Axim, on the West Coast of Africa. It was registered on the 22nd ult., with a capital of £45,000 in £10 shares.

ANGLO-ITALIAN "BRUSH" ELECTRIC LIGHT AND POWER COMPANY, LIMITED.—This company was registered on the 27th ult., with a capital of £400,000, in £5 shares, to carry on the business of an electric light and power company in all branches and for such purposes to carry into effect an unregistered agreement with the Electrical Association, Limited.

EGWIRA MINES, LIMITED.—Upon terms of an agreement of the 22nd ult., this company proposes to purchase from James Irvine, of Liverpool, the land known as the gold mines of Insimauko, situate at Upper Gwerah, in the district of Axim, of the Gold Coast Colony. It was registered on the 24th ult. with a capital of £120,000, in £1 shares.

ELECTRIC "SUN" LAMP AND POWER COMPANY, LIMITED.—This company was registered on the 26th ult., with a capital of £200,000, in £5 shares, to purchase the patent rights for the United Kingdom of the "Lamp Soleil" electric lamp, and to carry on the business of an electric light and power company in all branches.

HOLDERNESS STEAMSHIP COMPANY, LIMITED.—Registered on the 23rd ult., with a capital of £24,000, in £100 shares, to purchase the s.s. *Holderness*, now being built by Earle's Shipbuilding and Engineering Company, Limited.

RICHARD JOHNSON AND CO., LIMITED.—This is the conversion into a company of the business of coal merchant, carried on by Mr. Richard Coward Johnson, of Queen's Buildings, 11, Dale Street, Liverpool. It was registered on the 21st ult., with a capital of £10,000, in £10 shares.

RIO GRANDE DO SUL, BAGE AND CACEQUY RAILWAY COMPANY, LIMITED.—This company proposes to acquire concessions for the construction and working of railways in Brazil, and particularly a concession for a railway from Rio Grando do Sul to Bage, now held by the Compagnie Imperiale du Chemin de Fer de Rio Grande do Sul (Bresil), also a concession for the construction and the working of a railway from Bage to Cacequy. It was registered on the 26th ult., with a capital of £800,000, in £20 shares.

SOLWAY STEAMSHIP COMPANY, LIMITED.—On the 20th ult. this company was registered, with a capital of £25,000 in £50 shares, to transact the business of shipowners in all branches.

"STIRLING CASTLE" STEAMSHIP OWNERS, LIMITED.—Registered on the 21st ult., with a capital of £140,800, in £100 shares to purchase the s.s. *Stirling Castle*.

STEAMSHIP "CAMBODIA," LIMITED.—Registered on the 15th ult., with a capital of £45,000 in £100 shares, to purchase own and work the s.s. *Cambodia*, of Liverpool.

STEAMSHIP "ROMANIA" COMPANY, LIMITED.—Registered on the 26th ult., with a capital of £20,000, in 64 shares of £312 10s. each, to purchase and work the s.s. *Romania*.

STOURBRIDGE POTTERY WORKS, LIMITED.—Upon terms of an agreement of the 1st ult., this company proposes to purchase the Delph Pottery, Brierley-hill, Stafford. It was registered on the 21st, ult., with a capital of £10,000, in £1 shares. The purchase consideration is £2000 in fully paid shares, and £2000 in cash.

THOMPSON'S SMOKELESS KILN AND OVEN COMPANY, LIMITED.—This company was registered on the 21st ult., with a capital of £100,000 in £5 shares, to acquire and work certain letters-patent and provisional protection granted to David Thompson, William Henry Thompson and William Joseph Booer, for improvement in apparatus and machinery for bending, burning, staining, and annealing glass, and turning art tiles or pottery, also applicable to other purposes; and for improvements in the construction of gas kilns and furnaces, and arrangements for super-heating steam therein; and for improvements in the construction and arrangement of gas oven and apparatus connected therewith.

IRON.

No. 496.

LONDON, FRIDAY, JULY 14, 1882.

THE READING SHOW OF THE ROYAL AGRICULTURAL SOCIETY.

On Monday last, the 43rd annual meeting of the Royal Agricultural Society of England was virtually commenced at Reading by the whole of the show being thrown open to the public. The implement yard, however, was open to inspection last Saturday, but no great advantage was taken of this by the public. The show is a good one, the stands are conveniently arranged, and for the most part well filled, although there is no great display of novelties. Having last week published a plan of the show-ground, together with a list of the exhibitors of machinery and implements, and having given a general programme of the proceedings, we need not travel over that ground again, but proceed to describe the various exhibits of interest to our readers, many of which they will find illustrated and specially noticed in succeeding pages of our present issue. Before dealing with the exhibits, however, it may be as well to refer to the competitive trials of various machines which were arranged to take place during last week. The chief interest centered in the hay-drying competition, but those visitors who went day by day to the trial ground in the hope of witnessing it were doomed to disappointment owing to the heavy rain which fell at intervals each day. On Saturday the weather was more auspicious, although some heavy rain fell at intervals, and in two cases the stacking was commenced. There was a general impression that these hay-drying machines were to take the grass under any circumstances, dry it, and so make it into hay. As a matter of fact, however, they are hay, and not grass-drying machines; and it is therefore necessary that the grass should have become converted into hay by being deprived of its sap before it can be dealt with. This preliminary process has to be effected by the sun and air, but as there was but little sun and much rain last week, the hay was not made, and consequently could not be stacked and operated upon by the various hay-drying systems. Had the hay been ready the rain would not have been a drawback, but would have assisted the judges in determining the best machine, as it would have placed the hay in that unfortunate condition in which it is the province of the drying machines to step in and assist it.

The trial field is just outside the town, and is nearly 100 acres in extent. Here seven competitors were assembled, their machines being distributed over the ground. There was an eighth competitor, who, however, had failed to enter in time for the competition, and so was debarred from taking the field. He, however, made up for it by taking up his stand near the entrance to the meadows, and there showing his exhaust fan. The unfortunate individual was Mr. E. Pratt, of the Albert Iron Works, Uxbridge, and his fan appeared to be a very fair one. It is not driven by belting, but by one large fine-pitch spur wheel, gearing into a very small pinion, thus attaining high speed with little loss of power by friction. The blades are light, and set at an angle. The casing not being concentric with the revolving fan, allows the free discharge of air, and adds to its efficiency. The machine is mounted on wheels so that the connection with any rick can be made without trouble or loss of time. The first competitor within the field is Mr. James Coultas, of Grantham. His is a large fan of the ordinary type, mounted on a pair of wheels for removal from stack to stack, and provided with three suction inlets for three sets of pipes from as many ricks or places in a large rick. The fan is 35 inches in diameter over the tips, and has four flat blades 12 inches square. It is driven by a portable engine of 8 horse-power, by Messrs. Brown and May. The rick is 30 feet in length and 10 feet in width, and is built over the mouths of five 9 inch diameter pipes. The latter are imbedded in the ground, and except the short lengths nearest the fan, are of glazed earthenware. In building the ricks over the mouths of the pipes a light wood cage, 8 feet in height and about 12 inches square, is employed, so as to leave a space into which the heated air and moisture are drawn from all parts of the rick. It will be seen that this system, like most others, is based upon that of Mr. Neilson, which has been described by us. The second competitor on the field is Mr. Champion, the manager of the Reading sewage farm, who is exhibiting Mr. Gibbs' hay-drying apparatus, which he has used with much success on the farm he manages. Mr. Gibbs' apparatus has also been described by us. It consists of a double furnace and a large fan driven by an engine. The heated air is delivered into two reciprocating troughs, into which the hay is fed and in which it is kept well agitated until it leaves the machine quite dry. Mr. Gibbs has himself entered an exhaust fan, which is connected with the rick made from the hay dried in his hot-air apparatus. Mr. C. D. Phillips comes next with his exhausting fans, which will be found described and illustrated on another page. Messrs. R. A. Lister and Co., of Dursley, have a turbine fan, mounted on a cast-iron framing carried on wheels and driven by a strap, the fan being worked by either steam, horse, or hand-power. The Agricultural and Horticultural Association, of 3, Agar Street, Strand, London, have two fans, the leading principles in which are a very high rate of speed and a proportionately powerful suction. This is obtained by the aid of a modification of the sun-and-planet motion, as described by us last week. The final competitor is Mr. A. C. Bamlett, of Thirsk, who uses a small fan mounted on a framing, the small fan pulley being driven by a strap off a large wheel turned by hand. Although not on the trial ground, Messrs. C. Kite and Co., of 117, Charlton Street, London, have entered their system of stack-drying by means of their exhaust ventilator. In this case perforated zinc cylinders are built into the rick and are connected with one of Messrs. Kite's exhaust ventilators by means of a pipe passing through the rick. The action of the ventilator draws off the heated air, and should the external atmosphere be sluggish an induced current is caused by the application of a peculiarly constructed safety stove. This system has been tried on two very bad ricks with perfect success. The wet weather which hindered the trials of these machines last week has unfortunately again prevailed, and has retarded operations so that little or nothing has been done.

The other competitions relate to steam draining machinery, cream separators, milking machines, and straw-compressing and binding machines. There were two entries of steam draining machines, but both were withdrawn before the day of trial arrived. The cream separator contest was a smart one, although confined to two competitors out of ten who entered, eight having withdrawn. The two competitors were Messrs. D. Hald and Co., of Great Winchester Street, London, with a Lamm machine and the Centrifugenbau-Actien-Gesellschaft of Hamburg, with their own apparatus. Of these trials and those of the other machines referred to, and of their results, we shall have more to say hereafter.

We now, therefore, turn to the exhibits of machinery and implements, in which connection we may mention that many of the leading exhibits, which will be referred to in general terms in the present article, will be found fully described and illustrated in succeeding pages, either in our present or next issue. Referring to the general exhibits, we cannot do otherwise than give the *place d'honneur* to the Reading Ironworks, who well deserve it. As local exhibitors they have, as a matter of course, endeavoured to make a good show, and excellently well they have succeeded, for their two stands will compare favourably with any others of their class in the show. Where there is so much to notice and when all is so good in design and workmanship, it is difficult, and may seem invidious, to particularise any special exhibits. We will, however, take those which are most strikingly prominent, and foremost amongst these is their new horizontal compound condensing engine, which we fully describe and illustrate on another page. This engine has been designed with a view to its compactness and the easy removal of its various parts for examination as well as for the development of the highest economy in fuel consumption, obtainable by the system of compounding, whilst the construction is such that it will occupy but a moderate amount of space. Besides the engine, there are three new machines to which we would direct special attention. The first of these is a brick and tile making machine, in which the clay rolls are driven by a pitch chain, and can be readily removed; the bearings are so arranged that they are not likely to be worn by the falling clay. The Pug Mill is made with a hinged case to open for cleaning, and the machine is worked by an 8 or 10 horse-power engine. The next machine is one for washing railway milk cans. It is Pocock's patent, and consists of a strong wood tank in which are fixed three horizontal revolving brushes, two of which clean the outside of the can whilst at the same time the brush on the centre of middle spindle cleans the inside, the operation of cleaning being very rapid and very thorough as the judges convinced themselves in their trials. The last of these new machines is a newly designed circular saw bench on a strong iron frame, fitted with rising and falling spindle, adjustable bevel hinge fence which can be turned back off the table. It carries a 24-in. saw, with fast and loose pulleys. The other exhibits of the Reading Iron Works comprise a number of engines of the traction, portable, horizontal and vertical classes, of various powers, as well as an assortment of "Universal" wrought iron split pulleys, one being of large size, 8 feet in diameter. There was also a goodly variety of chaff cutters, corn grinding, and oil cake and grain crushing mills, carts, rollers, ploughs, and agricultural machinery shown, the whole forming an excellent and highly creditable display.

The first stand to meet the eye of the visitor on entering the show-ground, is that of Messrs. John Fowler & Co. of Leeds, who exhibit specimens of most of their principal varieties of agricultural engines and implements, and likewise an example of their compound semi-portable engines, suitable for any stationary work, together with models of their portable railway. They exhibit two different methods of steam cultivation, which are intended to supply different requirements; one being their ordinary double tackle, which is worked by two engines—one on each headland; and the other the double-drum tackle, worked either direct on the headland with an anchor, or as a stationary or roundabout tackle. The general form of the double-engine tackles is too well known to require detailed description; the increased size of the road wheels, a great advantage in soft land, being the principal novelty. The power of the engine is transferred to the implement in the most direct manner, viz., by the direct pull of a straight line of wire rope. The loss of power, by unnecessary moving parts, friction, or bending of ropes, &c., is therefore very small. These engines are suitable for all kinds of farm labour. By taking off the winding-drum, they become at once traction engines, and by means of the fly-wheel, they can be used for thrashing or any other similar operation. There are circumstances where it may be necessary to employ an apparatus of less cost than the one just referred to and for these cases the double-drum tackle is provided. It embodies two systems of working. The Stationary or Roundabout and the Direct. In the latter, the engine travels along one headland opposite a self-moving anchor. The winding-drums are placed horizontally under the engine, and the rope is at liberty to pay off at any angle that may be required. The engine is specially adapted to the general work of the farm. The general form of the engine is the same as usual, although Messrs. Fowler have introduced several improvements in detail, such as the liberal introduction of steel in the working parts, the double riveting of the boilers and the improvement of the coiling gear. Steam traction is represented by several road locomotives. The principal novelty in the traction engine is the introduction of high driving wheels, which greatly increase the adhesion, and prevent the wear and tear of the road. They effect also a remarkable increase in the tractive power of the engines. A further improvement is the arrangement of the gear, which is entirely within the wrought-iron crank-shaft box, thus reducing the width of the engine. Messrs. Fowler exhibit their new pattern agricultural locomotives or thrashing engines—one of which is on the compound principle. The ordinary balance-ploughs, turning cultivators, harrows, and rollers are fully represented, showing a number of improvements in details, such as the fixing of the plough skifes to the main beam, by which the width of the furrow can be altered, and the new arrangement of the centre part of the plough, which, in ploughing rough, uneven, or rigid land, avoids the violent shocks which otherwise would throw an implement with an ordinary plough-centre out of work. Messrs. Fowler also exhibit the models of a portable railway, the principal feature of which is, that the two rails are fixed to corrugated steel sleepers of a strong and light section by patent clutch bolts, a set of two rails forming thus a rigid whole, light enough to be handled, taken up, and put down by a man with ease.

Messrs. Clayton and Shuttleworth, of Lincoln—whose works we describe and illustrate on another page—exhibit two of their portable engines of 5 and 8 horse-power respectively. They are fitted with jacketed cylinders of large area, improved water-heater effecting a considerable saving of fuel and a simple reversing eccentric, which admits of the fly-wheel revolving in either direction, and can readily be altered. The firm also exhibit a 10 horse-power portable engine fitted with Elworthy's apparatus for burning straw, and an excellent agricultural locomotive engine, with an 8½-inch cylinder, and mounted on strong wrought-iron driving wheels. It is fitted with a winding drum for drawing thrashing machines or other loads out of places inaccessible to the engine, or up very steep hills where the engine has to be taken up alone, and the load to be drawn up by means of a strong steel wire rope, while the engine remains stationary. Besides these the firm show some good examples of horizontal engines of simple design, and fitted with expansion gear, adjustable by hand whilst the engine is running. The working parts are few in number, and the proportions have been carefully considered. Being erected upon a cast-iron bed-plate, planed on the upper and under sides, the engines require only to be bolted down to a brick foundation. The flywheel is turned up on its face to receive a driving band, and the crank-shaft is sufficiently long for an extra pulley to be fitted on either end to suit different speeds. The remaining exhibits of this firm comprise thrashing and finishing machines, stacking machines, and chaff cutters. Messrs. Aveling and Porter, of Rochester, have improved the construction of their engines in detail by carrying the bearings in a cast iron bracket piece, which is rivetted on to their patent side-plate brackets, the three bearings being bored out at one and the same operation after the plates have been fixed on the boiler. This method insures accuracy of fitting, and that the gear shall all run true, all bearings being round. The firm are introducing this

ELEVATOR AND SEED DRILL.

BY MR. GEORGE CORNISH, BURY ST. EDMUNDS.

(*For description, see page 27.*)

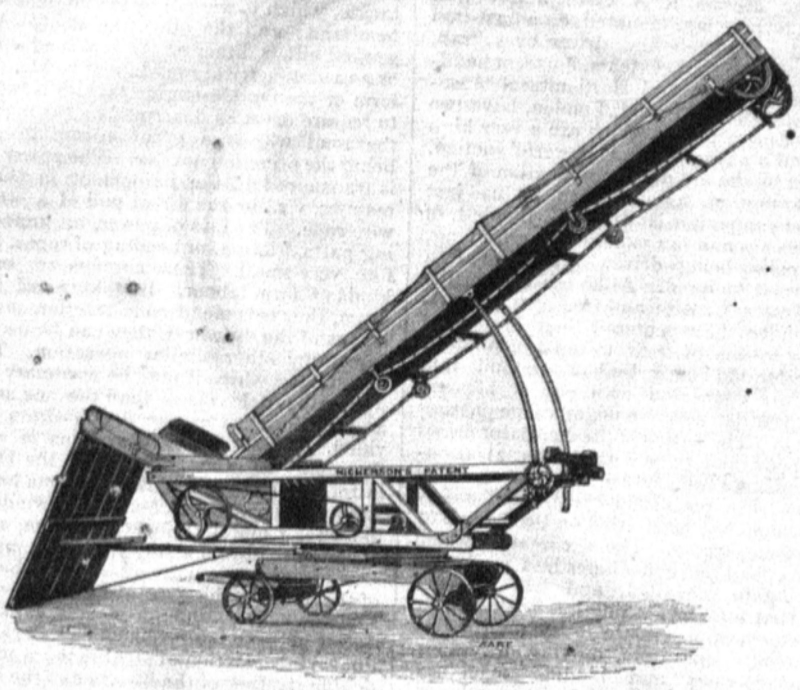


FIG. 1.

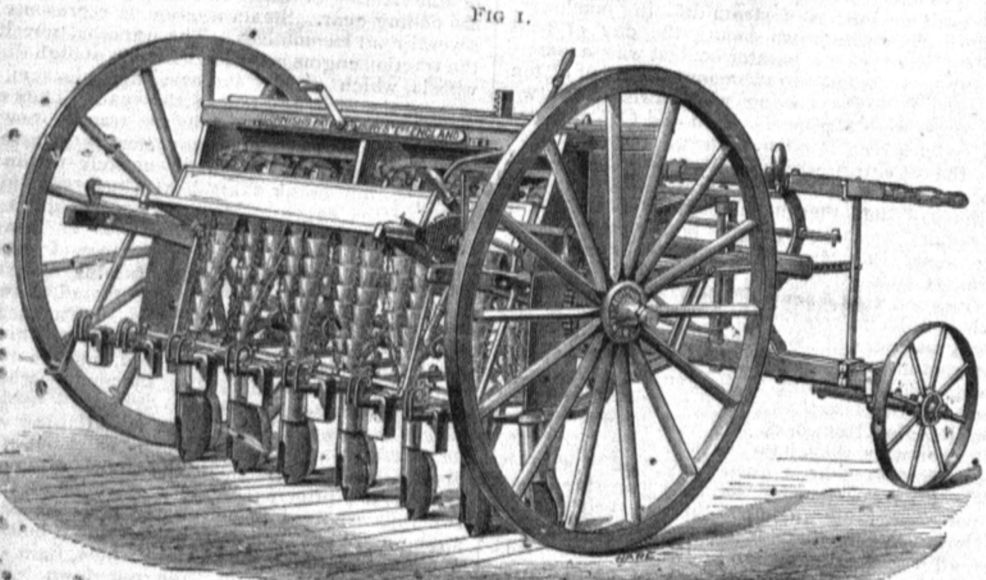
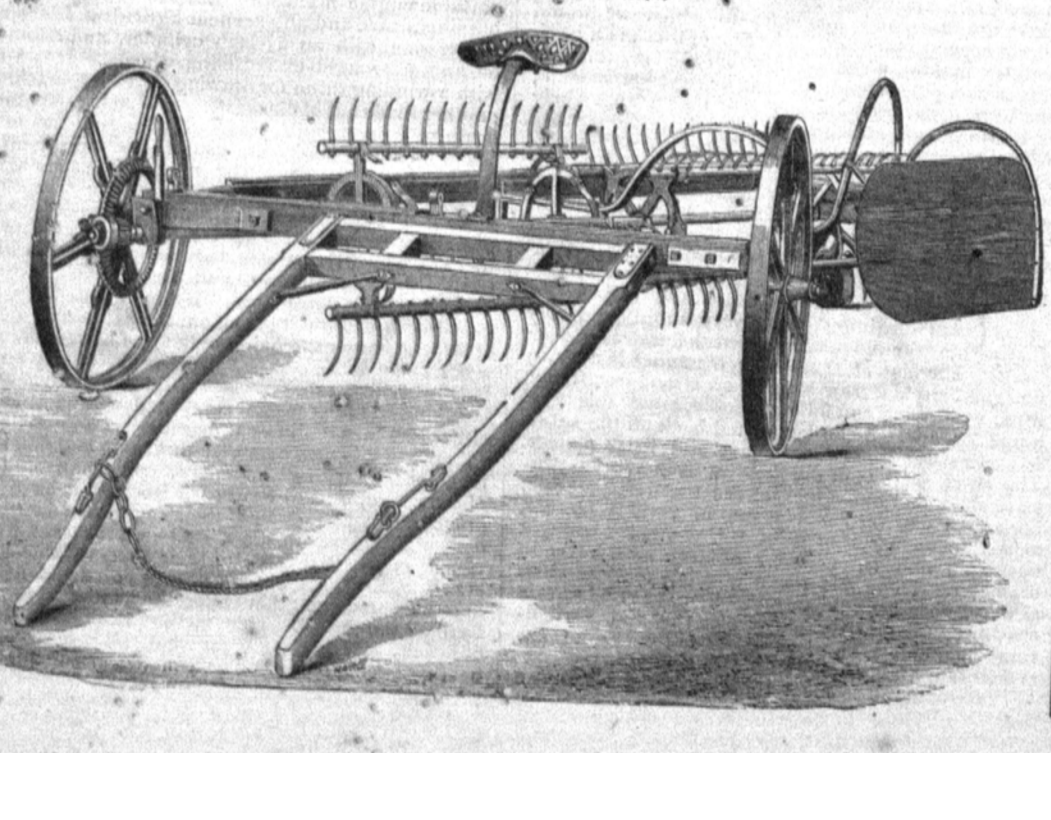


FIG. 2.

LANDER'S HAY COLLECTOR.

(*For description, see page 27.*)



improvement in all their engines. They make a good show of their agricultural and road locomotives, steam ploughing engines, and road rollers. They also show their agricultural locomotive waggons, some of which are arranged for tipping either side.

The Agricultural and General engineering Company, of No. 2, Walbrook, London, exhibit Darby's broadside steam digger in action. This machine was described and illustrated by us in connection with the Royal Show last year, so we need only now observe that it is of 8 horse-power, and is designed to thoroughly disintegrate the soil. The weight is equally distributed, and the machine adapts itself to uneven ground, and it will dig more than an acre per hour. It is a handy engine for thrashing, grinding, and all kinds of farm work where steam is required. Since the last Royal Show, it has been improved by having five forks instead of three. It is stated that crops at Chelmsford grown on ground cultivated by this digger, are found to be greatly improved owing to the soil having been thoroughly aërated by the digging process. Messrs. Marshall, Sons and Co., of Gainsborough, make a very fine show of engines and machinery, notably their new compound stationery engine, which we describe and illustrate on another page. This engine is of 20 horse-power, and is fixed over a locomotive multitubular boiler. It is fitted with automatic expansion gear, and is mounted on a wrought-iron foundation frame. The firm also exhibit an 8 horse-power portable engine, with an enlarged fixe-box, and fitted with all the most recent improvements for promoting economy in fuel and durability in working. Their other exhibits consist of traction and vertical engines, finishing thrashing machines, and other agricultural implements. Messrs. Ransome, Head and Jefferies, of Ipswich, make their usual excellent display of engines, thrashers, ploughs, and other agricultural implements, several of which are described and illustrated on another page. Messrs. Robey and Co., of Lincoln, exhibit one of their fixed engines, combined with a locomotive boiler, which is especially designed for providing economical steam power in a small space. In their traction engines instead of securing the crank, countershaft, and axle bearings to a prolongation of the fire-box shell, as is ordinarily done, they are carried on the side plates of the tender, which are made specially strong for the purpose. This method of construction entirely removes all danger of straining the boiler and causing leaky seams down the front, and is undoubtedly a step in the right direction. The boiler is also attached to the tender in an improved manner, so as to prevent all straining of steam joints by the side pull of the tender in turning corners. The firm also exhibit a number of portable and other engines which are alike good in design and construction.

Messrs. E. R. and F. Turner, of Ipswich. show one of their automatic expansion portable engines of 8 horse-power, and another of 5 horse-power, in which economy of fuel is insured by the introduction of various improvements in construction, as experience has from time to time suggested. They exhibit several other engines of equal excellence, and a variety of their corn-grinding and other mills. Messrs. Cochran and Co., of Birkenhead, exhibit one of their well-known vertical multitubular boilers with horizontal flue tubes. The vertical engine and boiler combined, which is exhibited, presents several new features which are not to be found in the ordinary engines of this class, and if it lacks some of the elegance of design offered in competing engines, it certainly excels in strength of construction and in large wearing surfaces, which in all important parts are adjustable. The Cochran boiler will necessarily give great economy, and from trials actually made it has been known even to excel some portables which lay claim to the first class. The other exhibit is a two-wheel portable, intended for easy transit in mountainous districts. A specimen flange plate exhibited shows the high-class work this firm are now regularly doing by the aid of hydraulic machinery. Messrs. Charles Burrell and Sons, of Thetford, make a good display with their traction and portable engines and thrashing machines. The arrangement for varying the speeds from fast to loose is an ingenious and important feature in these engines. The pinions slide on keys worked up out of the solid shaft instead of being let in as is the general practice. The portable engines exhibited by this firm are of two kinds, one is a fine example of a high-pressure engine, whilst the other is on the compound principle the engine being designed tandem fashion. The low-pressure piston which is nearest the crankshaft is provided on the front side with an extra wearing surface, which forms it into a crosshead, the small end of the connecting rod taking hold of a pin within it. Each cylinder is practically single acting, the stroke from the crank being performed by admitting steam to the crank end of the high pressure cylinder while during the return stroke the steam is admitted to the side of both pistons furthest from the crank. The high-pressure piston being thus put in equilibrium while the steam acts effectively on the area of the low-pressure piston. The distribution of the steam for both cylinders is effected by a single valve. We understand the economy reached by this engine is very marked. Messrs. Burrell also make a good show of their thrashing machines, which are good alike in design and make. Messrs. R. Hornsby and Sons, of Grantham, exhibited their new combined reaper and string binder, which we describe and illustrate on another page and which they have made very perfect in action. They also exhibit a new narrow gauge traction-engine or agricultural locomotive of 6-horse power, and another of 10-horse power, as well as a variety of horizontal engines, and a fine collection of ploughs and harvesting implements.

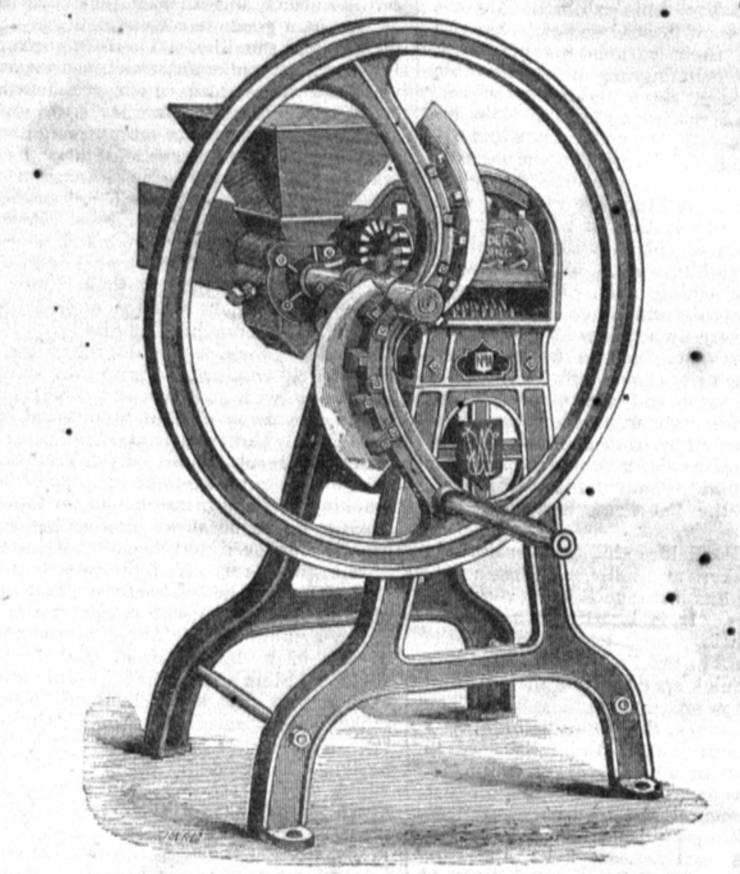
Messrs. Ruston, Proctor and Co., of Lincoln, exhibit a new compound portable engine containing a number of recent improvements, in detail which engine we illustrate on another page. They also exhibit a good horizontal expansive fixed engine of 20-horse power, having a 14-inch cylinder, with a 28-inch stroke. The firm also exhibit an 8-horse power portable and a 6-horse power traction engine, as well as some thrashing and finishing machines. Messrs. J. and F. Howard, of Bedford, have, as usual, a splendid collection of their ploughs and other implements of tillage, and of harvesting machinery. The Simplex ploughs attract well-merited attention from the fact that they possess the two good qualities of strength and lightness in combination. The "Simplex" mowers and reapers of this firm are also well worthy of notice, particularly their string sheaf binder which binds into sheaves the cut grain as it is delivered from the platform of the reaping machine. The sheaves are automatically separated and bound with Manilla twine. The sheaves can also be regulated in size, and are delivered of uniform bulk, whether the crop be light or heavy. The Bristol Waggon Works Company of Bristol, exhibit a large collection of their well-known vehicles, specially noticeable amongst which was a cattle van on Margetson and Hek's patent. It is mounted upon locking carriages at both ends, connected with each other by diagonal bars which gives it many important advantages. We also noticed Margetson and Hek's tip waggons and carts, of which the Bristol Waggon Company are the sole makers. These vehicles, which have been described and illustrated by us, are easily tipped by means of a windlas placed at the front. The company's other exhibits comprise a variety of useful farm and other vehicles. At the stand of Messrs. Atkinson and Philipson, of Newcastle-on-Tyne, we found a very neat and powerful brake which was fitted to some of their exhibits, which comprised some very elegant light carriages. It is Mortimer's patent, and consists of a divided circular spring, having its outer surface covered with leather, and working inside a ring which is fixed on the nave of the wheel. Upon the spring being expanded by a simple lever arrangement, the leather is forced in contact with the inner surface of the ring, and a powerful frictional retarding action is produced. Whilst on the subject of carriages, we may refer to some very ingenious devices in details which we found in some of the carriages shown by Messrs. C. S. Windover and Co. of Long Acre, London. These include self-acting heads with which some elegant Landaus were fitted, and some window ratchets fitted to several circular broughams. The display of carriages by this firm is of an exceptionally high-class character.

At the stand of Messrs. Samuelson and Co., of Banbury, the chief exhibit of interest is the sheaf binding reaper, which received the silver medal of the Royal Agricultural Show at the severe competitions at Derby last year. The binding operation, so far as the size of the sheaves and the tying are concerned, is automatic, and by adjustment before commencing work, the machine will form sheaves of one uniform size, irrespectively of the variations in the density of the crop in different parts of the field. The knot formed is perfectly secure, the tightness of the band can be regulated, and this tension in no way affects the security of the knot. Amongst controllable rake reapers, passing reference may be made to the "Omnium" and "Prince," with four rakes each. The "Harvest Queen," with five rakes (the controlling arrangement in this machine is automatic), and the "Imperial" reaper, with six rakes. Manual delivery machines are well represented. Gardner's Turnip Cutters occupy their usual place, and there are also one or two types of root pulpers of the disc pattern. A bean mill and combined mill and chaff cutter complete the list of agricultural articles exhibited; while in the Horticultural Department, various sizes of the popular "Villa" and "Favourite" lawn mowers complete the fine display of machines on this stand. Messrs. Samuelson also exhibited Pilter's patent hay press, which compresses hay, straw, and other fibrous materials into cylindrical bales of about 2 cwt. each, very convenient for stowage as well as for loading and unloading or moving about.

