GOLD MINING MACHINERY FOR THE TRANSVAAL.

By HENRY LOUIS, A.R.S.M., F.I.C., &c.

AT the present moment, when gold mining in South Africa is attracting so large a share of the attention of the mining public, and when makers of mining machinery are so largely engaged in supplying the requirements of these new goldfields, a few notes on the exact nature of these requirements may probably prove of service. The proposition that gold milling machinery must, in order to attain to its maximum of efficiency, be carefully adjusted to suit the character of the quartz that it will have to be employed upon, is so self-evident as not to require any demonstration, and accordingly I will proceed at once to point out what class of machinery is best suited to the two important goldfields of South Africa, viz., the Witwatersrand (or Johannesberg), and the De Kaap (or Barberton) districts.

Witwatersrand.—The material to be milled here is not a true quartz, nor does it occur in reefs ; it is a quartzose conglomerate, the hardness of which varies from a very friable to a very firm metamorphosed mass. There are, it is true, a few small veinlets of quartz in the district, but the bulk of the auriferous material is the conglomerate. The gold which it carries is free, crystalline, is sometimes rather coarse, but more often moderately fine, and very readily amalgamable. The deposits—which are beds dipping at angles of from 40 to 60 deg.—are thick, and the auriferous ore is therefore abundant. I estimate the probable average yield of the best of these deposits at about 10 dwt. per ton. Under such circumstances it will prove more profitable to mill fast and to put through large quantities of material, rather than to attempt very close saving. Amalgamation inside the battery boxes, which should be furnished with inside plates, at any rate on the discharge side, will prove the most satisfactory process ; amalgamated copper plates should then suffice to catch all the gold escaping from the battery boxes, and below the plates should be a few yards of strakes, furnished with riffles, to catch any particles of mercury that may be carried off the plates. No further amalgamating or concentrating machinery should be needed if the mills are properly worked, as the gold is very free, and no sulphurets have as yet been found in noticeable quantities; there should be no difficulty at all in keeping the plates bright, the ore being exceptionally clean. The battery box ought to be fairly deep, so as to admit of long runs being made without cleaning up; but the dies should at the same time be very deep, in order to make the discharge as shallow as possible. The most satisfactory results will probably be obtained with a depth of discharge of 1½in. to 2in. The ore being upon the whole rather friable, light stamps are preferable to heavy ones; the best weight for them will probably be between 450 lb. and 600 lb., according to the nature of the ore in each individual case. The drop should be small—5in. or 6in.—and the speed of milling as high as possible, at any rate not under 90 drops per minute, and more if practicable. In order to run successfully at these high speeds it will be necessary to have the frames made exceptionally strong and substantial, and the greatest care should be devoted to the foundations, both for the battery blocks and the sills, otherwise it will be impossible to run at as high a speed as above recommended without unduly increasing the repair account, and moreover wasting time in repairs. It may perhaps be advisable to substitute single for double cams, in order to facilitate running at high speeds.

The best size of mesh for the screen will probably prove to be 900 to the square inch ; instead of this, a vertical slot screen with slots of No. 9 width may be used. Both forms will probably give good results here, and it is hard to say which should give the better. In some of the mines the conglomerate is so excessively friable—having apparently never been consolidated—that it will not be necessary to pass the whole of it through the mill ; in such a case the ore may be dumped into revolving drums into which a stream of water is run, and which are connected with or continued as revolving screens; the coarse portions of the conglomerate, requiring crushing will be delivered from the open ends of the circular screen direct into the mill hopper, whilst the finer portions suspended in the water can be streamed over amalgamated copper plates followed by riffles. By this system of working the effective capacity of a mill of given size may be greatly increased at very small expense.

There is little or no water-power available throughout the Witwatersrand district, and most of the mills will have to be worked by steam. At present the only fuel available is wood, though there are seams of good coal within thirty miles of the goldfield, and there is a proposition on foot for constructing a railway line from Kimberley to Pretoria, which line would connect Witwatersrand with the Potchefstroom coal region. The best wood for fuel is that of various species of thorn ; at present the consumption of it appears to be at the rate of about one ton of wood to five tons of quartz. Wood is even now worth about 30s. per ton, and it is thus evident that the cost of the fuel will be one of the most serious items in the cost of milling. All possible precautions should accordingly be taken to diminish as much as possible the consumption of fuel. The boilers should be good steamers and have a very large steam space ; whilst it will be advisable to use engines with automatically varying expansion gears. Except for a very large mill, compound engines are not to be recommended for a country like the Transvaal, where large machine shops and good engineers are scarce. It must be remembered that it is very difficult to transport into the interior any pieces of machinery weighing over three tons in one piece, as they have to be carried on ox wagons over roads of the most rudimentary description ; boilers of the tubular type, without shells (such as the Root's boilers), are therefore the best boilers to send out, and they should be adapted for burning both wood and coal as economically as possible.

Barberton district.—The auriferous material here is a true quartz, very massive and hard, containing a certain proportion of sulphurets of various kinds ; the gold is sometimes coarse, but more often it is very fine, and is not always very freely amalgamable. In order to treat it to the best advantage, the quartz should first of all be put through rock breakers, set rather fine, to break down to, say, 1in. cubes, in order to throw less work upon the stamp mill. The quartz being hard, heavy stamps from 750 lb. to 900 lb. in weight may be employed with advantage, and worked with about a 7in. drop ; ninety drops per minute will probably be found ample. The battery boxes should have inside plates, and in order to give a sufficient opportunity for amalgamation in the battery, a 3in. discharge may be used with advantage in conjunction with a fine screen ; about 1200 meshes to the square inch seem to have given the best results up to the present. The pulp from the battery will, of course, pass over amalgamated copper plates, and then be concentrated on Frue vanners. Hardly enough is yet known of the nature of these concentrates to enable anyone to pronounce positively as to the best method of treating them. One mill has obtained very satisfactory results by treating their concentrates—in the case in question, blanket concentrates — in Wheeler pans. Chlorination has been suggested for the treatment of the De Kaap tailings, and it has even been proposed to erect a central establishment for the purpose. Such a scheme may, no doubt, be successful in the future, when communication between the various scattered mining properties and a central point, such as Barberton, has been improved, and when the Delagoa Bay Railroad has been completed, so as to admit of acids, salt, &c., being brought into Barberton at reasonable prices. At present, whilst the price of chemicals is, owing to the excessive cost of transport, very high, and whilst the difficulties and the expense of carrying tailings or concentrates from the mills to any central chlorination works are extreme, it is greatly to be feared that the attempt to establish chlorination works at Barberton will, if executed, prove a failure. The best plan at present will doubtlessly be found to be close concentration of the tailings, and treatment of the crude concentrates, either with or without calcination, in pans of some approved Californian pattern, to be followed by amalgamators and settlers. The tailings escaping from the settlers can then be stacked for future treatment if advisable. At present, most of the mills in the De Kaap district are badly worked, heavy loss of gold being the rule and not the exception. Many of the mills, notably those of Colonial manufacture, are very badly constructed, and seem as though they had been designed to waste as much power as possible. I may instance one mill which is worked by a Pelton wheel with a fall of over 200ft., the diameter of the nozzle being about 1¾in.; and yet this wheel barely suffices to drive a light 5-stamp battery at a low speed. A brake power of 5-horse power ought to suffice to drive this mill, and the theoretical horse-power developed by the water should be about twenty. The power by which the mills in the Barberton district are to be driven is, for the most part, water power. This is obtained either from the De Kaap (Queen's) River, in which case the quantity of water available is comparatively great, and the fall low, or from water-races brought along the hill side, at high elevation, often from very considerable distances ; the quantity of water obtainable in the latter case is, of course, less, but the power may be great, owing to the height of fall available ; this, in some of the properties on Moodie's concession, will exceed 500ft. In such cases the Pelton wheel is the best motor for use in the Transvaal. It is quite true that the power that it is capable of developing may be inferior to that given off by a first-class turbine, but its efficiency is not decreased by wear, as is the case with the latter class of wheels. Moreover, it is lighter, thoroughly portable, and easily erected and worked even by those who have not made a special study of hydraulic engineering ; for all falls of over 100ft. the Pelton wheel is to be highly recommended, and its efficiency may be taken at 50 per cent. of the theoretical horse-power developed by the water ; more is, I know, claimed for it, but I consider the above figure a pretty safe one. For moderate falls a turbine or a vortex-wheel may be used, and for low falls, such as those on the Queen's River, a turbine or a water-wheel. The chief objection to the latter is its comparative weight and bulkiness, and the fact that it would have to be put together on the spot, the carriage up country of a water-wheel of even moderate dimensions, ready for work, being quite impracticable. There are several steam mills now at work in the Barberton district ; they are all small mills, driven by semi-portable boilers and engines, using wood for fuel. This is, however, rather expensive, and will become more so in the immediate future, so that unless the Delagoa Bay Railroad—the proposed line of which is said to traverse some good coalfields—can bring in cheap coal, the steam mills will have to give way to mills driven by water-power. In order to show how costly all milling operations are, I may state that one of the custom mills charges an average of £2 per ton for milling quartz, and the proprietor finds that even at that price it barely pays expenses, though it must be added that the mill in question does not appear to be well managed. In North America the charge for custom milling is about 6s. per ton.

The main rule to remember in designing machinery for the Transvaal is that it should be so arranged as to economise labour, and more especially white labour, as much as possible. The rock-breakers and automatic battery feeders are advisable, and concentrators such as the Frue vanner are to be preferred to blanket strakes. There being no foundries of any importance yet, steel shoes, dies, cams, &c., are to be preferred to cast iron. Native construction timber is scarcely to be obtained in either of the goldfields, whether for battery frames or foundations. Where timber is required it will have to be sent from home, but it will probably prove cheaper to make the frames of cast iron, wrought iron, or steel, whilst concrete may be advantageously employed to replace timber for the foundations; it must be remembered that the American type of mill, with wooden frames and battery-blocks, was designed for a country where heavy timber is found on the spot, and under circumstances so entirely the opposite of these, a different type of construction must of course be adopted. All machinery should be of the highest quality, as transport is a very great item in the cost of the erected mill, and it costs no more to carry the very best than to carry inferior machinery. In fact, the constructor must bear in mind that he is working for a new country, where the roads are disgracefully bad, skilled mechanics scarce, and machine shops almost non-existent.

THE DRAINAGE OF FENS AND LOW LANDS BY STEAM POWER.

By W. H. WHEELER, M. INST. C.E.

No. IX.

PUMPING STATIONS.

Podehole, Deeping Fen.—The taxable area of this drainage district is 30,000 acres, the quantity of land actually drained by the wheels being 32,000 acres. The water from the fen is collected into two large drains, from which it is pumped into an outfall cut, called the Vernatt's drain, which discharges into the tidal river Welland, about six and a-half miles distant. The average lift is about 5ft., the extreme being 7ft. The machinery was erected in 1824, and consisted of two scoop wheels worked by two low-pressure condensing beam engines of 80 and 60 nominal horse-power respectively, working at a maximum pressure of steam in the boiler of 4 lb. This pressure has since been altered and other improvements made. The crank shaft from the engine passes through the wall of the engine house, and carries a pinion gearing into a spur wheel on the shaft of the scoop wheels. The ratio of the velocity of the engines to the wheels is 16 to 5, and 22 to 4½ respectively. The larger engine—called the Holland—has a steam jacketed cylinder, 44in. in diameter, with 8ft. stroke. The fly-wheel is 24ft. in diameter. The smaller engine—called the Kesteven—has a steam-jacketed cylinder 45in. in diameter and 6ft. 6in. stroke. The fly-wheel is 24ft. in diameter, making 22 revolutions a minute. The framing of the scoop wheels is of cast iron. The larger wheel was originally 28ft. in diameter, and fitted with forty scoops, but the diameter was increased about ten years ago to 31ft. The scoops are 6ft. 6in. long—radially—by 5ft. wide, giving an area when wholly immersed of 32·5 square feet. The mean diameter is 24ft. 6in., number of revolutions a minute 5, giving a gross discharge, after deducting the space occupied by the scoops, of 11,215 cubic feet per minute, or 313 tons. These wheels, as running at the present time, have been very accurately fitted in their places, and run very true, so that there is a clearance of barely half an inch between the floats and the masonry at the bottom and sides. The smaller wheel is 31ft. diameter, with the same number of scoops, each being 5ft. 6in. long by 5ft. wide, giving an area of 27·5 square feet. The mean diameter 25ft. 6in., number of revolutions a minute 4½, equal to a discharge, after deducting scoops, &c., 8959 cubic feet per minute, or 250 tons. The scoops dip from the radial line at an angle of 25 deg., being tangent to a circle 7ft. 6in. in diameter, the end of each scoop, for a length of 18in., drips further back 6in. The straight part of the scoops enters the water at average flood level at an angle of 29 deg., and leaves it at 36 deg. The average dip in floods is 5ft., and the average head 5ft., rising to 7ft. in extreme floods. Steam is supplied to the engines by five double-flued Lancashire boilers, having water pockets above the furnaces; they are 7ft. diameter by 26ft. long. The total discharge of the two wheels is 563 tons per minute. This is equal to about the fourth of an inch of rain over the whole area of 32,000 acres when the wheels are working to their full capacity for twenty-four hours a day.

The efficiency of these wheels has been greatly increased by alterations carried out a few years ago. On the inlet side—see Fig. 8 and 9—a shuttle has been added, by which the amount of water coming to the wheel can be adjusted and the supply regulated to the quantity best adapted for keeping the wheel fully charged without its being drowned by it. This shuttle is of the same width as the wheel, and consists of a wooden door fixed across the inlet close up to the wheel, and working on friction wheels in a frame placed in the masonry. The door is fixed close to the wheel, at an angle of 45 deg. to the bottom of the race-way. It is provided with a balance weight, hung by a chain working over a pulley. The shuttle is lifted or lowered by a toothed rack gearing into a spur wheel and pinion attached to a shaft, which is carried up into the inside of the building. The floor drops away from the bottom of the shuttle in the inlet side in a circular form, so as to give a larger space for the admission of the water, and allow it to come up and pass freely under the shuttle. The water passing under the shuttle does not catch the scoops until they come towards the bottom of the trough, and then impinges on them in the same direction in which they are travelling, and with a velocity due to the head of water at the back of the door, and thus aiding in the forward motion of the wheel. The scoops become fully charged as they assume a vertical position. The apparent increase in the lift from the lower level from which the water has to be raised is more than compensated for by the avoidance of the mass of dead water which a wheel generally has to encounter on first entering the water, and by the wheel being just sufficiently fed with water having a velocity and direction which assist in sending it round. A much greater quantity of water is thus raised with the same amount of steam than could be done if the shuttle were not there. With the surface of the water in the inlet drain during floods standing 6ft. 10in. above the bottom of the scoops, the shuttle is lifted sufficiently to allow 1ft. 3in. of water to pass under it, and this keeps the wheel well supplied. A movable breast has also been fixed on the outlet side. It is made

of iron plates, and works into a recess cut in the masonry of the breast, so that its face is flush with it. The plates are bent so as to have the same radius as the wheel; the upper part of the segmental plate is hinged at the top into another flat wooden platform fixed to an iron frame, which when down lies in a recess in the floor of the outlet, and rises with the breast. To enable this platform to adjust itself to the space in which it has to lie, it is so formed that one end slides in and out of the iron frame. The lower end of the frame is hinged to the floor; thus, when the breast is raised the floor is also raised for some distance, forming an inclined plane from the top of the movable breast to the floor of the outlet channel. The breast is raised or lowered to adapt it to the height of the water in the outlet drain by a segmental toothed rack gearing into a spur wheel attached to a windlass fixed on the wall of the raceway. By raising this breast to a sufficient height to allow of the free egress of the water over it, the back current at the bottom of the outlet, which always exists with the old arrangement, is entirely avoided. These improvements to the wheel have been carried out under the direction of Mr. Alfred Harrison, the superintendent of the Deeping Fen drainage district.

During the five years, 1876-80, the average work of the two engines amounted to 219½ days of twenty-four hours each for one engine, and the consumption of coal averaged 5 tons 9 cwt. per day. These engines have lately been thoroughly overhauled by Messrs. Watt and Co., and new boilers provided, the working pressure of the steam being raised to 20 lb. on the inch. The coal consumption has been

FIG. 8.
SECTION

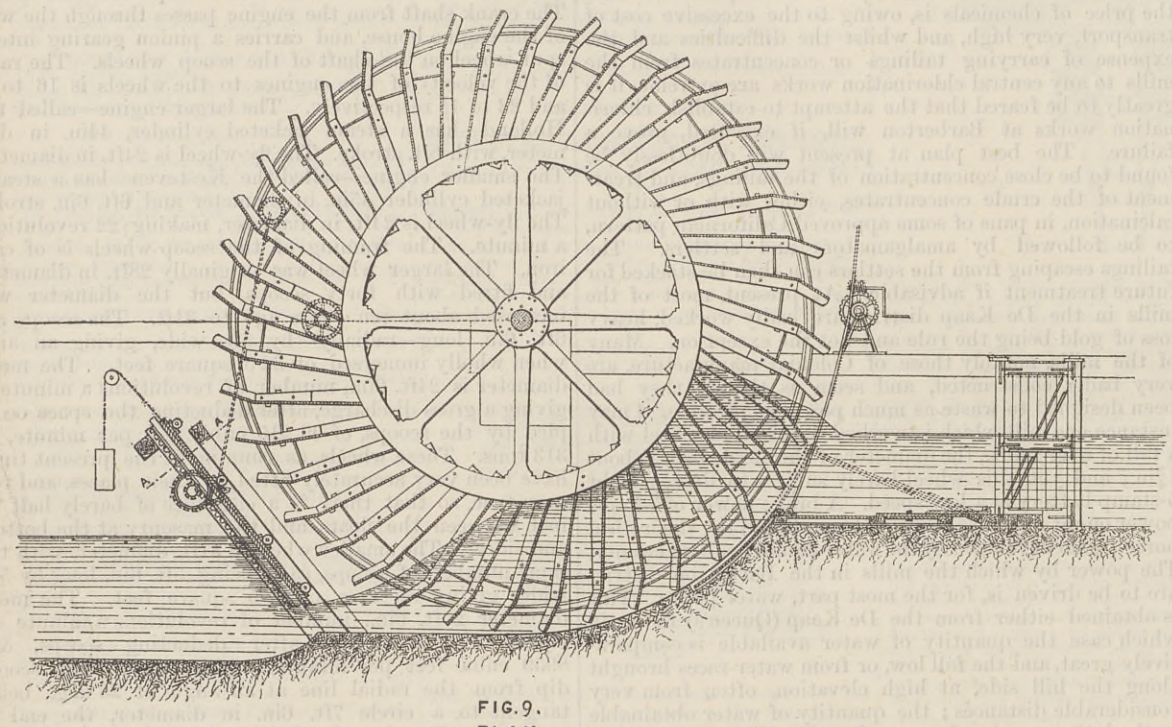
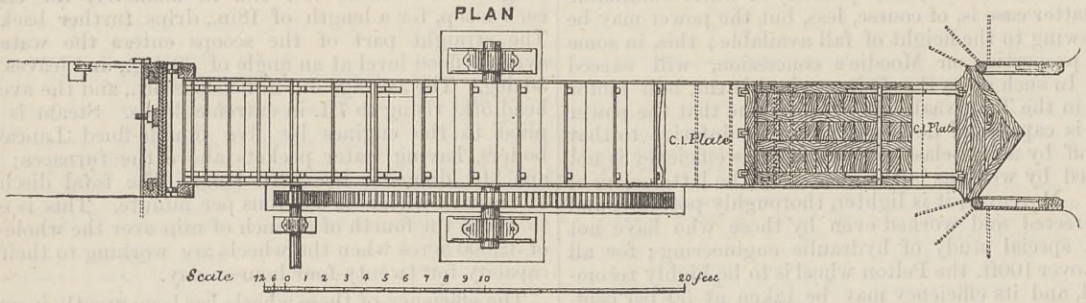


FIG. 9.
PLAN



SCOOP WHEELS, PODEHOLE, DEEPING FEN.

reduced to 3·28 tons per day, the amount of work done by the engines being at the same time very largely increased. It was reported that owing to these improvements 60 per cent. more water was raised with 42 per cent. less fuel. The annual saving was estimated at £450 in wet seasons. The average annual cost of this pumping station for the three years 1880-83 was £1412, of which £1009 was for coals, which cost about 15s. per ton. The average quantity consumed during the three years was 1356 tons a year. Taking the area drained as 32,000 acres, this gives 23·61 acres for each ton of coal. The cost per acre is 10·58d., or taking coals only, 7·56d. Taking the average lift at 5ft., this gives 1·51d. per acre per foot of lift for coals only. The following is the time the engines worked during the above period:—

	80-H.P. engine. Hours.	60-H.P. engine. Hours.	Coals consumed. Tons.	Rainfall. Inches.
1880–81	5112	3912	1104	37·12
1881–82	2616	1680	788	26·12
1882–83	2664	3756	1267	32·87

Taking the latter period as a fair sample of a wet season, and allowing the average dip of the wheels throughout the whole period the wheels were running to be 2ft. 6in., and the head 4ft. 6in., the average work done in water lifted would be 83·63-H.P. The average consumption of coal, 442 lb. per hour, equal to 5·28 lb. of coal per hour per horse-power of water lifted and discharged.

Sanitary Institute of Great Britain.—At an examination, held June 2nd and 3rd, seventy-seven candidates presented themselves—nine as local surveyors and sixty-eight as inspectors of nuisances. Questions were set to be answered in writing on the 2nd, and the candidates were examined *viva voce* on the 3rd. The following candidates were certified to be competent, as regards their sanitary knowledge, to discharge the duties of local surveyor:—Harry Geen, James Railton, Herbert Spurrell, and W. E. Clason Thomas, A.M. Inst. C.E., and forty-four candidates were certified as competent to discharge the duties of inspector of nuisances.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Italy—Trade of Central Italy for 1886—*Ironworks.*—A trade report on matters strictly limited to the consular district for Central Italy must deal principally with the improvements that are being carried out for the purpose of fostering industries and trade. The Societâ degli Alti Forni Acciaieria e Fonderia has lately increased its capital from £480,000 to £640,000, and proposes issuing obligations for an equal amount, making altogether £800,000 more to be employed in developing this undertaking. They now turn out tubes of large and medium dimensions, ships' armour, and steel rails. The motors employed are compressed air and hydraulic power. The foundry is provided with 5½ cubic yards of water per second, which by means of two turbines furnish a force of 400-horse power. There are five cupolas, one of 4 tons an hour, one of 6 tons, two of 10 tons, and one of 20 tons. There are now about 1000 workmen employed in and in connection with the foundry. The steel works have 2·62 cubic yards of water at a high level, coming from a distance of 4⅛ miles, and developing 4000-horse power, applied by forty-six turbines and four other machines, which compress air up to 5 atmospheres. The compressed air is stored in a reservoir of iron pipes 1·25in. diameter, and about 1093 yards long. It is thus distributed to the sledge hammer and to some of the largest cranes. By the substitution of air and water for steam power, a great saving in the expenses of the motors is accomplished. The present appliances of the steel works are fit to produce enough Bessemer steel to make 300 tons of rails a day, and to work four Martin-Siemens furnaces, each of a capacity of 20 tons. There are five sledge hammers, weighing 7, 10, 15, 25, and 100 tons respectively. The anvil of this latter weighs 1000 tons, all one jet, and is considered the largest piece of cast iron existing. There are 2000 workmen employed in and in connection with these works. The company own the iron mines of Val Trompia in Lombardy, covering 2900 acres of ground, in which there are abundant veins of iron ore. Part of the capital now being raised is to be employed in setting up large foundries on the spot, to supplement those already existing at Turin, and it is intended to start blast furnaces at Civitta Vecchia, to utilise the ore of Elba. For some special operations where coal is not necessary, lignites obtained from mines near at hand, or from the Spoleto mines, both of which are worked by the company, is used. In addition to what is stated above, one object of increasing the capital of the company is to complete and extend the steel works, and to provide them with the appliances required for building large and powerful steel guns, which at present have to be imported from abroad. When the works are completed it is expected that 7000 people will be employed in them.

Italy—Port of Civitta Vecchia.—Nearly all the trade of Civitta Vecchia being carried on by British ships, the present condition of the harbour affects principally British shipping. The works which have been for some time in progress for deepening the harbour are now so far advanced as to mark a considerable improvement on the previous state of things; but the general conditions of the harbour are still inadequate to the requirements of the shipping and trade. The depth of the harbour in the space between the mouth of the dockyard and the office of the commander is 21ft. In that part of the harbour may be placed steamers drawing up to 17½ft., the reason of this limitation being that rocks still exist in the bottom which will have to be removed, and in consequence ships whose draught of water reaches over 18ft. or 19ft. must still be moored at the breakwater, which is not a very safe place in bad weather. Very often ships have to be kept waiting at the bar outside the harbour because of want of room. To obviate this it has been projected by the Chamber of Commerce of Civitta Vecchia that some new quays be constructed, so as to hasten the unloading of ships within the harbour. A scheme for a new mole is about to be carried into effect, and it is expected that the work will be immediately commenced, but some years will be required for its completion.

Japan—Suggestions for manufacturers and merchants.—The present system of business was inaugurated simultaneously with the opening of Japan to foreign trade. By the terms of the original treaties permission was given to all classes to trade freely with foreigners at the open ports; but at the commencement vexatious obstacles of every kind were interposed by the Government of the country between foreign and native merchants, so that free and unrestricted trade was rendered a practical impossibility. Owing to the action of the Government, the only natives who gained access to the foreigners were keen-witted and unscrupulous adventurers who succeeded in usurping the place formerly held by the few holders of Government licences. These men have for years past formed a strong guild of monopolists, controlling nearly the whole trade of Japan. Competition with them on the part of other nations is impossible; and, in case of disagreement with foreigners, they combine to impose upon the latter whatever terms they please. No effort has been made—except in isolated cases—to shake off these disadvantages, and the British merchant in Japan continues to transact his direct business with the men to whom he has been accustomed from his earliest days. All trustworthy Japanese are of opinion that this system is unsuited to the present times, and that if adhered to British trade with Japan will surely continue to decline. The Japanese mercantile classes in Tokio now include men who by birth, education, intelligence, and probity are well qualified for a high place in society, and they are desirous that direct relations should be established between them and the best classes of foreign merchants. The Germans have taken advantage of this disposition, and in consequence many large and valuable orders for staples, which in the ordinary course of trade ought to have been obtained from England—the best and cheapest market—have been executed by German manufacturers. The success of the Germans is to a great extent attributable to their own energy, to the speed with which, through the efficient help of Japanese partners in Tokio, they discover the requirements of the Japanese, and to the fact that instead of waiting until the Japanese customer comes to them in their offices at Yokohama, they diligently seek him out in Tokio and there furnish him with the fullest estimates for all the goods he needs. I venture to hope that British importers will at least keep pace with their European competitors. The principal part of this report is devoted to the native cotton manufactures of Japan. Since 1881 there has been a gradual decline in the imports of cotton piece goods from England. This decline is in some degree attributable to bad circumstances prevailing among the lower and middle classes, and to a restricted circulation of money; but from every quarter there is an absolute concensus of opinion that it is in a much larger degree attributable to the disgust produced in the minds of all consumers by the bad quality of nine-tenths of the cotton piece goods imported in recent years. There is an appreciative and large market for durable and good articles, for which the Japanese willingly pay good prices, and it is a great mistake to minister only to the inferior class of buyers.

Norway—Trade of Christiania in 1886.—Machinery works have been well employed, and some have increased the number of their workmen, and have also had recourse to night work. Their earnings have been supposed to be tolerably good. Wages have been 3s. 4d. for a day's work of ten hours. Copper mines have suffered from the fall in value of that metal. Improvements with the object of cheapening production have been introduced at the Röros copper works. At the Vignaes mine, the largest in Norway, 30,000 tons of ore were raised, but sold only with difficulty. Wages have been slightly reduced without affecting materially the economic condition of the mines. A new washing apparatus is being set up at the Eger copper works to prepare the ore for use in the production of sulphuric acid. The yield of the Aamdul mines, worked by the Bratsberg Copper Company, continues to be good.

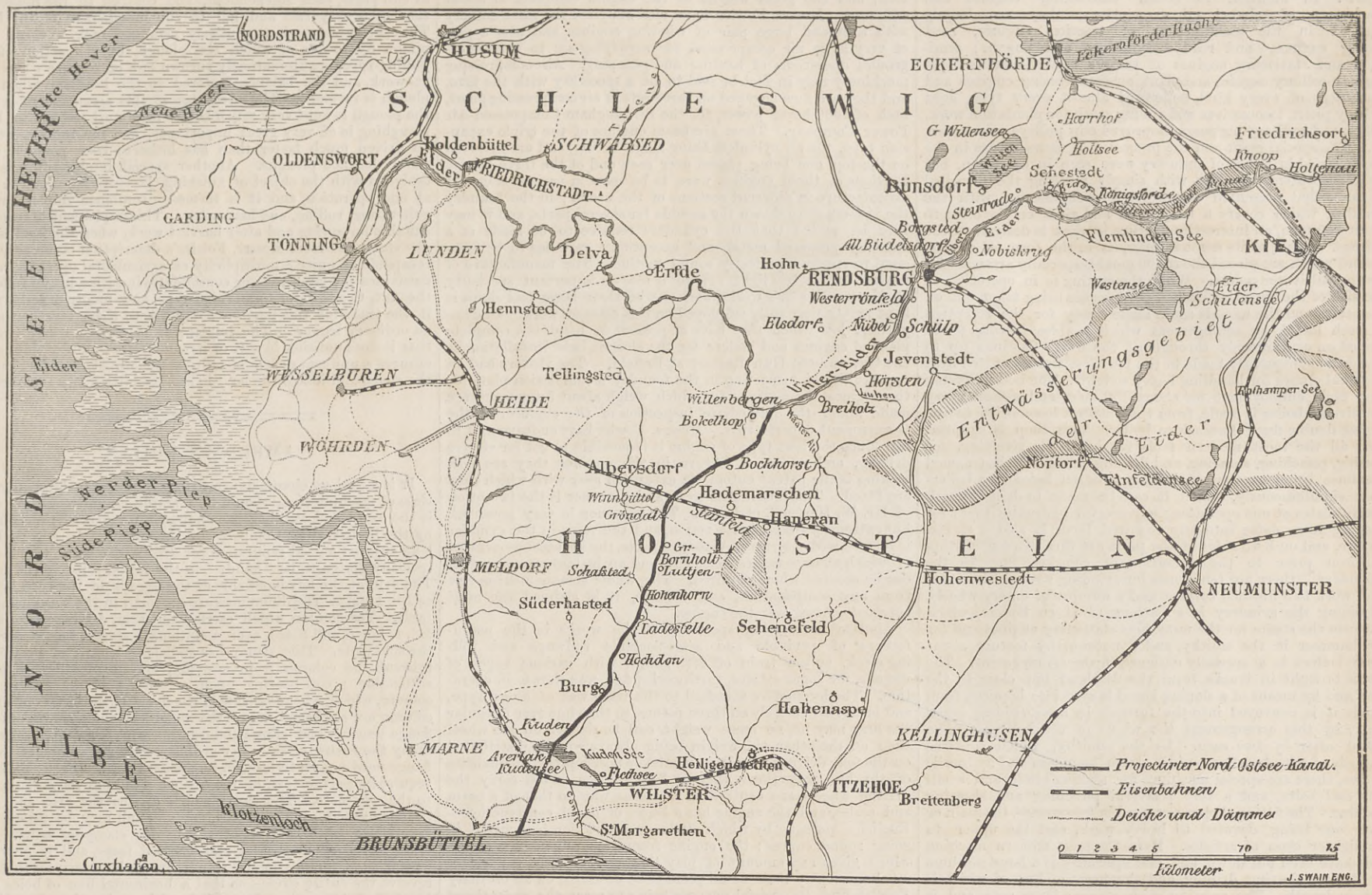
Norway—Trade of Flekkefjord.—The past year may be considered as very bad, in an economical respect, for that district. English Bessemer steel competes successfully with Belgian, German, and Swedish iron. It is preferable to Swedish iron, and sold at a cheaper rate, and would certainly quickly supersede all other kinds if pushed in the market by energetic agents. As a proof that English manufactured steel and other metal goods have a better reputation and are preferred to those of other countries in Norway, German goods of this description bear inscriptions in the English language and are delivered of satisfactory quality cheaper than from England. British metal goods therefore meet with the sharpest competition from Germany.

Norway—Trade of Porsgrund.—The import of coal shows a slight decrease, but an increase may be looked for, as a porcelain manufactory which will consume a quantity is finished. All the machinery for these works has been imported from Germany, the manager being German. A good supply of granite is to be obtained in this district, which could doubtless be delivered in England cheaper than from Scotland and other sources. Notwithstanding the bad times, it is most probable that a tolerably fast English steamer with accommodation for about forty saloon passengers, besides second-class and emigrant room, would if well managed succeed between this port and Grimsby and Hull, provided that the vessel be well suited for carrying ice and timber. The chief obstacle is the lack of imports, but it is possible that a regular trade in coals and merchandise to this district might be created.

Trade of Tonsberg.—Trade has been exceedingly dull, and all kinds of industry has suffered from the general depression. English goods are considered superior to those of other countries; but German manufactured goods are much cheaper, and this country is overflowing with German commercial travellers who bring samples, and in an eloquent manner persuade the merchants to buy their cheap goods. The Germans are more active than the English, who send out very few commercial travellers, perhaps labouring under the delusion that foreigners are still obliged to send to England for their goods. Every retail house here is now visited by the representatives of German wholesale houses, who consequently get the largest amount of business.