Messrs. Harrison, McGregor and Co., of Leigh, Lancashire, make a good display of their "Albion" self-taking reapers, which they have recently improved by making the rakes perfectly controlable. They may now be set to deliver the sheaf, every rake making a swathe, or every second, third, fourth, or sixth rake making a sheaf; while, by a simple pressure of his foot, the driver can cause any or all of the rakes to pass over the platform without delivering the sheaf. Mr. John Wilder, of Reading, makes a good show with his chaff-cutters, which are to be seen in every variety, as are also his combined chaff-cutters and root-pulpers, his

WILDER'S COMBINED CHAFF-CUTTER AND BEAN-MILL.

(For description, see page 27.)



BAMFORD'S HARVESTING IMPLEMENTS.

(For description, see page 27.)

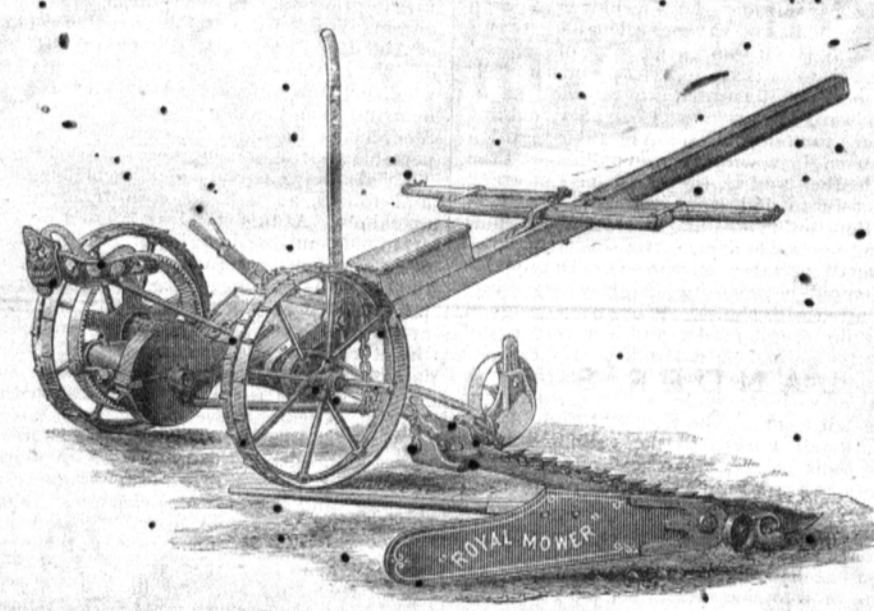


FIG. 1.

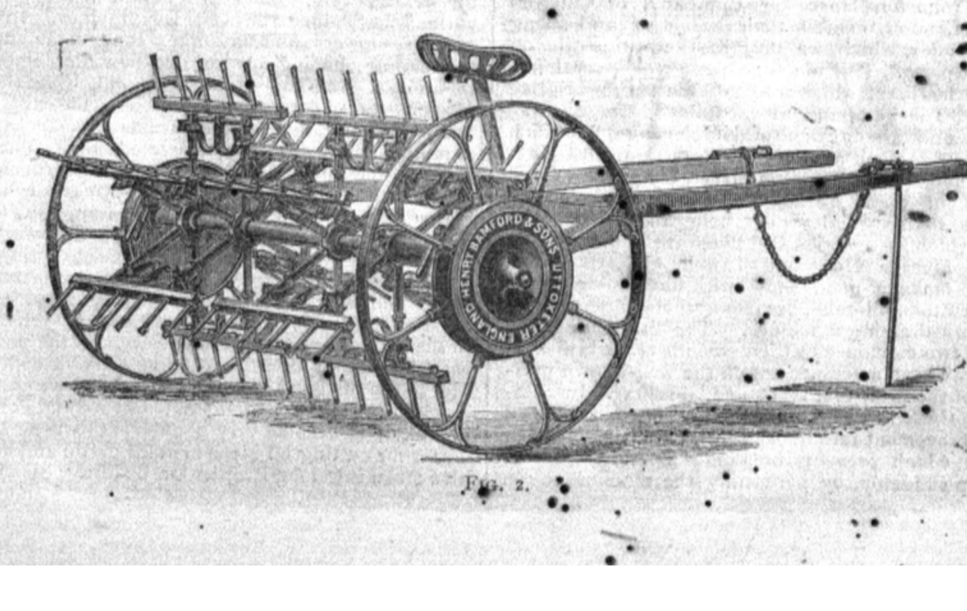


FIG. 2.

oilcake mills, his horse-gears, harrows, clod crushers, and a number of other agricultural implements. He has several novelties in chaff-machines, notably that combined with a bean-mill, which we describe and illustrate on another page. As a local exhibitor, Mr. Wilder maintains the credit of the town both by the quantity and quality of his exhibits. Messrs. A. H. Bateman and Co., of East Greenwich, have an excellent collection of their various manufactures, including their emery-grinding machines, portable forges, drilling machines, screw-making machines, boiler tube cutters, and the many useful tools for which their works are noted. We noticed particularly a new lock-up valve and tap of novel and simple construction, and which promises to subserve the many purposes for which valves and taps are required with credit, as it is so constructed that it makes a very durable and lasting valve. Mr. W. Brenton, of St. Germans, Cornwall, exhibits several of his mowing machines, drills, and crushing mills. His novelty is a centrifugal flour-dressing machine. The feed is introduced into the centre by a screw formed on the beater shaft, which prevents the reel being choked from the spouts if the belt comes off. The worm conveyor is made of steel, and the machines are adapted for dressing either wheat, meal, or flour from middlings, whether ground by stone mills or reduced by rollers. Mr. Brenton is well known as the inventor of some simple, safe, and ingenious door fastenings. He has now added to the list a safe and useful bolt for sliding doors.

Mr. C. E. Hall, of Sheffield, exhibits several of his well-known stone breakers and mills. He has a new bone mill, in which he has introduced some very substantial improvements. It is fitted with a third or pulverising roll, which is placed beneath and works in with the upper pair. The third roller is driven direct from the engine at a quick speed, whilst the crushing rolls are driven at a slow speed through gearing. The results are very satisfactory, the bones being broken up between the top pair of rolls and pulverised in passing out between them and the lower roll. Mr. Hall exhibits his new drive chain as applied to an elevator, each link being closed by a packing piece and a rivet, and a strong and useful chain being thus produced. Messrs. Hayward Tyler and Co., of Upper Whitecross Street, London, exhibit one of their well-known "Universal" steam pumps, the diameter of the cylinder being 7 inches and that of the pumps 4 inches, the pump being capable of raising 3500 gallons of water per hour to a vertical height of 120 feet. These pumps have been most successfully applied during the past ten years. In their hot air engine for domestic water supply several detail improvements have been introduced, and it has been adapted to existing well frames, as illustrated and described on another page. The firm have this year introduced a novel class of pump for raising large bodies of water to a low lift. It is a modification and an improvement of Roots' blower, adapted to water, and it promises well. This pump is also illustrated on another page. Messrs. Hayward Tyler and Co. also exhibit several other matters, such as their garden and house fire-engines, wrought iron pullies, and the "Victoria" leather belting, the excellence of which it is satisfactory to find is maintained. Mr. E. S. Hindley, of Bourton, makes his usual excellent show of vertical engines and boilers. His specialty, however, is a small portable engine—the Diagonal—which is mounted between two high wrought iron wheels, and fitted with shafts. It has been designed for travelling on rough roads, and is a very useful and handy little engine. Mr. Hindley also exhibits a new circular saw bench with a self-acting rope feed, which is variable while working, and thus meets a long-felt want. The Kirkstall Forge Company, of Kirkstall Forge, Leeds, exhibit a large collection of their shafts, which are rolled by their patent process and are produced as round, true and straight as any ordinary turned shafting. Butler's frictional couplings are also exhibited, together with various other products of the Kirkstall Forge. The shafting is of excellent quality, showing 20 per cent. greater strength in torsion and 33 per cent. in flexion than ordinary rolled iron, and is being largely used by most of our agricultural implement makers.

The Johnston Harvester Company, of Chiswell Street, London, exhibit their harvester and string sheaf binder, which we describe and illustrate on another page. This machine possesses several important features, which are stated in our descriptive notice. The company also exhibit their self-rake reapers and other agricultural implements, for which they have so good a name. Messrs. J. and H. Keyworth and Co., of Tarleton Street, Liverpool, exhibit several of their Adriance Buckeye mowers and reapers, their special exhibit being the Larsen hay-rake, which we describe and illustrate in our present issue. Messrs. Hunt and Tawell, of Earls Colne, Essex, make a good show with their horse-gears, chaff-cutters, oil-cake breakers, root-pulpers, mills and corn-dressing machines. The firm have lately added two machines to their smooth-roller bruising-mills. These machines are on the well-known principle of the firm, that is, two equal rollers. In addition to these new machines the firm have introduced an improvement into their horse-gears, viz., a spring clutch, which prevents breakages should the horses pull up suddenly, by permitting the machine to run on and come gradually to rest. It also prevents the poles knocking against the horses at the same time. This clutch is adjustable and can be made to run either way by simply taking off the face and reversing the clicks. Messrs. Carson and Toone, of Warminster, have an excellent display of chaff-cutters, turnip-cutters, and other fodder-preparing machines, as well as a good selection of horse-gears, cheese-presses and the like. Their specialty, however, is Lander's hay-collector, which we describe and illustrate elsewhere, and which, we hear, is finding a large sale. Messrs. John H. Ladd and Co. exhibit their well-known straw-compressing machine, which is in operation and attracts attention by the excellent way in which it performs its work. Mr. H. R. Marsden, of Leeds, shows his stone-breaker, which we illustrate and describe on another page, and into which he has recently introduced several detail improvements. Mr. Marsden also exhibits a new fine-crusher and pulveriser, 12 inches by 3 inches at the mouth, and which requires only 4 horse-power to drive it. This machine admits large lumps of stone and reduces them to any degree of fineness required. It is largely employed in gold mines abroad, in place of stamps, with good results, and its use in cement works does away with millstones and is stated to reduce the cost of cement making.

Mr. Walter A. Wood, of 36, Worship Street, London, makes an excellent display of his harvesting machinery. The arrangement for the delivery of the sheaf in his string sheaf-binding harvester, has been greatly improved by the introduction of a double discharging arm. A light and handy machine is shown, being a new 2-horse manual-delivery reaper of simplified construction, and which is very compactly arranged. Mr. Wood also exhibited a variety of his high-class mowers and reapers. Messrs. Picksley, Sims and Co., of Leigh, Lancashire, are well represented by their chaff-cutters, mills and other food-preparing machines, which have recently been improved in various respects according as experience suggested. A class of implements in which they also show up well is mowers and reapers, of which they have a variety suited to all requirements. Messrs. Davey, Sleep and Co., of St. Germans, Cornwall, are well known in connection with implements of tillage, particularly ploughs, of which they have an excellent assortment. Their novelty, however, is a combined implement for tilting and raising potatoes and other roots. It consists of a frame mounted on high wrought iron wheels. To the frame is attached a peculiar curved share and mould-plate, behind which is an oscillating or kicking skeleton platform, acted upon by a lever in connection with the main wheels. The roots falling on the platform are deprived of the soil and left ready for collecting. This implement is also useful for pulverising the soil. In corn drills, broadcast sowers, and manure distributors Messrs. Ben Reid and Co., of Aberdeen, are especially strong. Their leading exhibit is the excellent broadcast manure sower, which will sow all kinds of artificial manure, as is demonstrated on the show ground. Messrs. Wallis and Steevens, of Basingstoke, exhibit a variety of their portable and traction engines and thrashing machines. They also have a good collection of ploughs, harrows, and rollers, as well as corn-dressing and other machines. At this stand we found a very compactly arranged semi-fixed engine of 20 horse-power, fitted with a patent governor, which is adjustable while the engine is running. The firm also show a compact exhaust fan for harvesting in the rick. There are two varieties, one to be driven through a belt and the other through wheel gearing, the latter being intended for use in wet weather, when a strap would slip. The fans are portable, and exhaust from each side into a centre delivery.

Amongst other attractions of the show is Parker's steam digger, which is to be seen in motion at the stand of its exhibitors and manufacturers, Messrs. Proctor and Co., of Stevenage, Herts. This machine is described and illustrated on another page, so that we need not further refer to it here than to say that it possesses considerable merit, including economy in first cost and in the expenses of working. Messrs. John Williams and Son, of Rhuddlan, near Rhyl, have improved the details of their chaff-cutters and horse gears in various ways since the last Royal show. In their reapers, mowers, and hay rakes they come out well at Reading, having one or two new implements of this class. Messrs. Richmond and Chandler, of Manchester, occupy a considerable space with their food-preparing machines of various kinds. In chaff machines they are particularly strong. The new form of mouthpiece introduced by this firm entirely prevents choking, and hence the roughest hay or straw may be cut without any stoppage to the machine. The safety arrangements are worthy of notice. The hopper is fitted with a self-acting endless feeding web or creeper, which carries the material to the toothed rollers, thus rendering great assistance to the feeder, and moreover adding very much to his safety, as no thrusting forward of the material is required, and there is therefore no necessity for him to put his hand near the toothed rollers. Another machine of Messrs. Richmond and Chandler's, and one likely to become very popular, is their new litter cutter for cutting up green food for cattle and horses, also straw into long lengths for bedding, by which a great saving is effected, as the fouled parts can be removed and fresh litter put down without waste, which is impossible when long uncut straw is used. An important improvement has lately been affected in the corn crushers of this firm. By means of strong spiral springs fitted at the back of the larger sizes a great safeguard against accident is established. Should any hard substance (such as nails, stones, &c.) be present with the grain, the springs allow it to pass between the rollers without either injuring the rollers or breaking the frame or wheels. Messrs. John G. Rollins and Co., of Old Swan Wharf, London Bridge, have a large variety of farm requisites, including some useful American productions. Of lawn mowers, too, they show a great variety, the "Archimedean" being a very good machine. Messrs. George Cradock and Co., of Wakefield, show samples of their steel wire rope, which has now an established reputation for durability and general excellence. We have on a previous occasion described the construction of this rope and its special features, and we can only now add that incontestible evidences of its superiority over steel wire ropes of the ordinary construction have been submitted to us. At the stand of Messrs. John Crowley and Co., of the Meadow Hall Ironworks, near Sheffield, we found a very fine display of their chaff cutters. These machines, some of which are of larger size, have been improved in various ways in detail, as experience has shown to be necessary, since we last noticed them. In lawn mowers and horse gears this firm are also strong, besides which they show a collection of their malleable iron castings, which branch of their business is still greatly on the increase.

One of the most attractive stands in the show is undoubtedly that of Messrs. J. Rhodes and Sons, of Wakefield, who exhibit in operation, a fine set of their special machinery for cutting and forming sheet metal goods. There may be seen the manufacture of tin boxes and pans, which one minute are plates and the next finished articles. We do not now stay to describe the ingenious machinery by which this rapid change is effected as by favour of Messrs. Rhodes we intend illustrating it shortly. The Nottingham Malleable Iron Company of Nottingham, have their usual good display of the various articles manufactured by them, and which include thrashing machine beater-plates and other fittings, as well as a variety of malleable castings for agricultural implements generally. At the stand of Messrs. Schaeffer and Budenberg, of Southgate Street, Manchester, we found their usual assortment of steam vacuum and hydraulic gauges. An interesting and highly ornamental exhibit is a combination consisting of a clock, a vacuum, and a pressure gauge, an engine counter, and a thermometer. The higher powers of gas engines are well represented at the stand of Messrs. Crossley Bros., of Manchester, who exhibit three of their Otto silent gas engines of 16, 6, and ½ horse-power respectively. The smallest engine indicates 2¼ horse-power, and is fitted with a dynamo-electric machine. In connection with the engine is an oil gas machine, so that the whole plant is rendered portable. Messrs. Thomson, Sterne and Co., of Glasgow, exhibit two examples of Clerk's excellent gas engines, of 2 and 6 horse-power respectively. The Turner Gas Engine Company of St. Albans, show several of their handy and useful little gas engines of various low powers. Messrs. H. Wurr and Co., of Blomfield Street, London Wall, exhibit several of their Ord gas engine of 2 man, 4 man, and 1 horse-power. Some of these engines are employed in driving wood working machinery at this stand.

Messrs. John Whitehead and Co., of Preston, are exhibiting their systems of brick, pipe, and tile machinery in operation. In one of these machines they show the four processes of hoisting the clay from the pit, crushing, pugging, and moulding it into bricks. They also exhibit a new press for the manufacture of roofing tiles. It is of great power, being a combination of the lever and the screw. Messrs. J. and J. Mackie and Co., of Reading, make a good display of their wrought iron spring "electric design" split drums, in which they have lately made some improvement which have given them increased strength and durability. From drums to leather bands is a very short step, and in this latter connection we may mention the stand of Messrs. Hepburn and Gale, of Long Lane, Southwark, at whose stand every variety of leather belt is to be seen. In the same connection we may also refer to the stand of Messrs. S. E. Norris and Co., of Shadwell, who show some excellent leather driving bands. Messrs. Burney and Co., of Millwall Docks, London, are as usual represented by a large number of iron tanks, cisterns, corn bins and other similar articles which they specially manufacture. Messrs. Francis Morton and Co., of Liverpool have a great variety of iron fencing, hurdles, and gates. In connection with their wire fencing they have introduced an ingenious improvement in their straining bracket. Instead of having a loose pawl, it is cast in one with the bracket and the ratchet spindle works in an oval hole. The little dodge answers very well, and there are now no loose parts for the workmen to lose. Messrs. Morton and Co. are having a good demand for their thatch substitute, which consists of corrugated iron plates, which are readily put together and easily taken apart. Messrs. S. and E. Ransome and Co., of Essex Street, Strand, London, never attend the Royal Show without bringing with them some new piece of ingenuity or other, and the present show forms no exception to the rule. Their novelty at Reading is an ingenious water raiser, known as the "Rainbow." It is, in fact, a steam pump, without any moving parts, the action being due to the current induced by the steam. And here we may allude in passing to an excellent little knife-cleaner which we found at the stand of Messrs. R. Hodd and Son, of 31, Hatton Garden, London. It has indiarubber rollers, which can be adjusted to compensate for wear, rendering them very durable.

One of the most artistic, and at the same time practical and instructive stands, is that of Messrs. Sutton, seedsmen, of Reading. It was to be expected that they would make some display at a show held in their own town, and this they have done, but with perfect good taste. Their stand really forms a museum of agricultural, horticultural, and floricultural produce. Grasses and grass seeds are represented by a collection of several hundred dried specimens. This firm have made the subject of the advantageous laying out of grass lands their special study, and they have met with great success in preparing mixtures of seeds to suit the geological formation of the soil. As a matter of fact, the whole of the land occupied by the Royal Show at Reading was sown with grass by Messrs. Sutton. What a year ago, or less, was rough land growing crops of vetches, rye, and turnips, is now—or was at the commencement of the show—a splendid piece of turfed land. The transition from grass land to cattle is not great, and seeing that the stand of Messrs. Day, Son and Hewitt, of Dorset Street, Baker Street, London, is within sight of that of Messrs. Sutton, we may here draw attention to a good assortment of cattle medicine we found at the stand of the Baker Street firm. Their stockbreeders' medicine chest contains a well-arranged assortment of all the compounds made by the firm for diseases in horses, cattle, and sheep. Besides this, there is their chemical extract, their gaseous fluid, and their red drench, which are each of them adapted to the special disorders they are designed to cure. And here for the present we must conclude our notice of the Reading Show, owing to the pressing demands made on our space by the numerous illustrated notices in connection with the show which the present number contains.

IRON TRADE SUMMARY.

THE English iron market continues to display firmness, but the complications in the East have unsettled business to some extent, and new orders are not very freely given out at this moment, being limited to immediate requirements. The pig-iron markets have been quiet during the past week, but their steadiness has not been much changed. Political events have not, apparently, affected the Glasgow warrant market, which has remained firm, tending towards animation, during the week, and a fairly large amount of business has been doing. Prices have been tending upwards, and closed on Wednesday at 49s. 11½d. cash and 50s. 1d. a month for buyers; sellers near. Makers' irons are also rising, the demand, especially from the United States, becoming much stronger. At Tuesday's market at Middlesbrough, a cheerful tone prevailed, makers doing the principal part of the business, at their own quotation, which is 43s. 6d. for prompt delivery of No. 3; merchants being but poorly supplied with iron. Shipments have been large, and the exports to Scotland have increased to some extent. Pig-iron has been quiet in Lancashire, but makers are firm for native pig at 45s. and 46s., less 2½, for forge and foundry qualities, delivered equal to Manchester, and at this figure have been doing a moderate business. Lincolnshire iron remains at about 47s. 6d. to 48s., and Derbyshire at 48s. 6d to 49s. On the Tyne the pig-iron trade has been steady, and prices are still 45s. 9d. for Cleveland No. 3, and 44s. 9d. for forge, per ton, delivered in the Tyne. Elsewhere the demand for pig iron is well maintained, at steady rates. A strong tone prevails in the hematite iron market. A large business is doing both for home and foreign account. Prices are steady at 57s. 6d. for No. 1, 56s. 6d. for No. 2, and 56s. 6d. for No. 3, net, per ton, delivered at works, or f.o.b. west coast ports. The finished iron trade is steady, there is more enquiry, and prices are firmer than they were a little while back. Plates are quoted at Middlesbrough at £6 15s. and £6 17s. 6d., boiler plates £7 15s., angles and common bars £6 2s. 6d. to £6 5s., all less 2½, delivered in trucks at works. On the Tyne, £6 17s. 6d. has to be paid for ship-plates, for which there is still a good demand; £8 for boiler plates, £6 7s. 6d. for angle-iron, and £6 5s. to £6 7s. 6d. for bars, delivered to the Tyne or Wear. In Lancashire, prices remain firm at £6 7s. 6d. to £6 10s. for bars, £6 10s. to £6 12s. 6d. for hoops, and £8 5s. to £8 10s. for sheets, delivered into the district. At the quarterly meeting of the iron trade at Wolverhampton on Wednesday, the quotations for finished iron were unchanged. The tinplate trade is fairly steady, but prices are still low, 15s. 9d. to 16s. for common cokes, and 21s. 6d. to 22s. for charcoal-made per box. No alteration is reported in the tone and prices of hardware. At Sheffield there is a very stiff demand yet both for steel and iron ship-plates; prices, however, are not improving. The future of the heavy department depends very much on the course present political events will take. The enquiry for steel rails is scarcely so active in South Wales as it was a short time since; but this is of less consequence, since makers could hardly find room in their books for further orders, at least for prompt execution. Steel rails are quiet in Cleveland, and only few orders are given out at present. The nominal price is £5 5s. per ton at works. In North Lancashire the steel trade is briskly employed all round, and the plate mills are well supplied with orders. Rails are in large output especially on foreign account. Shipbuilders are still busy, and some fresh orders have been received on the Clyde. Engineering works continue brisk. Founders are doing an average business. The probability of further war complications in the East has quickened operations at ordnance and armour-plate works. The English coal market is fairly active. This is especially true as regards steam coals, which are in strong request for all parts of the world. Manufacturing coals are also going off very satisfactorily. Household fuel alone is comparatively quiet. The coke business is very brisk.

Very favourable advices are being received here respecting the position of the iron markets of the Continent. In the Austrian market inquiry is well maintained both for pig and manufactured iron, the tendency of quotations being towards firmness; but no changes have as yet taken place in prices, although the increased import duties have been in operation since June 1. The Belgian iron market is growing much stronger, both on account of the regularity with which orders are coming in and the generally favourable nature of the export returns, just issued, for the first five months of the year, the exports of iron and steel for that period of 1882 showing a large increase over those of the corresponding period of last year. The French iron trade are breathing a little more freely, having less to fear at present from Belgian competition, owing to the greater animation in the iron market of Belgium. That of France has consequently settled down once more to its accustomed firmness, and quotations are again very stiff. According to the statistics published in the *Bulletin* of the Comité des Forges de France, the imports of iron and steel during the first five months of 1882 have increased about 13 per cent. The German iron market preserves its healthy tone. Prices of both pig and finished iron are stronger, and tending towards another rise. The coal markets of the Continent are active, and prices have a rising tendency, with the exception of that of Austria, which is quiet, without any material alteration in prices. The American iron market is firm. Quotations of Scotch pig-iron have been very steady during the week.

THE IRON TRADE OF THE PAST MONTH.

THE month of June was a busy one as regards the shipments of iron and steel, and the Board of Trade Returns bear witness to the large overturn which took place. It will be seen from the following comparison that the exports for June exceed those for any of the preceding months this year, while the deliveries so far as the year has gone contrast very favourably with the shipments during the same period of 1880 and 1881.

Total Exports of Iron and Steel for Six Months, ending 30th June.

	1880. Tons.	1881. Tons.	1882. Tons.
January	275,979 ..	197,112 ..	317 390
February ..	264,252 ..	192,870 ..	299.911
March	387,305 ..	290,198 ..	376,206
April ..	444,991 ..	329,100 ..	345,704
May	360 603 ..	356,664 ..	377,418
June	361,865 ..	362,263 ..	378,210
Total ..	2,094,995 ..	1,728,207 ..	2,094,839

The shipments for the first half of 1882 are thus within a mere trifle of those for the first six months of 1880, although the trade was regarded as unprecedentedly active in that year, owing to the American "boom." This is all the more remarkable when we remember the complaints which have been so loudly made this year of dull markets and contracted trade, and points to the large business which must have been done in the aggregate, although the enormous powers of production possessed by this country now prevented the demand having any beneficial effect permanently upon prices. There does not appear to be any very speedy prospect of a stop being put to this continued expansion in the production, for besides the alteration and conversion of old works which are going on, we hear of efforts on the part of established works to increase their output as much as possible. It would seem to be the object of makers to compensate themselves for the narrowing margin of profits by enlarging their overturn, so that the evil is one which tends to grow rather than to diminish. This question of increased production is one which will force itself sooner or later on the attention of manufacturers, and we do not like to contemplate the state of matters which in all probability will prevail during the next period of depression. Compared with the deliveries for the opening half of 1881, the shipments this year are 366,632 tons more. It remains to be seen whether this rate of progress will be maintained throughout the year, and 1882 prove to be a year of even heavier exports than its predecessor. Our readers will recollect that 1881 showed the largest total on record, the deficiency which appeared at the end of June in comparison with 1880 having been more than compensated for by the heavy shipments which took place during the latter half. To all appearance this year has a good chance of eclipsing the total of 1881, the great activity which prevails at all centres boding well for the result of the exports for the second half of the twelvemonths, should no political accident occur, which might completely disorganise trade.

The exports for the month of June exhibit some features which should not be disregarded, although the principal interest at the present time is attached to the wider question of the shipments for the six months. While the deliveries for the month slightly exceed those for May, they are 15,947 tons in excess of those for June 1881. The chief part of this consists of an increase of 5033 tons in the quantity of pig-iron shipped, of 7461 tons in the quantity of hoops, sheets, &c., and of 8575 tons in that of tinplates; while the greatest falling off is shown under the head of old iron, of which 4500 tons less have been exported. As regards the changes in pig-iron, tinplates and old iron, a glance at the following table will show that the exports to the United States have been the great factor in bringing them about. So far as pig-iron is concerned, the effect of the comparatively large increase in the shipments to the States has been counteracted by the falling-off in other directions which shall be pointed out further on. Buyers on the other side would seem to be taking advantage of the low prices which prevail just now in the tinplate trade, but the large quantities which have been shipped to the States during the past month are quite within the powers of production, and prices have shown little or no movement. The tonnage of old iron taken by the States is considerably under the average of the shipments for the past six months. In steel (unwrought) there is also evidence that the demand from the United States is contracting. The heavy decline in the exports of railway material to America is fortunately more than made up by the improvement in the general shipments, so that the total quantity exported last month exceeds that for the corresponding month of 1881 by 727 tons.

Comparative Statement of the Exports of Iron and Steel to the United States during the Months of May, 1881, and 1882.

		Tons.	Decrease. Tons.	Increase. Tons.
Pig-iron	1882 ..	42,368		
"	1881 ..	29,015		
			—	[illegible]3,353
Hoops, sheets, &c. ..	1882 ..	2,776		
"	1881 ..	2,[illegible]28		
			—	348
Tinplates	1882 ..	21,182		
"	1881 ..	11,838		
			—	9,34[illegible]
				23,050
Bars, angles, &c. ..	1881 ..	1,091		
"	1882 ..	880		
			21[illegible]	—
Railway material ..	1881 ..	31,963		
"	1882 ..	21,531		
			10,432	—
Cast or wrought manufactures ..	1881 ..	307		
Cast or wrought manufactures ..	1882 ..	286		
			21	—
Old iron	1881 ..	9,864		
"	1882 ..	5,739		
			4,125	—
Steel (unwrought) ..	1881 ..	15,246		
"	1882 ..	12,453		
			2,793	17,582
Net Increase				5,46[illegible]

The following are the most noticeable changes in the exports in directions other than America:—So far as railway material is concerned, the chief items which go to counterbalance the deficiency in the shipments to the States are an increase of 1329 tons to Russia; 1775 tons to Sweden; 1574 tons to Italy; 2712 tons to Africa (B.P.); 4615 tons to India; 2686 tons to Australia; and 6291 tons to "other countries." Against these there must be set, however, a falling off in the deliveries to Mexico, of 2541 tons; to Brazil, of 3875 tons; and to British North America, of 5756 tons. The decline in the exports of pig-iron to Russia and Germany is rather heavy, amounting to 8834 tons in the case of the former country, and 5964 tons in the case of the latter; while to "other countries" they have decreased by 3933 tons. On the other hand, Holland, France, and British North America have taken respectively 3159 tons, 2813 tons, and 4229 tons more. The last-named country, however, figures on the wrong side, under the head of bars, angles, &c., the exports thither having been 2163 tons less than during June, 1881. "Other countries" have also diminished their consumption to the extent of 1051 tons, while the shipments to Australia have improved by 1800 tons. The total exports of tinplates are 8575 tons more, so that those to countries other than the United States show on the whole a slight falling of. The principal alterations under the head of hoops, sheets, and plates, are an increase of 2041 tons in the deliveries in Germany, 1587 tons in those to India, 1470 tons in those to Australia, and 1689 tons in the shipments to "other countries." As regards cast or wrought manufactures the changes are without particular significance, except the decrease in the quantity imported by Australia of 3367 tons.

Glancing briefly again at the exports for the six months, there are two points which call for particular notice. In the first place, the quantity of pig-iron exported from this country to Belgium appears to be steadily on the decline, the figures having been—1880, 79,263 tons; 1881, 44,450 tons; 1882, 33,486 tons. In the second place, although, as we have already seen, the shipments altogether come within a very little of those for the first half of 1880, when the demand for iron rose to an extraordinary pitch, yet the deliveries during the two periods to the United States exhibit a decrease of no less than 339,288 tons against this year. How this large deficiency has been made up will be best gathered from the subjoined statement of the exports to our principal customers during the first six months of each of the last three years, so far as can be gathered from the information furnished by the Board of Trade.

	1880.	1881.	1882.
	Tons.	Tons.	Tons.
Russia	62,138	52,979	44,319
Germany	110,818	121,550	163,824
Holland	92,539	110,960	164,438
Belgium	79,263	44,450	33,486
France	56,650	89,279	109,512
Italy	18,906	31,307	47,276
Turkey and Egypt ..	6,806	8,364	4 610
Spain and Canaries ..	11,520	13,216	14,684
British North America ..	104,590	95,141	91,039
United States	980,267	532,277	640 979
Mexico	5,799	16,049	15,074
Brazil, Chili and Peru ..	21,928	35,570	37,860
Africa (B.P.)	11,883	7,804	29,119
India	149,228	120,221	157,053
Australia	107,404	113,808	148,505

THE IRON AND STEEL TRADE OF THE UNITED STATES IN 1880.

THE occasion of the tenth census of the United States was made the opportunity for a full and careful stocktaking of the iron and steel trades of that country. The duty of compiling the statistics was committed to the care of Mr. James M. Swank, a gentleman whose name is widely known on this side in connection with the American Iron and Steel Association. The results of his labours in this matter are presented in the elaborate volume now before us* in which there has been gathered together a vast quantity of minute details relating to all the various branches of production. Many of these we shall not be able to touch upon, and, indeed, they are of little interest outside of the trade itself, but, on the other hand, the broad features are full of significance for all connected with the kindred industries in Great Britain. The special interest attaching to this particular summing up of the position of the iron and steel trades throughout the United States is described by Mr. Swank in the following words: "The census year 1880, which it may be stated extended from the 1st of June, 1879, to the 31st of May, 1880, was a year of exceptional prosperity for the iron and steel industries of this country. The coincidence is notable that it covered exactly the period which has been designated as 'the boom,' during which all iron and steel products were in such great demand by American consumers that the iron and steel works of the country were unable to meet it. The home supply was supplemented by large importations, and even these could not be made with sufficient rapidity to meet the urgent wants of consumers * * * * The census year 1880 will long be memorable as a year of general prosperity for our iron and steel industries, and as one which witnessed the beginning and the end of a most exciting epoch in their history."