Russia—Trade of Poland in 1886.—The year 1886 was a very bad one for the foreign trade of Poland. On the other hand, the trade with the rest of the empire has increased very much, Russia absorbing a large quantity of the goods manufactured for Poland, especially textiles. The imports from Great Britain continued in their downward tendency for 1886, and their value did not amount to one half of what it used to be before the year 1880, when the falling off commenced. Among the articles of British origin which continue to find a market in Poland are agricultural implements and machinery, Birmingham goods, machinery, power looms, Sheffield cutlery, and tools in small quantities, and spinning frames. The industrial development of Poland during the last twenty-four years has been very remarkable, and has given rise to the accumulation of great wealth among the manufacturing class, which are mostly composed of Germans and Polish Jews. In 1884 there were 6580 factories of different kinds producing £19,185,100 worth of goods, and employing 105,300 hands against £6,900,000 and 70,000 hands

THE NORTH SEA AND BALTIC CANAL.



in 1872. The chief Polish industries are iron, sugar, and textiles. Of the machinery used for the Polish textile mills, England supplies about three-fourths to the cotton and one-third to the wool mills, the rest being imported from Chemnitz and Mulhausen, and partly made in the country. English machinery is always preferred for worsted and combined yarns, and all higher class goods. The iron and steel industries are concentrated in the governments of Radom and Pietrokow. The largest works are in the south-western part of the latter, near the Silesian frontier, which may be called the Polish black country; but a good many small establishments have sprung up in the former, owing to the good quality of the ore and to the wages being lower, which, to a certain extent, counterbalances the disadvantages of being further from the coalpits and the Silesian frontier whence the coke for heating the blast furnaces is imported, Polish coal not giving coke fit for that purpose. The Polish ore is as rich as the Silesian, yielding from 25 to 32½, and occasionally as much as 48 per cent. The blast furnaces in Poland cannot supply all the pig iron required for the ironworks of the country, and large quantities are therefore imported from Silesia, and about 10,000 tons from Great Britain, *viâ* Dantzic and the Vistula—in summer, principally for the Warsaw Steelworks Company and the Koszyki Foundry. The standard price of Polish manufactured iron at works at Sosnource are:—Rolled iron, 9s. 2d. per cwt.; iron plates, 12s. 8d. per cwt.; wire, 4-9mm.—10s. 5d. per cwt. The principal smelting works, foundries, and iron and steelworks, are the Huta Foundry, Bunkowa, belonging to a French Joint Stock Company, capital £252,000. It smelts about 16,000 tons of ore from its own pits, 24,000 tons from neighbouring ones, and turns out per annum 24,300 tons of steel rails and a certain quantity of rod iron. The machinery is driven by engines of 1500 indicated horse-power, and 2000 hands are generally employed. Huta Chlewicki belongs to the Societé des Forges et Hauts Fourneaux of Paris, capital £120,000, producing 4000 tons of pig iron and 2400 tons of rolled iron per annum; has machinery driven mostly by hydraulic power, and employs 650 hands. Huta Blizyn employs 500 hands and engines of 120-horse power. The output is 2412 tons of pig iron per annum. Catharinen Hutte, a branch of the Vereinigte Königs, and Laura Hütte, of Silesia, is the principal establishments in Poland for wrought iron and rolled iron plate of all kinds—output 16,000 tons per annum. Milowitz Ironworks Company has a capital of £200,000, engines of 750-horse power, employing 350 hands; the output per annum is 6000 tons of iron plates, wire, &c. The Koszyki Foundry at Warsaw produces 6000 tons of rolled iron per annum. The Warsaw Steelworks Company at Praga, near Warsaw, has a capital of £300,000, engines of 2535 indicated horse-power, and makes principally Bessemer steel rails. The output of these works has decreased from 38,030 tons, valued at £492,635, in 1881, to 15,083 tons, valued at £174,183, in 1885. The works are about to be transferred to Kaminskaja, near Iekaterinosbaw, in South Russia, the break-up being caused by having to import all its pig iron from England, which answered as long as the duty was paid in paper currency; but when payment in gold became obligatory, which was equivalent to raising the duty over 60 per cent., competition with other works in Poland and Russia having their own blast furnaces became impossible. At Kaminskaja the company will have their own blast furnaces, and the ore is expected to yield 70 per cent. The Lilpop, Rau, and Loewensteins Engineering Works at Warsaw has a capital of £250,000, employs 1200 hands and twenty-five engines of 400-horse power, manufactures agricultural implements, bridges, machinery for breweries, distilleries, flour, oil, and sugar mills, railway trucks, threshing machines, tramcars, &c. The value of the output per annum is £270,000. Burman, Schweder, and Temler's Engineering Works at Warsaw employ 300 hands and engines of 40-horse-power, make boilers, bridges, iron pipes, &c. The value of the yearly output is £75,000. Scholtze, Replan, and Co.'s Engineering Works at Warsaw employ from 300 to 400 hands, engines of 80-horse-power; make boilers, gas pipes, machinery for saw, steam, flour, and sugar mills, steam pumps, water pipes, &c. Rudzki and Co.'s Joint Stock Company's Engineering Works, Warsaw, employ 300 hands and engines of 30-horse-power; make gearings, iron pipes, and railway water trucks. The value of the output per annum is £70,000. Ortwein, Markowski, and Karasinski's Engineering and Mechanical Works at Warsaw manufacture gearings, machinery for saw mills, steam engines from 4 to 40-horse power, steam gauges, valves, &c. There are also a number of less important establishments in which smaller articles are manufactured. The Polish coal mines are in the south-west part of the kingdom, where the iron industry flourishes. The richest seams are to be found in the district of Dombrowo, some being 40ft. in thickness. The total yearly output is about 2,000,000 tons, valued at about £550,000. The largest pits are the Graf Bernard, 176 yards deep, with engines of 1800-horse power, and the Wilhelmine and Johanna, from 80 to 85 yards deep, produced together 974 tons per day. The Kasimir mine has a capital of £150,000, employs 890 miners and engines of 1060-horse power; the daily production is 1028 tons. The Rudolph and Mortimer pit at Niwka and Zagorze is 300 yards deep, employs 1038 miners, and engines of 1850-horse power; the daily production is 1624 tons. The Victor mine, near Milowice, employs 412 miners and engines of 748-horse power; the daily production is 649 tons.

Negotiations have been entered into with the Russian Association of Navigation and Commerce and with the Black Sea Navigation Company for reducing the rates of freight, and a project for the establishment of museums in Bulgaria and Roumania for the exhibition of Polish manufactures has been submitted to the committee. It has also been resolved to send agents to Bulgaria and Roumania for the purpose of promoting commercial relations with these countries. The awakening up of the Poles to the necessity of finding new markets for their goods is the natural consequence of the great development of the country for the last few years, and British manufacturers should be prepared for an early and serious competition in the aforesaid countries, especially in iron goods and textiles.

THE NORTH SEA, BALTIC, AND THE WESTPHALIAN CANALS.

THIS long-talked-of project, which has been a wish of mariners for centuries, is at last about to become a fact, and the daily papers have already given accounts of the ceremony of laying the first stone of the lock at Holtenau by the Emperor William on the 3rd inst. The works, however, cannot at present be commenced, because it is first necessary to wait until the transportable barracks for housing the workmen are completed.

The ship canal is to be international as well as national. In regard to the first object, it will reduce the sea passage, as compared to the Sound route, by 237 sea miles, shorten the journey of sailing vessels by at least three days, and that of steamers by about twenty-two hours in normal weather, and these advantages are to cost the shipowners 9d. per registered ton when the canal is navigable. About 35,000 vessels pass through the Sound annually. With reference to the second, it is intended to strengthen the offensive and defensive power of Germany. However, it may be remarked that Count Moltke never from the first gave the plan his cordial support from a strategical point of view, maintaining then as now that the money which the canal is to cost would have been more judiciously spent if employed to strengthen the national navy.

Before referring more particularly to the great ship canal, it will be interesting in an industrial sense to say a few words concerning the project of another canal, namely, from the Rhine through the Westphalian coalfield to the Ems, which later on will bring the German coal into very close competition with English at the North Sea and Baltic ports. The plan is a very old one, and was resuscitated some thirty years ago, but nothing came of the project till two sessions ago, when the Chambers voted a large sum to carry it out under Government, provided the interested country districts through which the canal was to pass, beginning for the first at Dortmund, would acquire the requisite land through which the canal was to be cut and hand it over for the common good. The money has been coming in since by driblets, slowly and reluctantly, from one township and the other, but at last it seems probable that it will ultimately be subscribed, and for this eventuality English coalowners must be prepared. A glance at a map will show that from Dortmund to Emden, and thence through the North Sea Baltic Canal, a very direct route to the East seaports will be opened up; and as the Westphalian coal can then be placed at Emden at the same price as the English at one of the east coast shipping ports, and the distance from Emden to the Baltic by the new ship canal is twenty-three hours less than from Hull, twenty-seven from Hartlepool, thirty from Newcastle, and thirty-six from Leith, it is evident that a sharp rivalry will here be established. If the ship canal be not used, the difference in time between Emden and the Baltic will be less by thirty-eight hours from Hull, thirty-six from Newcastle, thirty-five from Hartlepool, and forty from Leith. No steps have yet been taken with regard to the continuation of the canal from Dortmund to the Rhine, which would then open up a new and shorter waterway from South Germany and Switzerland to the Baltic.

Returning to the Baltic ship canal; it begins at Holtenau, a small village just north of the royal dockyard of Kiel, on the Baltic and enters the Elbe fifteen miles above the North Sea, near Brunsbûttel, and will have a total length of 75 to 80 kilometres as seen on the accompanying sketch map. Its width is to be on the water surface 60 m.; on the bottom, 26 m.; its depth is to be 8½ m., and its total cost 156 million marks, as estimated. The canal may be looked upon as a mere cutting, in which the water level is to be that of the Baltic Sea, and there will only be floodgates or sluices where it enters the river Eider and at its termination in the Elbe; and these will be, as a matter of fact, kept open all the year round. For the convenience of the Royal Marine rather extensive works will be carried out at the Elbe embouchure, consisting of large and small locks, and eventually a floating basin for at least four large armour-clads, besides coaling stations at either end of the canal. The four railways crossing the canal, as well as the two main post roads, will be carried over it by means of iron swing bridges; and steam and manual pontoons will serve for the other various crossing-points of the canal. There are no engineering difficulties to contend with, excepting perhaps a boggy portion not very remote from the Elbe. The highest point of cutting is about 24 kilos. distant from the Elbe, and here it will be 30 m. deep to the bottom level of the canal, otherwise the ground to be removed is mostly sand or sandy loam.

STEAM PLOUGHS AND AGRICULTURAL ENGINES.

ON Tuesday a numerous party of visitors were invited to an inspection of the works of Messrs. John Fowler and Co., at Leeds, and also to a steam-ploughing exhibition at Scholes, in the outskirts of the town, where the newest and most approved types of engines and implements made by the firm were to be seen in operation. Although steam cultivating machinery is the branch of engineering with which the name of John Fowler and Co. is most prominently identified, the extensive works they

have erected at Leeds, and of which in our present notice we can only give but a very brief description, embrace several other important branches, in which the firm have obtained high repute. In addition to steam cultivating engines and machinery of almost all descriptions, they are largely engaged in the manufacture of traction engines, road rolling engines, and road locomotives and wagons; semi-fixed and stationary engines of various types; electric light engines, colliery engines and plant, air-compressing engines and machinery of every kind, boilers of almost every type, light railway plant, locomotives and rolling stock for plantation work, mines, and military purposes, improved clip pulleys, wire ropes, &c. The special plant and the processes of manufacture in the above varied branches of industry were seen in operation, but we must content ourselves with simply noticing the principal features that presented themselves. Commencing with the foundry, which covers a large area and gives employment to about 150 men, an interesting feature is what is designated the "circus." This, as its name implies, is in the form of a ring, around which are placed about 400 moulds specially arranged for casting cultivator points. While the casting is in operation at one side of the ring, the finished castings are being taken out on the other, and the moulds again made ready for the reception of fresh metal, an arrangement which enables casting to be carried on continuously throughout the day. Castings up to 40 tons are frequently made in the foundry, and it is fitted with powerful cranes for handling heavy weights. The boiler-making shop finds employment for about 100 men, and almost every conceivable boiler is made, from the smallest locomotive to the largest double-flued Lancashire boiler. This shop is supplied with all the most modern tools for hydraulic rivetting, for planing, punching, shearing, and drilling, one of the last-named machines being capable of drilling a dozen holes in a boiler-plate simultaneously, whilst it can be made to drill through twelve plates at one operation; a powerful hydraulic press for flanging iron plates into any required form is also a special feature, and on both sides of the press are furnaces for heating the iron prior to the operation of compression. In the "grindery" there are ten stones for grinding wrought iron and steel work to a finished surface, and a number of emery wheels. Adjoining the grindery is a battery of seven boilers, which generate the steam for the numerous stationary engines and for the hammer in the smithy, and a noteworthy feature about these boilers is a specially designed firing arrangement. The coal is brought in trucks from the Midland line close to the fires, and by means of a sloping board is shot into hoppers, from which it is conveyed into the furnace by a self-feeding apparatus; by this arrangement the whole of the boilers can be looked after by two men. In the smithy, which contains upwards of fifty hearths, besides steam hammers and hydraulic presses, there are special machines for making studs and small pins and bolts, and a very powerful punching and shearing machine. The fitting shop is arranged in two stories, the main or lower one being devoted to heavy work, and the upper to the lighter class of articles. Here the most modern machine tools have been put down, and one speciality is a large machine for planing, slotting, drilling, and shaping, the bed of which is 50ft. in length. The erecting shop covers a large area, and is traversed from end to end by two powerful travelling cranes, capable of lifting 20 tons, and this portion of the establishment is lit throughout by the electric light, as it is frequently necessary to keep this section of the works going night and day.

What is known as the "Plough shop" is specially laid out for the completion of every kind of agricultural implement, from the largest single-furrow plough, capable of making furrows 2ft. wide and 2ft. 6in. deep, to the lightest seed harrow. There is also a special building for the manufacture of steel wire ropes, a branch of industry which is an offshoot of the manufacture of the steam plough. A few years ago the firm purchased the wire rope they required, but expedience made it incumbent to manufacture it on their own premises, and for this purpose the most efficient machinery has been laid down.

With regard to the work in hand, to be seen in various stages of construction throughout the different shops, the most important, of course, was the manufacture of steam cultivating machinery, and of this it may be stated, that in steam ploughing the firm have now practically abandoned their former system of employing one engine and a set of "anchors" at the corners of the fields, by which arrangement the plough was pulled round about, and now manufacture nearly all their steam ploughing apparatus on the double-engine system, which requires two traction engines, fitted with winding drums, moving along opposite headlands, and the plough is drawn backwards and forwards in a straight line between them. The steam ploughing engines manufactured for the double-engine system are made of 4, 10, 16, and 20-horse power, and they are constructed with steam jacketted cylinders, and provided with steam domes. The road gear is made entirely of crucible steel, and the road wheels are of wrought iron from 16in. to 24in. wide. The engines have two travelling speeds, and are available as traction engines or for any agricultural purpose, and they are also made on the compound principle. Of the several varieties of cultivating implements to be used with these engines, one very popular type which is being made by the firm is their patent balance plough. The frame of this implement is very strong and rigid, and an adjustable width of furrow is obtained by means of a wedge, which throws the ploughs at different angles to the frame, and entirely dispenses with bolts and nuts. There are also a number of other special implements, which we cannot, however, deal with here, and we pass on to notice Messrs. Fowler and Co.'s system of steam traction. Five classes of traction engines are manufactured — the road locomotive, specially constructed for road work, but applicable also to farm operations; the traction engine or agricultural locomotive, designed for general purposes; the Sutherland engine, which represents a patent combination constructed very much on the principle of the road locomotive for traction, reaping, rolling, and general purposes; the military traction engine, specially designed for military purposes; and the combined traction engine and road roller, the general structural principles of the whole of which are much alike, and only vary in matters of detail and in their adaptation to special purposes. Engines and boilers for mining and general purposes are also an important branch of manufacture. Amongst their engines the patent "Yorkshire" semi-portable and the "Yorkshire" compound engines of the independent or fixed type are perhaps the best known. Numerous modifications of the semi-portable engine are also made, notably with one drum fixed on a shaft for winding, and with two for hauling. Winding and hauling engines are also made of somewhat different design for collieries, and in this connection passing reference may be made to the well-known clip pulley for communicating power to a wire rope. We may add that the largest winding engines erected at any colliery in this country were constructed at Messrs. Fowler's works. These were for the Harris Navigation Coal Company, South Wales, and the engines are of the inverted cylinder type, with cylinders 54in. in diameter by 7ft. stroke. The winding drum is of the conical type, constructed almost entirely of steel, and at its smallest diameter is 18ft., and at its largest diameter 34ft. The weight of the drum with its shaft, cranks, &c., is over ninety tons, and the gross weight of the engine complete is about 460 tons. Messrs. Fowler have also supplied the same colliery with a second large pair of winding engines, and also a pair of very large air compressors for supplying air to the underground operations of hauling and pumping. Air compressing machinery may in fact be said to be a speciality with the firm, and they are now engaged on three sets of air compressing plant, each of 1000-horse power, for the Birmingham Compressed-Air Power Company. These are beam engines of the triple expansion type, the air cylinders being single-acting, and are inverted on the top, one being placed over each end of the three beams. Portions of these engines were to be seen in various stages of manufacture in different sections of the works; in the foundry the visitors were shown the moulds for several parts, and it may here be added that the cylinders require to be made of a specially prepared metal, and exceptional care has to be exercised to ensure a perfectly sound casting. The manufacture of engines for electric light driving is also an important speciality at Messrs. Fowler's works, and one of their large tool shops is kept pretty near fully employed on this class of work. One important job which they have at present in hand is a complete plant of engines and boilers for the electric light installation at the Government Gun Factory at Enfield. The visitors had an opportunity of inspecting in the foundry a foundation plate for the engines, the castings for which weigh about 5 tons, and are made under the immediate inspection of the engineer of the Government departments. Messrs. Fowler have endeavoured to introduce the best type of engine it is possible to get for electro driving, and a special feature in the engines they are now making is the patent automatic expansion gear with which they are fitted. This automatic gear and governor is the invention of Mr. W. Hartnell, of Leeds. The governor is very powerful, but extremely simple in its action, and the valve in the cylinder is formed with a series of V-shaped ports, the slightest movement of which at once makes itself felt, and an instantaneous cut-off can be secured when required. The whole arrangement is free from any complication, and ensures, it is claimed, the most effectual control over the engine.

Another interesting speciality at the works is the manufacture of portable and semi-portable railways and rolling stock, and a train of 2ft. gauge, with various types of wagons, for sugar estates, earthworks, &c., was shown in operation. The locomotive attached to the train was of a new type, and is carried entirely on three points, so that however irregular the line may be, no more weight can be thrown on one wheel than on the other, the weight being always equally distributed on the four driving wheels in whatever position the inequalities of the line may throw them. The springs which carry the driving wheels are centred in a similar way to that of a beam and scales, and the engine has a bogie of novel construction—English's patent—by which little or no friction is incurred in going round curves; the engine frame is hung upon a crank, which gives any amount of play that can be needed; in fact much more play than would perhaps be desirable on an ordinary English line, its special purpose being to meet the exceptional requirements of light locomotives and narrow gauge and portable railways used chiefly abroad. The engines can be constructed, if required, on the compound as well as on the ordinary principle, and in the compound arrangement both cylinders can be used as high-pressure cylinders at any moment when additional power is required for ascending steep gradients, or at starting with heavy loads. The valve gear is Joy's patent, which greatly simplifies the motion and reduces the number of wearing parts; whilst the motion is all outside the frames, and easy of access for lubrication or repairs without placing the engine over a pit. Coal, coke, or wood may be used for firing the locomotive, or a special feeding apparatus can be attached for using petroleum. After the inspection of the various portions of Messrs. Fowler's extensive establishment, and luncheon at the works, the visitors proceeded in wagonettes to a large field, some sixteen or seventeen acres in extent, at Scholes, on the outskirts of the town, and here a large collection of the newest and most approved types of engines and implements manufactured by the firm had been brought together. We cannot attempt anything like a detailed description of all the agricultural plant and appliances which Messrs. Fowler had here on exhibition, and must content ourselves with selecting for notice several of the engines and ploughs which embrace the most recent improvements introduced by the firm. The chief novelty was a compound four-wheel-driven road locomotive. Special advantages are claimed for driving all the four wheels of traction engines, and during the past year Messrs. Fowler have fitted some of their ordinary agricultural engines with their patent driving-gear, by which the front wheels can be driven without interfering with the locking of the front axle. In the engine exhibited on Tuesday they have embodied their patented arrangement in an entirely new design of engine, in which both front and hind wheels are driven by spur-gearing, and all over-neck bearings are dispensed with. Both pairs of wheels are of the same size, and are both fitted with differential gear to enable the engine to turn sharp curves with ease, and the whole of the working parts is carried within frames as in an ordinary locomotive, so that the boiler is thus free from all strains due to the working of the machinery and the jolting of the road. This engine is intended entirely for road traction work, and in consequence of the additional adhesion obtained by the front wheels, it will, it is claimed, pull a much heavier load with less wear and tear to both roads and engine. For the steam-ploughing exhibition two new 16-horse power compound ploughing-engines were first got to work. These engines are fitted with winding-drums, steel rope and coiling gear for the double-engine system of cultivation, and they have fast and slow speed for the pulling-rope, so that the engines can be used for any agricultural operations; they are also fitted with fast and slow speed for travelling on the roads. One of these engines was stationed at each end of the field, and attached to what is termed a single-furrow vine-plough of new design; this is a strong balance plough, constructed to turn a furrow 2ft. wide by 2ft. 6in. deep, specially designed for vine cultivation, and it created some astonishment by the ease with which it did its very heavy work. It has shares of cast steel with renewable steel bar points, and is fitted with subsoil tines and renewable points to work 6in. below the bottom of the furrow. A two-furrow deep plough, which has been specially designed for heavy land, where deep ploughing is necessary, was next tried; and to this followed an exhibition of a contrivance styled a mole-draining plough, an implement which, burrowing in the earth at a depth of 2ft. 6in., leaves a drain, which it is claimed answers its purpose very effectually. Several of Messrs. Fowler's well-known types of engines and implements for various agricultural purposes were next put to work, which we need not here specially notice; there were, however, on the ground, one or two other implements of new design, of which a short description will be of interest. Amongst these was a seven-furrow patent light duplex plough, with a patent self-acting anti-balance gear, specially constructed for cultivating wide tracts of land, and for shallow ploughing from 4in. to 6in. deep. The frame is in two parts, each independent, and centred in the middle so that each may rise and fall to suit inequalities of the land. The special feature is a peculiarly arranged rack, working on a pinion by means of which the plough, by the action of the pulling-rope, is automatically thrown out of balance when it is at work, and the balance restored at the headland when the plough is reversed. The advantage of this arrangement is that the plough is kept very much better into work, which in light ploughing is of very great importance, and the implement can be driven much faster than has hitherto been possible with purely balance ploughs. Another special implement was one designed with the object of finishing the cultivation of the land at one operation, and it is termed a combined implement for cultivating, rolling, and harrowing. This implement is specially suitable for spring and after harvest work, when the land is in a dry state, and from Messrs. Fowler's description of its action it is capable of quite a multiplicity of agricultural operations. It cultivates the land, rolls or consolidates it with a heavy roller of the flat, Crosskill, or Cambridge type, and finally drag-harrows it, the tines for this purpose being placed close together as in an ordinary harrow. The implement is carried on rollers, so that it does not sink in soft or irregular land, and by this means ensures a uniform depth of cultivation, whilst the roller breaks the clods, and leaves the land in good condition as a seed bed.

AMERICAN DRILLS.

It is a curious circumstance that a company making only one class of machine tools should find ample employment, yet such is the case; and we illustrate on page 490 two of the tools made by the Radial Drill Company, of Cincinnati. Americans have long enjoyed a good reputation for drilling machines, which they specially design to be "handy" in the fullest sense of the term. The drill at the left-hand side of the page is of the type known as No. 1 and 2. The differences are set forth in the accompanying table. The column which carries the arm, driving-gear frame, &c., is bored and fitted over a stationary stump, bolted fast to the sole plate. This stump has sufficient length of bearing to prevent the column from swaying, and is provided with an adjustable pivot bearing upon an elastic diaphragm in the column, which, when the bolts in the flange at the lower end of the column are slackened, takes the weight of the machine off the flange bearing, and allows the column, with arm, &c., to revolve easily the entire circle. For ordinary drilling, the bolts in the flange need not be tightened, but when extraordinary rigidity is required a partial turn of the wrench will bind the column fast to the sole plate. The sleeve which carries the arm and gear frame is fitted snugly to the column, and may be raised and lowered by power, and is provided with clamping bolts. The table has both horizontal and vertical faces, and is provided with T slots. The arm and spindle frame have swivels that will revolve the entire circle—so that a horizontal line of holes may be drilled at any angle parallel with each other by adjusting the angle of the arm, and traversing the saddle on the arm, and a vertical line may be drilled at any angle by adjusting the angle of the spindle frame, and moving the arm vertically to any point desired on the column. A hole may be drilled vertically downward, vertically upward, or at any angle within the range of the arm. The counter-shaft consists of a frame with horizontal shaft and T and L pulleys, and a pair of cut mitre gears to connect with vertical shaft at centre of the top of the column. All gears are cut, and the bevels and mitres in arm and spindle frame are made of cast steel and cut. The spindle, feed screw, and elevating screw are made of machinery steel, and the feed worm is made of the best tool steel, and hardened; all the thrust bearings are provided with phosphor bronze washers. The dimensions and weights of both are as follows:—

	No. 1.	No. 2.
Diameter of column	11in.	13in.
Height of column	7ft.	8ft.
Length of arm	5ft.	6ft.
Drills to centre of circle, outside of column of	8ft.	10ft.
Greatest distance from sole plate to end of spindle	5ft. 5in.	6ft. 1in.
Greatest distance from floor to end of spindle	5ft. 10in.	6ft. 7in.
Total height of machine without counter-shaft	8ft. 3½in.	9ft. 6in.
Total height of machine including countershaft	9ft. 7in.	11ft. 1in.
Total height of table from sole plate	20in.	24in.
Size of table	20in. × 20in.	26in. × 26in.
Diameter of spindle	2½in.	2⅝in.
Size of hole in spindle, Morse socket, No. 4	1¼ with ⅝ taper	1¼ with ⅝ taper
Traverse of spindle	11in.	19in.
Size of counter-shaft pulleys	12in. × 3½in.	12in. × 3½in.
Speed of counter-shaft pulleys, per minute	180 revolut'ns	180 revolut'ns
Width of belts on cones	2½in.	3in.
Floor space required for base	70in. × 54in.	86in. × 60in.
Weights, about	4000 lb.	8000 lb.

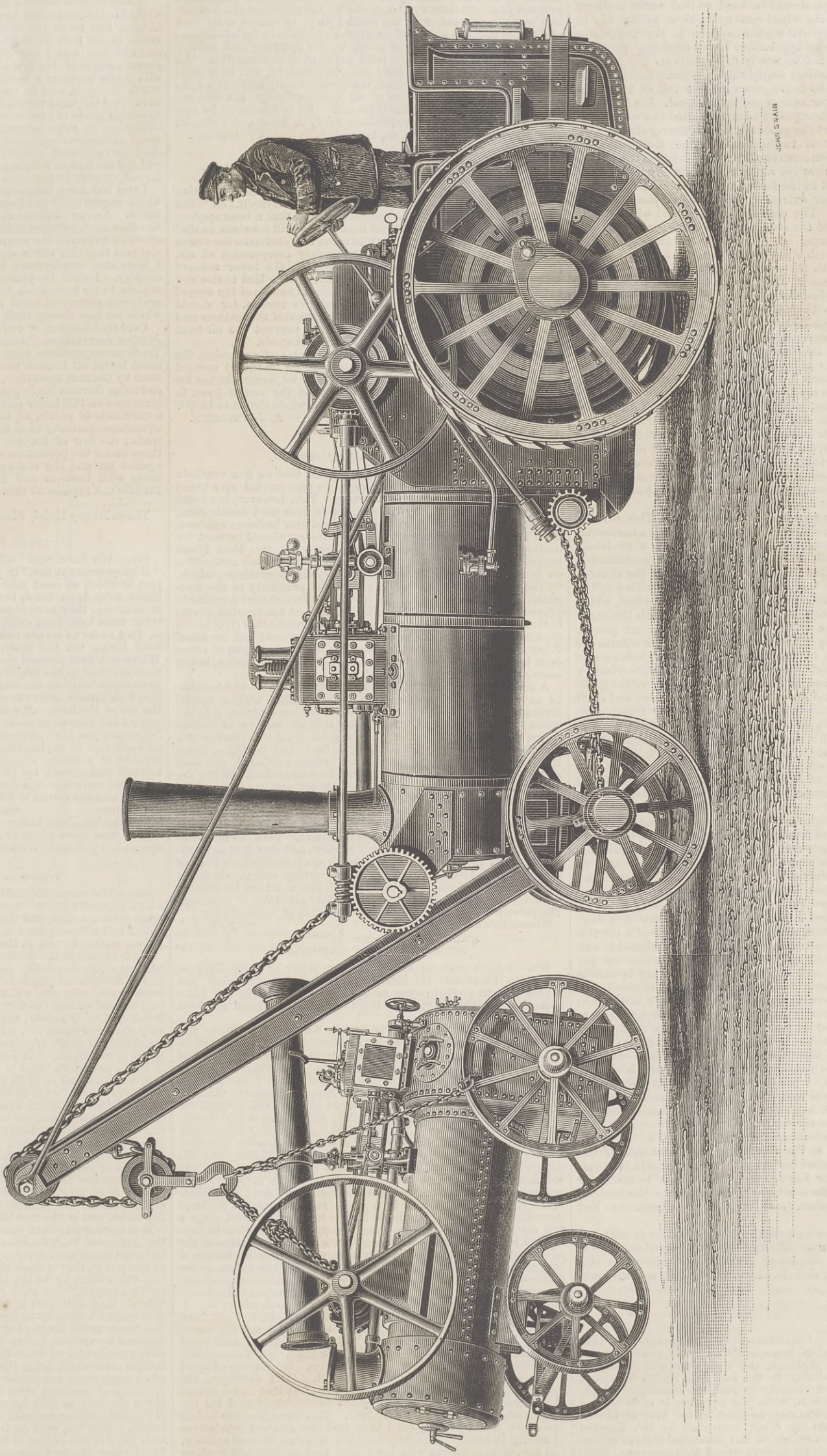
The machine to the right is known as No. 0, 1, and 2. This machine will drill or bore a number of holes parallel with each other—vertically downward—anywhere within the range of the arm. The spindle is geared with unusual power, has quick return, and is counter-balanced for heavy boring. The column which carries the arm, driving gear, and frame, is identical with those already described. The dimensions are given in the following table:—

	No. 0.	No. 1.	No. 2.
Diameter of column	10in.	11in.	13in.
Height of column	6ft.	7ft.	8ft.
Length of arm	4ft.	5ft.	6ft.
Drills to centre of circle outside of column, of	6ft.	8ft.	10ft.
Greatest distance from sole plate to end of spindle	4ft. 1in.	5ft.	5ft. 10in.
Greatest distance from floor to end of spindle	4ft. 5½in.	5ft. 5in.	6ft. 4½in.
Total height of machine without counter-shaft	7ft. 5in.	8ft. 3½in.	9ft. 6in.
Total height of machine including counter-shaft	8ft. 8½in.	9ft. 7in.	11ft. 1in.
Total height of table from sole plate	20in.	20in.	24in.
Size of table	20in. × 20in.	20in. × 20in.	26in. × 26in.
Diameter of spindle	1⅛in.	1⅛in.	2⅜in.
Size of hole in spindle, Morse sockets, No. 3 and No. 4	⅜ with ⅝ taper	1¼ with ⅝ taper	1¼ with ⅝ taper
Traverse of spindle	15in.	15in.	20in.
Size of counter-shaft pulleys	12in. × 3½in.	12in. × 3½in.	12in. × 3½in.
Speed of counter-shaft pulley, per minute	180 revolutions	180 revolutions	180 revolutions
Width of belts on cones	2½in.	2½in.	3in.
Floor space required for base	63in. × 51in.	70in. × 54in.	86in. × 60in.
Weights, about	3500 lbs.	4500 lbs.	8000 lbs.

COMBINED TRACTION ENGINE AND CRANE.

MESSRS. C. BURRELL AND CO., THETFORD, ENGINEERS.

(*For description see page 482.*)



TURBINES AT THE MANCHESTER EXHIBITION.

WE place before our readers on p. 486 illustrations of several turbines made by Mr. W. Günther, Central Works, Oldham, and exhibited at Manchester. These turbines are four in number, and include three Girard and one suction turbine. We may preface our description by pointing out that the great advantage claimed for the Girard turbine over all others is that it yields proportionate power—within one or two per cent.—with reduced supplies of water, even if the supply decreases to one-sixth or one-eighth the normal quantity. Turbines of the Girard type should be fixed so that under ordinary conditions of working the wheel runs quite close to the top of the tail water; but they will work immersed in the tail water during flood times without appreciable loss of efficiency provided they are working with full or nearly full injection.

The largest of the turbines exhibited is a Girard turbine for a medium fall, yielding 90-horse power with a fall of 22ft., and making 96 revolutions per minute under this head. We illustrate this turbine in Fig. 1. Four pillars, securely bolted to a strong cast iron foundation, support the guide ports with the regulating slide apparatus and the steel turbine case. The turbine wheel —42in. diameter between centres of buckets—is keyed to a hollow cast iron shaft, which revolves round a fixed steel shaft cottered into a foot block bolted to the foundation plate. The fixed steel shaft carries at its upper extremity an oil vessel, containing an adjustable steel plate. The cast shaft is arranged with a flange corresponding to that of the coupling for connecting the driving shaft. Below this flange, in the interior of the shaft, is a wrought iron screw with a bell-metal footstep at the bottom. This screw revolves with the shaft, the footstep working on the steel plate in the oil vessel. By means of a nut on the screw the shaft may be so adjusted—in case of wear in the footstep—that the wheel works with just sufficient clearance between it and the bottom of the guide ports. The footstep is thus entirely above water, is easily accessible, and may be readily examined or adjusted whenever the turbine is not in motion. The regulator of the turbine consists of a slide which moves over the guide ports and opens or closes one guide port on each side simultaneously. The guides are so constructed that any degree of injection may be given to the wheel by means of this slide, which will also shut the water off entirely, thus serving also as a stop valve. The slide is worked by means of suitable gearing from the turbine house, an index on the hand-wheel pillar showing the number of ports open. This turbine is shown in the Exhibition fitted up complete with governor, adjustment pillar, and hand-wheel, &c., forming a very conspicuous exhibit as seen from the main staircase leading to the galleries.