Mr. Swank's report is divided into two parts, the statistical and the historical. With the latter we shall not concern ourselves at present, leaving it for review alone on a future occasion. As regards the former, the space at our disposal will only admit of a very rapid and cursory glance being taken at the principal points, comparing them, where materials are available for comparison, with the corresponding facts in the industry of this country. The figures for weight, given by Mr. Swank, refer always to the ton of 2000 pounds, but for the sake of easier and clearer contrast we have converted them invariably into the English ton of 2240 pounds. The result is that the tonnage turned out in the United States, as given below, appears to be considerably less than stated in the official papers. The total weight of all kinds of products, then, was 6,486,732 tons for the year ending 31st May, 1880. It is necessary to explain, however, before going any further, that the term "total production" embraces all the produce of every process or stage of manufacture, so that the same metal may appear two or three times in the "total production," with the result that the quantity of iron and steel given is considerably in excess of that which would finally go into consumption. For example, the "total production" would thus include both the weight of the pig-iron and the weight of the bars, plates, iron rails, &c., into which it was ultimately rolled. In endeavouring to form an estimate of the progress of the iron trade of Great Britain it has generally been considered sufficient to ascertain the quantity of pig-iron produced, although this method makes no provision for the old iron which may be remanufactured. This, however, is not of very much importance, but it is different in the case of the United States where old iron and scrap iron are largely used in the rolling mills, the greater proportion, perhaps, of these materials having been imported. Some idea will be gained of how much this is the case, as well as an approximate notion formed of the total quantity of iron that went into consumption in 1880 from the following statement:—

		Tons.
Pig-iron and castings from furnaces		3,375,910
Old iron rails,	Used in	632,530
Scrap iron and steel	the	497,722
Old steel rails and crop-ends	manufacture	76,475
Steel ingots and blooms	of	54,153
Swedish billets and bars	Iron and steel	9294

In the above there may be some repetition, as in the case of ingots and blooms, of weight which is also included under the item of pig-iron, but as blooms are largely imported from this country, and there are no means of distinguishing between those produced in the United States, and those imported from other countries, the total weight given has been used. The quantity of pig-iron and castings from furnaces ten years previous had been 1,832,875 tons, so that the close of the decade witnessed an increase of about 84 per cent. in that item of production.

When we come to make a comparison between the pig-iron production of the United Kingdom and that of the States, the results obtained are noteworthy. The total quantity produced in Great Britain during the year ending 31st December, 1880, according to Mr. Hunt's *Mineral Statistics*, was 7,749,233 tons, the output of the blast-furnaces in America during the census year was, as we have seen, 3,375,910 tons. In the manufacture of the former 21,086,740 tons of iron ore were used, and in the manufacture of the latter 6,479,182 tons; that is to say, that while in this country 2 tons 14 cwt. 1 qr. 19 lb. of ore went to each ton of pig-iron, in the United States there was obtained one ton of pig-iron for every 1 ton 18 cwt. 1 qr. 15 lb. of iron ore smelted. This would point to a very high average in the quality of the ore employed by makers in the United States, but, unfortunately, Mr. Swank's present statistics do not furnish any further data on this subject, This is to be regretted, because it would have been useful to manufacturers on this side to have known whether the better results secured by their American rivals were due entirely to the cause indicated, or were owing partly to some other reason. The quantity of coal and coke consumed in the blast-furnaces in the United States was 5,174,276 tons, or at the rate of 1 ton 10 cwt. 2 qr. 17 lb. to each ton of pig-iron; the quantity used in the manufacture of pig-iron in Great Britain was 16,682,629 tons, which gives 2 tons 3 cwt. 0 qr. 6 lb. of fuel per ton of pig-iron. The lowest proportion obtained in any district in England was 1 ton 16 cwt. 1 qr. 3 lb. in Lancashire, which is considerably above the rate in the United States; but it should be remembered that large quantities of charcoal are used there in the blast-furnaces, the consumption during the census year having amounted to 53,909,828 bushels. As regards the yield of pig-iron per furnace, it would appear that the total daily capacity of the plant possessed by the States is about 17,181 tons, but that the actual output was something under 10,000 tons. The production per furnace was 4957 tons per annum, or about 14 tons per day, whilst in the case of Great Britain the yield per furnace for the year amounted to 13,643 tons, or slightly over 37 tons per diem. It is hardly necessary to observe that the State of Pennsylvania remains the principal centre of iron manufacture in America, having produced about 51 per cent. of the whole output of pig-iron; Ohio stands second with 15 per cent.; and New York third with 8 per cent. The quantity of charcoal pig-iron made was 388,409 tons.

The development of the iron trade of the United States is still more strikingly shown when we examine the production of finished iron and steel manufactures. As regards the output of iron rails, it, as was to be expected, showed a considerable diminution, having declined from 474,647 tons in 1870 to 416,890 tons in the census year, 1880; but, on the other hand, the quantity of bars rolled increased from 436,459 tons in the former to 590,366 tons in the latter year. We also find the production of plates, rods, and other forms of manufactured iron greatly increased, whilst such products as axles, hoops, fish-plates, spikes, &c., which were not made at all in the States in 1870, were turned out in large quantities in 1880. As for steel, the progress made is still more remarkable; in 1870 the total quantity of finished items made was 17,324 tons; in 1880 it amounted to 877,713 tons, of which 670,160 tons were in the shape of rails. Although the manufacture of steel has sprung up thus quickly, and so far as railway material is concerned has outstripped iron, yet the production of steel rails is confined to seven States, two of which, namely Pennsylvania and Illinois, yielded about six-sevenths of the total output, while iron rails were made in seventeen States. Turning to the relative increase in the values and in the quantities produced, a noteworthy disproportion is exhibited. The "total production," reckoned by weight, increased 98·76 per cent., but the value of it was only 43·12 per cent. greater than that of the outturn in 1870. It will therefore be seen that notwithstanding the extraordinary activity which marked the year 1880 the range of prices has been considerably lower than in the earlier year, the advances made in the mechanical and scientific treatment of the various processes of manufacture during the decade having assisted greatly towards an abundant and cheap production. Another factor is found in the lower scale of wages which prevailed in 1880. The total number of hands employed in 1870 was 77,555, in 1880 it was 140,978. The former earned 40,514,981 dollars, while the wages of the latter amounted to 55,476,785 dollars; that is to say, that while the number of employed had increased 81·78 per cent. the value of their labour had improved to the extent of 36·93 per cent. only. From the foregoing hurried sketch of the principal features of Mr. Swank's statistics it will be observed that although the United States has made great progress in the development of its iron trade it is yet a long way behind the parent country as regards the magnitude of the industry. The single fact that the total exports of all kinds of iron and steel from this country amounted in 1880 to 3,792,993 tons is ample demonstration. Whether in course of time America will become the rival of Great Britain in the supply of foreign markets is a contingency upon which commercial economists might expend a great deal of argument. Two considerations may, however, be mentioned which will always have a paramount influence on the problem; the first is the tariff policy of the States, and the second the geographical position of the large proportion of the works in that country. The former may be altered, but the inland position of the vast majority of the iron-producing centres will always remain an obstacle in the face of their competition with the mother country.

* Statistics of the Iron and Steel Production of the United States compiled by James M. Swank, Special Agent of the Census. Washington: Government Printing Office, 1881.

OCCASIONAL NOTES.

STEAM TRAMWAYS IN LONDON.

THE London Street Tramways Bill, notwithstanding considerable opposition, has passed through committee in the House of Lords, and thus the thin end of the wedge for the introduction of steam as a moving power for tramways in London has been successfully inserted. The bill provides for the construction of a tramway along the Pentonville Road from the Angel, Islington, to King's Cross. Pentonville Road having a very steep gradient, the cars will be driven by stationary engines placed at several points on the line, on a principle already in use in America, that is to say, by wire ropes passing under the permanent way. We are sorry to see this, although the tramway itself will be of very great convenience, completing the link that was much wanted between the Great Northern and Midland Railways and the tramways which branch from the Angel, Islington, to the north and east. But the nuisance which will arise from stationary engines to the neighbourhood will be intolerable. Lords, and, for that matter, Commons, however, do not reside in the North or East of London. We are sure they would never permit the introduction of steam tramways in the fashionable quarters of the West.

A BRIDGE BELOW LONDON BRIDGE.

An almost fierce controversy is at present raging with respect to whether there is to be another bridge below London Bridge or not. The opponents of the scheme very persistently urge that its construction would destroy the port of London, while those who advocate it say that it has become an absolute necessity. The latter party have much to commend their view of the matter to the public. It is vehicular traffic which suffers most from the present abnormal state of things. The Thames Tunnel and East London Railway and the Tower subway are useless for the purpose, and only the Thames Steam Ferry remains to be dealt with. Perhaps if manufacturers could pass their waggons across the river at a slight cost, or free, this means of communication would afford better evidence of being a great convenience. The failure of the ferry arose, partly, from the heavy tolls demanded. It was suggested at a recent meeting that the ferry should be worked free for a time as an experiment. But that would not solve the problem; what is really wanted is another bridge. If a swing bridge were considered too much of an impediment for the navigation of the river, then the other plan of a high-level bridge, enabling sea-going ships to pass under, would be available. The expense of constructing such a bridge, whether it be a high-level one or a swing bridge, would, no doubt, be very heavy; but we cannot see any valid reason why the Eastend of London should not have as free intercommunication between the two banks of the river as any other part of the metropolis. Some fresh and convenient communication, not affecting river traffic, is absolutely necessary.

AN UNDERGROUND RAILWAY FOR PARIS.

As a scheme for an over-head line, as planned by previous projectors, would probably fail on account of the enormous expense entailed in the acquisition of property, the scheme, by MM. Siben and Soulié, of an underground railway for Paris appears to be on the point of being carried out. The promoters propose to form a central line from Saint-Cloud to the Lyons terminus, from which would branch a large outer circle and a smaller inner circle, with additional branch lines to the various termini. In the south the railway would pass through the principal business quarter, intersect the boulevards at the Place de l'Opéra, but turn in the north also to the terminus of the Chemin de Fer de l'Est. The network resembles in some respects Fogerty's project for the Vienna girdle railway. The stations of the proposed Paris railway are very numerous, and close to each other; most of the waiting rooms are to be overground, whence commodious stairs are to lead to the platforms. A central station is to be erected at the Place de la Bourse. The length of the railway with all its branches is to be nearly 24 miles (38 kilometres.) The cost of construction is estimated at £6,000,000, or £250,000 per mile. The fares are to be, for any distance, 50 centimes (5d) for first-class and 20 centimes (2d.) for second-class. Penny tickets (10 centimes) are to be issued to workmen. The gross receipts are reckoned at 400,000 francs per kilometre and year (over £25,000 per mile), or 15,200,000 francs (£608,000) for the whole line per annum, an estimate, it is thought, which will probably be exceeded.

THE MECHANICAL VENTILATION OF MINES.

At the recent meeting of the Manchester Geological Association, Mr. Charles Cookson, in a paper read by him on the relative efficiency and useful effect of centrifugal fans for mine ventilation, maintained that, while mining engineers had become convinced, on the ground of safety and efficiency, that mechanical was greatly superior to furnace ventilation, the only point now at issue is the relative superiority of the various systems of mechanical ventilators. These may be divided into two classes: the first consisting of the Waddle, the Guibal, and the Schiele, which are centrifugal ventilators; and the second consisting of those machines which are known as varying capacity ventilators. The latter class, however, are not at all suited for the enormous volumes of air required nowadays for the ventilation of coal mines, and it is therefore not necessary to consider their relative merits. But as regards the former, if the fans are all working under similar conditions and at the same speed of periphery, the Waddle will give 16·6 per cent. and the Schiele 26·9 per cent. less air than the Guibal, or, putting it in another form, to produce the same amount of air, the Waddle will have to run at 20 per cent. and the Schiele at 36·6 per cent. greater speed than the Guibal, so that, whatever the result as to the useful effect calculations, it may be said that, as a matter of efficiency with regard to the speed of the fan, the Guibal is the most efficient. It was urged in the course of the discussion which followed that, although the time was coming when mechanical ventilation will be more applied than it has been before, the time had scarcely yet arrived when it could be said that under some conditions it is altogether superior to furnace ventilation. Mr. Cookson, very rightly, we think, replied that no doubt at certain depths furnace ventilation is found to be more economical than mechanical ventilation, but the principal point to be considered is the question of safety.

DINING CARS ON THE MIDLAND RAILWAY.

At last we are to have some of the comforts to which travellers on American railroads have become thoroughly accustomed to long ago. The Midland Railway Company has begun to run a Pullman dining-saloon car with the 5 o'clock express train from their St. Pancras Station to Manchester and Liverpool, and one of these comfortably fitted-up carriages will also be attached to the express daily leaving Liverpool at 4·5 p.m. and Manchester at 4.50 p.m., so that business men coming to town and the thousands of travellers annually passing from and to America through Liverpool may make the most of their time in London, and safely trust for the provision of that important meal of the day, which must be eaten somewhere, to the Midland Railway Company. The new Pullman dining-saloon car, which in fittings and appointments contains some improvements, suggested by experience, may be described in general terms as a railway carriage between 50 feet and 60 feet long, capable of seating twenty-one passengers, and having tables and seats on each side of a gangway that runs from end to end, there being an apartment provided in which those who wish to light a cigar or cigarette after dinner may smoke without annoyance to other passengers; a kitchen, in which a compact range gives the cook the means of grilling a chop, roasting a joint, and stewing or boiling entremêts and vegetables; a pantry, wine cupboard, &c.; a lavatory for gentlemen, and a dressing-room for ladies. The Pullman Company seem to have found a practical way of overcoming the difficulty of enlisting the sympathies of the mechanic on the side of the capitalist, and each new car added to the 1000 or more which have for some time been in use in the United States and Europe contains some ingenious novelty in fitting or construction. Among points that may be noted in the Delmonico car are the perfection of workmanship by which any rattling of the windows is prevented without the use of dust-collecting cloth; the invention of hinged end-rails to the seats, which swing down to permit the passenger to take his place at table; and other improvements.

THE ROGERS SYSTEM OF ELECTRIC LIGHTING.

As this journal was one of the first to notice the various inventions which have from time to time been introduced by Mr. J. B. Rogers towards the perfecting of a system of electric lighting, it is naturally within our province to sum up the results of his labours, which are now about to be acquired by a company formed to utilise them for the public benefit. A comparison of the dates of the patents granted to various inventors will show that Mr. Rogers was one of the earliest—if not the first—workers on the utilisation of the electric current for house to house lighting, at the same time bringing this subtle agent under perfect control. His incandescent lamps have stood the test of several months' continued use, and a comparison with those of other makers will satisfy an impartial observer that the light is at all events equal to that of any other system, and it is stated that they can be produced at a price calculated to bring them into general use. We understand that the patent acquired by the company include a practical invention for equitably apportioning the charge to each consumer according to the amount of light used, also for the construction of arc lamps on simple and inexpensive principles, and further for a lamp which can be used either as an arc or as an incandescent illuminator. Taken as a whole, it would appear that the progress of electric lighting for all purposes, both outdoor and indoor, can be clearly traced in Mr. Rogers' successive patents, and this tends to show that his system embodies all the advantages which can only be otherwise obtained by an aggregation of other systems. We refer our readers to the prospectus of The J. B. Rogers Electric Light and Power Company (which appears in our advertising columns) for further particulars, and to the works of the company, at No. 47, Holborn Viaduct, for an inspection of the system, where they can see it for themselves and judge of its merits.

THE INSTITUTION OF CIVIL ENGINEERS.

THE Council of the Institution of Civil Engineers have awarded the following premiums during the session 1881—82:—

FOR PAPERS READ AT THE ORDINARY MEETINGS.—1, a Watt medal and a Telford premium to Dugald Clerk, for his paper on "The Theory of the Gas Engine;" 2, a Watt medal and a Telford premium to Joseph James Coleman, for his paper on "Air Refrigerating Machinery and its Applications;" 3, a George Stephenson medal and a Telford premium to Thomas Fletcher Harvey, Assoc. M. Inst. C.E., for his paper on "Coal Washing;" 4, a Watt medal and a Telford premium to William Proctor Baker, for his paper "On the Various Systems of Grinding Wheat, and on the Machines used in Corn Mills;" 5, a Telford premium to William Henry Wheeler,* M. Inst. C.E., for his paper on "The Conservancy of Rivers; the Eastern Midland District of England;" 6, a Telford premium to Leveson Francis Vernon-Harcourt,† M.A., M. Inst. C.E., for his paper on "Harbours and Estuaries on Sandy Coasts;" 7, a Telford premium to Ewing Matheson, M. Inst. C.E., for his paper on "Steel for Structures;" 8, the Manby premium to Henry Joseph Butter, M. Inst. C.E., for his paper on "Forces and Strains of Recoil considered with reference to the Elastic Field Gun-Carriage."

FOR PAPERS PRINTED IN THE PROCEEDINGS WITHOUT BEING DISCUSSED.—1, a Watt medal and a Telford premium to John George Mair, M. Inst. C.E., for his paper "On the Independent Testing of Steam Engines, and on the Measurement of the Heat used;" 2, a Telford medal and a Telford premium to James Mansergh, M. Inst. C.E., for his paper on "The Lancaster Waterworks Extension;" 3, a Telford medal and a Telford premium to Wilfrid Swanwick Boult, Assoc. M. Inst. C.E., and a Telford medal and a Telford premium to John James Potts, Assoc. M. Inst. C.E., for their joint paper on the "Seacombe Ferry Improvement Works;" 4, a Telford premium to Charles Henry Moberly, M. Inst. C.E., for his "Account of some Tests of Riveted Joints for Boiler Work;" 5, a Telford premium to Robert Harvey, Assoc. M. Inst. C.E., for his paper on "Plant for the Manufacture of Iodine;" 6, a Telford premium to James Barron, Assoc. M. Inst. C.E., for his paper on "Buckie Harbour;" 7, a Telford premium to Patrick Walter Meik, M. Inst. C.E., for his paper on "The Bo'ness Harbour and Dock Works;" 8, a Telford premium to Harry Pasley Higginson, M. Inst. C.E., for his paper on "The Kawarau Suspension Bridge, N.Z.;" The special thanks of the council were voted to their colleagues Dr. William Pole, F.R.S., and Mr. B. Baker, for their contributions on "Aerial Navigation," and on "Steel for Tyres and Axles."

FOR PAPERS READ AT THE SUPPLEMENTAL MEETINGS OF STUDENTS.—1, The Miller scholarship to Alan Brebner, jun., B.Sc., Stud. Inst. C.E., for his paper on "Dioptric Apparatus in Lighthouses;" 2, a Miller prize to John Augustus Thompson,‡ Stud. Inst. C.E., for his "Description of a Composite Screw Tug-Boat;" 3, a Miller prize to Albert Havelock Case, Stud. Inst. C.E., for his paper on "Cranes and Lifting Apparatus;" 4, a Miller prize to William Townshend Batten, Stud. Inst. C.E., for his paper on "Modern Apparatus for the Manufacture and Purification of Coal Gas;" 5, a Miller prize to William Bashall, Stud. Inst. C.E., for his paper on "Laboratory Work: Iron and Steel in Compression, Hardened Iron in Tension and Deflection;" 6, a Miller prize to Richard Marion Parkinson, Stud. Inst. C.E., for his paper on "The Swindon, Marlborough, and Andover Railway;" 7, a Miller prize to Louis Samuel, Stud. Inst. C.E., for his paper on "Excavating and Dredging Plant;" 8, a Miller prize to Urban Hanlon Broughton, Stud. Inst. C.E., for his paper on the "Narrow-Gauge Railways of Ireland."

* Has previously received a Telford premium.
† Has previously received the Manby premium.
‡ Has previously received a Miller prize.

CORNISH'S ELEVATOR AND DRILL.

IN the engraving on page 22 we give perspective views of two of the leading exhibits of Mr. George Cornish, of the Risbygate Street Foundry, Bury St. Edmunds, at the Royal Show at Reading. Fig. 1 represents a combined hay, corn, and straw elevator in which the horse works are built in the main frame, so that no fixing is required. The driving wheel is 6 ft. 5 in. diameter, and the trough is 30 ft. long, and telescopic, so that one half is made to slide into the other. The hopper folds over, and when shut up the machine then will not occupy more space than an ordinary waggon. Fig. 2 represents Mr. Cornish's improved corn and seed drill, with 14 coulters, double purchase chain steerage, and improved press bar, which is fixed to the main axle to take the weight off the horses' back when used without steerage. It is fitted with wrought iron levers and coulters, the blades of which are made of a special chilled metal, and are easily replaced when worn out at a small cost. The arrangement for lifting the coulters is very simple and efficient. The box has a false bottom for clearing out the grain. The wheels are 4 ft. 10 in. high, and have turned axles. Altogether this drill is a good example of its class of machine, both in design and workmanship.

LANDER'S HAY-COLLECTOR.

A VERY simply constructed and efficient implement for putting dry hay into wind rows, and for turning it, is illustrated in perspective in the engraving on page 22. This is Lander's hay-collector, which is exhibited at the Reading Show by Messrs. Carson and Toone, of Wiltshire Foundry, Warminster. This machine runs on three cast-iron wheels, the left hand one having cogs on its inside face to drive the shaft, the hind wheel being constructed to turn in any direction that may be needed. The frame is of wrought iron, and is made as light as possible with regard to the necessary strength. The shaft is constructed to revolve at an angle with the front axle, which gives the rakes the power of collecting instead of throwing the hay over. The rakes are fitted with springs as in an ordinary haymaker, and consequently, when travelling, can be closed; the shaft can also be thrown out of gear. The pinion on the end of the shaft is fitted with a ratchet motion, so that in the event of the machine being turned or stopped the rakes revolve. A shield, shown on the right-hand side of the engraving, is provided, and can be set either wide or narrow, according to to the size of rake required, or it can be removed if necessary. The machine is so simple in construction that there is practically no chance for anything to get out of order very easily. One of the great advantages claimed for this machine is that where a field of hay is ready for carrying this collector can precede the waggon and put the hay rapidly into wakes to pitch from, so that there is no delay in waiting for hay to be collected in the old fashioned way across the ground.

WILDER'S COMBINED CHAFF-CUTTER AND BEAN-MILL.

FEW, if any, of the Royal shows have passed without some novelty being seen at the stand of Mr. J. Wilder, of Yield Hall Foundry, Reading. Amongst other novelties this year at Reading, is the combined chaff-cutter and oat and bean mill of which we give a perspective view in the engraving on page 23. The chaff-cutter is fitted with the most improved form of feed rollers, and Mr. Wilder's new spring mouthpiece, 8½ inches wide, rising from 2½ inches to 3½ inches, and which is hardened on the face so as to keep the knives in good condition. It is also fitted with a very heavy fly wheel, as will be seen from the engraving. This gives a good reserve of power for running the mill, which is worked from the fly-wheel shaft. This mill will crush oats as well as all other grain and pulse properly, and can easily be adjusted to kibble fine or coarse, as may be desired. This combined machine will prove useful where only two or three horses are kept, as it combines in one machine the three essential requisites of the stable.

BAMFORD'S HARVESTING IMPLEMENTS.

AMONGST the implements exhibited at the Royal Show at Reading by Messrs. Bamford and Sons, of the Leighton Ironworks, Uttoxeter, were two which we illustrate in the engravings on page 23. These are their new "Royal" mower and their new back action haymaker. The mower, which is shown in perspective at fig. 1, is a well-designed and substantially made machine, adapted for working in the heaviest crops. It is a nicely-proportioned machine, and is fitted with a lever for tipping the fingers, an important improvement, which enables the knife to get under laid grass. The gearing has a spring cover, so that it can be readily got at for oiling; a spring catch is also provided for holding up the finger bar; also one for the knife, which can be readily taken out. This machine was first brought out at the Bath and West of England Society's meeting at Cardiff this year, where it was worked in the trial-field, and did some excellent work in a very heavy crop. The single or back action haymaker is represented in perspective in fig. 2. It has been introduced to meet a demand for a back action machine to follow the mower where tedding or tossing is unnecessary. This machine seems to be especially suited for this purpose. It is wide enough to take two swathes of the mower, is very light in work, and is provided with a seat for the driver. The mechanical arrangements in this machine are very simple. By moving a lever, a spur pinion slides into gear with the road wheel. The gearing is all machine cut, thus ensuring the greatest ease in work and lightness of draught. The height of the forks can be regulated to suit any size of horse by means of a spring bolt placed in front of the machine. It has a very quick action, and separates the grass well.

ON THE TRIPLE EXPANSIVE ENGINES OF THE SS. *ABERDEEN*.*

By A. C. Kirk.

ECONOMY of coal in our steamships is a point of so great importance that any step in this direction is worth chronicling. Steamships are now making long voyages, and at high rates of speed, which, till within a few years ago, were made by sailing ships. To accomplish these profitably, economy of coal is all important. Every ton of coal saved means a ton of freight earned, and in many cases every stoppage to coal is a loss of time, besides the exorbitant rates for coal charged at these ports. Coal-saving, too, is equally important for high-speed steamers, as, unless their voyage is only one of the shortest duration, coal becomes the greatest weight the ship is burdened with. The obvious direction in which to look for saving is increase of pressure. Unfortunately as we get higher in pressure, we do not by any means gain in efficiency in anything like a proportionate degree, and the time must come, may indeed not be far away, when farther increase of pressure will not pay. The time has not come yet. When James Watt utilised the lower pressures, from 15 lb. downwards, he unquestionably had at his disposal the most prolific portion. Pressure gradually rose—I am speaking now more particularly of the marine engine—to 30 lb. and sometimes 40 lb., but, used as the steam was, in one cylinder, exhausting direct to the condensor, little additional economy was gained by this increase of pressure. The variation in temperature, [illegible] 300 degs. in the cylinder, was too great; steam was condensed at the commencement of the stroke when it had its full work before it, and re-evaporated towards the end when it had little left to do but go straight to the condenser. Steam-jackets ameliorated this action, but besides the difficulty of getting them attended to at sea, they effected their purpose imperfectly and at a very considerable sacrifice of steam. The next step was to divide the work between two cylinder, effecting part of the expansion of the steam, first in one cylinder, and completing it in a second, thus limiting the range of expansion and of temperature in each cylinder. Several incidental advantages accompanied this change, which we need not advert to here. A marked economy followed this improvement, and when a pressure of 60 lb. per square inch was reached, the economy over the older form was very marked; in round numbers only about half the coal was required. For six or seven years the pressure in use remained, for the most part, at 60 lbs., but of later years a gradual and steady increase of the working pressure of steam in our steamships has taken place, 100 lbs. being now not uncommon. So far, however, as the imperfect data obtainable of steamships performances at sea show, the increase in economy of fuel has made but little progress, and I am not aware that any perceptible increase of economy has been attained by exceeding 70 lbs. to 75 lbs. pressure. In fact, the compound or double-expansion engine has relapsed into the condition of the old single-expansion one. This gradual increase of pressure, using all the time the ordinary type of internally-fired, fire-tube boiler, has dissipated at once the mistrust of boilers of larger diameters, and the craving for boilers composed of water-tubes and other such complicated arrangements. These may yet have their day.

However, I am indebted to one of these water-tube boilers for having driven me seriously to take up the question of utilising advantageously steam of much higher pressure than was at that time generally in use. While I was with Messrs. John Elder & Co., in 1874, Mr. W. H. Dixon, of Liverpool, anxious to attain greater economy of fuel, made up his mind to fit his steamer *Propontis* with high-pressure water-tube boilers on Messrs. Cowan & Hotton's patent, and thus I had to consider the best engine to utilise this high-pressure steam advantageously. Being thoroughly convinced that the great secret of success in the ordinary compound engine of the day over the earlier simple engine (even the Woolf engine) lay in the range of temperature through which the steam in any one cylinder passed in the course of one stroke, being very much reduced (nearly halved in fact, compared with a single cylinder), it seemed to me that with these high pressures we must use three successive expansions, and divide the total range of temperature in three parts. Of course this was incidentally favourable to a more uniform distribution of strains, reduced leakage to the condenser, &c. Thus the engines of the *Propontis*, constructed in 1874 for a steam pressure of 150 lb. per square inch, consisted of three cylinders of progressive capacities, the smallest being the high pressure to which the steam was first admitted, next the intermediate one to which the steam passed from the high pressure cylinder, and the third the low pressure cylinder, receiving the steam from the intermediate cylinder and discharging it into the condenser. The arrangement consisted of a three-throw crank with a cylinder above each, and possessed no specialities of construction or design. Unfortunately the boiler very early gave trouble, and ultimately was taken out, the causes of which do not come within the scope of this paper, but during the time it worked at its full pressure I found, on comparing the diagrams with those of an ordinary compound engine, that these engines ought to have required only about 1½ lb. of coal per indicated horse-power. The practical results of working the engines were satisfactory, no difficulties being introduced by the use of high-pressure steam; indeed, they are at work to the present day, though at reduced pressure. For when Mr. Dixon took out the water-tube boilers, the idea s ill haunted most people that an internally-fixed fire boiler was unfit for such high pressures, and the new boilers of the ordinary type only carried 90 lbs.—still a high pressure for such a boiler in the year 1876. The engines are still doing good work in the *Propontis*. From that time till January last year (1881), when Messrs. George Thompson and Co. entrusted to my firm (Messrs. R. Napier and Sons) the building of the ss. *Aberdeen*, I failed to find anyone who cared to make so long a step, and in doing so I hope Messrs. Thompson will have their reward. In designing a ship for the long voyages their ships make from this country to Australia and China, more importance attaches to a small consumption of coal than in ships making shorter voyages, and it was necessary to use every device to attain this end. The engines of the *Aberdeen*, are essentially of the same design as those of the *Propontis*, the cylinders being 30 inches, 45 inches, and 70 inches by 4 feet 6 inch stroke. The boilers, two in number, are ordinary double-ended boilers, constructed entirley or steel, with six of Fox's corrugated furnaces in each, the total heating surface being 7,128 square feet. There is no superheater. The construction of these boilers for so high a pressure is 125 lbs. per square inch—was facilitated by their being built of steel and to Lloyd's, whose rules allow the shells to be made thinner than required by the Board of Trade, althoug the internal parts are as strong as these required by the latter. After all, the shell is the simplest and strongest part of a round boiler, where, even if built to Lloyds, there is superabundance of strength, but to doubly ensure success—the internal parts of a boiler being those which oftenest give trouble—they were made stronger than required by either Lloyd's or the Board of Trade, whose scantlings for these parts are practically the same. The high-pressure cylinder was not jacketed, the second was jucketed with steam of 50 lbs. pressure, and the low-pressure one with steam of 15 lbs. above the atmosphere. The *Aberdeen* is a ship built of iron, both ship and engines being to the highest class at Lloyd's, 350 feet × 44 feet × 33 feet. When the ship was complete, 2000 tons of dead-weight were put on board, and arrangements were made to test the consumption on a six hours' run 1800 horse-power; this, however, bo the owners' desire, was reduced to four only. The coal was Penrikyber Welsh coal, and Messrs. Parker and Dunlop, who happened to be on board, kindly undertook to examine the state of the fires, and see the coal weighed. The result was a consumption of 1·28 lbs. per indicated horse-power. According to usual anulogy, we should expect from this a sea consumption of good Welsh coal of from 1·5 to 1·6 lbs. per indicated horse-power. The next trial was to find the maximum speed, which, on four runs on the measured mile (occupying two hours), was 13.74 knots, the mean power being 2631, and the consumption of coal during these two hours being 1 ton 17 cwt. per hour. I am aware that the consumption of coal on so short a trial is not of implicst value, but the trial was made with the utmost care, and is thoroughly reliable so far as it goes. The engine, I ought to mention, is fitted with "Weir's" feed-heater, with a view to the better preservation of the boilers.

I mentioned above that the high-pressure cylinder was not steam-jacketed, while the others were. As it did not seem to me that the value of jackets could be great in such an engine, with so limited a range of temperature in any one cylinder and a considerable speed of piston, I sacrificed the steam jacket in the case of the high-pressure cylinder purely from prudential motives (the voyage being a very long one), to avoid any chance of cutting, when worked with very little lubrication, as it was desirable the engine should. Farther, when we take into account the thickness of the interior chamber of the cylinder and the speed of piston, it is not conceivable that the interior surface of the chamber can be maintained by the steam on the outside of it, at a uniform temperature. In fact, the slower an engine runs the more efficient the jacket becomes. There is no doubt that in such an engine as the above, or indeed, in any compound engine when the range of expansion and temperature is kept within moderate limits, that economy from the use of steam jackets is at least small; that, in fact, the steam condensed in the jackets, if admitted to the high-pressure cylinder, would have been for all practical purposes as efficient This has been a fortunate thing for the compound marine, engine as it is always extremely doubtful if, at sea, the steam jackets receive the attention they require to make them efficient. These remarks do not apply when engines are being worked at comparatively low powers. I may mention that the weight of steam condensed in the jackets, carefully measured into a tank, was 3¾ deg. per cent. of the greatest weight of steam admitted to the high-pressure cylinder (by diagram), the pressure on the jacket of the middle cylinder being 30 lb., and on the low-pressure cylinder 10 lbs. In a second experiment, the condensed water was still the same percentage when the pressure in each jacket was doubled. I may mention that the loss of steam from high-pressure cylinder to the low-pressure, just before release, plus the steam condensed in the jackets, was the same as took place inside the cylinders with the steam shut off from the jackets. I do not, however, quote this as absolutely conclusive, for, by an omission, Weir's feed-heater was connected and at work on both trials, abstracting a certain amount of steam from the low pressure receiver. Still I feel certain the result is tolerably correct, as the quantity abstracted by the heater must have been very nearly in the same proportion on both occasions. But a much more conclusive argument is to be found in the trials of a compound engine at Blackburn, made by Mr. Longridge (see *Engineering*, February 24, 1882), where it will be found that the feed-water per indicated horse power per hour was, when no steam was in the jackets, 16·87 lb., and when all the jackets were supplied with steam, 17 lb.; on a second trial, the figures were respectively 16·97 lb. and 17·16 lb.

Unfortunately, at sea, it is extremely difficult to get data of this sort with the completeness Mr. Longridge was able to carry out on land. I made complete arrangements for some further experiments on the way from Glasgow to London, but, owing to the state of the weather, my good intentions, to a great extent, fell through. The form of engine adopted on board the *Aberdeen*, of three cylinders, each over a crank, though a very convenient form for overhauling and giving a very uniform rotary motion, is not, by any means, the only form in which such an engine can be arranged. Indeed, from the unwieldy dimensions the low-pressure cylinder would attain, it would not be advisable for large powers. About four years ago—but several years subsequent to the *Propontis*—Messrs. Douglas and Grant, of Kirkaldy, made a comparatively small set of marine engines for the *Isa* with triple expansion, by placing the first, or high pressure, above what in an ordinary two-cylinder compound engine would be the high-pressure cylinder. This makes a neat and, in some cases, a convenient arrangement, but is open to the objection that, if you make the ratios of expansion approximately equal in each cylinder, the strains are very unequal, as also the several ranges of temperature. A better arrangement is to have two low-pressure cylinders, with the high-pressure cylinder on top of one, and the intermediate cylinder on the top of the other. This arrangement is adapted to high powers, and does not occupy any excessive length It is also the best plan for altering a compound engine of the present type into a triple expansive engine, as it does not alter the strains on the cranks, connecting rods, &c. It farther lends itself to certain horizontal arrangements of engines, as are used in unarmoured ships of war. The weight of the machine would not be perceptibly increased, while the weight of coal to be carried would be considerably reduced.

* Read at the twenty-third session of the Institution of Naval Architects.

METALLURGY AND MINING.

A CONTINUOUS PLATE MILL.—Mr. Jacob Reese, of Pittsburgh, known in connection with the basic process, proposes to roll nail plate by a very novel, and, if practicable, a very economical method. He proposes to cast hollow ingots having a length of 30 inches, a central opening 26 inches in diameter, and walls 5 inches (more or less) in thickness. The ingots will be taken from the moulds while hot, and placed in one end of a furnace 35 feet in length and 40 inches in width. This furnace declines about 3 feet from the charging end to the end from which the ingots are drawn. In front of the furnace, and on a line with it, is a railway track connecting with the rolls. This track also declines towards the rolls. When an ingot is charged into the furnace, it rolls of its own gravity down to to the outlet door, and in this manner the furnace may be filled. When the front ingot is hot, it is drawn out with a hook, operated by machinery and placed on the railway, when it will roll like a barrel toward the rolls. When the ingot is withdrawn from the furnace, all of the other ingots roll over one one-half, or one-half of a revolution, thus bringing the bottom side up, and as there will be eight ingots in the furnace, each ingot will be turned over from eight to sixteen times, according to the position of the stops provided to check them, without any manual labour for turning them; the object being to economise labour and secure a more uniform temperature. The rolls employed are two-high sheet rolls of 25 inches diameter and 40 inches long. The rolls are mounted in housings so arranged as to permit of the top roll being drawn endways through one of them. Both rolls are connected with the pinions by spindles, the top spindle having an arrangement for holding it and the roll-box in place when the roll is withdrawn. At the outer end of this top roll, and on a line with its axis, is placed a hydraulic ram or steam cylinder provided with an adjustable attachment to attach it to the end of the roll. Beneath the bottom roll a hydraulic ram is placed for forcing up the roll. When the ingot is to be rolled the ram is connected by a clutch to the top roll, and the roll is drawn endways through the housing, the roll carriage and sides sliding on and supported by a suitable frame. The hot ingot is then permitted to roll down between the housings against a stop. The ram forces the top roll through the ingot and into the bearing and box. The ram clutch is detached, the rolls put in motion, and the bottom roll pressed up by the ram, and the ingot is caused to rotate and be rolled between the two rolls. The advantages of this method of rolling nail plate are stated to be (1) that he gets a more economic and uniform heat of the ingot; (2) that he can run his rolls double the usual speed, as there will be no backlash from the metal going in or out of the rolls; (3) that the metal being in the rolls continuously, no time is lost in reducing the metal from the time it enters until it is finished; (4) the metal can be reduced in one-third of the time otherwise required; (5) the metal may be finished hotter, and the strain on the machinery greatly reduced; (6) it will require less power, as the reduction may be lighter, the metal finished hotter, and backlash and sudden strains avoided; (7) the cost of labour will be greatly reduced, both in heating and rolling; (8) a greater amount of plates can be produced from a given cost of plant than by the old methods. The thickness of the walls of the tubular ingots will vary with the size of plates desired. When the plate has been rolled to the desired dimensions, the bottom roll is lowered, the plate is thus stopped; it is then cut by means of a circular saw, when the bottom roll is again raised and the plate is caused to run out in a straight sheet. If the ingot be 5 inches thick, it will produce a plate 32 inches wide and 150 feet in length. For thinner sheets the walls may be made of less thickness. An ingot having 5 inch walls and 30 inches in length may be rolled into a plate 150 feet long, 32 inches wide, and ¼ inch thick in five minutes. Such an ingot would weigh 2000 lb.; so that a single plant of this class will produce five tons per hour, or 100 tons on double turn, leaving ample time for rest and repairs. This plant is especially designed for the purpose of rolling nail plates, boiler plates, bridge plates, ship and tank plates, from ingots produced by the basic process. According to Mr. Reese, by this method of rolling, a saving of at least 10 per cent. will be effected in scrap, which has heretofore been cut off the ends of the sheets.

STEAM CORN MILL.

BY MESSRS. RANSOMES, HEAD AND JEFFERIES, IPSWICH.

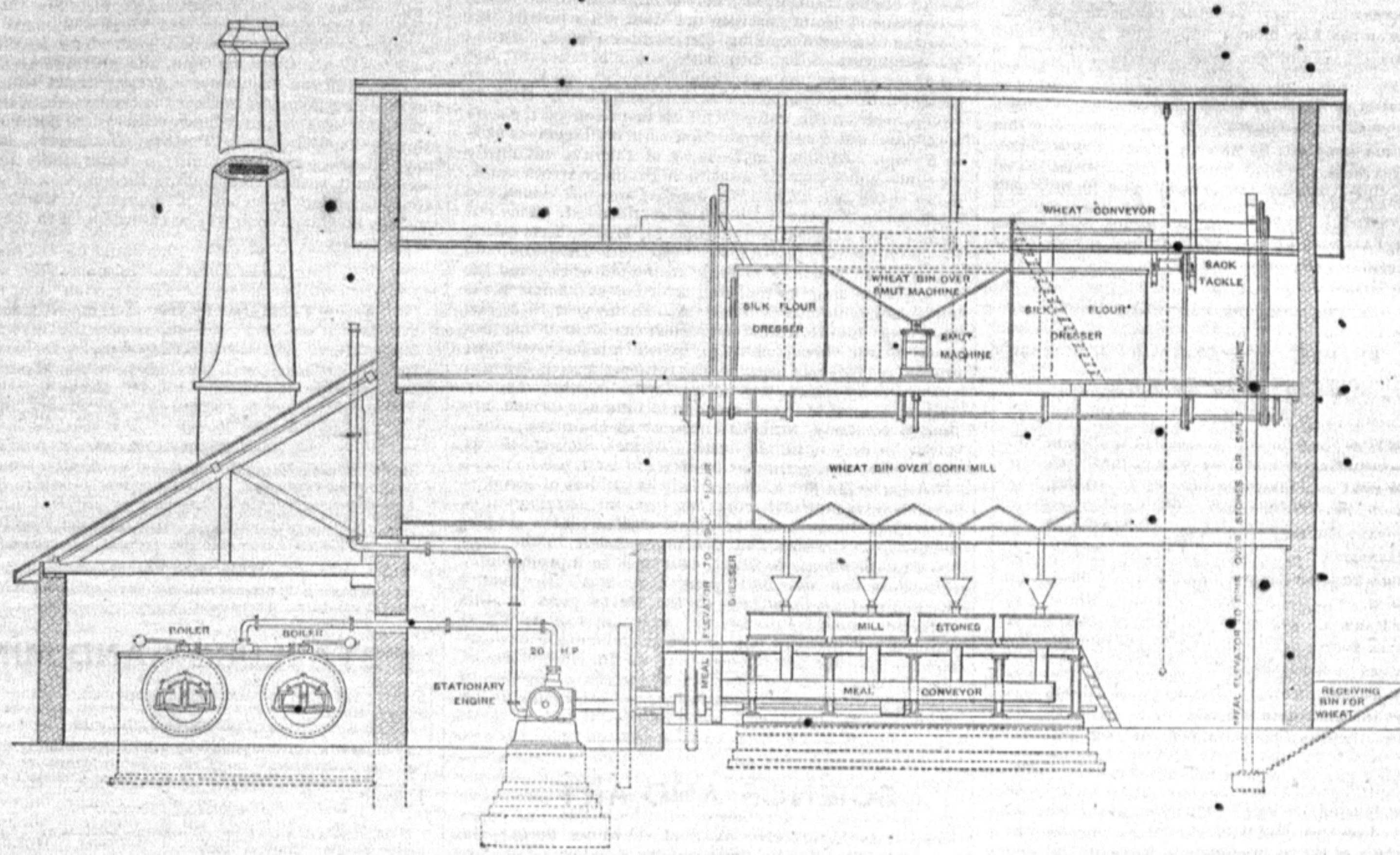


Fig. 1.

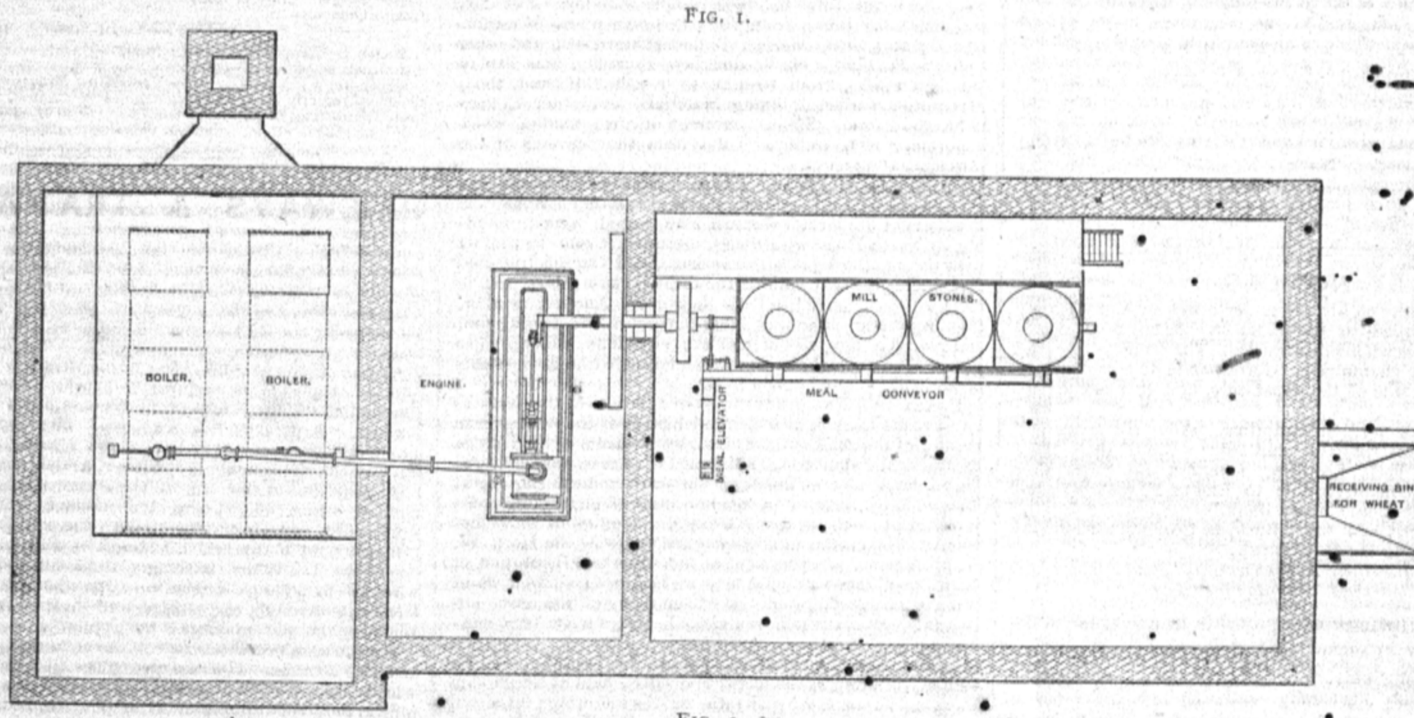


Fig. 2.

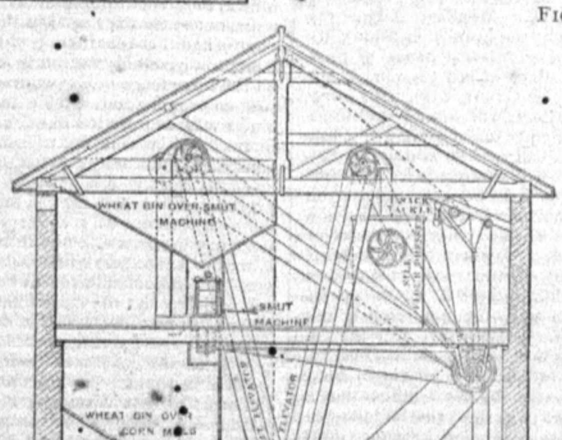


Fig. 3.

STEAM CORN-MILL.

In the annexed engravings we illustrate a very complete steam corn-mill, which has been designed by Messrs. Ransomes, Head and Jefferies, of the Orwell Works, Ipswich, who have devoted considerable attention to the manufacture of corn-mills of various sizes, and both with and without the attendant machinery. The illustrations show at fig. 1 a sectional elevation, at fig. 2 a plan, and at fig. 3 a sectional end view of a complete mill for making fine flour, with four pairs of stones and all the accompanying wheat-cleaning and flour-dressing machinery. The motive power consists of a 20 horse-power stationary steam-engine, which is supplied with steam by two boilers as shown in the engraving. The lay shaft of the mill, it will be seen, is coupled direct to the engine crank-shaft, thus dispensing with all intermediate spur gearing, and making a very simple and economical arrangement. The corn is first carried to the top of the building, either by the wheat elevators or sack hoist, from whence it passes through the smutter, or cleaner, which extracts all refuse matter from the grain. It afterwards falls into the bins over the stones, and then passes through the feed hoppers into the stones. The meal is delivered from the stones into a creeper placed in front of the frame, which conveys it to the end of the mills, where it falls into an elevator. The buckets of the elevator take the meal to the second floor, where it is discharged into the silk flour dressing machine. It is hardly necessary to explain that this machine consists of a hexagonal skeleton reel of iron and wood, covered with the best Swiss silk of different meshes, and placed obliquely in a large wooden casing. The revolving motion of the cylinder causes the flour to be sifted through the silk cloths, thus producing the finest sample it is possible to obtain, whilst the middlings and bran pass out at the lower end of the cylinder. The fine flour falls from the dressing machine into a reservoir underneath, from whence it can be sacked on the ground floor through spouts, as required. Such is the general arrangement of these corn mills, the details, however, being varied as circumstances may require.

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NOTICES.

Communications on literary subjects and books for review are to be forwarded to the Editor. Anonymous correspondence will be wholly disregarded. The return of rejected MSS. cannot be guaranteed. Correspondents are requested to write on one side of the paper only, and to mark papers sent.

All payments for Subscriptions, Advertisements and General Accounts are to be remitted to the **Office, 161, Fleet Street, E.C., London.** Cheques and Post Office Orders are to be made payable to Perry F. Nursey, and crossed "London and County Bank."

Advertisements and other Business Communications are to be addressed to the Publisher.

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THE CONTINENT.

Messrs. Galignani (Baudry, Jeancourt et Cie.), 224, Rue de Rivoli, and M. Em. Terquem, 15, Boulevard St. Martin, Paris, will supply thick or thin paper copies of Iron on application, and will receive subscriptions and advertisements.

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[*The Editor does not hold himself responsible for opinions expressed by correspondents.*]

A NEW DIRECT PROCESS.

To the Editor of Iron.

Sir,—Referring to the remarks on the above subject in your issue of last week, permit me to make a qualification respecting the statement of the approval of Sir Henry Bessemer being accorded to my invention. His approval was restricted to the principles which guided me being sound, but whether the system will produce the results anticipated, neither he nor I can tell, until it has been put to the practical test on a large scale.—I am, &c.

J. C. Bromfield.

40, Selborne Road, Hove,
July 13, 1882.

OBITUARY.

Stewart.—On July 7, Mr. C. P. Stewart, who for the last thirty years has been the principal member of Messrs. Sharp, Stewart and Co., one of the best-known and oldest established engineering firms in the Manchester district died at the age of fifty-nine, at his Berkshire residence, Silwood Park, Sunninghill. The firm with which Mr. Stewart had been so long connected was established about half-a-century back by Mr. Thos. Sharp, an iron merchant, and Mr. Richard Roberts, well-known not only for his invention of the self-acting mule, but for the production of many ingenious self-acting tools. At first the business of the firm was chiefly that of machinists carried on at their Faulkner-street works, but subsequently a locomotive building was introduced and new works named the Atlas works were erected. This was followed by a division of the concern, Mr. Roberts taking into partnership Messrs. Fothergill and Dobinson, and carrying on the machine making at the old works, and the locomotive building branch being carried on at the new works under the style of Sharp Bros. About the year 1852, Mr. Stewart was admitted a partner, when the style of the firm became Sharp, Stewart and Co., by which it has since been known. A few years later, by the retirement from the firm of the brothers Sharp, the concern came into the hands of Mr. Stewart and Mr. Robinson, and in 1864 was formed into a limited company, with Mr. Stewart as chairman, which position he held until his death. Messrs. Sharp, Stewart and Co. who usually employ from 1,200 to 1,300 hands at their Atlas works are known chiefly as builders of locomotives, and their principal work has been the carrying out of important contracts in this branch of trade, with the gradual development of which, and the improvement in the construction of locomotives, Mr. Stewart has been prominently identified. The deceased gentleman was also mainly instrumental in introducing to the steam users of this country the Giffard injector, the advantages of which so struck him whilst travelling abroad that he made arrangements for bringing the injector over to England, where as is already known, it was speedily so largely adopted as to fully justify Mr. Stewart's conclusions as to the value of the discovery.

SCIENCE AND ART.

South Kensington Museum.—Visitors during the week ending July 8, 1882 :—On Monday, Tuesday, and Saturday (free), from 10 a.m to 10 p.m., Museum, 10,401 ; Mercantile Marine, Building Materials, and other Collections, 4515. On Wednesday, Thursday, and Friday (admission 6d.), from 10 a.m. to 6 p.m., Museum, 2604. Mercantile Marine, Building Materials, and other Collections, 566; total, 18,086. Average of corresponding week in former years, 16,867. Total from the opening of the Museum, 21,122,130.

Overhead Electric Wires.—An accident of a peculiar character occurred last week at Brighton. While the members of the local Volunteer Fire Brigade were proceeding up North Road with their fire-escape, it came in contact with the electric light wire overhead, and the electric fluid descending the wirework of the escape, caused those volunteers who had control to loose their hold. Another member, thinking the machine was falling, grasped the steering rod, and received the full force of the electricity, which was so powerful as to bend him double, and disable him for upwards of an hour.

Practical Engineering.—In addition to the lectures on physical science now being delivered at the new science theatre of the Alexandra Palace, by students of the college of Practical Engineering, Muswell Hill, the college staff will be reinforced by a number of eminent practical engineers, who will give lectures on some of the most important topics in civil and mechanical engineering. The first of these lectures will be on the subject of waterworks by the Hon. W. J. McAlpine, past president of the American Institution of Civil Engineers—an authority of European as well as of Transatlantic reputation—by whom many of the most important waterworks of the United States have been constructed.

Institution of Mechanical Engineers.—The summer meeting of the institution will be held at Leeds, commencing Tuesday, August 15th, and the following provisional arrangements have been made:—On Monday, August 14, the reception room will be open at the town hall, from 3 to 7 p.m., for the registration of addresses, issues of programmes, cards, &c. On Tuesday, at 10.30 a.m. there will be a general meeting in the civil court, town hall, when the mayor of Leeds, Mr. G. Tatham, will attend and open the proceedings. The chair will then be taken by the president, Mr. P. G. B. Westmacott, who will read an address to the members. A selection of papers will afterwards be read and discussed, at 1.0 p.m luncheon will be provided in the Victoria Hall, town hall, by invitation of the local committee. In the afternoon there will be visits to works in Leeds and the neighbourhood. Members only admitted, except by special permission of the local committee. On Wednesday, at 10.30 a.m., there will be a general meeting in the civil court, town hall, for the reading and discussion of papers, Mr. G. B. Westmacott, president in the chair. At 1.0 p.m. luncheon in the Victoria Hall, by invitation of the local committee. In the afternoon there will be visits to works in Leeds and the neighbourhood. Members only admitted, except by special permission of the local committee. In the evening there will be a conversazione in the Philosophical Hall, by invitation of the local committee. Ladies' cards will be issued on application to the local secretaries. On Thursday, at 10.30 a.m., general meeting in the civil court, town hall, for the reading and discussion of papers, Mr. G. B. Westmacott, president, in the chair. At 1.0 p.m., luncheon in the Vicoria Hall, by invitation of the local committee. In the afternoon there will be an excursion to Bradford, when the exhibition of textile industries will be visited, and also the works of Messrs. Illingworth and Son, Messrs. S. C. Lister and Co., Messrs. Thwaites Brothers, and others. At 7.30 p.m., the annual summer dinner of the institution will be held in the Victoria Hall (evening Dress). Tickets can be obtained by members for themselves and their friends on application to the secretary, accompanied by a remittance for the amount (25s. per ticket). On Friday an excursion will be made to Hull, by special train, provided free by the kindness of the North Eastern Railway Company. At Hull, visits will be paid to various works, including those of the Hull and Barnsley Railway and Dock Company, by kind invitation of Messrs. Lucas and Aird. The return will be made to Leeds by special train, also provided by the North Eastern Railway Company. Arrangements will be made for enabling members to leave the return train at the various junctions, so as to take ordinary trains going north and south. During the afternoons of Tuesday, Wednesday, and Thursday, Messrs. John Fowler and Co. have kindly invited the members to witness in operation their system of ploughing and cultivation by steam. The principal works in Leeds and the neighbourhood will be thrown open to the members in the course of the week.

MEETINGS FOR THE WEEK.

MONDAY, July 17.

Geologists' Association.—Excursion to the West Riding of Yorkshire, under the direction of the President and Professor Morris. 4.30 p.m. Harrowgate. Old Sulphur Springs and Bog Springs. Yoredale Rocks. Diamond Field. Brik Cragg and Harlow Carr.

TUESDAY, July 18.

Royal Botanic Society.—2 p.m.
Malton Agricultural Show.
Horological Institute.—8 p.m. Anniversary.
Geologist's Association.—Yorkshire Excursion, Knaresborough Castle yard. Millstone Grit, and Magnesian Limestone. Dropping Well. St. Robert's Cave, Plompton Rocks. Brimham Rocks.

WEDNESDAY, July 19.

Lincolnshire Agricultural Society.—Show of Machinery and Stock at Sleaford. Three days.
Dialectical Society.—8 p.m. Mr. W. C. Coupland, on the Opposition to a Channel Tunnel.
Bedfordshire Agricultural Society.—Show at Luton.
Geologist's Association.—Yorkshire Excursion. Saltergate Quarries. Valley of the Washburn. Cat Crags and Kex Gill, Bolton Abbey. Yoredale Shales Anticlinal. Bolton Anticlinal. Skipton Rock.

THURSDAY, July 20.

Geologist's Association.—Yorkshire Excursion. Bell Bush. Malham Glacial Deposits. Craven Fault. Gordale Scars. Malham Tarn. Underground Channel of Tarn 1½ miles. Ryecloaf Hill. Trilobites.

FRIDAY, July 21.

Geologist's Association.—Yorkshire Excursion. Clapham Caves Ingleborough. Norber. Iceborne Boulders. Moughton Fells Combe Quarries.

SATURDAY, July 22.

Royal Botanic Society.—3.45 p.m.
Zoological Society.—4 p.m.
Geologist's Association.—Yorkshire Excursion. Raygill Quarries, recently excavated fissure bones of Elephas, Hippopotamus, Rhinocerus, Bear, Lion, Bison, &c. Veins of Barytes.

RAILWAYS & TRAMWAYS.

Railway Passengers.—A parliamentary return just issued shows the number of railway passengers and the amount of passengers' fares in Great Britain in the years 1873 and 1880, and the amount of passenger duty paid in those years. In 1873 the number of first and second class ordinary passengers and periodical ticket-holders was 103,033,078, the amount of the whole fares was £8,647,151, and the amount of passenger duty on which was £432,358; the number of third-class ordinary passengers and ticket-holders was 336,239,981, who paid fares amounting to 11,238,283, and passenger duty to the amount of £74,697. A considerable decrease is apparent in the number of and receipts from first and second class passengers in 1880, the number being 98,483,636, the amount of their fares £8,213,889, and the passenger duty thereon £410,694. A proportionate increase is, however, noticeable in the statistics of the third-class passenger traffic for the same year, when 488,622,960 passengers were carried in this class, whose fares amounted to £14,333,271, and the passenger duty on which amounted to no less than £339,025.

Railway Construction Prospects for 1882 in the United States.—Unless a great financial panic shall occur, which does not seem at all probable, we are satisfied that railway building will continue at a rapid rate, and from present appearances that the total for 1882, in spite of the temporary depression in the marketing of securities, will be very likely equal to or possibly exceed that of 1881. Our belief is based on the knowledge of the work now in progress, and we think that an examination of the enterprises projected and actually under way, as reported in our columns during the past year or two, will be sufficient to convince any one that railway construction not only has not ceased but is being continued at an astonishing rate of progress. Of course it is well to proceed with reasonable caution, and we do not find any fault with those who are endeavouring to hold back the tendency to speculation by intimations of possible evil. It is well to have some counterbalance lest the wheel of progress, as embodied in the form of railway building, revolve too rapidly. At the same time we are willing to place on record our prediction that unless a serious failure of the crops and actual financial disaster, which we believe no one now anticipates, overtake the country this year, the mileage of track added in the United States during 1882 will not much fall short of that of any previous year, and that the work of succeeding years is likely to very greatly exceed even that of 1881.—*Railway Age.*

Engineering Competition in Roumania.—"The Roumanian *Official Gazette* publishes a decree announcing a public competition for plans of the bridges to be built over the Danube connecting the Kustendje-Cernavoda and Bucharest-Fetesti Railways; and also for plans of a tunnel to be constructed under the Danube about the same spot. The prizes for the plans of the bridges will be of the value of 100,000f., and those of the tunnel will be worth 50,000f. The cost of the bridges is estimated at about 20,000,000f. The Roumanian government invite the principal engineers in the world to compete.

PHILLIPS' HARVESTING FANS.

OUR readers will doubtless remember that one of the special features of the late Bath and West of England Show at Cardiff, was the trial of various processes for drying hay. Two systems only were exhibited in action, and these were described by us at the time in our general report of the show. Of these, the one which appears the most reasonable, and which met with the approval of competent judges at the time, was the system of harvesting in the stack by Mr. Charles D. Phillips, of Newport, Monmouthshire, and which system that gentleman is exhibiting at the Royal Show at Reading. The principle involved is to cure the material stacked by means of the heat generated by its own fermentation. If grass, which has been imperfectly cured by the sun and wind, is placed in stack, it will heat to such an extent as to become the subject of spontaneous combustion. If this heat can be properly regulated, it can be made to produce all the effect upon the grass which ordinarily results from the action of the sun and wind upon it in the process of haymaking upon the field. The credit of inventing or discovering this scientific method of harvesting in stack is due to Mr. B. Neilson, of Halewood, near Liverpool. Taking Mr. Neilson's principle as a basis, Mr. Phillips has improved upon the mechanical means of efficiently carrying out the system, and which improved means we illustrate in the engravings on page 32. These consist of exhausting or ventilating fans, either for horse, hand, or steam power, placed in connection with the stack by means of tubes laid in the ground and communicating with the interior of the stack. In proceeding to use this arrangement the ground for the stack is first marked out, and holes are cut in the ground at intervals, in which damper-boxes are fitted, which communicate with each other and with the exhaust fan by pipes laid in the ground. The damper-boxes are closed in at the top with a slide, which is operated by a rod having a handle outside the rick. Over each damper-box an air-chamber is built in the rick by means of wooden framing. The temperature is taken by means of a pointed thermometer, which can be thrust into any part of the rick and the temperature ascertained, the reading being on the outside of the stack. Should the heat developed in the rick show that it requires to be cooled, the slide over the damper-box nearest the heated part is withdrawn and the fan started, the exhaust action drawing off the heated air and the cool air following it up. Mr. Phillips makes these fans portable for hand-power, as shown in our engraving where figs. 1 and 2 show one of these fans in side and front elevation respectively. The pipe for operating on single ricks is shown at A, and that for drawing from a series of ricks at B. By a subsequent improvement, the arrangement at A has been slightly altered, a sliding piece, and a bend to rest upon the ground having been substituted for the pipe and bend as shown in the engraving. Figs. 3 and 4 show respectively a side and front view of Mr. Phillips' exhaust fan, as arranged for steam power, and as shown in action at Reading. A is the intake or suction, and B is the outlet or discharge. Having to run at a very high speed, this fan is made with special regard to strong material, fitted with steel spindles and long bearings—the intakes are provided with cast iron suction cases with the bearings outside, so that dust, sand and fibre can pass through the fan without touching or injuring the bearings. There are two suction cases, each provided with flanges to attach to tubing, and these cases may be made to point sideways or downwards as may be required. Mr. Phillips has designed a fan, for power, having only one circular suction case or intake, similar in every respect to the hand fan illustrated in figs. 1 and 2, but without the pedestal and gearing. The fan will exhaust 1000 cubic feet of air per minute, when worked at the rate of 2500 revolutions. It is adapted for steam, water, or horse power, but in order to attain the requisite speed, an intermediate motion will be required. We need not dilate upon the merits of such an obviously excellent method of dealing with crops in the stack, its value having been demonstrated both at Cardiff and Reading, and which is of far more importance in extended practice. We have merely to point out that Mr. Phillips' new fan meets the demand for a cheap, portable and efficient means of harvesting hay, corn, &c., in the stack, and thus enables the farmer to stack his crops first and harvest them afterwards, however bad the weather may be.

HORIZONTAL COMPOUND CONDENSING ENGINE.