In Fig. 2 is shown another Girard turbine. This turbine is designed for high falls, and is constructed with a horizontal shaft and partial injection. In order to obtain a moderate speed under a high fall, the wheel is made of large diameter, and the water is admitted on only a small portion of the circumference. This turbine will give 102-horse power with a fall of 140ft., making 213 revolutions per minute. The wheel, which is 42in. internal diameter, is formed of cast iron, with the vanes or buckets of steel, the object of this being to secure greater strength and durability. The water, which is admitted on the internal circumference of the wheel, passes through five guide ports, the vanes of which are also of steel. A slide, worked by a pinion, worm and wheel, and hand-wheel, moves over the guide ports, closing them one after the other. The wheel and shaft are carried by three standards, bolted to a strong frame composed of wrought iron girders and cast iron cross bridges. The turbine is designed with a view to easy transport, as high fall turbines, such as the one shown, are frequently intended for use in mountainous districts where transport is difficult. A wrought iron cover, which is left off in order to show the turbine, is placed over the wheel to prevent the water splashing about in the turbine house.

Fig. 3 is also a high fall Girard turbine, but of much smaller dimensions and capacity. This turbine is similar in construction to the larger one, but the method of regulating the turbine differs. In this case a single guide port is regulated by means of a gun-metal slide, which forms the top of the port, and by moving this up or down by means of a screw, worm and wheel and hand-wheel, the area of the port is increased or diminished. The turbine, 8in. internal diameter, is placed in a cast iron case, and is coupled direct to a dynamo—Hall's patent—for electric lighting. The turbine is for a fall of 220ft., being designed to suit the speed of the dynamo, which runs at 1350 revolutions per minute. The dynamo will drive from fifty to sixty 16-candle power incandescent lamps. A turbine and dynamo similar to the one shown has been working for some time past in a mansion in North Wales, where it continues to give the greatest satisfaction.

The fourth turbine—Fig. 4—is a suction turbine with a horizontal shaft. The turbine is intended for use in places where it is desirable to place the turbine at some distance—not exceeding 25ft. to 30ft.—above the tail water-level. This turbine is similar in principle to the Jonval turbine, but differs from the latter in the slower speed of the wheel and degree of reaction. This turbine having a comparatively small diameter and large capacity, the vanes of the wheel are so constructed that the speed of the wheel at different parts of its diameter bears correct relation to the velocity of the water leaving the guide ports. The regulation consists of a slide similar in principle to the one described for Fig 1. Special provision is made for effectively lubricating the bearings under water, and the footstep works in an oil chamber, and is easy of adjustment and examination.

Mr. Günther also shows photographs of a number of turbines made by him for falls from 6ft. upwards, and the whole exhibit is probably the finest display of turbines ever shown in this country. Mr. Günther also shows several blowing and exhausting fans.

JUBILEE BANQUET AT COLCHESTER.—On Saturday, the 11th inst., Mr. Paxman, Standard Ironworks, Colchester, gave a Jubilee banquet to his staff and workmen, and their wives and daughters. About 600 sat down to dinner in the new Drill Hall, a handsome building with a somewhat remarkable roof, the framing of which, about 50ft. span, is of iron, while the covering is of Willesden waterproof paper. Mr. Paxman, as head of the firm of Davey, Paxman, and Co., was in the chair, supported by Mr. Egerton Green, the Mayor, and a number of the influential citizens of Colchester. The usual loyal toasts were drunk with immense enthusiasm, and it is a noteworthy circumstance that "God Save the Queen" was encored. There is no lack of loyalty at the Standard Works. Several speeches were made, Mr. Paxman briefly reviewing in an interesting summary the principal engineering events of her Majesty's reign. During the evening a handsome testimonial, in the shape of a silver inkstand, was presented to his son, Mr. William Paxman, who has just attained his majority, by the staff and workmen. The proceedings were in every way successful, and bore testimony to the excellent feeling existing between employer and employed.

LETTERS TO THE EDITOR.

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

NATIONAL MARITIME EXHIBITION OF CADIZ.—AUGUST TO OCTOBER, 1887.

SIR,—Through the medium of your widely-circulated paper, I should esteem it a favour if you would kindly make known that the above Exhibition will be opened on the 15th August next, and that British will be entitled to the same privileges as native exhibitors therein in the following respects, viz.:—A right to receive the medal granted to all exhibitors; to compete for the diplomas and honourable mentions accorded by the special jury; to receive orders and effect sales in conformity with regulation; to share in the advantages offered for the conveyance of goods by the shipping and railway companies; and to exemption from payment of customs dues. An elegant bazaar, to be open from dawn to midnight, will be erected within the area of the Exhibition, composed of forty tents, at a daily rent of 15f., in which articles of all kinds, although not forming part of the same, can be offered for sale. All articles must be sent in by the 31st July. For particulars apply to Messrs. J. Grimaldi and Co., commercial agents, 69, Eastcheap. U. MONTEGO.

London, E.C., June 1st.

THE PROBLEM OF FLIGHT.

SIR,—Will you kindly allow me space for a few remarks relating to the article published in THE ENGINEER of the 27th ult., on "The Flight of the Pelican." Mr. Lancaster tells us that a brief application of Hutton's Tables of Wind Resistances will convince us that the bird's flapping is far too weak to cause it to overcome the action of gravity. Is it not rather the temporary compression of air, produced by the rapid downstroke, between the lower concave surface of the wing and the body that enables the bird to rise and not the wind resistance produced by the rapid motion of the wings? Nor need the upward stroke retard the bird's motion, for should the air above be slightly compressed the position of the feathers and the raised head during upward motion will prevent the air from rushing forwards and so pushing the bird backwards.

Taking the example given by Mr. Lancaster, and supposing the bird's action to cause the same result that an increased upward pressure of $\frac{4}{5}$ lb. per square inch acting on 60 square inches for $\frac{1}{3}$ sec., we find the bird's upward velocity at the end of $\frac{1}{3}$ sec. to be $21\frac{1}{3}$ft. per second, and at the end of the whole stroke to be $\frac{2}{3}$ft. per second. A. J. CRICHTON.

5, Stonor-road, West Kensington, June 7th.

THE VENTILATION OF SEWERS.

SIR,—A few months ago it was suggested that we now ventilate town sewers too freely, and that merely a pipe carried up a house here and there is all that is necessary. This, however, is a great mistake. The gases would still exist, and in their most deadly form, and would either force house traps or escape near bedroom windows, &c. Then some persons maintain that furnaces should be used for destroying the sewer gases, but not only has this been found impracticable but the cost would be enormous. Other authorities go in simply for multiplying the ordinary street gratings—which, by the way, are often placed in unpleasant proximity to the footpaths. But wind and a number of other circumstances combine to prevent this alone curing the evil. In the best constructed sewers foul vapours will arise, and of course partial ventilation (?) is better than nothing; but in this age of progress we should look for something more than this. Perhaps to have the whole length of sewer open to the surface would be an ideal method of ventilation, but of course this would not be tolerated.

A method has recently been invented—McCallum's—which claims to have solved the problem. It is found that with a special arrangement, the air in a sewer travels in the same direction as the water; and a system of intercepting this air current at certain places is adopted. The plan preferred for doing this consists of a peculiarly-shaped valve actuated by a float, and having a hinge which cannot stick; and means are taken so that if the float should happen to leak the sewer cannot become choked. Shafts are carried to the surface at proper places to act as inlets and outlets, causing thereby a through circulation, which prevents gases accumulating; and the fresh air which is constantly being drawn into the sewer practically purifies in a natural manner the sewage emanations before they emerge into the street. This, the inventors maintain, is the proper aim to have in view, and that it is not sufficient merely to take the sewer gas in its crude state above roofs of houses. The system can be applied to existing sewers, whether a quick or flat gradient; and being automatic in action, its efficient working does not depend upon the constant attention of workmen. The principle is also applied to the ventilation of house drains.

Newcastle-on-Tyne, June 6th. N. E. S.

MODERN MILLING MACHINERY.

SIR,—I have seen an article in your paper of April 22nd on "Modern Flour-mill Machinery," and should have asked you before this to publish some remarks of mine in reply had not a somewhat lengthened visit to the Continent prevented me from doing so.

You state that the son of Mr. G. A. Buckholtz, to whom you had previously referred in your article, designed the first automatic roller plant in the world. This matter has been the subject of much controversy in the milling journals. Believing for a long time that I was the designer of the first automatic roller plant in the world, I advertised it without question for probably three or four years. Mr. Buckholtz, however, in March, 1886, claimed for himself the honour of having done this; but, Sir, as it is evidently the object of your article to give to the person who successfully established the automatic system of milling any honour that may be due to him, I beg to ask that even if Mr. Buckholtz, jun., did design the first automatic gradual reduction roller plant in the world, and moreover, as you say, carried out his invention with perfect success in the mills of Messrs. Barlow and Sons, of Bilston, in 1879, how comes it that in a paper read before the National Association of British and Irish Millers in the year 1880, after a full reference to the gradual reduction system, and what he considered its defects, and comparing it with what he considered the advantages of his low-grinding system, carried out by means of his patented low-grinding mill, he states: "We are driven to the conclusion that the granulation [semolina milling] is not suitable for general milling in this country." This statement of Mr. Buckholtz and that contained in your article do not harmonise.

In a letter I wrote to a milling journal in June, 1886, I put forth my own claims to having successfully established the automatic system in the following words:—"(1) I designed my first plant with the fixed intention of making it automatic. (2) I succeeded, with willing help, in making it also a success. (3) Having adopted the principle, I have never abandoned it. (4) I developed the system almost immediately in one way only, but that an important one, namely, I invented and patented an automatic feed for the roller mills and purifiers, March, 1881. This invention was looked upon with doubt at first, but I have had the greatest satisfaction of seeing it nearly universally adopted in some form or another, and few, if any, millers who have used such feeds would work an automatic roller plant without them. (5) My only reason for not advocating my speciality in the various papers and discussions it was my privilege to read and take part in with operative millers and others, and thus having at the earliest date a public record of my claim, was that in all those papers and discussions I studiously avoided reference to any distinguishing features of my own system."

I fully believe it was the great success of my automatic gradual reduction mills erected for Mr. Patrick Boland, of Dublin, Mr. Fredk. Moss, of Salford, and Messrs. Robinson and Hanley, of Doncaster—all of which were visited by many millers from all parts of the kingdom and from foreign countries—that led to the general adoption of the automatic system. J. H. CARTER.

June 15th.

FREE TRADE, FAIR-TRADE, AND NO TRADE.

SIR,—Some months since you were good enough to permit me to ask a few questions concerning free trade and no trade in your correspondence columns, and I do not forget that I was sharply taken to task for my errors. I think I learned something at that time, and I now venture once more to return to the subject, with a view not only to my own enlightenment, but that of others.

It may be remembered that I wanted to know how it was that while England exported no gold, she continued to import goods to at least five times the value of what she exported. It is not too much to say that to this I did not receive an explanation which satisfied me, and I now venture to ask again why it is that a pound's worth of English pig iron will buy in France £5 worth of silk, while a pound's worth of cotton yarn will get nearly £6 worth of sugar, and so on. I may say that, for my own part, I have tried the experiment, and find that it will not work. When I consign goods to France and get other goods in return, I find the difference in value almost infinitesimal as compared with the usual statements gathered from Board of Trade reports, &c. I shall be very much obliged to any reader of THE ENGINEER who will tell me how to take my goods to a market 500 per cent. in my favour, or even 10 per cent.

I also laid down the proposition that that country was best off in which employment was found for the largest number of the population. No one disputed this, I am happy to say. My deduction was that moderate and judicious protection was in the present day essential to secure the employment of the greatest number; but I was told that this was a complete error. For many months back I have seen employment becoming scarcer and scarcer in this country. I shall be pleased if any of your correspondents could explain to me how much worse off we should now become with a moderate protective tariff and the whip-hand of those countries which are now closing their ports against us.

I see that London is employing very large numbers of men on Jubilee decorations, illuminations, &c. Will some of your Free Trade correspondents take the trouble of explaining to me how much better off London would have been if all this work had been done by German operatives, working at lower wages than Cockneys and using German made gas-fittings, &c.? I am in a state of dense ignorance on this latter point. I am indeed absurdly ignorant on a multitude of points, as, for example, the precise nature of the advantages accruing to us as a return for the ruin of the milling trade; the flow of English capital to Canada to start ironworks there under the protection of a high tariff; the closing of Russia against us, and the consequent development of her native iron trade with German and English capital. No doubt the Free Traders can explain all this. I hope they will, and I remain

A TRADER.

The Salisbury Hotel, Fleet-street, June 15th.

STEEL CYLINDER LINERS.

SIR,—We have read with great interest the able article on "High-pressure at Sea," in your issue of June 3rd, but there is one part to which we must take exception, viz., where you say, "Steel liners have been tried, but the results obtained have not been satisfactory, they were found to be liable to crack, &c." This we think must have been written under a misapprenshion, for the fact is, that so far as we are aware no engines for ships for H.M. Navy built during the last twelve to fifteen years have been without Whitworth fluid pressed steel liners, and of the many hundreds we have supplied to the English and various foreign Governments we have never heard of one single liner cracking; we have, however, heard on various occasions of serious accidents being prevented by the use of the liner. We feel no compunction in asking you to correct the statement made in your issue of the 3rd, knowing how frequently you have advocated the use of thin liners, and we have no hesitation in saying that we could supply liners of $\frac{1}{4}$in. thick capable of standing almost any pressure required, and we could further make them up to the largest diameter. It is true the merchant marine have not adopted these liners to any appreciable extent, and the reason of this is solely the small extra first cost of the engines. SIR JOSEPH WHITWORTH AND CO.

Manchester, June 13th. H. S. CARINGTON.

[The steel liners which to our own knowledge have cracked were not made by Messrs. Whitworth.—ED. E.]

TORPEDO BOAT CASUALTIES.

SIR,—The very remarkable article on "Torpedo Boat Casualties," which appeared in your issue of May 27th, demands more than a mere passing notice, and this notice it should have received earlier, only I had not completed the inquiries, which I deemed necessary before writing to you, in time for last week's issue.

With regard to the earlier part of the article, which treats of the wisdom of the Admiralty in testing the flotilla of torpedo boats, and of the reasons which led those in authority to decide that the boats should race over a distance of about 100 miles, I have little to say, beyond stating the fact that according to the officers in command of Nos. 47 and 57, the actual distance run by the boats was only about 86 miles, *i.e.*, sea miles or knots. This matter is not apparently of much importance, but the distance serves to fix the speed of the Thornycroft boat No. 46, which is stated to have come in third, and whose time is given as 5 hours 15 min. These data give a mean speed of 16·38 knots, which, when compared with the measured mile speed of 21·018 knots, or the speed during the run of two hours of 20·522 knots which this vessel attained on her official trial with a trained crew, will give an idea of the skill of the engine room crew on board at least one boat in this memorable race, even after discounting the possibility of this boat being more heavily laden than upon her official trial, and allowing for the influence of the tide, which may have been for a portion of the time at least against her. Although many of our boats did considerably over 21 knots on their trials, I have it on good authority that the mean speed of the winning boat in the race was something like $16\frac{3}{4}$ knots, and of the last $12\frac{3}{4}$ knots.

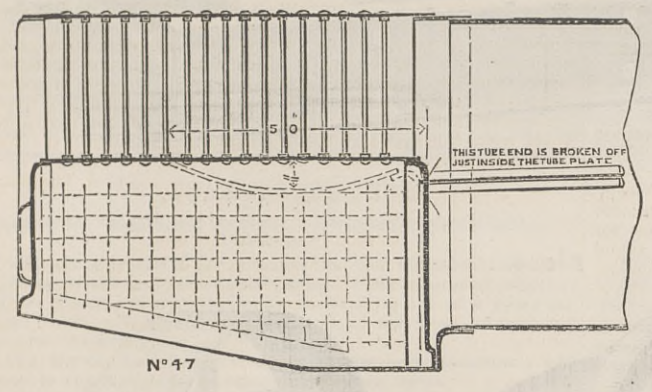
It is a great pity that you did not continue your quotation from the *Army and Navy Gazette* a few lines further; if you had, or if you had read them more carefully, you would have seen it stated, not as you put it, that "there were four boats by Messrs. Yarrow and Co., three boats by White, of Cowes, the remaining seventeen were by Thornycroft," but that "only three of Yarrow's and four of White's boats took part in it to fifteen of Thornycroft's," and this statement I believe to be correct, as there were originally twenty-four boats in the flotilla, but one of ours and one of Yarrow's were disabled by collision before the race. You could then have run your percentages up from 41 to 46·6 per cent., or 466 out of every 1000, a ratio which from the magnitude of the figures employed looks much more remarkable than 7 out of every 15; although the difficulty of manning even the 100 boats of which you write so glibly can only be fully appreciated by those having a knowledge of the difficulty experienced in manning the twenty-four boats of the flotilla. Now Sir, with regard to the nature of the failures which took place in the engine or boiler-rooms of Nos. 27, 41, 50, 42, and 55, of which you first profess ignorance, but fancy, before you have done, that your readers will be of the opinion you hold that "the main cause of the failures must be sought and found in the machinery of the boats, and even in the boats themselves."

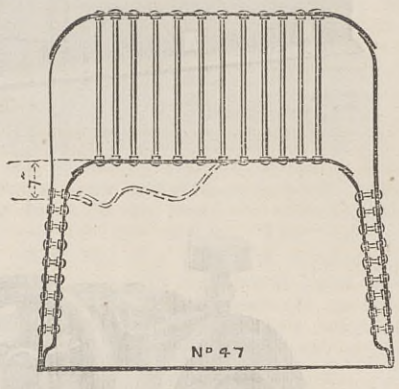
Why "the main cause of the failures must be found in the machinery of the boats, and even in the boats themselves," I am at a loss to understand. Now I have gone into this matter, and your readers shall judge if weakness of the machinery or boats had much or anything to do with the breakdowns. On No. 27, the split pin in the bottom of the slide spindle of the fan engine worked out after the boat had been running for half an hour, and the nut

came off, bending the spindle. This took two hours to put right, but there was no reason whatever for stopping the boat, as she might have continued on her course without the fan, at a speed of twelve or thirteen knots. Our engineer, Mr. Brown, reckons that with his crew, the fan would have been running in an hour. There were no hot bearings, as stated by the correspondent of the *Army and Navy Gazette*, and quoted by you. Nos. 41 and 50 had hot bearings—so hot that the white metal ran out of the after crank-pin brasses.

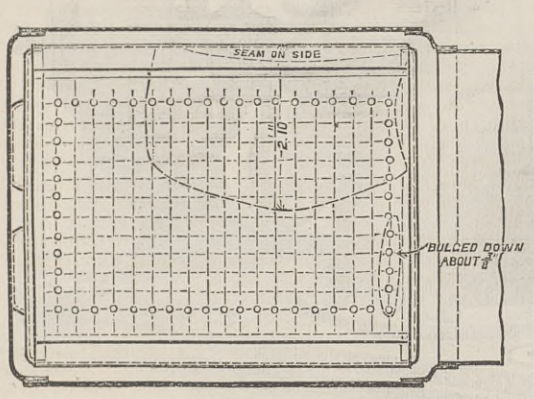
Now in all our boats the appliances for cooling approach very near perfection, and a very hot bearing can, as you say, be cooled in a very few minutes, and a boat will not be much retarded thereby. If, however, the appliances are not resorted to till the white metal has run out of the brasses, the case is very different, and the boat, if able to go at all, will only do so very slowly. In No. 42, the joint between the starboard feed check valve and the boiler gave out, and at each stroke of the pump, the water was spurted against the front of the boiler. The proper treatment would have been to shut off the starboard pump and run with the port only, and the donkey if necessary. This has been done more than once by our crew, but the crew on No. 42 drew the fire and re-made the joint. In No. 55 there were no serious defects, but the tubes leaked, a trouble which often occurs in torpedo boat boilers, and is not confined to the boilers made by one firm. Now can you honestly say that the defects which stopped these boats "have been due to the desire to make the machinery of the boats as light as possible," or could be remedied by an addition of weight to that machinery? I think not. We now come to the casualties in Nos. 47 and 57, which are the most serious in our fleet of fifteen boats, three men having unfortunately lost their lives in No. 47, and the crown plates of the furnaces being destroyed in both boats.

After the disclaimer by Messrs. Yarrow and Co. in your issue of June 3rd, your readers will be quite prepared for the statement which I now make, that the boiler styled the Thornycroft boiler in your article does not represent the boiler fitted by us in any of the boats of the flotilla. In fact, the two sets of drawings representing respectively the Yarrow boiler and the Thornycroft boiler may be said to illustrate the article, but they have nothing whatever to do with any boilers fitted in the boats of the flotilla beyond showing the bolt-headed stays in the one case and the rivetted

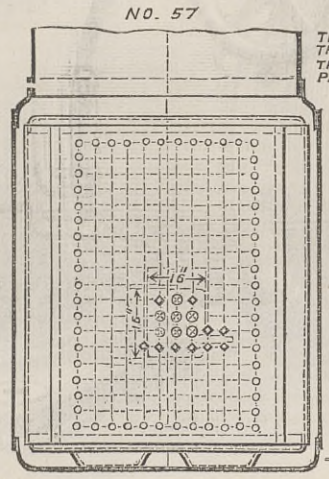




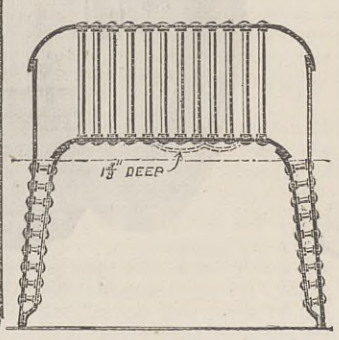
NO. 47



NO. 57



NO. 57



THORNYCROFT FIRE-BOXES.

stays in the other. You are quite correct in stating that our boilers have rivetted stays in the crown of the fire-boxes, and that Messrs. Yarrow and Co.'s have bolt-headed stays, and if in denying "that a screwed and rivetted stay is just as strong as a screwed stay with head and nut," you mean that the screwed and rivetted stay has not such a firm hold of the plates as a screwed stay with head and nut, I quite agree with you; but all that it means is that you may space your bolt-headed stays a little further apart than would be prudent in the case of screwed and rivetted stays.

Altogether we have built many scores of boilers with the furnace crowns supported by means of screwed and rivetted stays without having ourselves had, or having heard of, any of the Governments to whom we have supplied them having a single accident, and the only precaution that has been taken is to keep sufficient water over the crown plates, a matter of much less difficulty than you image even in a good stiff sea. The rivetted ends of the stays in the old Lightning, which I examined very carefully on Friday week last, are as sound as they were when they left our works over ten years ago; but then as you say, "the Lightning has been managed by men of great experience." Just so. She is, I believe, the only torpedo boat in the service which has a regular crew attached to her, and until some better system of manning our torpedo boats is adopted than the present one of giving men in the reserve a fortnight's training of, at most, a couple of hours full speed running per day, and then setting them to manage a torpedo boat boiler, these boats will always be subject to accidents and to be placed *hors de combat* by casualties which ought never to occur, or which might easily be remedied without stopping the boats. Mr. Webb, of Crewe, would, I think, hesitate before placing any man in charge of one of his passenger locomotive boilers whose only recommendation was that he would like to earn a penny per day extra, and that he had gone through a fortnight's "course." I think they would hesitate also at the Admiralty if it were proposed to put engines of 700-horse power, driving a ship, in charge of the ordinary "artificer" and stokehold crew of a torpedo boat. Ships and boats call up different ideas as to their machinery, although now-a-days the machinery of boats is frequently more powerful than that of ships.

In torpedo boat machinery changes take place with great rapidity, and great watchfulness and skill are necessary in detecting those changes, and expertness in applying remedies. These qualities are partly personal and partly the result of experience, and the men possessing them should be reserved for torpedo boat work alone, and not drafted off to fill vacancies in the engine-room or stokehold of an ironclad. We have now to consider the value of screwed and rivetted, as compared with bolt-headed or nutted, crown stays in the case which is rarely if ever contemplated in practice, viz., when there is no water over the crown plate. As an engineer I am quite prepared to concede that in a Yarrow boiler with bolt-headed stays and no water on the crown plate, one of the earliest manifestations of the action of pressure on a rapidly softening plate would be to bring it down in pockets between the stays, and that it "must get very hot indeed" before the heads could be forced off the stays or drawn right through the plate.

Unfortunately it does get very hot indeed, and I should expect that when that somewhat vague temperature is attained the top would give way suddenly and go through the bottom of the boat, as, I believe, happened in the case of the Russian torpedo-boat Sulina—said, by the way, to have been built in England—in the Black Sea. According to the account in the *Revue Maritime et Industrielle*, the Sulina left Odessa on August 11th, 1879, and was followed by the Sterlet at a distance of five miles, the officers of which saw a great cloud of steam, then two black masses, and when the cloud disappeared the Sulina had sunk. The two survivors thought that the explosion was caused by shortness of water in the boiler. The Sulina must have had a good rate of speed, as she is said to have run seventeen miles an hour on the day of the disaster. Now, what took place on No. 47 boat? I examined the boiler very carefully, and I found that not only had the top been red-hot, but the sides and tube-plate had been red-hot also, for about 6in. down. Many of the tubes in the upper row had also been red-hot, but with all this there was no "total disruption," and everything held on except the stays, which seem to have been drawn through the plate one by one, thus gradually lowering the pressure within the boiler and checking the fire—acting, in fact, as so many fusible plugs. The appearance of the boiler with some of the stays beginning to be drawn through indicates so clearly the comparatively gradual nature of the destruction of the fire-box—I will not call it explosion—that any one looking at it could only arrive at the conclusion which I arrived at—viz., that if the air flaps in front of the ash-pan had been allowed to act freely, and the fan had been kept running, there would have been no fatal accident, and that the boat would have stopped ultimately for want of steam. Unfortunately, these flaps had been fixed up, possibly under the impression that the air would pass more readily into the furnace. It may be urged that if the flaps had been closed the front of the ash-pan would have been carried away; but I think this is scarcely likely, as the steam above the fire would have escaped through the tubes, and any passing through the fire would have escaped by the ash-pan relief door on deck, which seems to have acted perfectly. There was no sound of explosion, and the man who was in the bunker at the time trimming coal, when he came on deck asked the gunner what was the matter.

In the boiler of No. 57, although seven stays had been drawn through completely, and ten partially, nothing was known about anything being wrong till the boat came alongside the watering tank.

After what I have written, your readers will, I think, be disposed to say of our fire-boxes, when the tops are red hot, as Sir Frederick Bramwell said of the Thunderer's boiler, "If the weakest part had been any stronger, it would only have been an aggravation of the mischief." I enclose tracings of sketches showing the condition of the fire-boxes of Nos. 47 and 57 boats after the accident, which you may if you please publish for the information of your readers.

Tower House, Chiswick, JOHN DONALDSON.
June 14th.

[We do not think that Mr. Donaldson's letter calls for any comment at our hands. His ingenious defence of what we believe to be the unique practice of his firm in the matter of crown stays will be admired, and the hitherto inaccessible information he supplies will be valued.—ED. E.]

THEORETIC DIAGRAMS.

SIR,—On p. 471 in your last week's issue you publish the concluding portion of a paper by Mr. J. Jennings Campbell, on "Compound Engines for Atlantic Steamers," read before the Liverpool Engineering Society. In perusing same I find my name is mentioned in connection with a certain method of placing successive diagrams within a theoretic diagram, as follows:—"A third method has been proposed and used by Mr. Mudd of Hartlepool. He takes one zero line of volumes for all the cylinders, as in the previously described methods, but places the separate figures at distances from it, proportionate only to that portion of the clearance unfilled by compression. That is to say, when the compression is sufficient to fill the clearance of any cylinder at half the initial pressure the distance = half the clearance; if the steam is compressed up to two-thirds the initial pressure the distance will = one-third the clearance, and so on. This plan is at least as incorrect as the last, as it neither gives the correct standard area for comparison, nor the correct positions of diagrams in relation to the theoretical curve, and it makes this curve itself wrong for the same reason as method No. 1."

I think, Sir, when anyone undertakes the responsibility of describing in public the opinions of another, he should at least take reasonable pains in learning what those opinions really are. The paragraph quoted describes me as holding an opinion and using a method which I do not hold, and have never used; and which I am not surprised at Mr. Campbell branding as quite incorrect. Indeed, the description of my views is so much unlike anything that has ever fallen from me in public on this question that I fear Mr. Campbell has been content to take my opinions at second or third hand from people who did not themselves understand them. His very lucid and interesting paper proves to me that if he had carefully read p. 111 of the present volume of THE ENGINEER, and pp. 48 to 50 of the February "Proceedings" of the Institution of Mechanical Engineers of the present year, and studied the diagrams therein referred to, he would have discovered that my method is identical in every important particular with that of Mr. Schönheyder, although arrived at quite independently and in ignorance of the fact that Mr. Schönheyder had twice previously called attention to this method, viz., in 1871 and again in 1879. I have not been able yet to see either of these earlier references to the method, but as I consider Mr. Schönheyder's description on p. 64 of the "Proceedings" above referred to is quite correct, I take it for granted that his earlier statements on the subject were the same; and I therefore lay no claim to priority on the subject, as it was only quite recently when engaged upon theoretic diagrams of triple and quadruple expansion engines that I discovered the errors of the older and more common methods, and set about the development of a more accurate system. I regret that Mr. Sohönheyder did not put his views more frequently before the public so that this system might have come into general use in less than sixteen years, for I regard it as much more important than many are prepared to believe, inasmuch as by it the designer has his attention more accurately drawn to those points in his design where loss is occurring and where improvement may be sought.

I would take this opportunity of mentioning an omission that occurred in the illustration I gave at the Institution of Mechanical Engineers of the application of the principles laid down. In the discussion the hour was getting late, and speeches were restricted to five minutes in length. Under these circumstances it is not surprising that speakers should feel with unusual force the truth of Dr. Johnson's statement that "things we know are not always with us." In Fig. 57, Plate III. of "Proceedings" above referred to, the points J and K are described correctly as holding a similar relation to the second and third diagrams as the point A holds to the first. But H J and L K should have been produced a little beyond J and K to include the remainder of the clearance in those cylinders, and the curves H L and L C should have included those remainders just as the curve B H for the high-pressure diagram included the remainder A F. The relative positions of the diagrams, however, was not affected by this, and as the description of the principle on which the diagram was constructed was correct, it would be apparent to anyone conversant with the subject that this was a mere omission; nevertheless, I purposely refrained from correcting it either in the proof of report to THE ENGINEER or in that of the Institution "Proceedings," having no wish to interfere afterwards with Mr. Schönheyder's description, which was correct in this particular.

Mr. Schönheyder's practice and my own, therefore, regarding the placing of the diagrams are quite identical, and in the method adopted for the development of a standard area for determining the degree of efficiency of the steam; the only difference is in position, and in this case position has no virtue. I prefer to use the vertical line dropped from the point A—Fig. 57, Inst. "Proceedings"—and cut off at C D the necessary amount to bring the theoretic area to the length representing low-pressure cylinder volume; whereas Mr. Campbell describes Mr. Schönheyder's method as placing the vertical line at the admission to low-pressure cylinder—that is to say, he shows the whole diagram shifted bodily till its base corresponds with the low-pressure diagram. This is a distinction without a difference. Indeed, it might be best to have the theoretic area diagram quite apart from the diagram of positions, as a little confusion is otherwise apt to arise. With regard to what the standard area shall be we appear to be at one.

Returning to Mr. Campbell's utterly fallacious description of my views and practice on this subject, I have written the secretary of the Liverpool Engineering Society requesting that my contradiction of the statement be recorded in the journals of that institution, and I beg to emphasise my regret that Mr. Campbell should have made such a statement in his paper without due enquiry, as I can assure him that if he had applied to me for the information, he would at least have received a courteous reply.

Hartlepool, June 13th. THOMAS MUDD.

SLAG CEMENT.

SIR,—I see that in your issue of the 10th inst. you publish a communication from Mr. R. J. Friswell, in which he states that in my paper, read before the Cleveland Institute of Engineers, I did not mention the process of Mr. F. Ransome. This, I beg to say, is a mistake, as I did on page 107 describe briefly the principle of the process, and stated that "Mr. Fred. Ransome and others maintain that good Portland cement can most readily be obtained by this process."

There is room for many processes, and if, as Mr. Ransome states, good cheap cement can be made from furnace slags by his process, there is nothing to prevent him from working it on a large scale, and thus cause rejoicing in the heart of the slag maker, the cement user, and the slag cement manufacturer. Slag costs the manufacturer a considerable amount to get rid of, so that it will be readily understood how welcome any person will be who not only will take the slag from him, and so reduce the cost of disposing of it, but who will also pay him a small sum for preparing it for the cement process. The remarks of Mr. Friswell confirm my own observation that slag cement when properly made will stand the test of time, and will eventually in a great measure take the place of Portland cement. J. E. STEAD.

Laboratory and Assay Office, 5, Zetland-road,
Middlesbrough, June 14th.

OVERWINDING GEAR.

SIR,—We are very much obliged to you for your description of our exhibits at the Newcastle Exhibition in your issue of the 10th inst. Will you kindly allow us to correct the following:—In your reference to our automatic overwinding gear, p. 455, you state it has not been applied in this country. We beg to say that this automatic overwinding gear has been at work for several years at the Lingdale mines belonging to Messrs. Pease and Partners, and Mr. Heslop, the resident manager, will be glad to show it in action. The title of the coal-getter on p. 406 should read, the "Haswell Mechanical Coal-getter, Hall and Low's patent," instead of, as you have it, "Haswell's Patent Mechanical Coal-getter." Kindly per these corrections. The GRANGE IRON COMPANY.