PROMINENT amongst the numerous exhibits of the Reading Iron Works at the Royal Show at Reading is the engine of which we give a perspective view in the engraving on page 32. The first considerations in designing this engine were to make it as compact as possible, to render easy the removal of the various parts for examination, and, above all, to develop the highest economy in fuel possible by compounding. These points have been fully attained in this engine, which is an excellent example, both as regards design and workmanship. On referring to our engraving, it will be seen that the cylinders are placed one behind the other; the high-pressure cylinder being nearest the crank-shaft; and they are placed as closely together as consistent with room to pack the glands. The front cover of the low-pressure cylinder is made in halves, and when removed, the back cover of the high-pressure cylinder and the high-pressure piston can be passed out through the large cylinder, which is a very ingenious arrangement. The steam-ports to the cylinders are kept short, which is accomplished by placing the expansion, or outer valve eccentric, close up to the main shaft bearing, and carrying the connection straight through to the valves. The exhaust valve eccentric is outside the one working the expansion valves, and its rod is connected to a pin, on one side of a hollow wrought iron sleeve, carried in double guides. On the opposite side of this sleeve, another pin connects to the exhaust valve-rod, so transferring the motion of the exhaust eccentric, from the centre line of the latter to that of the valve-rod, which is situated much nearer the centre of the cylinders. The expansion valve-rod is guided by passing through the sleeve, the ends of which are bushed with gun metal. The governors are of the Porter type, and determine the partial revolution of the cylindrical expansion slide valve, having ports shaped, so as to alter, automatically, the point of cut-off. Variable expansion is applied only to the high-pressure cylinder, the low-pressure cylinder being provided with a fixed cut-off slide. The bearing surfaces, throughout, are very ample, securing smoothness of working and absence of undue wear under high pressure, and quick piston speed. Another ingenious device is that connected with the condenser which is sunk a short distance below the ground line, at the flywheel end of engine, clear of the engine foundation, and occupying the waste space which the overhang (projection) of the flywheel past the end of the bed-plate necessitates. It is of an ample capacity, and the air-pump, which is single acting, is driven by means of a connecting rod, carried by a strong return crank from the main disc. The engine is altogether of massive construction, the centres of the cylinder's main bearing are kept low, to secure rigidity; and the various parts are strongly and well proportioned. These points, combined with good workmanship and neat finish, render it in every respect a high-class engine of the best modern construction and a credit to the Reading Iron Works.

COMBINED REAPER AND CORD SHEAF-BINDER.

ONE of the prominent exhibits of the Royal Show at Reading is the new light-draught combined reaper and cord sheaf-binding machine of Messrs. R. Hornsby and Sons, of Spittlegate Ironworks, Grantham. This machine we illustrate in the engravings on page 33, fig. 1 of which represents it mounted for travelling, whilst fig. 2 shows it set for work. The experience of the makers has enabled them to add the latest advantages to the reaping part of the machine. The width of cut is 5 feet, and the draught of the machine is very light, so that two horses will work it. The machine can be quickly mounted on the two spare wheels as shown in fig. 1, so as to pass through a 7-foot gateway, or travel on narrow roads. The process of binding and delivering is as follows:—The crop as cut falls on a travelling platform, and is thence elevated over the main road wheel and on to the binding table, where it is received by packers of simple and effective construction, which thrust it forward, laying it in the cord and against the compressing lever, where it lies until sufficient bulk has been accumulated to form a sheaf of the proper size, which is previously determined, and the apparatus set accordingly. Three different sizes of sheaf can be made. The compressing lever is then moved by the force of the packers pressing the sheaf against it, bringing into action the binding arm, and subsequently the knotter and ejector. The binding arm (carrying the cord) rises from beneath the table, making a clear division between the sheaf to be bound and the succeeding crop, and carrying the cord over the sheaf, lays it in the knotter. The binding material is manilla cord, which costs less than good hemp, and is considerably stronger—points of importance, especially where a large acreage is to be dealt with. The machine is conveniently arranged, so that the driver can, without leaving his seat, effect all the necessary adjustments.

ROBEY'S VERTICAL ENGINE AND BOILER.

IN our general notice of the Reading Show we have referred to the leading exhibits of Messrs. Robey and Co., of the Globe Works, Lincoln. Of these we now have to notice specially their improved vertical engine by itself, and in combination with their vertical boiler. The engine, which is illustrated at fig. 1 of the engravings on page 37, is worthy of notice for the simplicity of its design, the solidity of its construction, and the accessibility of all its parts for adjustment and examination. Fig. 2 represents the engine and boiler combined. The engine is erected upon a massive cast iron standard, and is thus independent of the boiler. The base plate serves not only as a tank, but as a water heater. The engine is provided with a self-starting feed pump, and is fitted with an improved governor, which works an equilibrium valve, effectually controlling the speed of engine under great variations of load. The boiler is of tubulous construction, and was described and illustrated in IRON for December 9, 1881. It has two sets of straight tubes, set at a slight angle from the vertical, and so arranged that the circulation of the water is perfect, and thus not only is the generation of steam facilitated, but incrustation is prevented. At the upper end of the tubes the water parts with the steam, returns down the side of the boiler, and having suddenly to change its course at the bottom, it there parts with any mud it may have in suspension, which mud can be removed. The flue tubes are so disposed that the products of combustion on their way to the chimney strike upon and pass round the water tubes, thus breaking up the flame and abstracting the maximum heat. In fig. 3 we are carried a step further with this engine and boiler as the figure shows it mounted on an angle iron frame, so constructed as to permit of the employment of wheels of a comparatively large diameter, so that the engine can be easily and safely moved from place to place, thus adding to its usefulness.

COMPOUND STATIONARY ENGINE.

THE ever-increasing purposes to which steam power can with advantage be applied, and the great need for the utmost economy in the consumption of fuel—the chief element of expenditure in the working of steam-engines, especially where this can only be procured at high prices—renders absolutely necessary the employment of steam-engines and boilers, in which not only is the steam most economically generated, but also its fullest expansive force obtained, and thereby the largest amount of power developed for the quantity of coal consumed. This result is obtained in the compound stationary engine, by Messrs. Marshall, Sons and Co., of the Britannia Ironworks, Gainsborough, which we illustrate in the engraving on page 40, and which is exhibited by them at the Royal Show at Reading. In this engine, moreover, the result is obtained without involving complication, and without sacrificing ease of management, portability, readiness of fixing, durability, and general efficiency; and where a plentiful supply of water is readily available this economy is further enhanced by the application of a condenser in connection with the low-pressure cylinder. Steam is maintained in the boiler at a high pressure (from 120 lb. to 140 lb.), and by the employment of a high and a low pressure cylinder, it is expanded to about six times its original volume, and discharged very little above atmospheric pressure. Its full force is thus obtained, and no power is lost, as is the case with the ordinary engines wherein a larger quantity of steam is used for the comparative power developed and exhausted at a considerable pressure. Thus the advantage gained by the employment of compound engines will at once be apparent. The engine in question is erected on a wrought-iron frame, and is surmounted by the boiler. The frame extends beyond the crank-shaft to receive a casting forming an ash-pit, which supports the boiler at the fire-box end, and is fitted with a door for regulating the draught to the fire. The cylinders are constructed with a radial flange at the top to receive the smoke-box end of boiler. The boiler is of large capacity, the shell plates being made of steel, and the internal fire-box of Bowling iron. The cylinders are placed side by side, and both high and low pressure are so proportioned as to divide the duty given off equally between them. The crank-shaft is of steel, and cylindrical guides are employed, embodying large sliding surfaces for the crossheads. The high pressure cylinder is fitted with patent automatic expansion valve gear, rendering the engine specially adapted for driving electric light machinery and for any other duty where regularity of speed is essential, and also for working with the least amount of fuel. The whole is a very fine example of design and workmanship, and forms a very compact arrangement requiring very slight foundations, the fixing necessary being only of a very simple character.

THE JOHNSTON HARVESTER.

ONE of the attractions of the Royal Show at Reading in connection with harvesting machines is the automatic string sheaf-binding reaper exhibited at the stand of the Johnston Harvester Company of Chiswell Street, London. This reaper we illustrate in the engravings on page 40, fig. 1 of which shows a rear and fig. 2 a front view of the machine. The general construction of this harvester is now so well known that we need only here point out some of its leading features. In the first place it is in all respects self-operating, sizing its own bundle and making a perfect separation, whatever the condition of the grain. Every bundle is of uniform size, being thoroughly compressed by the compressor arms, admitting a certain quantity of grain; this effects a great saving in twine, and aids materially in stacking. The binder is not shifted forward and backward for different lengths of straw, thus throwing extra weight on the necks of the horses, or tilting the tongue far upward. The grain is guided to its proper place by a small apron near the front of the binder deck, in sight of the driver and under his control. By one movement of a light lever he can shift the butts to any desired position. With regard to the binding material we may observe that last season the Johnston Harvester Company experimented with various kinds of twine, and found that manilla twine, running about 700 feet to the pound, well and evenly made, is the best and cheapest for their binder. Of this it will take from 1 to 1½ lb. to the acre, according to the crop. The device for raising and lowering the machine is convenient and practicable. The driver is not obliged to leave his place and go round to both ends of the machine. Without leaving his seat, he can, with a lever, raise and lower both ends of the harvester at one time, anywhere within a range of 22 inches, which is a great improvement. The sickle is driven from the end, instead of the centre, dispensing with the objections to the sway bar movement. There is no resistance to the grain while being conveyed to the elevator, and no openings through which grass and weeds can work between the canvasses. The reel is operated with one lever, and can be adjusted to any desired position, forward or backward, up or down. It can be brought directly over and close to the sickle, enabling the machine to elevate short grain in good condition. Experience having shown that the double canvas elevator is the most practicable for binders in all kinds of grain, it is adopted in this machine which we may add has been awarded the silver medal of the Royal Agricultural Society.

RIDER'S HOUSEHOLD PUMPING ENGINE.

WE have before now had to direct attention to Rider's excellent little hot-air engine in its various useful applications. We have now to notice it in connection with the Royal Show at Reading, where it is exhibited by its manufacturers, Messrs. Hayward Tyler and Co., of London and Luton. In this engine, as arranged for domestic water supply, a new feature is introduced. In order to simplify it and adapt the engine to existing well-frames, a simple gearing is applied, so that the speed of the engine is reduced at the engine. Hence a shaft may be carried from the engine and coupled directly to the crank shaft of the pumps. A very neat arrangement of this kind is illustrated in fig. 1 of the engravings on page 41, which represents an engine of ¾ horse-power coupled directly through gearing to the crank shaft of a well-frame, driving two 2½ inch pumps with a 6-inch stroke. The engine is speeded at 120 revolutions, the gearing being 4 to 1; a speed of 30 revolutions is produced on the pump crank shaft; a pressure of 35 lb., or equivalent to a head of about 80 feet, is produced, and the quantity by actual measurement is 600 gallons per hour. Figs. 2 and 3 represent respectively a side and front view of a Rider's engine, together with sectional views of a well showing the pumping arrangements. One of the ordinary hot-air engines for raising 500 gallons per hour to a height of 80 feet is also exhibited at Reading. The Rider hot-air engine has become quite a domestic institution, and may

PHILLIPS' HARVESTING FANS.

(*For description, see page* 31.)

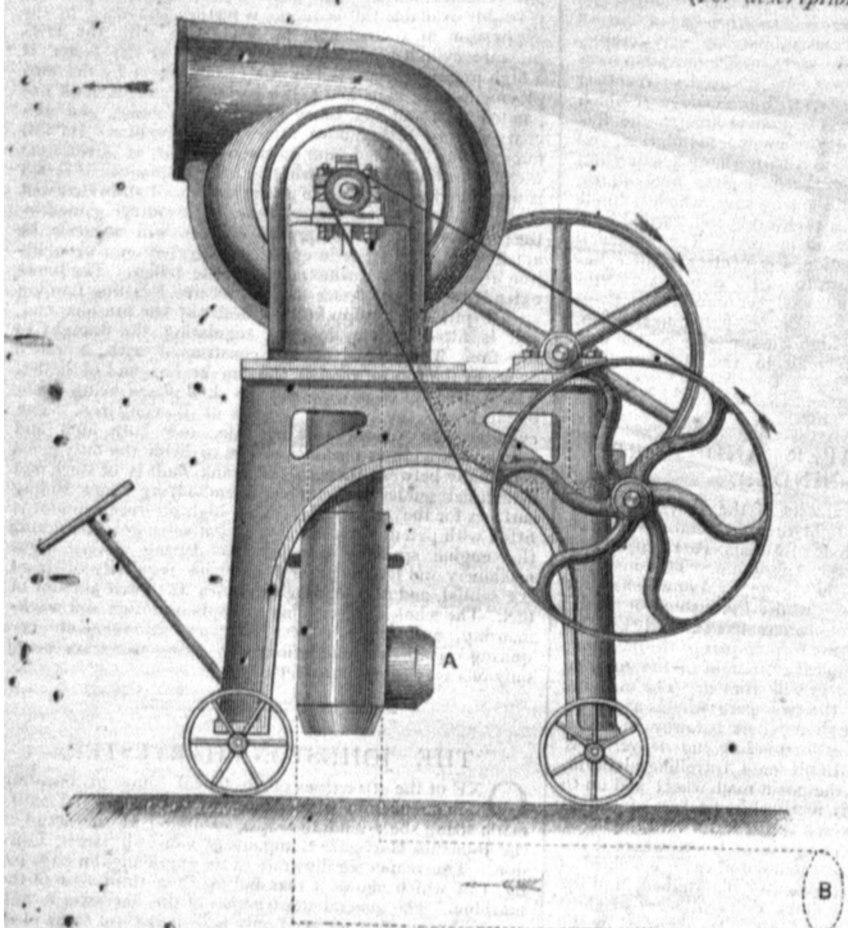


FIG. 1.

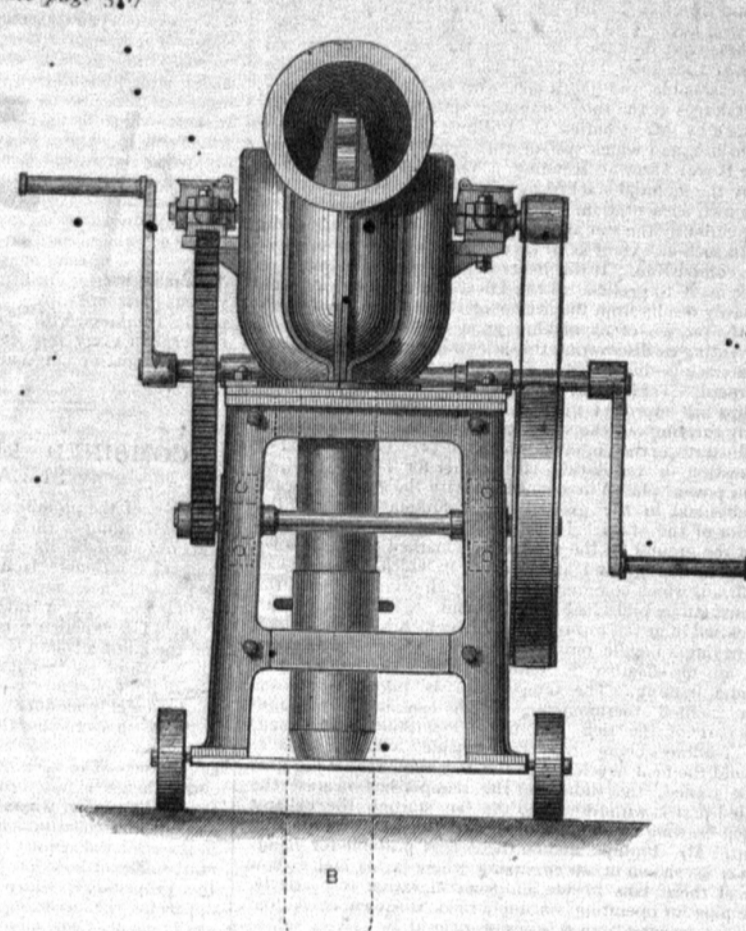


FIG. 2.

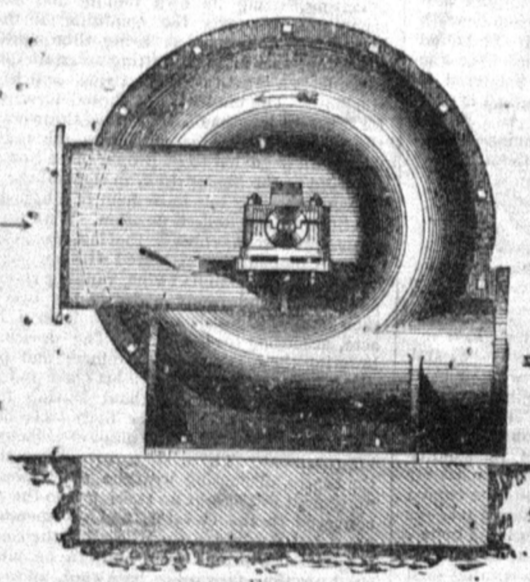


FIG. 3.

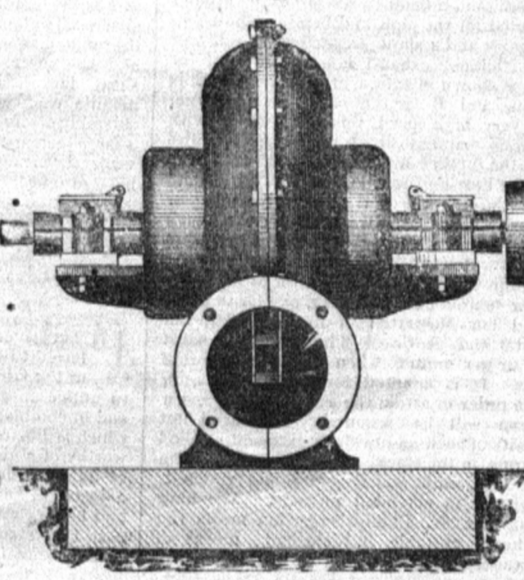
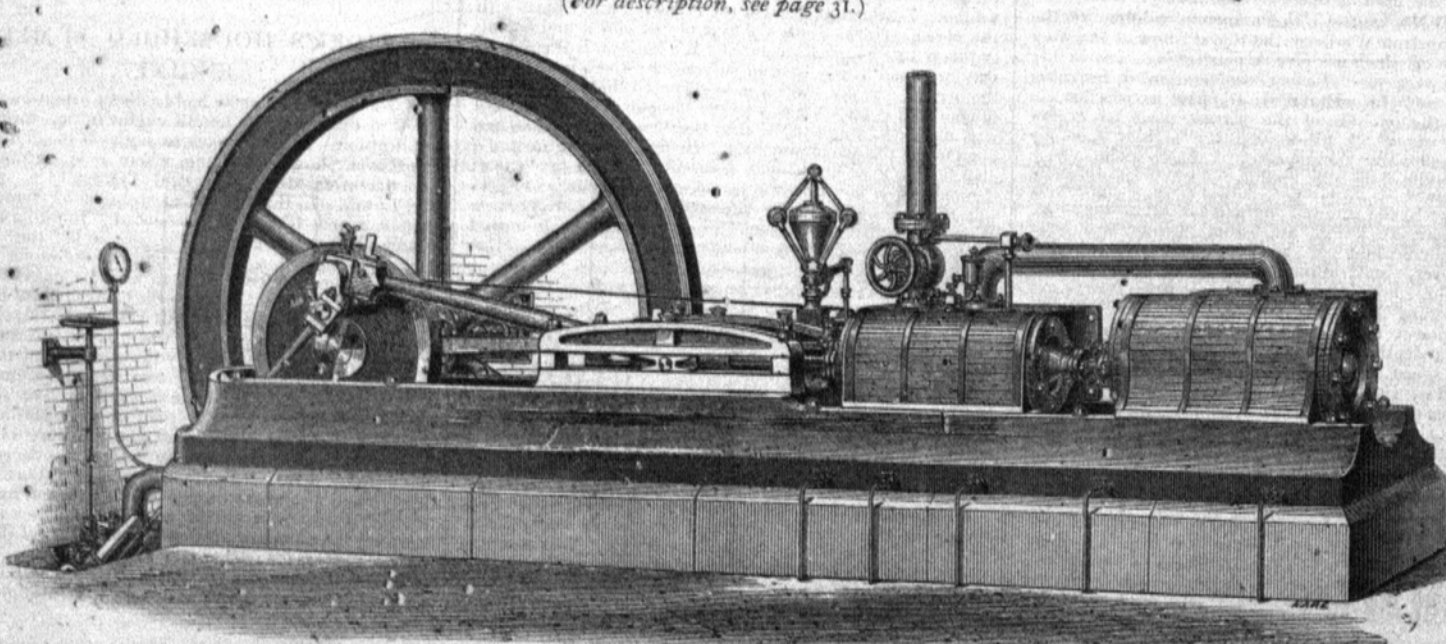


FIG. 4.

HORIZONTAL COMPOUND CONDENSING ENGINE.

BY THE READING IRON WORKS, READING.

(*For description, see page* 31.)



COMBINED REAPER AND CORD SHEAF-BINDER.

BY MESSRS. R. HORNSBY AND SONS, GRANTHAM.

(*For description, see page* 31.)

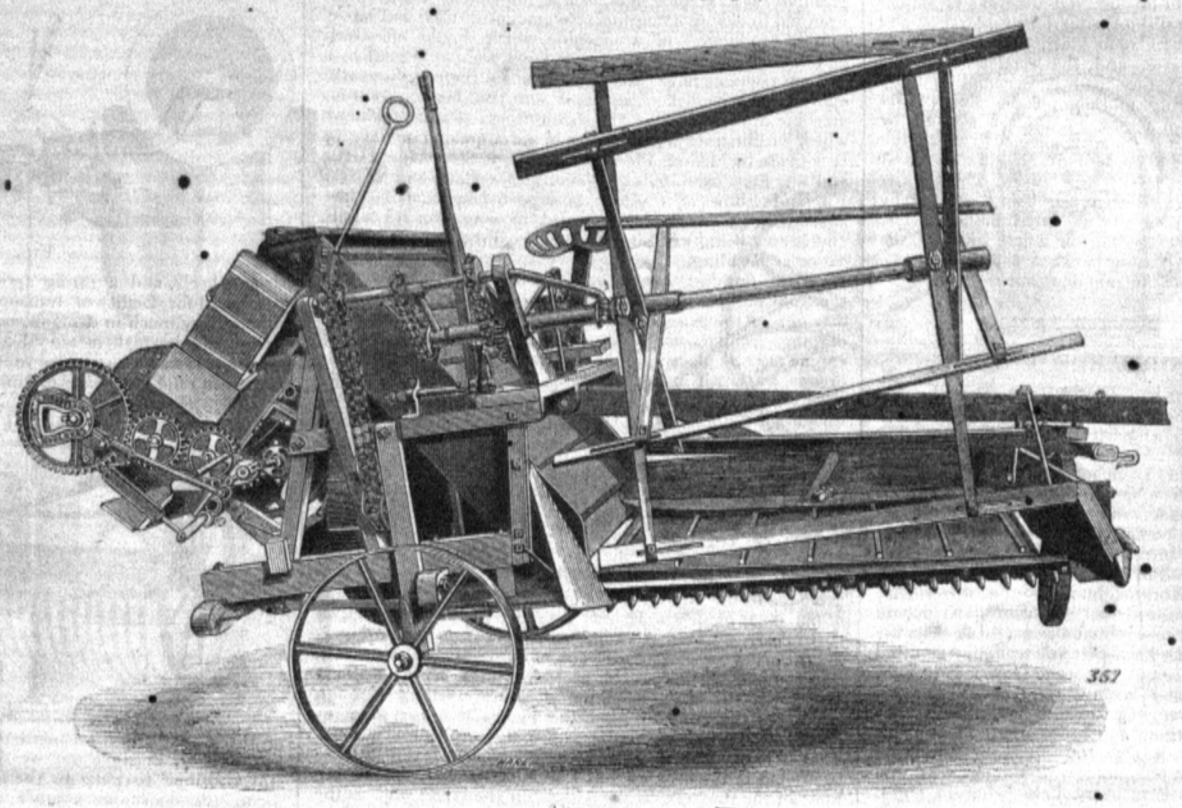


FIG. 1.

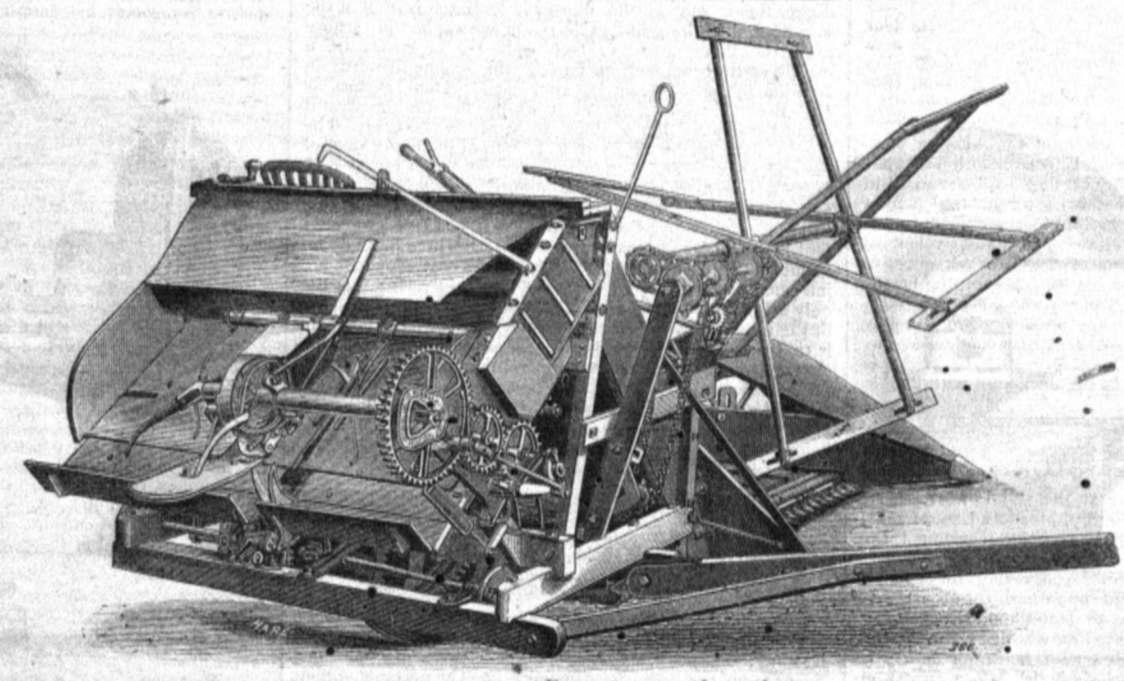


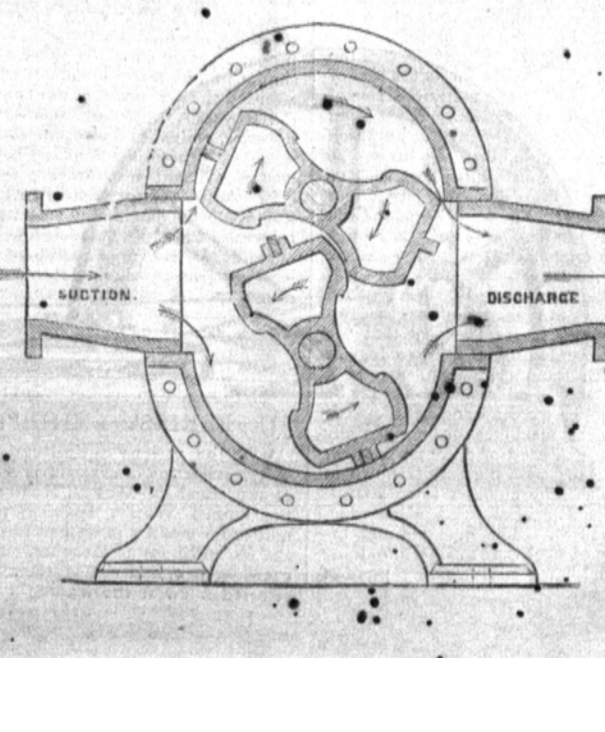
FIG. 2.

now be found in hundreds of country mansions. It certainly is a remarkable little engine, and must be a boon to those who have to supply their residences with water from a depth or from a distance. We should add that one of these engines has been in operation for the last four years at the office of Mr. Okes, C.E., 39, Queen Victoria Street, London.

THE ROOTS PUMP.

A NOVELTY in the way of pumps has just been introduced into this country by Messrs. Hayward Tyler and Co., of London and Luton, and is exhibited by them at the Royal Show at Reading. This pump, a section of which is shown in the annexed engraving, is for raising large bodies of water to a low lift, from 50 to 60 feet. It is a modification of and an improvement on Roots' blower, and although at present it is new in the field, it promises well. When tested at Messrs. Hayward Tyler and Co.'s works, in Whitecross Street, previously to its being sent to Reading, it drew water from a depth of 21 feet, running slowly. When driven at a speed faster than the water could rise in the small temporary suction pipe a vacuum of 14½ inches was obtained, thus proving that under its ordinary circumstances with pipes of proper dimensions water could have been raised from 28 to 30 feet. For ship purposes, where large quantities of water are required to be lifted from the hold in case of springing a leak, or from some accidental cause, Messrs. Roots' new pump would seem to have a very promising future before it. So many ships and so many valuable lives are yearly lost, simply because our large sea-going vessels are not supplied with adequate means of coping with the leaks. We heartily wish the pump success, in this, as well as in every other direction.

THE ROOTS PUMP.



THE LARSEN HAY RAKE.

IN the engraving on page 44 we illustrate the Larsen self-acting hay rake, which is of Canadian origin, and is exhibited amongst other things at the Royal Show at Reading by Messrs. J. and H. Keyworth, of 35, Tarleton Street, Liverpool. As will be observed this rake is similar in appearance to the generality of American hire rakes, and has twenty-four teeth of elastic steel, large wheels of hickory, made in two parts, and the usual seat for the driver. The discharge of the load is accomplished by means of a double spring motion on the hub of the wheel, which is put into action by a lever worked by the foot of the driver and connected with the spring by iron rods. This method of clearing the load prevents check to the progress of the horse. The manner in which the tines are cleared is novel, being effected by means of two arms with an elbow-jointed motion. The arms act on a wooden bar extending the whole width of the rake, having short prongs passing between the teeth. The Larsen rake cannot clog, as the axle does not revolve.

COMPOUND PORTABLE ENGINE.

THE novelty of Messrs. Ruston and Proctor, of Lincoln, at the Reading Show is the compound portable engine, of which we give a perspective view in the engraving on page 44. This engine is of 12 horse-power nominal, with two cylinders of 7 inches and 11 inches diameter respectively, to use steam of 120 lb. per square inch, which is admitted first into the smaller cylinder and expanded to twice its original volume, and then passing to the larger cylinder is again expanded, escaping into the air with a final pressure of under 10 lb., or less than in an ordinary engine. By this system the full available work is obtained from the steam, which, combined with carefully worked-out proportions and excellent workmanship, has enabled a remarkable economy in fuel to be realised. The high-pressure cylinder is fitted with a simple and efficient automatic expansion gear, actuated by a powerful and sensitive cross-arm governor. The speed is, therefore, very regular and particularly suitable for electric light machines. In the construction of this engine there are several novel points. The cylinders are both jacketted and cast in one piece, with a flange all round which is bolted to the boiler, every bolt being in sight. Steam is admitted at the back from a separate casting containing an improved balanced stop valve and the two safety valves, so that only one connection to the boiler is required for these three fittings. The crankshaft is of steel supported by strong brackets, which are connected to the cylinders by Messrs. Ruston and Proctor's steam expanding stays, thus relieving the boiler of the working strain. One of these brackets has a facing for receiving the pump, so that the latter can be removed on disconnecting the flange of the delivery pipe, without breaking any other joint. In corroboration of what we have stated as to the economy of fuel to be realised in this engine, we may mention that in a recent trial, with a load of 30·26 horse-power on the brake, it ran for 3 hours 45½ minutes with only 300 lb. of Welsh coal, equivalent to the remarkably low consumption of 2·63 lb. per effective horse-power per hour, or about 2·4 lb. per indicated horse-power, whilst the feed-water required was only 20·46 lb. per effective horse-power per hour. Such economy has only been possible hitherto by the use of costly condensing engines, and is then seldom obtainable, whilst this engine is no more complicated than the ordinary kind with double cylinders.

THE BLAKE-MARSDEN STONEBREAKER.

AMONGST the attractions at the stand of Mr. H. R. Marsden, of the Soho Foundry, Meadow Lane, Leeds, at the Royal Show at Reading, may be mentioned the improved Blake-Marsden stonebreaker, which we illustrate in longitudinal section at fig. 1 of the engravings on page 44. The frame A, which receives and supports all the other parts, is cast in one piece with feet to stand upon the floor or upon timbers. It is also mounted on wheels when required to travel. The feet are provided with holes for bolts, by which it may be fastened down if desired. P is a fly-wheel on a shaft which has its bearings on the frame. F shows a section of the shaft, and at every revolution the eccentric causes the lower end of the movable jaw, D, to advance towards the stationary jaws, C 1 and C 2, about ½ an inch and to return. Hence, if lumps of stone be dropped in between the covergent faces of the jaws it will be broken by the next succeeding bite, the fragments will then fall lower down and be broken again until they are small enough to pass out at the bottom. The readiness with which the hardest stones yield at once to the influence of this gentle and quiet movement is remarkable. It will be seen that the distance between the jaws at the bottom limits the size of the fragments. The distance, and consequently the size of the fragments, may be regulated at pleasure. A variation may be made by turning the nut on the wedge L, which moves forward or backward the toggle block next to it. A further variation may be made by substituting for either or both of the toggle plates, J and K, others that are longer or shorter. The connecting rod or pitman H, is made of the best crucible cast steel, which admits of it being made much lighter than the old cast iron one; thus admitting longer toggle plates and giving increased leverage, which reduces the power required to drive the machine. For making road metal the reversible cubing jaws in four sections are successfully used. For this purposes it is necessary that the material should be well and evenly broken up to a regular gauge and cubical form, which the machine will do. It is in considerable use and with very good results. It may be interesting, in conclusion to notice a crucial and an unlooked-for test to which one of these machines was accidentally put. Upon one occasion a hardened steel stone-hammer fell into the jaws of the machine with the result shown in figs. 2 and 3 of our engraving. The hammer is cast steel, hardened and tempered; it is 8 inches long, 3 inches wide, 2¼ inches thick, and weighs 12 lb. The fractures and indentations in this solid piece of steel were made without any injury to the machine, which affords a satisfactory proof of its strength and crushing power.

PROCTOR'S STEAM DIGGER.

ALTHOUGH the superiority of digging over any other mode of cultivation has long been admitted, the great expense attending the employment of manual labour, and the very limited extent to which it could be employed, render it prohibitory. Hence agricultural implement makers have been led to devote a considerable amount of time and labour to the production of a machine which should effectively perform the work of digging on a large scale at a small cost, and our columns have borne witness to their praiseworthy efforts. The most recent and not the least promising machine of this kind is the steam digger (Parker's Patent) which we illustrate in perspective in the engraving on page 45. It is made by Messrs. Proctor and Co., of Stevenage, Herts, and was first exhibited by them at the Bath and West of England Show at Cardiff, as reported by us at the time. Since then it has been improved in several of its details, and is now being exhibited by Messrs. Proctor at the Royal Show at Reading. The digger consists of a light but strong plate iron framing, carried on four wheels with broad tires, the front pair for steerage, the rear driven by spur-gear for driving. Attached to the rear end of the framing is the digging apparatus. Any portable or semi-portable engine may be placed upon the framing for actuating the digger, as shown in our engraving, so that a farmer who has an engine may use it. This is one of the special features of this digger, and it is a very important one. The digging apparatus consists of a digger shaft with three cranks equidistant, *i.e.*, cranked at an angle of 120 deg. Each crank actuates a digging fork 4 feet wide, with eight prongs bolted to the angle-iron fork head. From each fork a lever arm rises, and at the top it is connected to a short oscillating link lever. It is this curved lever arm and link lever that guides the movements of the fork in digging. The mechanical movement is a very beautiful one, and similar in principle to the link lever that guides the binder arm of some of our sheaf-binders. It was first patented in America, so that all Mr. Parker can claim is its application to his digger. By means of the slot-articulation of the link lever to the fork arm the path of the points of the prongs of the fork are timed with the greatest certainty. For travelling through gates, &c., and on the road, the two side diggers are removed. The weight of the steam digger is about 7 tons. This is mostly supported on the rear wheels. It is utilised in driving in the digging forks into the ground, thus taking most of the pressure on the wheels off the land; and as the bearings of the digger shaft form a fulcrum to the three digger forks, and as the spur-gear leverage is that of the first kind, something like twice the power applied in turning over the three spits, 12 feet wide by 12 inches by 6 inches is thus applied, in forcing the engine forward, in addition to that of steam by spur gear. There is thus no difficulty in accounting mechanically for the successful manner the new digger does its work in the field. The digger shaft is driven by spur gear from the crank shaft of the engine, as seen in the engraving, and at a recent trial made forty-five revolutions per minute, the driving wheels advancing 45 feet in the same time, so that each fork in one rotation of the digger-shaft turns up a slice 4 feet long and 1 foot broad with the greatest regularity, the three forks doing about 7½ acres per day of ten hours at a cost which we are informed is under 5s. per acre. We understand that the only attendants required are a man and a strong lad. One of the most admirable points in connection with the machine is that the engine itself is very much of the ordinary traction character, and as the digging apparatus can be readily taken off and refitted to it, almost every work requiring to be effected on the farm by steam power can be effected by the engine when not in use for digging purposes. Other things being equal, there would appear to be a very promising future before this steam digger.

PORTABLE ENGINE AND THRASHING MACHINE.

AMONGST other exhibits of Messrs. Marshall, Sons and Co., of the Britannia Ironworks, Gainsborough, at Reading, are the portable engine and thrashing machine illustrated in the engravings on page 45. The portable engine is of 8 horse-power, and is one of the standard type of this firm, into which, however, they have recently introduced several important improvements in detail. The engine illustrated is fitted with wrought-iron crankshaft brackets, a simple feedwater heater, cross arm quick-speed governors, an outside stop valve, and a very complete equipment. The whole is mounted on improved wrought iron travelling wheels, and wrought iron plate undergear for draught, which are found to be practically indestructible. The thrashing machine illustrated in our engraving is adapted for preparing the corn for market at one operation. It is similar in design to the one for which Messrs. Marshall were awarded the first prize at the last great competitive trials of the Royal Agricultural Society, at Cardiff, in 1872. It, however, embodies improvements in detail which subsequent experience has pointed out as being necessary. It is fitted with a wrought iron drum 5 feet wide, adjustable rotary corn screen, safety drum guard, and has an extra strong frame, stayed diagonally, and is mounted on wrought iron travelling wheels. This machine is complete with a full set of riddles for the various kinds of grain, and the whole of the working parts, including the elevator, being fixed within the frame, they are thus protected from the weather.

MESSRS. RANSOMES, HEAD AND JEFFERIES' EXHIBITS AT READING.

AT the various agricultural shows a large and varied collection of exhibits is so usual a thing to be found at the stand of Messrs. Ransomes, Head and Jefferies, of the Orwell Works, Ipswich, that it would indeed be a matter for wonder if we had to report differently of them at the Royal Show at Reading. As it is their display is an excellent one, and out of their numerous exhibits we have selected a few of the leading types for illustration in our present notice. First, with regard to ploughs, their name is almost legion, and they comprise a great variety of this class of implements suitable for every country, soil, and crop. Some of them are made of iron, and others of wood, and with one, two, or more furrows. We noticed a four-furrow skim plough, or seed-coverer, which we illustrate at fig. 1. This implement, as will be seen, is fitted with two

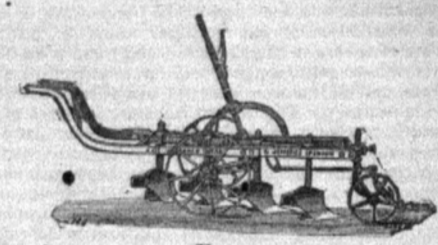


FIG. 1.

large wheels, and a lifting apparatus for raising it out of work, and for facility of transport, and is, we understand, already very much in demand, both in England and abroad. Rakes and haymakers are also exhibited in considerable numbers, amongst which we may mention the Anglo-American rake; a light, cheap implement, after the style

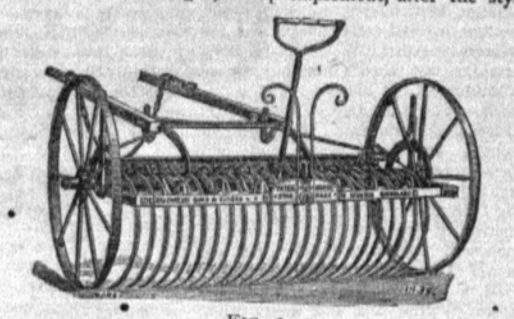


FIG. 2.

of those made in the United States. The patent "star" horse rakes, brought out by Messrs. Ransomes in 1869, still continue to keep to the front in this class of implement, the enormous number of 30,000 having been sold since their introduction. This rake is shown at fig. 2. Messrs. Ransomes, in common with several other leading

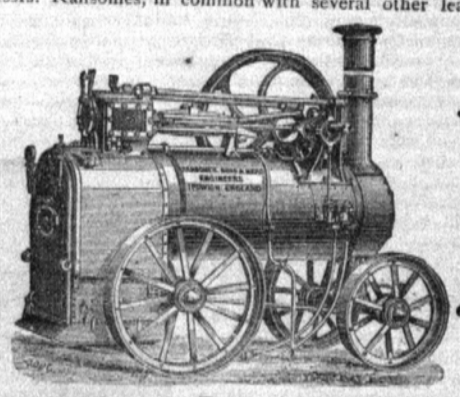


FIG. 3.

makers, have this year refrained from exhibiting their steam machinery in motion; they show, however, some capital portable engines, of 6, 8, and 12 horse-power respectively. The 12 horse-power engine, shown in fig. 3, is a particularly fine specimen of workmanship. It is fitted with link motion reversing gear, and is therefore suitable for winding, hoist-

FIG. 4.

ing, or other similar work which requires a frequent change in the movement of the engine. All these engines are, as usual, of excellent design and proportions, and the whole get up indicates care and good finish. Messrs. Ransomes exhibit one of their 6 horse-power agricultural locomotive engines, which is intended for driving a thrashing machine, and haul-

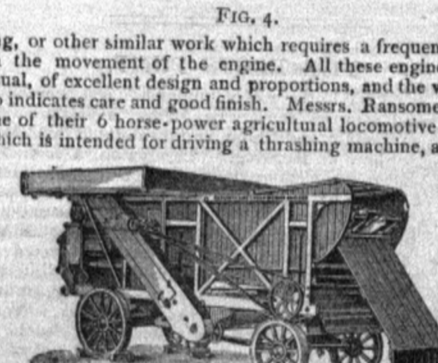


FIG. 5.

ing it from one place to another without the aid of horses. This engine has lately been improved in many of its details. Two vertical engines are also shown, one of which is an engine of 3 horse-power nominal, and the other, which is somewhat larger, is fitted with Cochran's patent multitubular boiler, which we understand gives very good results as to economy of fuel. This engine is illustrated in fig. 4 of our engravings.

Messrs. Ransomes' thrashing machines are limited to two exhibits, but here we find that they have introduced considerable novelty into their manufactures. One of the machines has a drum 54 inches wide, and is fitted with every modern appliance for producing a perfectly finished sample of corn at one operation. The frame-work and the general construction of this machine, which is shown in fig. 5, are of a very strong character, and there is no doubt that it is able to get through a very large amount of work. The drum, and all the other spindles, are of large diameter, with wide bearings. The second machine, although of the same width, is what is termed a "light" machine, and it is therefore well adapted for mountainous or hilly districts, where it would be difficult to move any heavy machinery. These machines can also be driven by portable engines of less power than those required for the full-sized machines. Such are the leading exhibits of this firm, which attract considerable and well-merited attention at Reading.

THE SOCIETY OF CHEMICAL INDUSTRY.

THE first annual meeting of the Society of Chemical Industry, was held in the chemical theatre, Owens College, Manchester, on July 5, and, if we may judge from the age of the society, which was founded as recently, we believe, as April 4th, 1881, and the number of the members attending last week's meetings, we may certainly say that the promoters of the society ought to be well satisfied with their work. The president, Professor Roscoe, F.R.S., in his address, congratulated the members on the status of the society, and mentioned that, while in June 1881, 297 members were on the books, the numbers had since increased to 1140. This number comprises most of the leading technical men engaged in the important chemical industries of Great Britain, as well as many other scientific men well known at home and abroad. We notice the names of Professor Abel (president-elect), Messrs. Lowthian Bell, E. K. Muspratt, H. L. Pattinson, Dr. Siemens, Professor Williamson, and many others, as among those who fill the office of vice-president. On Wednesday, Dr. Roscoe opened the meeting at Owens by giving his address. In this he stated that, if the importance of chemistry were more thoroughly recognised in the vast industries of Great Britain, much economy to the country would ensue, and that in one department alone, namely, that of coal-tar colour, and colours generally required for calico and other printing, £3,000,000 were annually lost to the country, and this simply, because of the greater attention paid on the Continent to chemistry than obtains in England. The president further said that the method employed in the continental manufactories was entirely scientific, the first aim being to have highly trained chemists at the head of the works, the various departments of which were also sub-managed by well-trained and well-paid chemists, who personally investigated the commercial production of the various articles, and superintended the manufacture of others, which had already been brought within the charmed circle of financial success. In some of the larger colour works as many as 30 to 40 well-trained and well-paid chemists were employed in this way, with the natural result that the Continent very largely supplies the home demand for these and other chemicals, and when they are produced in England, German chemists and German processes are frequently employed. The president's address was followed by the reading of the treasurer's report to the society by Mr. E. R. Cook, London, and the report of the patent committee read by Mr. Ludwig Mond, Northwich. This patent committee was formed by the society last year to promote better regulations in connection with patent laws, with special reference to chemical patents. Steps have been taken to communicate the views of the committee to Mr. Chamberlain, with the result that attention and support were promised to the committee when legislation on the subject was more matured. At present this was quite at a standstill, so little more could be done. It was, however, proposed last Wednesday to form a parliamentary committee to watch the bill when matters would allow of this being done.

The first paper read was one by Prof. Huntington, of King's College, London, on "The Mexican Amalgamation Process." In this Professor Huntington adduced new explanations of the various chemical operations involved in the processes. These explanations had been founded on numerous laboratory experiments made of course quantitatively, one result of which was to show that the formula ascribed by Rammelsberg and others to the action involved ought really to be represented by two, and that the explanation was obscured by the reversal of operations determined by the ammonia which investigators had used in their laboratory experiments. It is to be regretted, speaking generally, that the papers were not printed previously to their being read, as in the majority of cases where chemical reactions are involved it is very difficult, if not impossible, to follow their rationale; and then, again, much of the discussion on them would be more interesting, as, when they are not printed, it frequently takes the form of questions and explanations rather than a discussion properly so-called. Professor Huntington afterwards read a second paper on "The Metallurgy of Cobalt and Nickel." In this the analogy between these elements and iron was very strikingly made manifest. Professor Huntington had melted buttons of these in a Siemens electrical furnace with various results; the fracture of many being almost identical with that of pig irons which contain varying percentages of alloyed and graphitic carbon and silicon, some being so open as to approach No. 1 pig, others having a steely fracture. Professor Huntington further explained the production of malleable cobalt and nickel. This malleability was produced by the introduction of manganese, and specimens were exhibited of nickel and cobalt in the form of sheet and wire, though the latter, we believe, did not exceed about No. 8 B.W.G., and the sheets also were somewhat thick; but the fact of the malleability and the method employed are extremely interesting. Of course the connection between the latter and the Bessemer process is obvious. The carbon in these specimens was about one-tenth per cent. The other papers read were one by Dr. Otto Witt, read by Mr. Watson Smith, "On the Application of Indophenol Blue to Calico Printing and Dying," and another by Mr. Charles O'Neill, "On the Part of Chemistry in Calico Printing." In the evening the members dined together at Belle Vue.

On Thursday, Mr. Alexander Chance, of Birmingham, gave a description of the probable plant required for the recovery of sulphur in alkali waste by the Shaffner and Helbig process. In this important process three distinct chemical operations are involved:—(1) The decomposition of the calcium sulphides in the alkali waste by magnesium chloride, by which the sulphur is liberated as H_2S, without being diluted with other gases. (2) The reconversion of the magnesia (MgO) thus formed into chloride of magnesium, and the recovery of the calcium from the $CaCl_2$, in the form of carbonate of lime, by the action of carbonic acid gas. (3) The recovery of the sulphur from the H_2S by precipitating the S by means of SO_2 thus:—$2\,H_2S + SO_2 = 3\,S + 2\,H_2O$. These, from a chemical point of view, are very beautiful reactions, and the importance of any process which has for its object the recovery of the enormous quantity of sulphur obtainable is seen from the consideration that £357,000 is annually lost as the value of the sulphur in alkali waste. Several of the speakers in the discussion which followed spoke very highly of the process, and this opinion receives its best support by the fact that many large works are proceeding with the erection of the plant necessary for it. The second paper, on "Boiler Incrustations and the Purification of Water for Technical Uses," by Mr. W. Iveson Macadam, was postponed until the London meeting. In the evening on Thursday a very successful soirée was held at Owens College, when there was an exhibition of chemical products, especially those relating to the dyeing and calico-printing industries. These and the different fabrics were shown by 140 Edison incandescent lamps, worked by two Edison machines. Professor Huntington showed the action of the Siemens electrical furnace, worked by the college Siemens machine. Among the ordinary exhibits of a scientific soirée was one the importance of which warrants its special mention, viz., a series of microscope slides, illustrating the discovery of Dr. Koch, of Berlin, of the zymotic character of consumption. The Bacillae detected by him in pulmonary tubercles were exhibited *in situ*, and allied objects in this research were also shown.

The next and last day — Friday — was devoted to excursions. Among the works visited by the members were the East Lancashire Paper Mill, the Works of the Radcliffe Printing Company, Messrs. R. Bealey and Co.'s works, and the alkali works of the same firm, the Union Glass Works, and the alkali works of Messrs. Knotz & Co., St. Helen's, the Tharsis Copper Company, Messrs. Gaskell, Deacon & Co., and Messrs. Golding, Davis, and Co. Luncheon had generously been provided at St. Helen's for the members.

Altogether this meeting of the Society of Chemical Industry was, as we have said, a great success. The requirement of such a society is undoubted, and we hail with considerable gratification the establishment of a society whose distinct objects are to promote the application of chemistry in all its branches, and to promote the acquisition and practice of that species of knowledge which constitutes the profession of a chemical engineer. In our own subject—namely, that of iron and steel—the disparity as regards the scientific training between the average staff of officers in an English works and that of a continental works is manifest to anyone who has had an opportunity of judging. The scientific education of the actual workman is looked after in many works on the Continent, and it is uncommon to find a blast-furnace manager who is not a chemist, or a general manager who is not a man of considerable scientific attainments. There can be no question that the practical application of science to the procedures of iron and steel works is being attended with results whose importance is almost in direct proportion to such application; indeed, nothing else is to be expected if the pursuit of science is the pursuit of Truth. And it, therefore, behoves us in English works to be as far as possible *en courant* with our subject, lest the advantage every day increasing with our friends on the Continent surpass those with which a bountiful nature has endowed us.

MESSRS. CLAYTON AND SHUTTLEWORTH'S WORKS.

IT has been our practice from time to time to place before our readers descriptions of some of our leading engineering and manufacturing establishments. Following this practice, we now describe the works of Messrs. Clayton and Shuttleworth, at Lincoln, the extent of whose establishment will be seen from the engraving on page 36. The Stamp End Works, as they are called, are situate between the river Witham and the Manchester, Sheffield and Lincolnshire Railway, and cover about twenty acres of ground. They have a dock communicating with the river, and a branch line to the railway, for facility of carriage by canal or rail. Although Messrs. Clayton and Shuttleworth manufacture a variety of agricultural implements, yet the *spécialités* to which they have directed their chief attention, and by which they have largely achieved their present reputation, are portable, traction, and stationary steam-engines and thrashing machines. The first portable engine manufactured by this firm, was turned out in 1845, and was of eight horse-power. This engine is not only in existence, but is—or what was quite recently—at work. It had a pair of horizontal six inch cylinders fixed to the top of the boiler; the crank shaft was carried by brackets from the boiler, but the fly-wheel was placed upon a second shaft, geared to the crank-shaft, which was carried by high brackets fixed to a wooden frame, by which the boiler was also supported. In 1846, Messrs. Clayton and Shuttleworth turned out, we believe, only two engines, the construction of portable engines then being considered entirely as a secondary matter. In the following year eight engines were made, but shortly afterwards the firm recognised the important position which this manufacture was likely to assume, and were not long in making it their speciality, so that in 1852, after the Great Exhibition had brought for the first time the manufacturers and farmers into direct contact, Messrs. Clayton and Shuttleworth were enabled to complete no fewer than 209, with a total of 1153 horse power, and in the following year they took the first prize for this class of manufacture at the Royal Agricultural Show at Gloucester. Since then they have been continually extending their operations, erecting new plant, improving the design and construction of their engines, and adopting improved methods of manufacture, until in 1863, the year following the Second International Exhibition, they turned out 395 engines, or considerably over one per day. Their business still continued to increased, and during the year 1870 the number of engines delivered from the Stamp End Works was over 700, which has increased year by year since that date. The engines have been numbered consecutively from the "No. 1" made in 1845, and those now in course of construction all bear numbers over 20,000, the present production being at the rate of three and a half per working day. This enormous amount of work represents the production of one department of the works only. The other departments, devoted to the manufacture of thrashing machines, being of but little less importance.

The original site of the works was a plot of ground about $1\frac{1}{2}$ acres in extent, on part of which the foundry was built, and still remains, although considerably enlarged, and from time to time the premises have been extended on the three of the four sides. The dock, already referred to, formerly extended down the centre of the works, and formed a sort of division between the workshops devoted to the construction of engines and those in which the construction of thrashing machines is carried on, the former collection of buildings constituting what is usually termed the "engine side," and the latter the "machine side" of the works. The south end of the dock has now been filled in and railway sidings laid down thereon, with branches leading in every direction, to deliver materials where they are wanted.

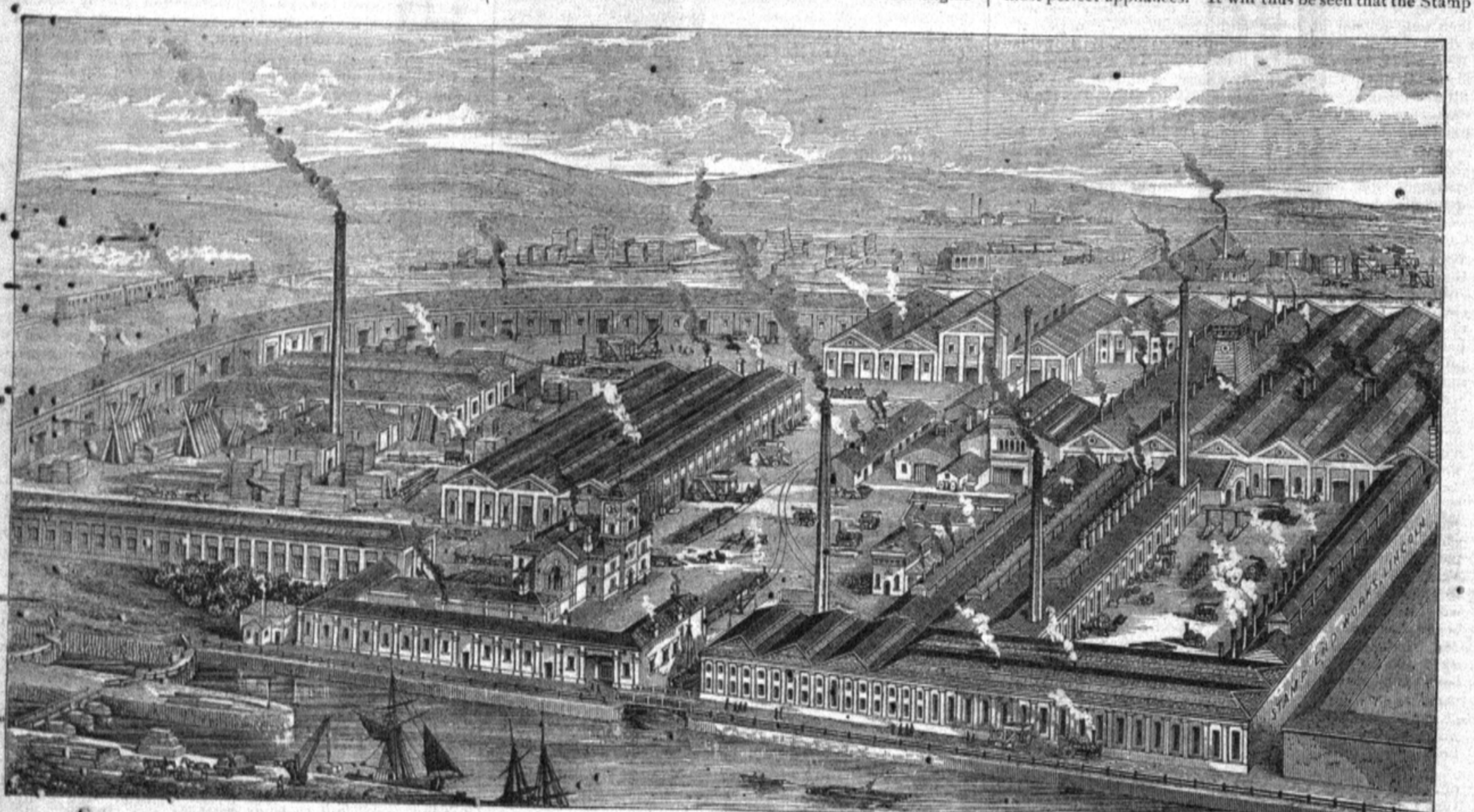
The foundries are two in number, the larger one for ordinary castings, and the smaller one for the malleable castings, of which so many are used in the construction of thrashing machines, &c. Machine moulds are used throughout, and the cost of this machinery must have been very great, but doubtless the firm have been repaid by the diminished cost of moulding, and the improved class of work that can be turned out. The larger of the foundries is 130 feet by 100 feet, and the two cupolas outside are capable of reducing five tons each of the pig-iron. The coke and pig-iron are raised in barrows by a hoist worked from the shafting, and within the foundry is a ten-ton hydraulic crane, which commands the two furnaces, and also a long horizontal bar which can be raised or lowered by hydraulic power; this is fitted with a travelling carriage from which hang slings by which moulds or castings can be lifted. Tramways, with turntables placed at convenient points, are laid from end to end each way of the building to convey the heavy crane ladles from the cupola and the castings to the fettling shop. Adjoining the foundries is the usual open yard (with travelling crane for moving moulding boxes), and the fettling shop, where the castings are trimmed before being sent for use. Facing this are the sand sheds, and at the end of the latter is the case hardening house with the usual furnaces. The forgings for the axle arms for the engines and machines are not case-hardened in the ordinary furnaces, but are placed upright in a slow coal and coke fire, alongside a stream of water at the back of the works, whence, after having been allowed to remain sufficiently long to have absorbed the necessary amount of carbon from the heated fuel, they are lifted by a crane and dipped vertically in the stream.

In the brass foundry the chief thing which attracts the eye is the great extent to which plate moulding is adopted. This is a peculiar method by which a number of articles of the same pattern can be moulded simultaneously with great rapidity and even with greater accuracy than in the ordinary way, but the expense of preparing the plates prevents the system from being economically applicable, save where large numbers of articles of a similar pattern have to be produced.

The smiths' shop is 147 feet long by 115 feet wide, containing no fewer than 60 forges, disposed in three double rows, punching and shearing, and other machines, and ten steam-hammers of various sizes and weight. The forging is done as much as possible between dies. From this shop we were informed that amongst other things, Messrs. Clayton and Shuttleworth turn out, for their own use, considerably more than 7000 iron wheels per annum. The wheels are as perfect in all their details as it is possible to make them. In the drilling machine employed for the tires of these wheels we noticed a simple but ingenious contrivance for holding the wheels, and for bringing any desired point in its circumference at will under the drill. We mention this improvement as illustrating the care taken to reduce manual labour to a minimum, and to enable each machine to turn out the maximum amount of work. At the end of the shop, adjoining the tire furnaces, are the bolt-making forges and plant, amongst which two of Ryder's swageing machines, and a peculiar heading machine, of American design, by Messrs Platt, Brothers, of Oldham, are particularly noticeable. At the opposite end also of the shop are several Olivers, or foot hammers, also used in bolt making, and also the various appliances for manufacturing the bent crankshafts for the portable engines. There are many other mechanical contrivances in this shop.

The boiler shop is a remarkably fine and well-lighted building, being the largest department upon the works, measuring 250 feet by 190 feet, and covering an area of about 4537 square yards. This shop is traversed by a line of rails for facilitating the removal of the heavy work, and the machinery is worked by a couple of lines of shafting, driven by a vertical engine coupled direct to one of the lines. This engine also drives the pumps for supplying water to the accumulator, the bolt making, saw and other machinery in the smith's shop, and the blower used at the foundry cupolas. The shafting, like most of that in other portions of the building, is supported by cast-iron standards, branches extending from the standards on either side and carrying wooden beams, to which counter-shafts, &c., can be fixed if desired. The boilers of various sizes and classes turned out at these works are all made to standard dimensions, the tube plates being all carefully drilled, and the other plates punched to gauge and template. Besides the ordinary punching and shearing machines, and rolls for bending plates, there are several ingenious machines worthy of mention. Amongst these is one manufactured by the firm for cutting out elliptical fire holes, manholes and mudholes in the boiler plates, the holes being expeditiously and correctly cut, and requiring no hand trimming as when punched out in the ordinary way. Messrs. Clayton and Shuttleworth have not only discarded the practice of punching out manholes and mudholes, but they have also substituted direct cutting for punching in other instances. A self-acting punching machine, constructed upon Manning and Macintyre's patent by Messrs. Manning and Wardle, of Leeds, is noticeable, its specialty being that by it lines of holes can be punched not only straight, but accurately following curves of any radius. It is only necessary to set out the four corner holes of the first plate of any series, and the machines then divides out the other holes and punches any number of duplicate plates with absolute accuracy, the rivet holes when the boiler is put together being almost as fair as if drilled in their places. In addition to the above there are a plate edge planing machine, grindstones for the outside edge surfaces of the plates for the fire-box casings, plate heating furnaces of the usual description, machines for bending angle iron rings for wheels, smoke-boxes, &c., some of the Garforth's direct-acting steam riveting machines, and several traversing cranes, worked by hand from below by means of endless chains passing over chain pulleys, for lifting plates and boilers, and for conveying the latter to the riveting machines, one of which latter, we should state, is placed at the foot of a high wooden tower, furnished with the necessary hoisting tackle so that the machine may be used for riveting up the large stationery boilers. Besides this boiler-making plant there is also a small rolling mill, used for rolling steel beater plates for thrashing machines, and the excellence of these beater plates is now so well recognised that, besides using them for their own machines, the firm supply them largely to other makers.

Messrs. Clayton and Shuttleworth build their engines of a certain number of standard types, and the component parts are made in considerable numbers and are passed into various store-rooms, whence they are taken out as required to be built up into engines. All the parts—including boilers, cylinders (the latter fitted with their covers, valves, guide bars, complete), connecting rods, crank shafts, fly-wheels, etc., are all finished according to gauge, and



carefully tested before being stored, so that any portion, or set of portions, of any engine of a particular class will fit equally well with the corresponding parts of any other engine of the same power, and thus much time and labour is saved, not only in the erection, but in repairs. The fitting shop store is 75 feet by 65 feet, adjoins the erecting shop, and contains the various sets of details for engines of every size and class. There are also in the same shop the gauges by which the various parts are tried, and close by there is a mercurial column by which steam pressure gauges are checked.

The millwrights' and erecting shops and the turnery, which may be classed together, occupy a considerable area, the dimensions of the erecting and millwrights' shop being 250 feet by 88 feet, and those of the turnery 150 feet by 110 feet, the shop being also surrounded by a broad gallery, with benches, and a large number of the lighter varieties of machinery. The machinery, consisting of special tools and special appliances, has mainly been constructed on the premises, and is driven by two single-cylinder inclined engines, coupled direct to the shafting, and supplied with steam from three Cornish boilers. In the passage near these boilers the soundness of the engine cylinders is tested as they are made, by turning steam into the jackets before they are completely fitted up, the pressure depending, of course, upon that existing in the stationary engine boilers, and being usually from 50 lb. to 70 lb. per square inch. Amongst the special tools used for erecting and perfecting the engines are two simple machines for finishing the centre of the iron wheels, and for trimming off the spokes to the correct length, so that their ends may take a fair bearing against the tire when the latter shall be put on. There are also two fine machines for drilling the various holes in the portable engine boilers, and at each of these machines over twenty boilers per week can be completely drilled. A boring machine, in which two cylinders for the double-cylinder engines can be bored out simultaneously, is worthy of notice, and there is also a very interesting set of machines for turning the eccentrics and eccentric straps. The finishing also of the nuts, studs, and bolts, necessary in such extensive works as those at Stamp End, affords employment for a considerable number of machines.

After the engines have been so far completed in the erecting shop they are passed into an adjoining testing shed, 100 feet long and 40 feet wide, where provision is made for testing ten engines at one time; for every engine before being sent from the works not only has its boiler tested by hydraulic pressure, but is tried under steam and carefully examined both before and after testing by special examiners. In the experimental sheds trials are made of modifications and improvements, and the engines intended for competition are there prepared for action. This range of shedding also comprises a lagging shop, 80 feet by 38 feet, where the boilers are lagged and prepared for the painters, whose workshop, 133 feet long by 38 feet wide, adjoins. This convenient arrangement of building enables the different staffs of men to pass the engines in their various stages from one department to another without loss of time, or travelling over unnecessary ground. The engine store is a fine building 214 feet long by 82 feet wide, where finished engines are stored previously to being sent away; but from the spring to the autumn, and especially the present season, the demand for engines is so great that this building is but little used.