Grange Ironworks, (Per HENRY LAWRENCE, Manager.)
Durham, June 14th.

THE DOGALI.

SIR,—I observe in your interesting description of the Italian cruiser Dogali in last week's ENGINEER the following statement occurs:—"We believe that no account of her exists in print, nor is she to be found under any of the names in Lord Brassey's Annual or other lists published in this country, so far as we know." Permit me to point out that you have been led into an error in this matter, as in the current issue of Lloyd's Universal Register you will find the vessel entered under her proper name, together with particulars of build, displacement, indicated horse-power, speed, &c. I beg to enclose herewith the sheet of the work which contains this entry. B. WAYMOUTH, Secretary.

Lloyd's Register of British and Foreign Shipping,
2, White Lion-court, Cornhill E.C.,
June, 15th.

TURBINES AT THE MANCHESTER EXHIBITION.

MR. W. GUNTHER OLDHAM, ENGINEER

For description see page 484.)

FIG. 1

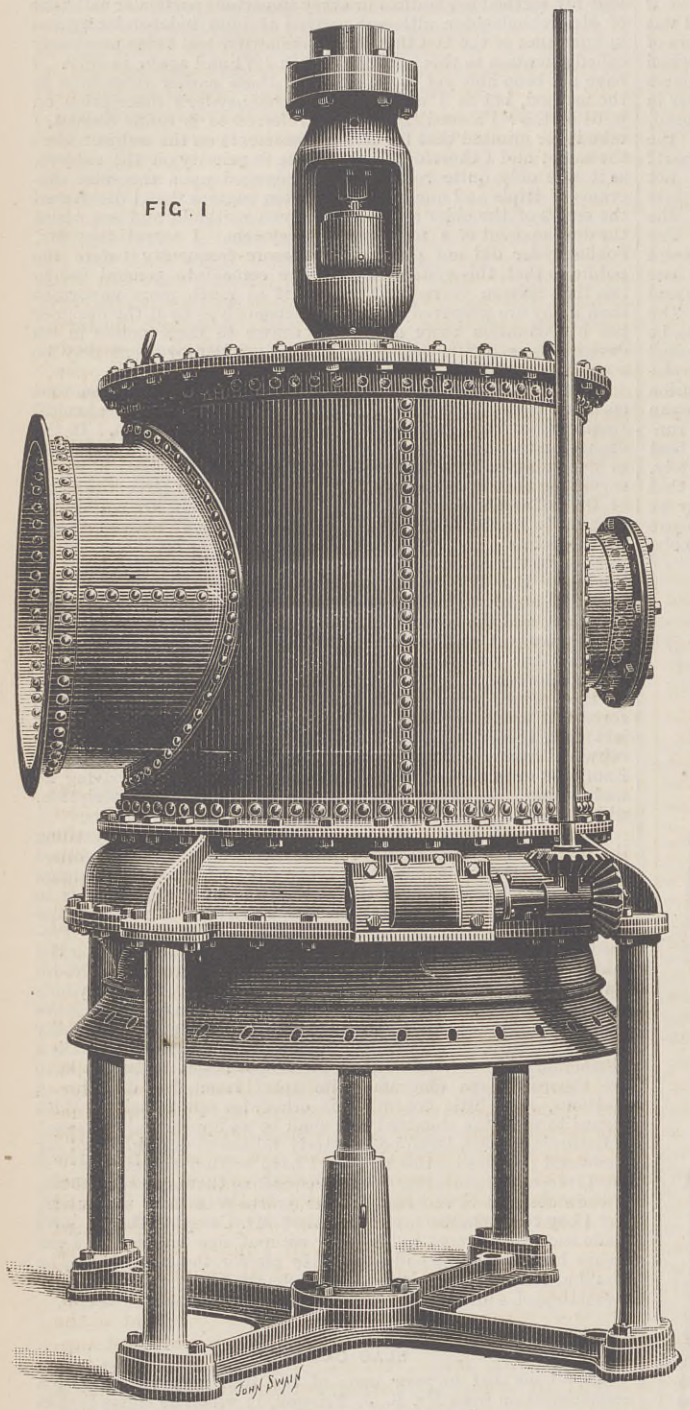


FIG. 2

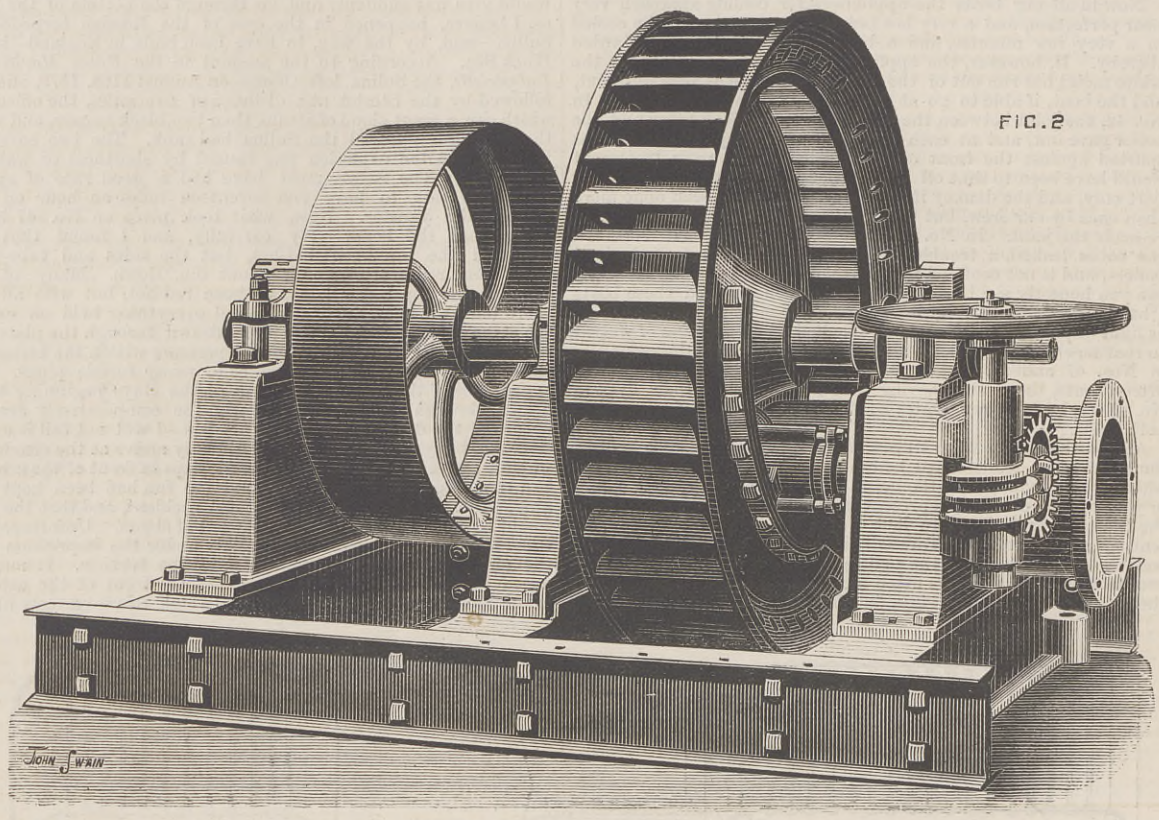


FIG. 4.

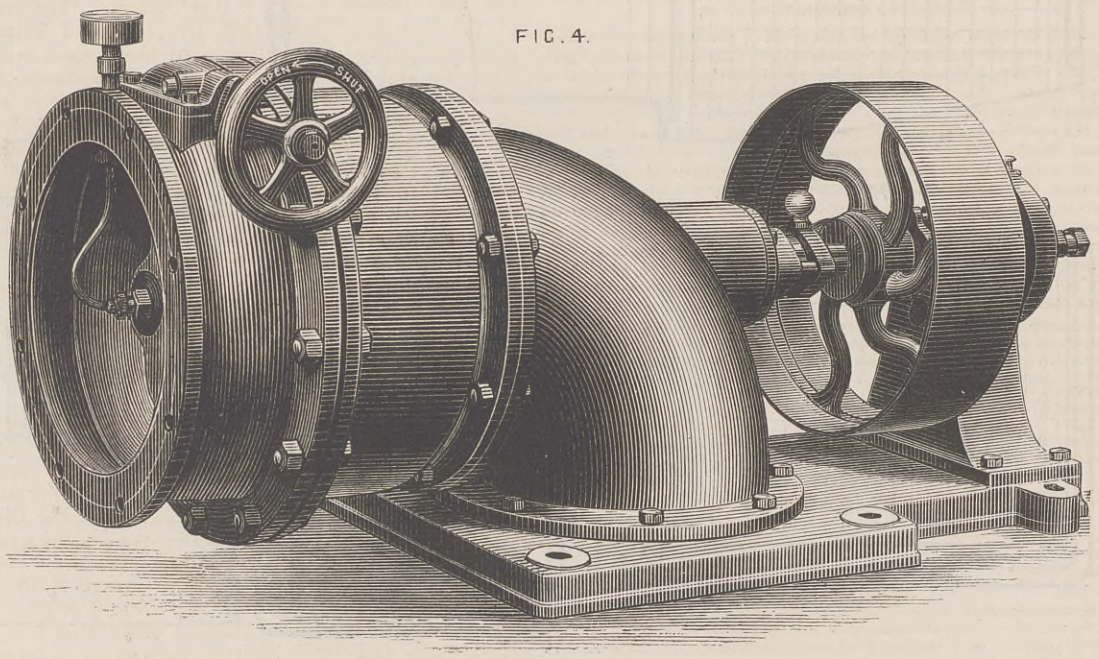
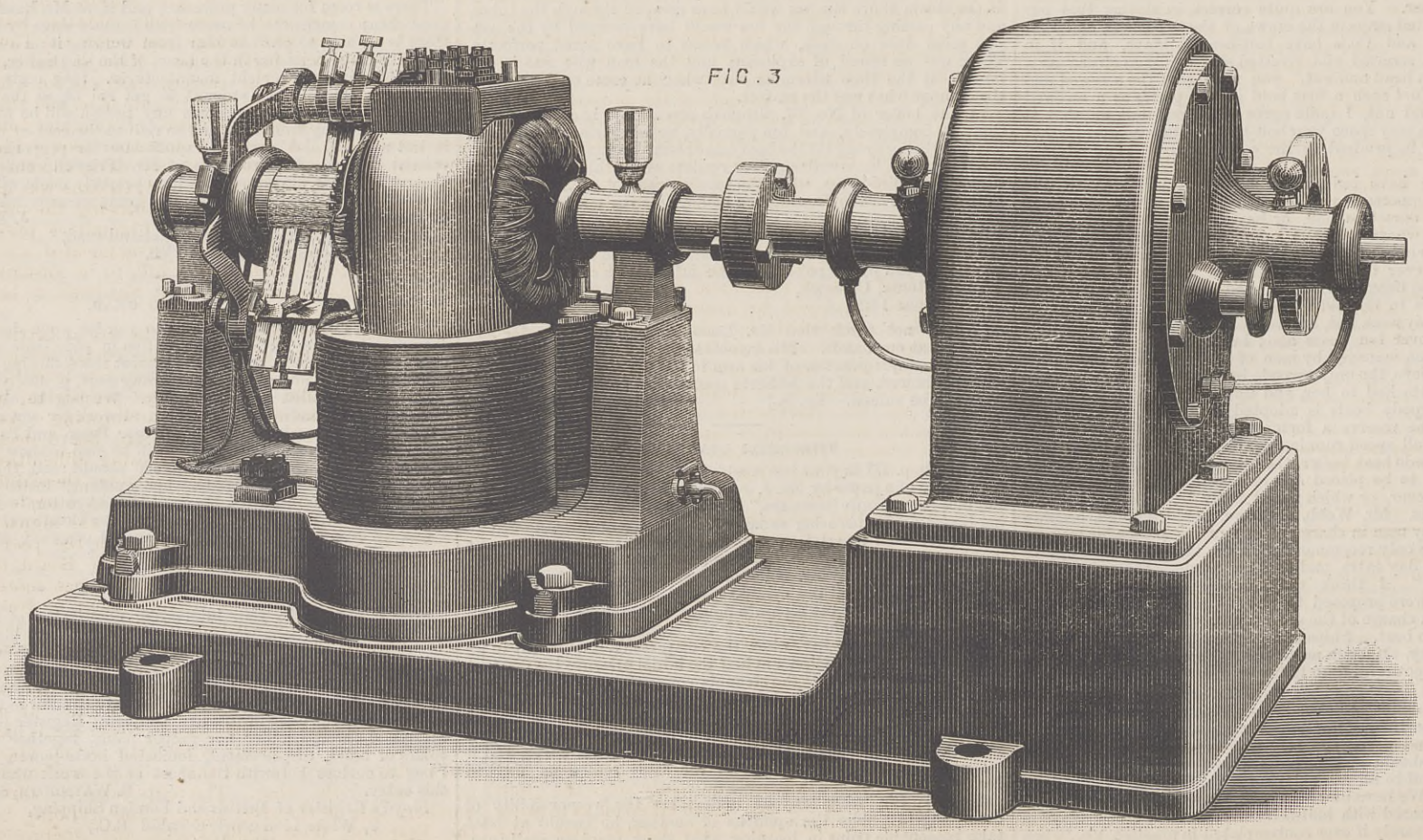


FIG. 3



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ENGINEER.—*The largest weight of coal which it is possible to burn with any draught seems to be about* 90 *lb. per square foot of grate per hour. As much as* 112 *lb. have been put into a furnace per square foot per hour, but it has not been all burned—very large quantities going into the smoke-box and up the chimney in the shape of cinders.*

ENGINES OF THE SCHULL AND SKIBBEREEN TRAMWAY.

(To the Editor of The Engineer.)

SIR,—Can any of your readers tell me the name of the makers of the above? W. P. S.

Wimbledon.

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MEETING NEXT WEEK.

CHESTERFIELD AND MIDLAND COUNTIES INSTITUTION OF ENGINEERS.—Saturday, 18th inst., at 2 45. p.m., in the Lecture-room of the Stevenson Memorial Hall, Chesterfield: Annual general meeting. The following will be open for discussion:—The proposed technical education scheme for classes and lectures at and in connection with University College, Nottingham. Mr. A. H. Stokes' paper, "Notes on the Report of the Royal Commissioners on Accidents in Mines." Messrs. Kirkland and Barnett's paper, "Kirkland and Barnett's Apparatus for Preventing Overwinding in Collieries." The following paper will be read or taken as read:—"A Simple Safety Blasting Cartridge for use in Mines," by Mr. W. H. Routledge.

DEATH.

On the 9th inst., at his residence, Ashbourne-road, Derby, of acute bronchitis, ANDREW HANDYSIDE, formerly of St. Petersburg, in his eighty-second year.

THE ENGINEER.

JUNE 17, 1887.

THE PETROLEUM TRADE OF THE BLACK SEA.

IT is somewhat singular that the recent edict of the Russian Government raising the duties to be charged upon coal imported into the Empire should have been issued almost concurrently with the announcement that final tenders have been received by its authorities for the privilege of laying a pipe line to convey petroleum from the Caspian to the Black Sea. The concurrence would seem probably to indicate a desire on the part of the Government at St. Petersburg to place difficulties in the way of coal importation so as to stimulate workers of steam power, both for land and marine purposes, to use petroleum as a fuel in preference to coal. No fault can certainly be found with such a desire, for it is perfectly legitimate that a Government should endeavour to extend the use of a fuel which its own territory supplies in abundance, in place of another of which the local supply is limited, and for which the country is largely dependent upon import from abroad. But the effort—if we have correctly assumed the reason for it—is manifestly directed towards that stimulation of the Russian marine in the Euxine which has always been a prominent object in the minds of the rulers of the Czar's vast empire; and as—to a very considerable extent—such an aim has heretofore been held to be at variance with many interests, and those of Great Britain especially, it will be as well to consider how far this new undertaking is likely to aid the Russian object.

The proposal largely to facilitate the transmission of the yield of the Caspian oil wells to the shores of the Black Sea comes at a time when there is abundant evidence that, for the present at all events, the mineral oil supply throughout the world is largely in excess of existing wants. Already the Scotch companies engaged in this important industry are seriously feeling the effects of the depression. One of these, and the oldest established of them all, shows by its last report a debit balance for the year of over £42,000, and special financial arrangements have to be made to overcome the difficulty arising out of the deficit. The directors of this company state that the prices of mineral oil products reached during the year the lowest point ever touched, and the difference in their accounts, as compared with those of the previous year's working, amounted to no less than £80,000! As with one, so it is with all the companies concerned in the trade. The financial papers report that the condition of things amounts to "positive panic," and the shares of the company whose accounts we have quoted, which stood at 10$\frac{5}{8}$ during last year and at 9 in January of this year, were bought a few days back at 35s. So much for the commercial aspect of the question. It is impossible to leave such a factor out of sight when dealing with a novel engineering work, the effect of which must be enormously to increase a supply which the facts above given show already to be largely in excess of present requirement.