The machine side of the works is, as we have said, devoted to the construction of thrashing machines and other agricultural implements, and forms a sort of triangle, comprising on the other side a range of shops 40 feet in width and altogether 550 feet in length. On the second side is another range of shops of similar width and including two machine stores, one 220 feet and the other 160 feet long, a timber store 290 feet in length, and an oil store. The third side consists of a block of buildings, 320 feet in length by 120 feet in breadth, and is divided out into engine store, machine erecting shop, and machine turnery shop. This triangle encloses about 4¾ acres of ground, which is utilised as a large timber yard, and which in turn encloses the saw mill, wood turnery shop, timber drying shed, and a small shop, for a vertical saw frame, which is driven by a small steam cylinder direct. The main saw mill and wood machinery shop is 150 feet in length, by 65 feet in width, and has its floor raised some feet above the level of the ground so as to give room for the shafting, which is all arranged beneath it. The wood machinery room also contains some ingenious machines and tools. In the timber drying-house, which is heated with hot-water pipes, the seasoned timber is prevented from absorbing atmospheric moisture before being made up into machines, so as to avoid shrinkage. The machine-shop turnery is 140 feet long by 40 feet wide, and the machinery in it is all worked by shafting driven by a vertical engine at the end of the shop. The greater proportion of the tools consist in the usual lathes, drilling machines, &c., but there are several specialties well deserving of attention. The machine frame makers and erectors' shops, where the various parts of the thrashing machines are put together, consist of two buildings; one 320 feet, and the other 300 feet in length, and both of them 40 feet in width. They are conveniently arranged and fitted up, one of the shops being provided with a continuous range of doors on one side, through which the machines can be readily taken out when finished. Part of this shop also is surrounded by a broad gallery which gives accommodation for benches, &c. In the construction of a thrashing machine a much greater proportion of hand labour is necessarily required than in engine building, but still considerable work is done by machinery, and all over the works are evidences that all the latest improvements have been adopted, not only for the articles manufactured, but also in the machinery employed for their manufacture. There is also a store for finished thrashing machines, 240 feet long by 100 feet; but this, like the engine store, is but little used, on account of the great demand for this class of machinery.

In these extensive and well arranged works are other departments which we must, however, content ourselves with merely mentioning; such as the wheelwrights' shops the millstone dressers' and makers' shops, for the millstones used in Messrs. Clayton and Shuttleworth's portable mills, the turners' and wire workers' shops, where the screws and some other details for thrashing machines are made; the pattern shop, the joiners' shop (for the firm employ their own building staff), and the packing case makers' shop, which is of considerable extent. There are also the oil and general stores; and a handsome block of buildings containing ample accommodation for the large staff employed, is fitted up for the offices of the firm.

At the end of the dock alluded to at the commencement of this article is a packing and loading station, through which the branch line of railway runs. This station is provided with a weighbridge, an overhead travelling crane, and a hydraulic lift platform for facilitating loading the finished engines and machines into the railway wagons, the water for working this lift and also the hydraulic cranes in the foundry being supplied by an accumulator in one corner of the boiler shop. From the loading station the lines of rail pass to one side of the dock—where ranges of sidings are laid down—and also to the boiler shop, foundry, smiths' shop, and erecting shop, facilities thus being afforded for the transport of coals and other heavy materials to the various points at which they are required, the shunting being performed by a neat little handy four coupled locomotive constructed upon the premises. We should add that direct communication is secured from the works to all the leading lines of rails, thus avoiding much delay, especially in export orders. The firm manufacture their own gas, for which purpose they have the most perfect appliances. It will thus be seen that the Stamp End Works are very extensive and well arranged, amply meeting all the requirements of the great manufacture carried on there of machinery and implements which are daily sent forth to every part of the civilised world.

THE RATIONALE OF PRACTICAL METALLURGY.*

No. IV.

WE now come to the ores which are next in richness and purity to the magnetic oxides, viz., the sesquioxides, Fe_2O_3, containing about 70 per cent. of iron when pure. They are found in various forms, crystalline, massive, pulverent, earthy, and reniform, or kidney-shaped, as in the so-called "kidney ore." A general name of "red ores" or "hematites" (Gr. *haema*, blood) is given to them on account of their colour. Some of the hematites are so soft in structure that their particles rub off and stain the fingers with an unctuous smear like black lead, but that the colour is red.

As they usually contain more or less of siliceous, calcareous, and other impurities, 60 to 65 per cent of iron may be regarded as a fair proportion for a rich commercial sample. When deposited in the midst of a limestone rock the red oxide may be very deceptive, as it stains the rock to its own colour, and thus samples from a given locality and of similar appearance may vary greatly, accordingly as they are portions of the actual hematite vein itself, or of the limestone in contact with it.

The most important of our British hematite deposits is that in the neighbourhood of Ulverstone, in Lancashire. It attains its maximum thickness and purity near Cleator Moor, where it varies from 15 to 60 feet in thickness. Hema-

* See pages 261, 408 and 466 of vol. xix.

ROBEY'S VERTICAL ENGINE AND BOILER.

(*For description, see page 31.*)

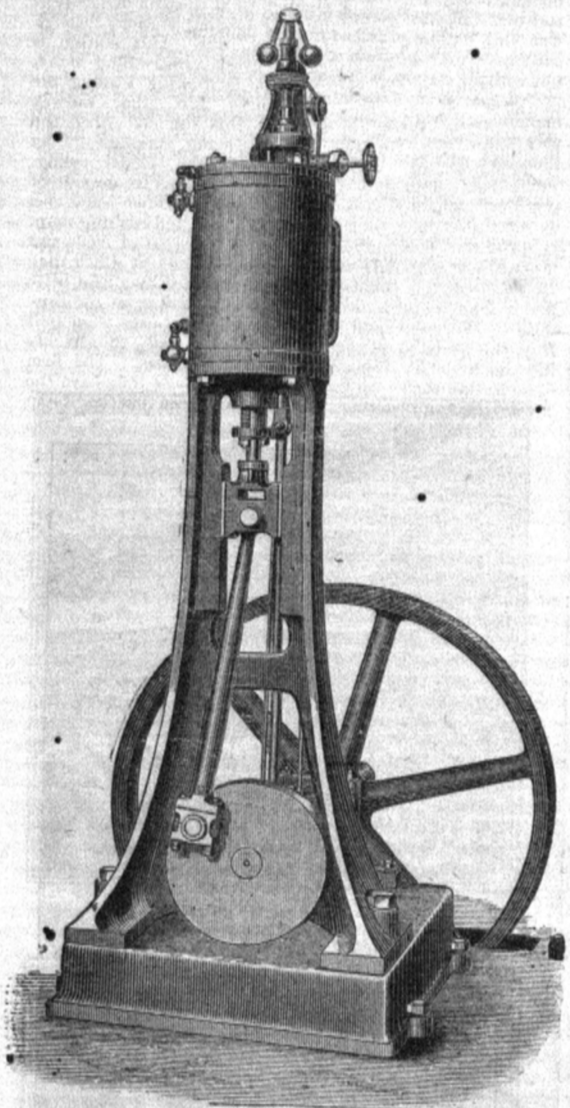


FIG. 1.

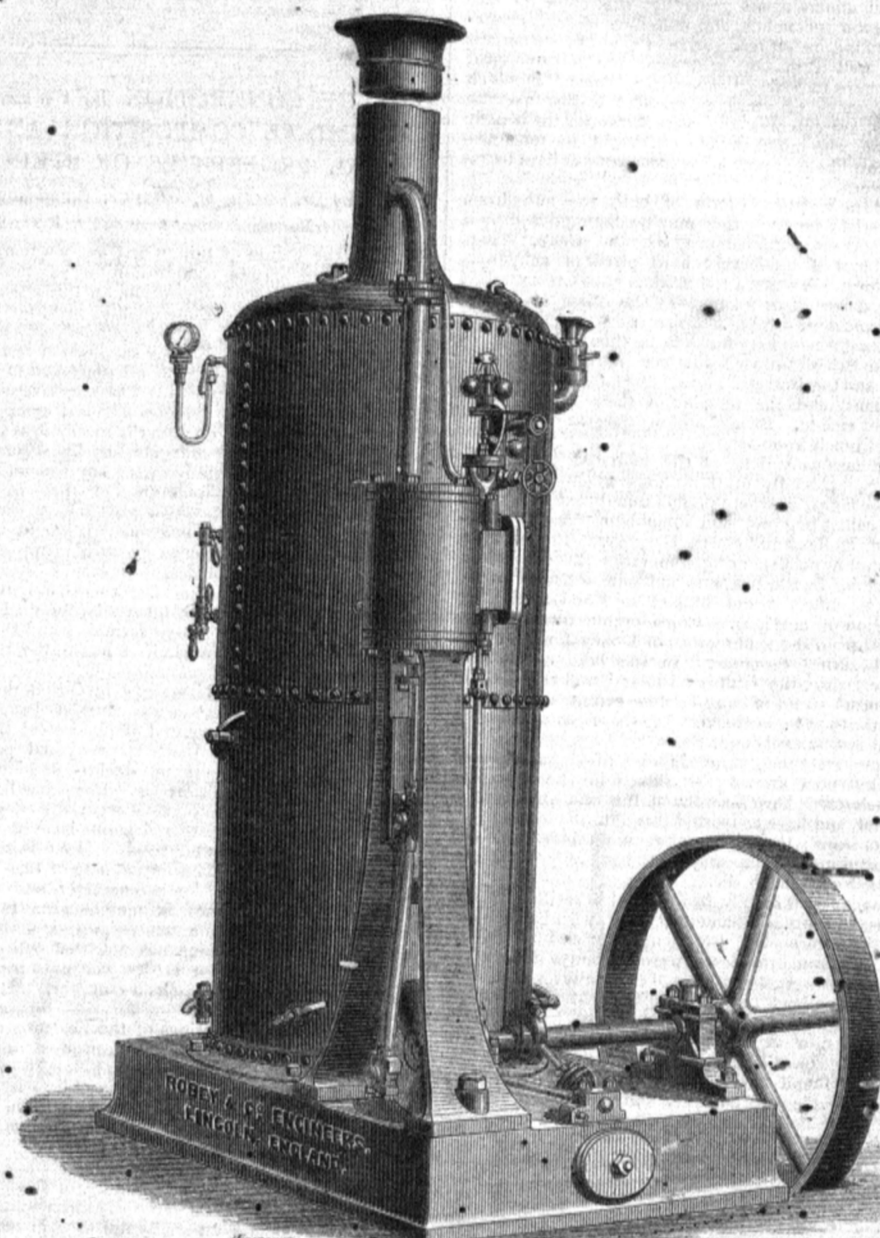


FIG. 2.

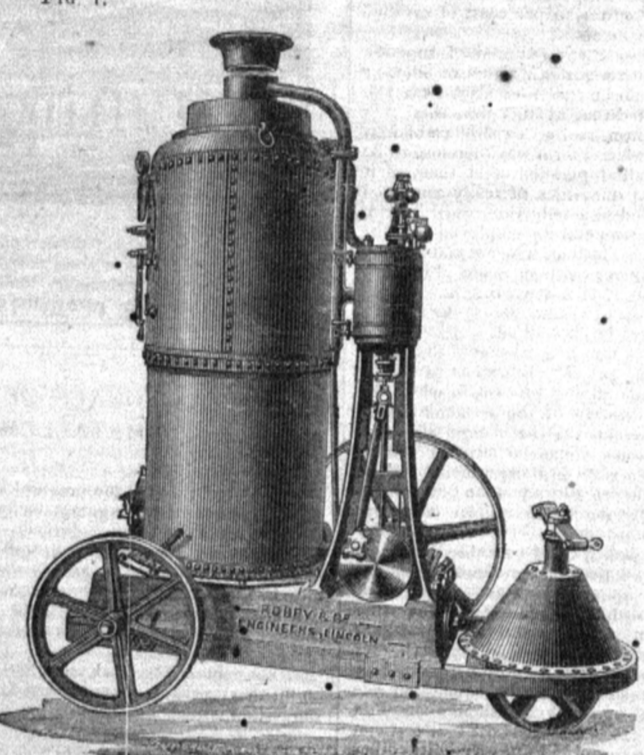


FIG. 3.

tite also occurs in Ireland, on the Antrim coast, in the neighbourhood of Red Bay. There are vast deposits in the neighbourhood of Bilbao, where it is worked by English and Spanish capitalists, and largely shipped. It is also abundant in America, especially on the shores of Lake Superior. The Iron Mountain and Pilot Knob, near St. Louis, in Missouri, are celebrated for this ore.

Owing to its comparative freedom from phosphates, it is largely in demand for the production of Bessemer pig-iron. This freedom from phosphates is due to its geological position. The phosphates, which are so damaging to the clay ironstones, are mostly, if not entirely, due to the remains of vertebrated animals whose bones contain so much phosphate of lime. The nucleus of many of the clay ironstone nodules is a fossilised fish. The hematite occurs in workable quantities, chiefly in the Cambrian and Silurian rocks, in which are only the remains of invertebrate animals, whose solid framework is carbonate of lime. Some is found in the Devonian, where the first dawn of fish-life appears.

Specular iron ore (not to be confounded with spiegeleisen, which it resembles both in appearance and etymology) is another variety of anhydrous sesquioxide of iron found in volcanic districts. It is in hard, crystalline, mirror-like plates, hence its name. It is probably formed by the action of volcanic heat upon hematite. The Elba deposit is one of the most famous.

Rouge is an artificial sesquioxide prepared by roasting the sulphate of iron (green vitriol) at a red heat. We merely name it in passing, as its uses for polishing glass and jewellery, and as a pigment, are not strictly metallurgical.

Iron scale, or scale oxide, requires further description, inasmuch as it is an important material in practical metallurgy, doing the work of an ore, although an artificial product. It appears to be a compound of the protoxide with the sesquioxide, and has therefore been named "Ferroso ferric oxide." (Ferric oxide is another name for the sesquioxide, as "ferrous oxide" is for the protoxide). Its composition, however, is variable. The outer surface of the scale, when thick and the result of long exposure of the iron to heat, is of nearly the same composition as the magnetic oxide, but the inner layer has a composition varying from 4 FeO_4, Fe^2O^3, to 6 FeO_4, Fe^2O^3. It all has similar magnetic properties to the magnetic oxide.

There is another set of sesquioxides differing from the above by containing water in combination. This must be distinguished from the water which adheres to the ores, and which, although accidental, is not unimportant. A hundredweight or more may easily be added to a waggon-load of pulverent hematite by merely leaving it exposed in wet weather. This, however, being merely held mechanically, is driven off as vapour by simply heating to the boiling point of the water. That in chemical combination forming the hydrate, requires roasting at a red heat to get rid of the water. Ordinary iron rust is an hydrated sesquioxide, which may be converted into rouge or anhydrous sesquioxide by such roasting.

The most important of the natural hydrated sesquioxides are the brown hematites. Brown ores and limonite are names also applied to the same. They vary greatly in structure and purity—some are hard and compact, with no particular structure; others are similarly hard, but on fracture present a fibrous structure, really due to crystallisation. Others, again, are ochreous, earthy, and yellow-brown. These are the more common, and they contain the largest amount of siliceous and clayey impurities. The rich brown, hard, and pure varieties may rather be regarded as museum specimens than ordinary ores available in quantity for practical working.

The practical metallurgist should always bear in mind when he visits a museum that the curators of these establishments, and mineralogists generally, care more for rare than for common specimens, and therefore museums generally are by no means representative of natural distribution. It would be well if in our geological and mineralogical museums we were to have a "vulgar department," in which ordinary specimens of average imperfect fossils, average ugly minerals, average ores, &c., were shown for the benefit of the student, who might thereby be taught to recognise what he is most likely to pick up as specimens, or have to use in practical work.

In spite of the varieties of form of both the anhydrous and the hydrated hematites, they may be distinguished by a very general and easily applied test, viz., the streak. Whatever be the colour of a tolerably hard piece of anhydrous sesquioxide ore it will show a red mark or streak if scratched by something harder than itself. On the other hand the hydrated sesquioxides display a brown streak. A penknife scratch is all that is necessary for showing this. The most important of our British brown hematites are those of Northamptonshire and the Forest of Dean. The latter were worked by the Romans, and the remains of their furnaces and cinders are yet visible. Brown ores are largely used by the Belgian and French ironmasters.

There is a curious variety of the hydrated sesquioxide found in bogs, especially in those bogs which occupy the sites of former lakes, or where pools formerly existed or still exist. It is called bog ore, and abounds in Sweden, Norway, Finland, Holland and North Germany. In the Irish bogs it is found in pockets or agglomerations here and there, and is picked out by the peasants and put in heaps on the road side to be collected and shipped to London, &c., for the purification of coal-gas. Considerable quantities are thus obtained from the wild regions of Donegal near to the coast of its beautiful estuaries. In the lake region surrounding the Baltic, the Gulf of Finland and the Gulf of Bothnia it forms strata of considerable extent, reaching to as much as thirty miles in thickness. Its origin was once a mystery, but is now explained.

Microscopic creatures, formerly described as animals (*naviculæ*), but now known and classed in the vegetable kingdom as *diatoms*, have assimilated the iron dissolved in the bog water, and have converted this into the material of their cases or skins; these locomotive vegetables have died generation after generation, and thus have deposited this oxide, together with much silica.

The silica renders it readily fusible, and beautiful castings for brooches and other ornaments, vying with lacework in delicacy, have been made. Between thirty and forty years ago these bog-iron ornaments were in active demand, so much so that there were shops devoted especially for their sale. The writer remembers one in Edinburgh, Müller's, where exquisite specimens were displayed. But fashion, ever capricious, has now set its veto against them, and they have become museum curiosities.

Franklinite, found and worked in New Jersey, is a mixture of the oxides of iron, zinc, and manganese. Rammelsburg's analyses show an average composition of—

Iron	45·16
Manganese	9·38
Zinc	20·30
Oxygen	25·16
	100·00

It is worked primarily for the zinc in conjunction with the deposit of red zinc ore which overlies it, and the residue of iron and manganese is made into spiegeleisen. Some of the metallic "Yankee notions" offered for sale in this country are made from the hard and brittle cast iron thus obtained. Steels for knife-sharpening, cheap pencils sold for glass cutting, consisting of a fragment of this mounted at the end of a stick, may be named as examples. The oxide of iron in this ore resembles in composition that already described as iron scale. It is feebly magnetic, theoretically a compound of $3FeO, Fe^2O^3$.

Ilmenite is abundant in Norway, where it forms masses of dense dark iron-grey rock of granular and somewhat micaceous or glistening structure. It is composed of protoxide and sesquioxide of iron, with varying quantities of titanic acid and magnesia. The iron sand found at Taranaki, in New Zealand, and in the Bay of Naples, is composed of siliceous particles mixed with darker grains that are separable by the magnet. They have a similar composition to ilmenite.

Good specimens of all these ores are workable by the primitive methods, above referred to, nothing more being being required than to drive off the water in the hydrated kinds and bring the anhydrous oxides into contact with heated charcoal, when the simple reductions already described take place, forming either spongy iron or fluid steel. It is notable that these materials of the primitive ironworkers belong geologically to the similarly primitive rocks. But as these old rocks were worn away by dashing waves, by roaring torrents, and grinding glaciers, and their pulverised fragments were carried down into the still waters to be there deposited and form the sedimentary rocks of a later age of the world's growth, the ferruginous particles of the original rocks were exposed to the reducing action of vegetable and animal matter in the course of decomposition. Such reducing agents, acting in the humid way, are not competent to effect the complete reduction of sesquioxide or magnetic oxide into metallic iron, but, as the experiments of Bischoff have shown, they do effect a reduction from the sesqui to the protoxide. But what will happen at the same time? A little reflection on the well-known chemical relations of such substances will enable us to answer this question, and, we believe, correctly. The decaying organic matter gives out carbonic acid; the protoxide of iron is a base that readily combines with this acid, and thus carbonate of iron must be formed under such conditions. Our theory is verified by a world-wide array of facts. In the later geological formations, where the remains of animal and vegetable life abound, the ironstones there are carbonates, instead of oxides as in the older rocks; and these carbonates are associated with other materials, the necessity of removing which has built up the art and science of the modern ironmaster, *i.e.*, the British ironmaster; for this greater and more difficult art of working these impure iron ores is a purely British conquest, which all the other nations of the world have only shared as humble followers. The carbonates and their complexities will form the subject of our next.

ON THE CONNECTION BETWEEN THE CHEMICAL COMPOSITION AND PHYSICAL PROPERTIES OF STEEL.

By Dr. Fried. C. Müller, Brandenburg.

(Continued from page 488, vol. xix.)

It is in the nature of things that every attempt to in any way fix a definite composition for any desired quality of steel must meet with opposition, for this attempt involves the hypothesis that a definite quality, such, for example, as Wöhler's quality of 85, can be obtained only by a definite chemical composition. Such a supposition is logically untenable, and being opposed to all precedent of experience, calls for no further discussion. The converse of this is also incorrect, *i.e.*, that any definite chemical composition must always imply a definite quality, the mechanical properties of a metal being so largely influenced by the special method of production, and particularly by its physical and mechanical treatment during manipulation; so that two steels of identical chemical composition may behave very differently when put in the testing machine. It would, therefore, be wrong to demand a definite chemical composition in the event of such being of less importance than the actual tenacity and softness. On the other hand, it implies an advance if the wished-for quality is obtained, or, indeed, exceeded by the use of a new formula; and this advance is so much the more estimable if it leaves the trodden paths and supersedes inherent prejudices.

From the time of Bessemer's invention the conditions were such that only carbon was considered the base of true steel, and it was only required of good steel that it should contain nothing more than a prescribed percentage of carbon. To-day pure carbon steel is undoubtedly an excellent metal, but it has rivals. For it has happened that with the softer varieties of steel especially adapted for constructive purposes, that other elements have been substituted for carbon with remarkable results. In this respect silicon holds the first place. The importance of this metalloid, so nearly approaching carbon in character, and exercising so considerable an influence in metallurgical processes, first became recognised some ten years ago, and a prejudice, which at the present time has not been entirely overcome, against silicon became rooted. The existence of this prejudice has been entirely a chance matter, as a slight examination will show.

Previous to the inventions of the Bessemer and Siemens-Martin processes, all merchant iron was produced by the finery or puddling furnace. In puddling all the silicon goes into the slag. The forged or worked iron is also free from silicon. If chemical analysis shows silicon in this material, it is due not to alloyed silicon, but to interspersed slag. Accordingly, the percentage of silicon is in direct proportion to that of the slag, but this last is a measure of the solidity of welding, and, accordingly, of the homogeneity of the material. The finest varieties of iron contain only traces of silicon. This is especially the case in what alone was formerly known as steel—namely, that obtained by the cementation process—a material capable of intense hardening, and containing from 0.60 to 1.20 per cent. of carbon, and almost free from other elements.

Hence, with perfect validity, it was required of superior iron and steel that it should contain only traces of silicon; in other words, that it should be free from slag. On the other hand it should be noted that at this time there was little else than this puddled iron, and no experience of iron containing silicon in the combined form was therefore to be got. Only the crucible melted puddled steel then, as it does to-day, showed varying quantities of really combined silicon, which may be ascribed to a reduction of silicic acid, brought about by the high temperature employed and the nature of the crucible used. This fact was noticed as long as fifteen years ago in the heavy castings made in German and French steel works, and it is noteworthy that no injurious—but on the other hand favourable—influence was ascribed to the introduction of this metalloid.

Bessemer's great invention was not calculated to change the old views respecting silicon. The Bessemer process is in reality an extremely rapid refining process, in which the heat produced by the combustion of the elements to be eliminated raises the temperature of the charge far above the melting-point of pure iron. Chemical analysis demonstrates the fact that there is a point in this purification as in puddling in which silicon almost entirely alone burns, after which the carbon and the remaining silicon disappear almost absolutely together.

The published and unpublished charge sheets of the last ten years are a proof that all Bessemer works have worked from their commencement on the lines above indicated. The Siemens' process has also been conducted on the same plan, consequently the experiences gained from the puddling process were applied to that of Bessemer and Siemens. As a matter of fact, a metal was obtained in ordinary working, which was almost free from silicon, and the conclusion was drawn therefrom that ingot iron and steel should contain a little silicon as forge iron. It is easy to show that this conclusion, perfectly legitimate for forge iron, was quite otherwise for ingot metal. It is not possible for the latter to contain inclosed slag, and it must also be free from silica and it was only against these two bodies that former objections were urged.

Technical men could not rightly judge of the merits of combined silicon as an ingredient of steel, as it did not exist as such. It is extraordinary how they were guided entirely by appearances in applying the old rules to the manufacture of the new metal. It was, however, one of those things which one acquainted with the natural history of human error might have foretold—namely, that strong opposition not only to the demands of argument, but to contradiction contained in the new facts, would for a long time have been offered by those whose views were restricted by their prejudices and the limitations of their experience.

These new facts are at present abundantly illustrated. From the middle of the year 1870 analyses of Bessemer steel containing a quite considerable percentage of silicon may be found in the papers of German, Austrian, and French authors, without any special comment being made thereon. The first who had the boldness to state distinctly that entirely good steel might be produced with a markedly high content of silicon was Mons. Gautier, of Terre Noire. His paper contained in the "Journal of the Iron and Steel Institute," March 30, 1876, notwithstanding some errors in theory, was an important landmark in the history of steel manufacture. In it Gautier stated the hitherto unheard of fact that rail steel containing 0.40 P, 1.00 Si, 2—3.00 Mn, was still usable, provided that it contained only traces of carbon. A composition of iron, with 7.50 per cent. silicon, but without carbon, was found to be forgeable.

"Whatever may be the explanation of these phenomena, metallurgists have changed their opinions considerably on this point, and, no doubt, the future will decide the question, and iron will be presented under a new form to the trade. It is like a productive mine of new alloys suddenly placed at the disposal of mankind, which must make its influence felt."

I commenced my studies on the Bessemer process in 1877, which, as relating to the German procedure, are very completely set forth in my papers.* An important result of the work was the discovery that from the commencement of 1870 an entirely new practice had developed itself in German works, characterised by the behaviour of silicon. Fig. 1 shows the German and fig. 2 the English practice.†

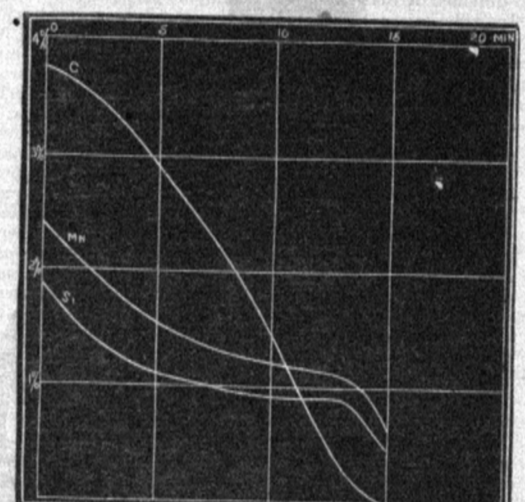


FIG. 1.

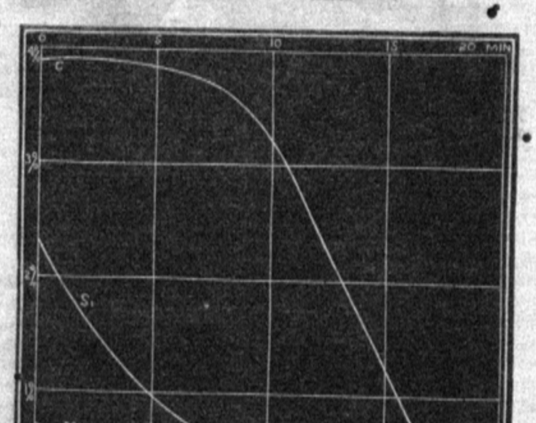


FIG. 2.

As mentioned, the English practice was adopted in German works at their commencement; but all manner of difficulties presented themselves. Being yet in the experimental stage, our ironmasters sought to discover a practice more applicable to our requirements. Everyone independently noticed that the temperature at the early part of the blow was abnormally high, and so produced very hot steel. So arose what I have termed the German Bessemer process. Technical men have ever been guided by their practical knowledge, and so my communications on this new departure in steelmaking were most unexpected by those who had conducted the process. Still more unexpected was the fact that the new process had produced a new metal, namely, silicon steel.

In my papers, I have shown that it was far from policy on financial grounds to follow the German procedure. My suggestion, which was made principally on account of the

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* *Zeitschr. d. Ver. deutsch. Ing.* xxii. 385.

† I have in the mean time had opportunities of observing the behaviour of a number of very cold casts. In one of these it was ten minutes before the sodium line, a sign of the commencement of the removal of carbon, was visible in the spectroscope. The silicon and manganese at this stage were not removed in a degree proportionate to the quantity of blast injected. Much more than half the blast goes through the bath unused. As a consequence, much heat is lost. And, with such charges, it is obvious that not the theoretical 0·8 of silicon, but 1·2 and more, may be removed from the bath before the carbon begins to disappear. The heat due to excess of silicon in respect to time and work involved in its removal is clearly doubly lost—once in the blast-furnace, when it is brought into the iron; and secondly, in the converter, when it is removed from the iron. And it will be found difficult to discover any set-off for this loss.

high phosphorus in most German pig-iron, to substitute silicon and manganese for carbon, which is so incompatible with phosphorus—seemed to require modification, from the fact that Austrian Bessemer works always produced a manganese silicon steel from very pure pig when hot charges were used. Against this, however, the higher percentage of manganese appears to exert a far more powerful influence in the later stages of the German process. Manganese, which at the commencement of the blow burns energetically, and, as the Swedish practice shows, produces great heat, restricts the combustion of the silicon. Conditions also modify this result, since a similar silicon curve is given by English hematite pig, as soon as it raised to a high temperature in the converter, as that obtained by German pig rich in manganese. Practically, in the new process, it is only necessary to aim at very hot steel, since this invariably gives better yields and higher quality of product than a colder cast of equal chemical composition.

It is not necessary in the previous discussion to follow the exact stages which occurred in actual practice; the simple fact is sufficient for us that the new variety of steel grew in importance in spite of the opposition surrounding its existence, held its own, and consequently represents a very natural advance. This advance was, moreover, generally confirmed by the good name which German railway material bears, and hence the question whether a high content of silicon spoils steel or not has been settled for every one. The special novelty of the new steels is entirely their percentage of silicon, and it will be impossible not to ascribe the superiority of them to the influence of silicon, hitherto maintained to be so injurious. These facts also exhibit in a remarkable degree the good quality of the much-slandered metalloids.

While we wish by special facts to confirm the convictions obtained by the general considerations before mentioned, it must be previously pointed out that the influence of silicon, as of every other constituent, is not exhibited by itself, but that the quality of a steel is dependent on an entire series of physical circumstances, and especially on the temperature of the casting. This uncertainty, however, ceases when such examples are compared in which, with the exception of the content of silicon, all other conditions are practically the same. The case will be still clearer if we show statistically that silicon steel has universally higher qualities than equally hard carbon steel; or, finally, if we find qualities in silicon steel which hitherto have not been obtained by any means whatever. As it would lead us too far to quote only a small part of the observations relating in particular to this subject, published in the technical journals, I will premise the thesis, as a result of my studies, that a silicon percentage of 0·20 to 0·70 considerably increases the tenacity of steel, without reducing its contraction of area or extensibility.

Some exhaustive experiments on German rail steel lead me to this position, the composition of the rails were:—

	Per cent.
Carbon	0·10 to 0·15
Silicon	0·30 to 0·60
Manganese	0·60 to 1·00
Phosphorus	0·12 to 0·15
Sulphur	0·03
Copper	0·05

In 1878, I published the two mechanical tests:—

	I.	II.
	Kilos per sq. mm.	
Absolute breaking strain	70·7	62·0
	Per cent.	Per cent.
Contraction of area	43·6	38·5
Elongation	24·0	19·0
Carbon	0·144	0·106
Silicon	0·435	0·423
Manganese	0·828	0·592
Phosphorus	0·150	0·150

I remarked on these tests that such softness in conjunction with the great tenacity could only be obtained with German Bessemer steel. This was acknowledged in the technical journals of England and America, without exception being taken to it.

During the years 1878 to 1880 I have not been able, in spite of numerous analyses and mechanical tests, to establish any material variations in the quality and composition of the rails of the works alluded to. In my paper of 1879 the following unheard-of tests are to be found:—

Breaking Strain ..	62	58	66·5	68·3	70·7	62·0	67·4
Contraction ..	52	52	40·0	40·0	43·6	38·5	52·3
Quality ..	114	110	106·5	108·3	114·3	100·5	119·7

In April and May, 1881, two analyses, which were almost identical with my own, were made on the above steel by the Imperial Technical Experimental Works, they were:—

	I.	II.
Silicon	0·49	0·36
Carbon	—	0·10
Phosphorus ..	0·144	0·150
Sulphur	0·055	0·077
Manganese ..	0·740	0·57
Copper	0·060	0·07
Ni and Co ..	0·290	0·22

Finally, I have had sent me a consecutive series of mechanical tests of the same rails, steel made, between October, 1880, and April, 1881. These were communicated by a very exacting and experienced inspector of rails for the State railways of Holland.

The analysis of the tests gave:—

(1) Absolute breaking strain under 50 kilos—none, 50—55 in 40 tests; 55—60 in 9 tests; 60—65 in 15 tests.

(2) Contraction (circular section of 20 mm. dia.) under 40 per cent., only three tests, respectively, 38, 34·4, and 38·7 per cent.; 40—45 per cent. in 11 tests; 45—50 in 9 tests; 50—55 in 19 tests; 55—60 in 8 tests; 60—65 per cent. in 13 tests; and, finally, one with 69 per cent. of contraction with 54·5 kilos breaking strain.

(3) Wöhlers numbers of quality were in two tests under 95, being 86·9 and 91·7 respectively.

95—100 in 6 tests.
100—105 ,, 12 ,,
105—110 ,, 22 ,,
110—115 ,, 16 ,,
115—120 ,, 4 ,,
123·5 ,, 1 ,,

Professor Tetmajer showed in his paper* a table of thirteen mechanical tests made by him on North German rail steel. In this the material from the works named gave 65·5 breaking strain, 42·0 per cent. of contraction, 23·6 per cent. of elongation, and was therefore, as measured by Wöhler's scale, of the first quality, and as measured by his capacity of work test, only one of the remaining tests was inferior to it.

That a material giving such excellent results withstood the most severe drop test, including that of the Russian requirement, at—18° C., is of course only to be expected.

Other German Bessemer works produce equally high class rail material, and this is generally of essentially the same chemical composition. An extensive series of observations made in a well-known works on silicious steel are now before me, and being especially instructive, the following figures extracted from them may here be quoted:—

	C.	Si.	Mn.	P.	Kilos per sq. mm.	Contraction.	Elongation.	
1	0·338	0·367	0·802	0·08	66·8	30·5	17·9	Tyre steel.
2	0·256	0·731	0·914	0·08	82·0	25·3	19·0	Hard rail st
3	0·254	0·576	0·768	0·08	61·4	40·5	20·6	Rail steel.
4	0·144	0·236	0·487	0·08	51·0	50·2	24·3	Soft rail stl.

To these observations on German metal we may add the following as quoted in the Journal of the last autumn meeting of the Iron and Steel Institute, and made at the instance of the Swedish Ordnance Commission:—

	C.	Si.	Mn.	P.	Kilos per sq mm.	Contraction.	Elongation.
5	0·120	0·234	0·527	0·109	65·5	48·30	18·7
6	0·470	0·443	0·410	0·083	61·8	44·70	14·4
7	0·450	0·351	0·511	0·040	65·5	48·70	18·7
8	0·400	0·023	0·216	0·019	51·3	49·20	18·5
9	0·420	0·025	0·360	0·042	45·9	56·20	21·5
10	0·550	0·040	0·217	0·024	50·6	39·50	17·5
11	0·550	0·175	0·128	0·014	53·0	42·00	19·5

It may be noted that the last analyses, with the exception of No. 5, were made in Sweden, and the carbons were apparently obtained by the colour test; they are all somewhat high, but are, of course, comparable among themselves. No. 5 is Siemens steel from Terre Noire, No. 6 crucible steel from Witten on the Ruhr, No. 7 is Siemens steel from Bofors in Sweden made with silico-manganese, No. 8 and 9 are Bessemer steel free from silicon, 10 and 11 are Siemens steel with different contents of silicon.

On comparing the results of Nos. 8, 9, and 10 with the previous ones, or even comparing Nos. 10 and 11, the truth of my proposition stated above is strikingly shown. The main conclusion to be derived from the values as given above, and especially from Nos. 2, 3, 5, and 7 is, that a higher breaking strain and degree of toughness may be obtained from such steel than is possible with ordinary carbon steel.

The conclusion to which the previously mentioned facts lead receives support from the following considerations: Many Siemens-Martin furnaces are worked with steel scrap, the bath is decarburised, and the desired percentage of carbon introduced by means of a proper charge of spiegeleisen. Now when, as is the rule, Bessemer steel scrap is used, an opportunity occurs for comparing practically the same metal when it contains silicon and when it does not. The Siemens steels under normal circumstances contain only traces of silicon. Now I have settled in the most definite manner that both products under these conditions give, with equal percentage of carbon, approximately the same elongation and contraction of area, but that the absolute breaking strain is about 5 kilos. lower in the desiliconised metal than when the silicon is present to the extent of about 0·40, the metal being otherwise identical in chemical composition and in previous mechanical treatment.

In what way the silicon improves the quality of steel is, of course, of no practical importance. Some metallurgists are inclined to think that it only indirectly raises the quality, namely by increasing the viscosity of the bath. I have repeatedly alluded to this explanation in my researches on the gases occluded in iron and steel.† The simple existence of silicon in the steel bath is without influence on the phenomena exhibited in the Bessemer process, wherefore the greater number of Bessemer works which make silicon steel produce no especially dense ingots. As might be expected, the mechanical tests from large-sized rolled or hammered ingots are exactly the same as those obtained from dense ingots of the same composition. In the case of rolled or forged material much importance attaches therefore to the casting. This may be increased in density by the addition of silicon, a result which may be easily observed in a Siemens furnace. Steel which rises in the moulds, whether it contains silicon or not, may be deadened by increasing the percentage of silicon to about 0·2 by means of silico-manganese. Accordingly this important property of silicon may be referred to its power of facilitating the absorption of gas. At the end of the refining process the bath both in the converter and the Siemens furnace is saturated with gas, consisting, as I find, of four-fifths of hydrogen and one-fifth of oxygen. The addition of silicon neutralises the excess of gas by correspondingly raising the power of the ingot to absorb it.

Whatever may be the influence of silicon on those obscure properties of steel which play so important a part on the ordinary tests, it may be definitely settled that it does not considerably influence either the natural hardness or its capability of tempering. I have found that a test piece of rail steel containing 1·5 per cent. silicon and 0·2 per cent. carbon was scratched by a piece of unhardened steel containing 0·4 of carbon. Hence the rail spoken of above with 0·15 carbon and 0·4 silicon must, in spite of high breaking strain, be classed as soft material. 0·3 carbon and 0·4 silicon gives middling hard steel. Although hardness must stand in the closest relation to the abrasion of the rails in working, few observations have been made on this point with German rails. One case is known in which highly silicious rails have been down on a Trunk line for 10 years without any abnormal behaviour being noticeable. It may be pointed out that sufficient material for analysis may be obtained from the rail *in situ* without much cost or trouble, in order that the dependence of the wear on the composition may be traced. I do not consider it at all necessary to take the rail up, as 20 grammes may easily be bored from the head without in any way compromising safety.

As somewhat secondary to the most important applications of Bessemer steel, it ought to be added that a higher content of silicon seriously prejudices the forgeability of it. The fracture of high silicon steel is fine-grained and dull. It has also the peculiarity of forming a bad scale at a red heat, which only imperfectly separates on chilling it.

What the possible maximum content of silicon in steel is depends largely on the purposes to which the steel is to be applied, and also on the percentage of carbon accompanying it. With an absence of carbon it would be incredibly high. If a judicious percentage, rather than the possible maximum, were asked for, at which silicon would be beneficial, it might be put at about 0·6 per cent.

I close this section by particularising the essay of Mr. Hupfeld,* director of the Prevali Works, Carinthia. Mr. Hupfeld is an enemy to silicon, and his opinion on the subject is therefore of value to us. His chief argument against silicon is that a steel made by him containing 2 per cent. of silicon, 0·96 Mn, 0·2 C, 0·02 P could only be forged with great care, and cracked when it was chilled. My views lead exactly to this result, *i.e.*, that in comparison with carbon or, indeed, with phosphorus, silicon is quite innocuous. 2 per cent. carbon used to give white iron, and 1 per cent. in Bessemer steel is the extremest limit for welding purposes, and such material would undoubtedly crack on being chilled. Hupfeld's résumé would be the salvation of silicon for any unprejudiced person. It reads literally. "Whatever may be the influences of silicon on Bessemer metal, as applied to varied purposes, it is natural that all articles which have not to undergo further serious changes of form may, without prejudice to their perfect fitness for the desired object, contain much more than such as are only unfinished material for further fine work. Rails, for example, may contain 0·6 with absolute impunity, as the previously-mentioned drop, bending, and loading tests have been borne by them. It is therefore going too far if a railway directorate at the present time reject steel containing more than 0·1 of silicon, and at the same time consider a much higher percentage of phosphorus harmless. In shafting, girders, angles, and similar material this holds good. Boiler-plates are delicate and require a lower percentage, so also does implement steel and material for cutting tools, in such 0·10 to 0·25 may occur without in any way lowering the quality, and we found in illustration of this a percentage of ·214 silicon, ·55 C., and 0·42 Mn in a well-known brand of crucible steel adapted for scythe making."

(To be continued.)

ON THE ANALYSIS OF IRON AND STEEL, WITH SPECIAL REFERENCE TO THE ESTIMATION OF CARBON AND SILICON.†

By FRANCIS WATTS, Birmingham.

NOTWITHSTANDING the large amount of attention which has been given by chemists to the perfecting of the methods adopted for the estimation of the carbon and silicon in iron or steel, there remains much to be desired in reference to the processes for the estimation of the so-called "combined" carbon, and especielly for the estimation of the silicon. Some doubts have arisen as to the condition in which the latter element occurs in iron; that is to say, it appears to be believed by some chemists that the silicon occurs in iron and steel in a state of chemical combination with the iron, forming a silicide, whilst others appear to favour the view that at least a portion of it exists there in a condition corresponding to that of graphite Whatever may be the truth in regard to this point, it is certain that when a specimen of cast-iron, wrought-iron, or steel is treated with an acid, the soluble residue generally contains a portion of the silicon in an unoxidised condition. The processes commonly adopted for the estimation of silicon in general depend upon the conversion of the silicon into its oxide by the action of acids or of bromine or iodine, and the oxidation of the unoxidised silicon of the residue, either by roasting or by fusion with nitre. Another, and for certain purposes an excellent, process proposed by Boussingault, consists in roasting a weighed portion of the iron in a muffle, whereby the iron is converted into oxoide, the silicon into silica, and the carbon is burnt off. On subsequently exposing this mixture of oxides to the action of hydrochloric acid gas at a red heat, the iron is volatilised in the form of chloride, whilst the silica which remains in the boat be weighed. In none of these processes, however, is any distinction observed between the silica which results from the oxidation of the silicon and that which exists ready formed in combination with various bases in the form of mechanically intermingled slag or cinder. That this distinction is of real importance there can be no doubt, but no serious attempts have been made to get over the difficulty. In the usual process the slag, if present, is sure to be more or less decomposed by boiling with the acid, and the silica thus liberated goes to augment the quantity of that from which the production of silicon is calculated. If, as is sometimes the practice, the residue is boiled with solution of sodium carbonate, with the object of dissolving away

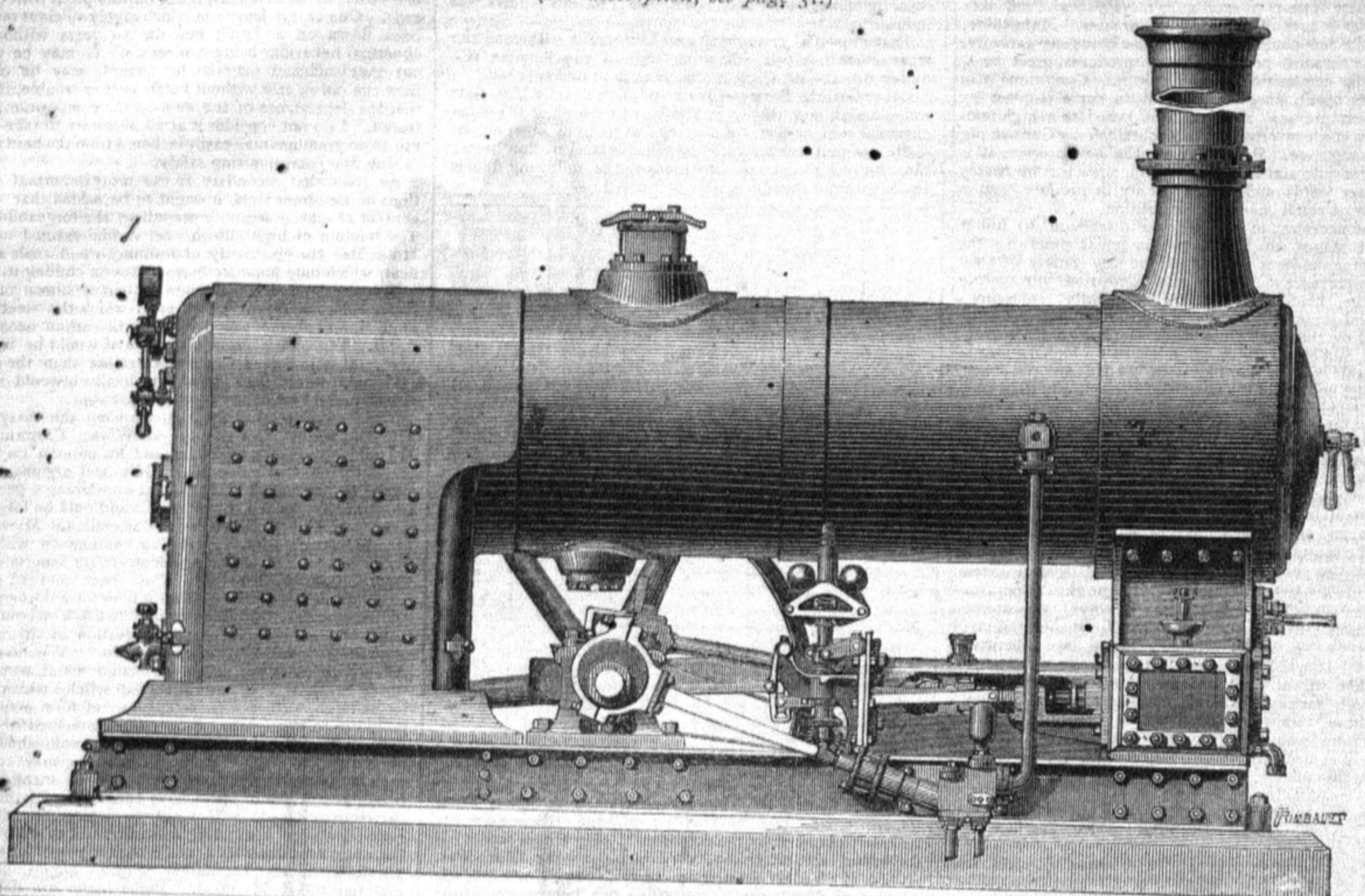
* *Eisenbahn*, xv. No. 3.
† *Zeitsch. d. Ver. deutscher Ing.* xxiii. 443. *Berichte der deutsch. chem. Ges.* xiv. 6.

* *Zeitschrift d. berg- u. hüttenm. Ver. für Steiermark u. Kärnten* Sept. 1878.
† Read at a meeting of the Philosophical Society of Birmingham May 11, 1882.

COMPOUND STATIONARY ENGINE.

BY MESSRS. MARSHALL, SONS & CO., GAINSBOROUGH.

(*For description, see page 31.*)



THE JOHNSTON HARVESTER.

(*For description, see page 31.*)

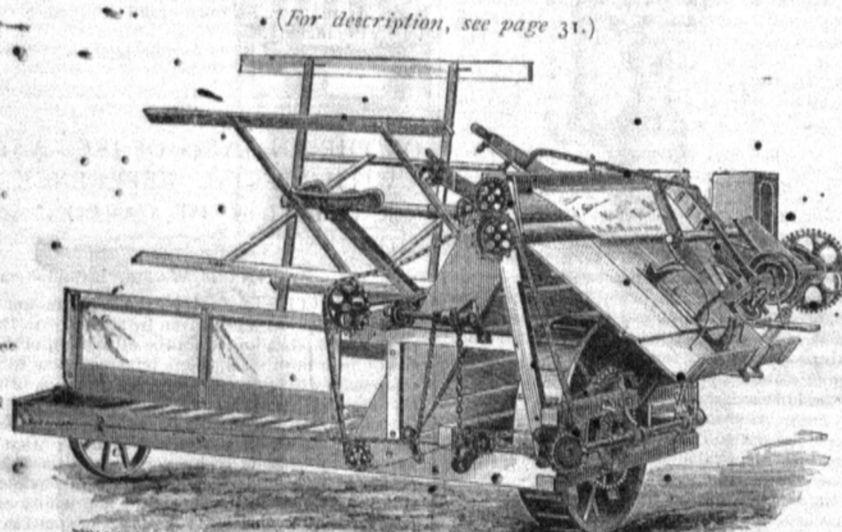


FIG. 1.

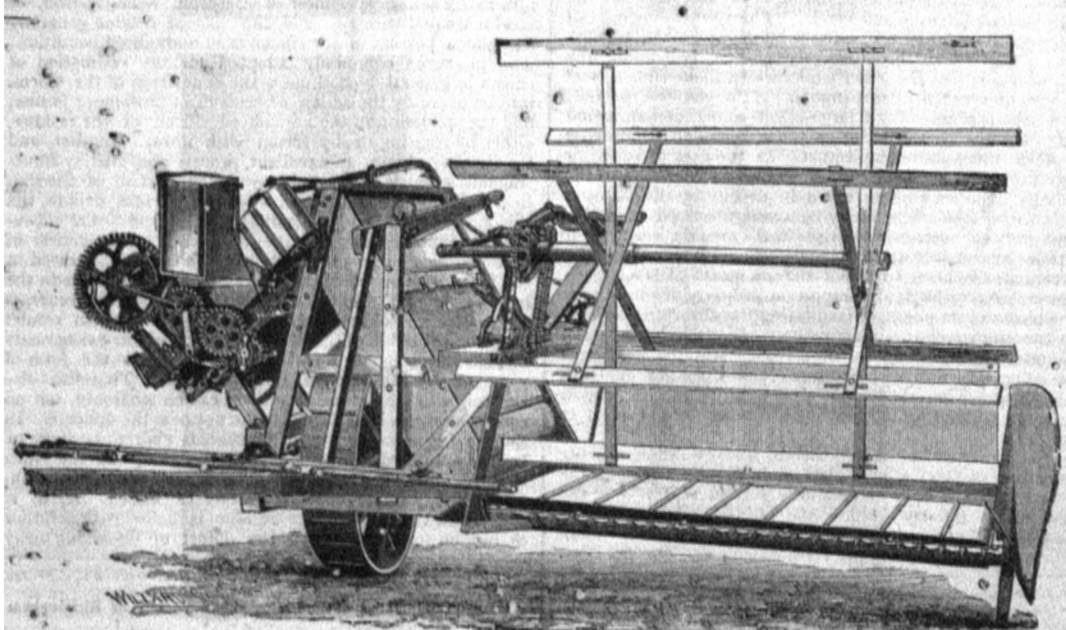


FIG. 2.

the silica from the graphite and slag, an uncertainty is introduced into the result, from the impossibility of avoiding the introduction of more or less silica with the alkali, and also from the difficulty of operating without loss upon so small a quantity of material. Bromide and iodine have both been suggested as substitutes for acids, and these agents do not act upon the slag, but the precautions to be taken and the length of time occupied make the operations very tedious. For the estimation of the total carbon, the following methods have generally adopted:—

(1) Combustion of a weighed quantity of the iron in a porcelain tube in a stream of oxygen. The chief objection to this process is the very high temperature required.

(2) Combustion of the carbon in the residue, left when iron is dissolved by the aid of iodine in the presence of water, but the length of time required for solution is a great objection to this method.

(3) The total carbon is frequently estimated by dissolving the iron in a solution of copper chloride or sulphate. The whole of the carbon is left in the residue. The presence of the finely-divided metallic copper with which it is mixed is rather an advantage than otherwise, for it assists the combustion of the graphite—a matter of some difficulty. The chief defect in this otherwise excellent process is that unless the vessel containing the iron undergoing solution is kept very cool, a decided smell is perceptible, probably indicating the evolution of hydrocarbons. The time required for solution, too, is somewhat lengthy.

(4) Weyl's method for determining the total carbon is a modification of the above process, and consists in attaching a lump of the iron to be analysed to the positive pole of a battery, of one Daniell's cell, the negative pole consisting of a piece of platinum foil, the menstruum as before being a solution of a copper salt. But even in this case it is difficult to prevent the evolution of gas from the iron.

(5) Lastly, the method of Wöhler, to which further reference will be made presently, consists in heating a weighed portion of the iron in chlorine gas, whereby the iron is volatilised as chloride; the residual carbon can then be submitted to combustion in the usual manner.

At Dr. Tilden s request I have undertaken some experiments with the object of avoiding some of the difficulties just referred to. Our first desire was to secure a process by which silicon could be rapidly and easily determined in iron and steel, and at the same time distinguished from the slag, which is almost invariably mechanically intermingled to a greater or less extent. The action of chlorine at a red heat presented itself as a reaction which might be turned to account for this purpose and after some preliminary trials the following process has been adopted. Divested of details it is briefly this. The total carbon is first determined by Wöhler s method, with the precautions to be described hereafter. Another weighed portion of the iron is similarly treated in a stream of chlorine, whereby not only the iron but the silicon, and probably the sulphur and phosphorus, are volatilised in the form of chlorides; the gas as it issues from the combustion tube is caused to bubble through water contained in a flask; the water in the flask immediately decomposes the silicon tetrachloride, which is carried forward with the excess of chlorine, and soluble silica results. The water is afterwards evaporated to dryness, and the silica recovered and weighed. Unfortunately the presence of manganese is the source of a little difficulty, for its chloride is not sufficiently volatile to be readily removed from the contents of the boat, by the steam of chloride. Hence, when manganese is present, which is almost always the case, it is necessary to wash the residue in the boat before weighing. The residue, which consists of the total carbon and the slag, having being weighed, from this weight, the weight of total carbon previously determined is deducted, the difference being the amount of slag. Thus, in two simple and rapid operations, are determined, first, the total carbon; second, the silicon and slag.

Regarding the process more in detail, the following arrangements are recommended. It being necessary to obtain a sufficient supply of chlorine which shall be well under control, some modification of the usual apparatus for generating the gas becomes desirable. A Wolff's bottle is filled with manganese ore in lumps; the necks are fitted with two tubes, one of which passes to the bottom of the bottle, the other passes just through the cork, and is provided with a glass stopcock. The bottle is placed in a saucepan of water, arranged so that it can be heated. The longer tube is connected with a stoneware jar containing common strong hydrochloric acid, the jar standing on a higher level than the generator; a gentle heat being applied to the saucepan, a supply of chlorine is obtained which may be regulated at will. The stoppers should be of indiarubber, well coated over with paraffin. The chlorine, before entering the combustion-tube must be rendered perfectly free from air and moisture. To effect this the gas is passed through three wash-bottles, the first containing water, the others strong sulphuric acid. The oxygen is removed by passing the gas through a tube containing lamp-black, which has been strongly heated in a crucible for half an hour to free it from moisture and tarty matter, as well as to render it more coherent; the column of lamp-black is kept in position by plugs of gas carbon, and should be about 6 or 8 inches long, occupying only the central portion of the tube. In practice it was found that the chlorine always contained moisture after passing through this carbon tube, and to this cause the discrepancies in the amounts of silicon found in the earlier analyses were probably due, for it is of the highest importance that the combustion-tube should be quite dry. Much better results were obtained when a tube containing pumice moistened with strong sulphuric acid was introduced between the carbon tube and the combustion-tube. The only part of the apparatus remaining to be described is the combustion-tube, a portion of which, some five or six inches, is bent downwards, not drawn out, at an angle of about 100 deg., so as to conveniently dip into a flask about a third filled with water. The carbon-tube, together with the drying and combustion tubes, must be arranged to lie within the gutter of the combustion furnace,* the bent portion of the combustion-tube turned downwards and dipping into the flask placed at the end.

Having described the apparatus employed in this process, it now remains to give an account of the method of procedure. About 0·6 or 0·8 grm. of cast iron, or about three times that quantity of wrought iron or steel, in the form of borings, small lamps, or wire, is weighed in a porcelain boat; this is then introduced into a straight combustion-tube, taking care that the carbon in the carbon-tube is heated fully to redness, and the air in the apparatus and combustion-tube quite displaced by chlorine before the boat is heated. A slow stream of chlorine is steadily maintained and the boat heated gently, just sufficient heat being applied to volatilise the ferric chloride as it is formed. The stream of chlorine must not be too rapid, or there is a danger of particles of carbon being carried out of the boat. When the whole of the iron is removed the boat is taken out whilst still warm, allowed to cool, thus becoming freed from any traces of chlorine, and the carbon determined by combustion, in a separate tube, in oxygen in the usual way. A similar quantity of the iron is weighed in another boat and the *bent* combustion-tube placed in the furnace, care being taken to free it entirely from any moisture. A flask of about 500 c.c. capacity containing about 100 or 150 c.c. of distilled water is arranged so that the extremity of the combustion-tube dips under the water; the air is carefully removed from the apparatus by passing a stream of chlorine, and the carbon-tube strongly heated. The boat is now introduced and the chlorine allowed to flow for a few minutes before heating; a gentle heat is now applied as in the previous instance, a higher temperature being induced towards the end of the operation. When the whole of the iron is volatilised, a point most readily ascertained by the disappearance of red vapour the tube is allowed to cool, the stream of chlorine being maintained for a short time, and the boat and flask removed. On removing the boats they should in every case be at once placed in weighing tubes to preserve them from accident. The water is boiled whilst still in the flask, until free from chlorine, and then evaporated to complete dryness in a platinum dish in the water bath, the residue treated with a few drops of hydrochloric acid, well washed with warm water upon a filter, and ignited and weighed. This, less the filter ash, gives the weight of SiO_2, from which the percentage of silicon can at once be calculated. Should any silica adhere to the extremity of the combustion tube it may be detached by a glass rod, the extremity of which is covered by a short length of india rubber tubing, a few drops of solution of caustic potash being employed if necessary. A filter is dried at 100 deg. C., enclosed in weighing tubes, and its weight ascertained; the contents of the boat are now emptied into this, well washed with hot water, and again dried at 110 deg. C. and weighed. This is the weight of the mixed total carbon and slag, the percentage of which must be calculated. From this the percentage of total carbon already determined is deducted and the remainder reckoned as slag. The proportion of slag can be checked by burning off the carbon from this mixture and weighing the residue. The object of washing the carbon and slag is to remove the less volatile chlorides. Earlier experiments, in which the washing of the residue was omitted, were far from satisfactory, for it was found impossible to entirely volatilise the chloride of manganese, which, when the boat and its contents were ignited in oxygen, formed black glittering crystals of oxide upon its sides.

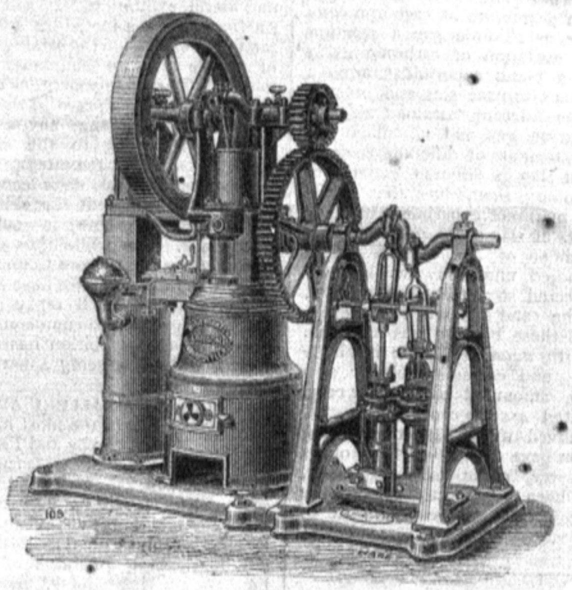
The process which has just been described appears at first sight to be complicated, but when the operator has a number of analyses to perform and is provided with two com-

* One of Griffin's long combustion furnaces was used.

RIDER'S HOUSEHOLD PUMPING ENGINE.

BY MESSRS. HAYWARD TYLER & CO.

(*For description, see page* 31.)



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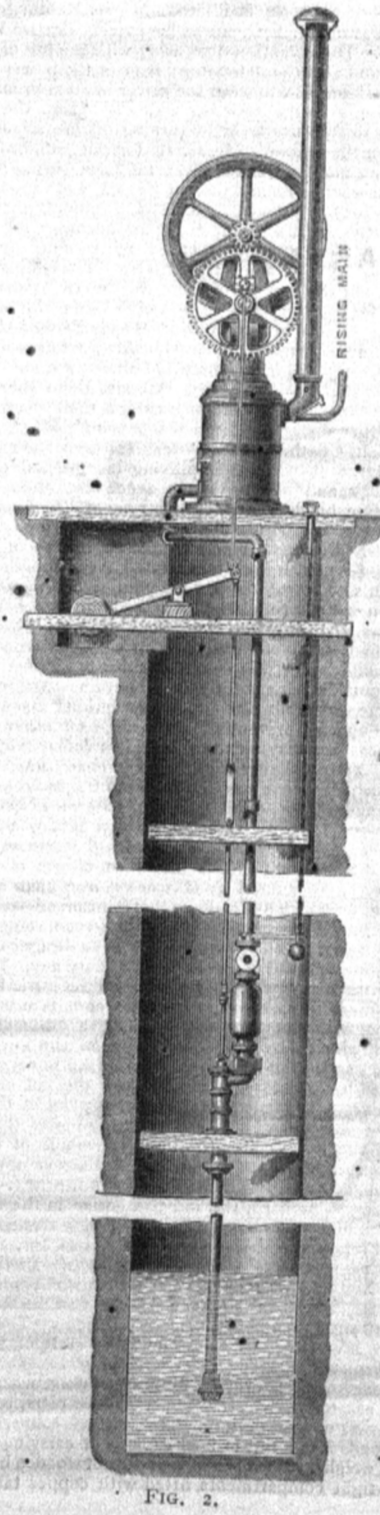

FIG. 2.

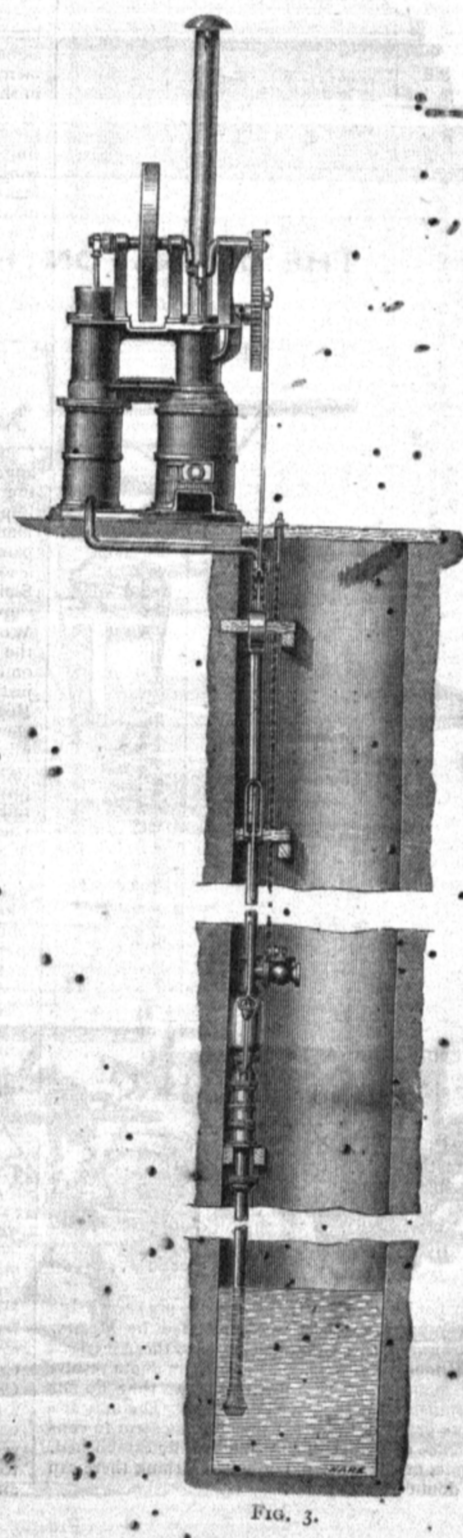

FIG. 3.