The conditions of the grant of the concession for which tenders have now been received demonstrate what the amount of that increase is likely to be. The capacity of the pipe is to be such that from the commencement it is to be equal to transmitting to the shores of the Black Sea no less than 130,000 poods a day—a pood being equivalent to 40 lb. of English weight—while after two years the capacity is to be raised to 200,000 poods daily. Now, consideration being given to the present low price of the article, and to the almost ruinous effect that it is having upon many important British industries, we may well feel some alarm at the prospect of an increase to the supply within a comparatively short term of no less than 8,000,000 English pounds per diem. It is yet an engineering question to be solved whether the transmission through the great length of pipe designed can be accomplished in a practically commercial manner. We are unable to quote the actual mileage of the proposed transmission, but we know it to be so great that we must presume that the oil must be raised at several points throughout the length of transit. It will be in the memory of our readers what an amount of adverse criticism was bestowed upon the proposal to send fresh water through pipes to supply our troops on their advance against the Soudanese from Suakim. It is doubtful whether the resistance to movement of oil, owing to its tenacious nature, must not exceed that of water, and in that case greater power must be employed to overcome that resistance. The difficulties predicted by those who commented on the proposal of our own Government some few years back, if they had proved to have any existence, must be enhanced in dealing with mineral oil. That these are not unexpected may be deduced from the statement of the amount of capital required for carrying out this scheme. This is stated at from twenty-five to thirty millions of roubles. Taking the rouble at about its full local standard, this would represent an expenditure equal to between two and a-half and three millions sterling. As an engineering problem, however, there is really little reason for thinking that any serious difficulties need be apprehended, but with a yield already overdone, and the prospect of further increase in several other quarters of supply, it may be questioned whether there can be a prospect of such an amount of capital having profitable investment in the scheme, even supposing all engineering difficulties to be surmountable.

But, of course, as we have pointed out, the Russian Government probably has ulterior views to serve. The supply of fuel to its Black Sea fleet and to the commercial marine it so desires to foster, has year by year become more and more difficult and costly since the grain trade from the ports of that sea has so fallen off as to cause outward freights to rise largely upon former rates. We know it is asserted that petroleum as a fuel for steamships can now be successfully used, but we confess to much doubt as to the fact. Had the use of this fuel been proved to be safe and economical in all ways, we should have heard, considering the low price at which it is now obtainable, of far more extended use of it than we have as yet done. It is possible that patent objections to its employment may in the near future be overcome, though the process may be slow, and it must be admitted that hitherto continued low price has not been sufficiently certain to give much encouragement in this direction.

A SECOND THAMES BRIDGE BELOW THE TOWER.

A DEPUTATION from various districts north and south of the Thames below London Bridge, headed by Colonel Hamilton, M.P., has waited upon the Metropolitan Board, presenting memorials from local authorities on either side of the river, asking the Board to seek Parliamentary powers for the construction of a low-level free bridge across the Thames from Shadwell to Rotherhithe. The proposal is to receive consideration at the hands of the Works Committee, and in due course a report will be made to the Board, when some kind of discussion will naturally follow. What the decision will be is not very difficult to anticipate. It is not likely to take the form of an absolute refusal; but it is still less likely to embody an actual assent. The proverbial "third course" is open, and the reply to be looked for is one in the nature of delay. The Corporation are building a bridge just below the Tower, and there is every probability that the Metropolitan Board will carry its scheme through Parliament for constructing a tunnel under the river to connect Blackwall with Greenwich and Woolwich. Should the London Coal and Wine Duties Continuance Bill fail to pass, the Metropolitan Board may plead the want of funds; and although the Bill may have good luck next year if it breaks down this year, yet the risk of its entire rejection will have to be taken into account. The Board may therefore adduce excellent reasons for waiting, based on the wisdom of seeing what effect the Tower Bridge and the Blackwall Tunnel will have upon the traffic, and what will be the final decision of Parliament as to the coal duty.

While it is perfectly fair to speculate on what may be the answer of the Metropolitan Board to the request thus made, it is worth while, in the public interest, to consider the merits of the scheme itself. Of course, when the memorialists speak of a low-level bridge, they mean one that shall be capable of opening to permit the passage of ships. This was distinctly expressed by a gentleman who spoke on behalf of one of the eastern districts, and who made reference to the Tower Bridge as showing what could be done to accommodate both the land and river traffic. But the proposal to establish a low-level bridge, however capacious its openings, at a point so far down the river as Shadwell, is a bold and somewhat novel departure. In 1882, Sir Joseph Bazalgette, in his capacity as engineer to the Metropolitan Board, brought forward a comprehensive scheme embracing three new lines of communication. One was a high-level bridge at the spot where the Corporation are now constructing the Tower Bridge. A second proposal suggested a tunnel between Shadwell and Rotherhithe, where now it is asked that there shall be a low-level bridge; and the third scheme was that of the Blackwall Tunnel, which is now in a fair way to be accomplished, at an estimated cost of £1,500,000. The three schemes proposed by Sir J. Bazalgette were estimated to cost above £5,000,000, and as the Board could not obtain the promise of Government support in seeking for a renewal of the coal duty, it was resolved to apply to Parliament for power to make a subway or tunnel under the river from Nightingale-lane on the north side to Dockhead on the south. Farther down the river it was proposed to establish two steam ferries for the conveyance of vehicles, with proper approaches on each side. This was the entire programme, and these proposals failed to give satisfaction. To meet the views of the parties concerned nothing less would suffice than a low-level bridge just below the Tower, and a tunnel or subway further east. Even at that date there was a demand from the eastern districts for a low-level bridge farther east than Nightingale-lane, and this would clearly point to the Shadwell site. Poplar and Limehouse demanded this. A Select Committee took evidence on the subject for more than twenty days, and the Board's proposal for a tunnel at Nightingale-lane was rejected, the Board at the same time withdrawing the project for the steam ferries. The Select Committee presented a special report, in which they recommended a low-level opening bridge at Little Tower-hill, to be constructed by the Corporation, and a subway at Shadwell, to be undertaken by the Metropolitan Board.

As the case now stands we see the site at Little Tower-hill adopted by the Corporation, the bridge being a high-level bridge for foot passengers, and a low-level bridge for all kinds of traffic, vehicular and pedestrian, with an opening on the bascule principle for shipping. As for the tunnel at Shadwell, the Metropolitan Board declined to undertake it, declaring the engineering difficulties to be greater than it could prudently encounter, these difficulties being such as could only be avoided by a mode of construction which, if proposed, would be the signal for an opposition of a formidable character on the part of the Conservators and the wharfingers. The Board, thus influenced in its own judgment, resolved once more to go before Parliament for the establishment of free steam ferries. In 1885, the sanction of Parliament was accordingly obtained for a steam ferry to convey foot passengers, horses, and vehicles across the Thames from Woolwich to North Woolwich. In the present session the Board is promoting its Bill for a tunnel at Blackwall. It must be acknowledged that this Blackwall project seems like going a long way east. It meets with little or no opposition, and perhaps it may be said that nobody cares much about it, one way or the other. The route takes its start on the northern side of the river along a line running between the East and West India Docks, and emerges in the

Greenwich Marshes behind Blackwall Point. Fifty years hence this may be a very useful route. At present it seems rather in advance of the age. It is one of the marvels or paradoxes of our day, that the old Thames Tunnel, which is virtually on the Shadwell site, and is now a railway route, commands so little attention and seems to be of so little service. A railway running under the Thames at such a spot ought to command a large amount of goods traffic. That it does not do so may be attributed to the want of harmonious arrangements between different railway companies; but from whatever cause the failure may arise, it is one very much to be regretted. Supposing a free low-level opening bridge to be constructed across the river between Shadwell and Rotherhithe, we cannot but expect that it would be extensively used. From London Bridge to the spot where the Tower Bridge is to cross the Thames is a little more than half a mile. The Shadwell site is about a mile and a-quarter below the Tower. The saving of distance to the traffic passing between the eastern and south-eastern parts of London by crossing the Thames at Shadwell would therefore be very material, taking the Tower Bridge as affording the alternative route. Concerning the river traffic, something has to be said as to the effect of the proposed bridge upon the docks above it, namely, the St. Katharine and the London Docks. These are not interfered with by the Tower Bridge. All Wapping, together with the Upper Pool and the greater part of the Lower Pool, would be placed "above bridge" by the present proposal. It was the opinion of Sir J. Bazalgette in 1882 that the most convenient points for crossing the river would be between Little Tower-hill and Bermondsey, between Shadwell and Rotherhithe, and between Blackwall and Greenwich and Woolwich. At intermediate points ferries might be used. As to the mode of crossing, he considered that a low-level opening bridge at the Tower would fail to meet the requirements of either road or river traffic, and he therefore recommended a high-level bridge. With regard to the crossings at Shadwell and Blackwall, Sir Joseph considered that the only suitable means of a permanent nature consisted in the adoption of tunnels. His design for a tunnel at Shadwell was represented by a line drawn diagonally across the Thames, so as to pass to the eastward of the Shadwell entrance to the London Docks and to the westward of the Commercial Docks. A bridge at this spot will evidently be placed under the same necessity. A route might be found through the London Docks, but there would be the disadvantage of a second opening bridge interfering with the road traffic, and the interruption would be fatal to the utility of the undertaking.

As the Metropolitan Board has rejected the plan of a tunnel at Shadwell, it remains to be seen whether a bridge is practical. As we have observed, Sir J. Bazalgette decides this question in the negative. Sir Joseph has no faith in opening bridges below London Bridge, and therefore could only advocate a high-level bridge at Shadwell, if any bridge at all at that spot. The demand is for a low-level bridge. The docks and wharfs have to be considered in reference to this subject, and the question of compensation is serious, even though the Tower Bridge limits the affected area, and the facilities at Shadwell are made equal to those at the Tower. It would be a happy arrangement if the docks above Shadwell could be made in some way to bend to the grand desideratum for a ready means of crossing the Thames eastward of Nightingale-lane. The need is great, but gold may be bought too dear. Compensation must be kept within reasonable limits. Experience gained at the Tower Bridge may show that the shipping can be accommodated with greater facility than has been supposed, and that the land traffic can submit to the required interruption. The case is assisted by the circumstance that there is a tendency to make increased use of the extensive dock accommodation provided in the lower part of the river, and which has undergone remarkable development in recent years. Large ships find it convenient to discharge their cargoes in the lower docks, the railways being at hand to complete the transit, whether to London or to parts beyond. What may be called the sea traffic is finding a home lower down. What may be called the land traffic is more and more embarrassed by the severance which the Thames effects below London Bridge. The Tower Bridge will simply modify the situation without essentially changing it. Unfortunately the extent to which the various docks interfere with the approaches to the river on either side seriously limits the sites available for crossing the Thames, especially when a bridge is proposed, and adds to the engineering difficulty of the problem. But there is the fact that nearly a million of people on one side of the river, and more than half a million on the other, wish to have ready means of inter-communication. Until such means are afforded, trading and commercial interests must in some degree suffer.

HIGH-PRESSURE MARINE BOILERS.

Last week we pointed out that so far as the engine is concerned, there ought to be little difficulty in using steam of 250 lb. pressure at sea. The real obstacle to be feared is the difficulty of constructing boilers which will sustain this pressure and yet be suitable for use under the prevailing conditions. Boiler shells are now made 14ft. in diameter, of steel plates 1½in. thick. These shells are intended to carry a pressure of 160 lb. on the square inch. If the pressure were augmented to 250 lb., the thickness of the plates must be raised to 2⅜in., provided the diameter remained the same; and we have good reason to doubt that any boilermaker would undertake to make such a shell, and we are quite certain that no plant exists in any part of the world adequate to the performance of the task. It seems, therefore, to be quite clear that whether the existing type of marine boiler be or be not retained, the existing proportions must be abandoned. Let us suppose that instead of a shell 14ft. in diameter containing three furnaces, we have a shell 9ft. in diameter containing two furnaces 3ft. in diameter. Such a shell made of 1½in. steel would be quite strong enough for 250 lb. per square inch. Yet we are no nearer to the required end, because it would be next to impossible to obtain a furnace tube at once sufficiently thin to prevent overheating, and sufficiently strong to stand up to 250 lb. Mr. Fox, by his corrugated flues, made high-pressures possible at sea; but there is a limit, and so far as the existing drift of engineering opinion goes, the limit for corrugated flues has been reached, if not a little overpassed, at 160 lb. It may be said that the difficulty can be got over by reducing the diameter of the flue. In one sense this is true; but small furnaces cannot be properly worked at sea. If they are to be adopted forced draught must also be used, and the shipowner would find himself saddled with not one experiment but several. Contemplating the trial of 250 lb. steam only, he would find that a totally unusual system of burning coal would have to be adopted, to say nothing of certain incidental minor novelties. The next important step in marine engineering will be the production of furnaces, which not more than ½in. thick, will carry safely 250 lb. pressure, and yet be quite suitable for use under ordinary sea-going conditions.

Arrived at this point, we expect to be told that the best solution of the whole difficulty lies in the use of water-tube boilers. To this we demur. We are by no means blind to the good points in, for example, the Root and the De Nayer boilers; but tubulous boilers have been well tried at sea and found wanting. The great objection to them is that for a given power they take up an inordinate amount of space. Their heating surface is inefficient. Seventy square feet of surface in an ordinary marine boiler will make more steam than 100ft. in a tubular boiler. This ought not to be so. It is contrary to all reason. It is absurd, but though absurd it is a stubborn fact. On land this is of no consequence; at sea it is a vital defect. It may be obviated perhaps. Till it is we must deal with things as they are. If, then, the water-tube boiler and the ordinary boiler cannot be used with high pressures, what is to be done? Unfortunately it is much easier to criticise and condemn than it is to suggest a remedy. Two schemes may, however, be mentioned, both of which are at least worth discussion.

A shell of steel $\frac{7}{16}$in. thick, double rivetted, will sustain a bursting pressure of about 1100 lb., so that with a working pressure of 250 lb. there would be a factor of safety of a little over four, which is sufficient. A boiler might be constructed of such cylinders, fired outside, and would be perfectly safe; because it would be free from all the objections which are justly urged against externally-fired boilers of the ordinary type. Such boilers have been used, although of very crude design, for many years on the great rivers of the United States. They have, it is quite true, exploded now and then, with disastrous results; but such explosions have almost always resulted from racing, or from the use of extremely muddy water without proper precautions. In the hands of modern English engineers nothing of the kind need be apprehended, and there is enough about such a system of construction to make it worth more consideration than it has yet received. Of course, each boiler proper would be built up of a number of sections, each consisting of one tube, 3ft. in diameter and 8ft. or 9ft. long, flanged and rivetted to a properly stayed flat-sided chamber, which would at once put all the sections in free communication and provide a portion of the steam place. Something in this direction was done years ago by Mr. Howard, of Bedford, and the experience he acquired might be utilised to make a further advance. A very powerful argument against externally-fired tubes must not be forgotten, however. It is well known that an ordinary furnace crown may come down without any one being killed or even scalded. The overheated metal bulges and stretches, but it does not give way, and even when it does crack so as to permit the escape of large volumes of water, the steam, instead of rushing into the stokehole, finds an exit up the funnel. Unfortunately, there is reason to fear that this would not be the case if an externally-fired cylinder became overheated because of accumulated deposit or other cause. Under these conditions, the overheated plate would give way, with disastrous results, unless some special, not very easily devised arrangements, were made to insure the safety of the firemen and engineers.

We have said above that two methods of construction suggest themselves. One we have just considered, the other means resorting to, in a sense, the locomotive type. Now, to this, insurmountable objections have hitherto arisen, when it was tried in the merchant service, although it has been very successfully adopted in war ships by both France and Great Britain. But we do not believe that the last word, or anything like the last word, has been said about the locomotive type at sea. One of the great objections urged against it is that a small depth of water is carried over the fire-box crown; but this is not the fault of the system, but of the way in which it has been applied. The good points about the locomotive boiler are that it permits us to use comparatively small shells, containing a great deal of heating surface, and that there is practically no limit to the strength which can be imparted to flat surfaces by staying, so that, consequently, we can have a fire-box or furnace of any dimensions we deem necessary without the least apprehension of evil results. We do not for a moment contemplate the adoption of a locomotive or torpedo boat boiler in the ordinary sense of the word at sea. But we might have a boiler containing at one end a locomotive fire-box, which box would communicate with the ordinary uptake of a marine boiler by three or more steel tubes, say each 12in. in diameter, and 3ft. or 4ft. long. The shell of the boiler proper could be subdivided, so that nothing more than about 4ft. in diameter would be exposed to a bursting pressure. Boilers in some respects resembling this type have been used at sea with success in the United States, but not with high pressures. It will be understood that what we propose is a boiler which shall combine the best features of the present marine type with the best features of the locomotive type. It would be, in short, a composite structure, and we see no reason to doubt that it might with due care be made a perfect success. There is just one other way in which high pressures may be carried at sea, namely, by using a number of small boilers—simply reduced copies of the normal large boiler—but, as we have shown, they must have small furnaces and small grates, and they would in the aggregate take up much more space than one or two large boilers of equal gross power.

Against everything that can be suggested objections will be urged. But that quadruple expansion engines and pressures of 250 lb., or perhaps a little more, will be adopted within the next few years we feel certain, always provided that the right kind of boiler is to be had. It may be that the difficulty will be solved by departing much further than we have suggested from existing types. Some form of vertical boiler may, for example, solve the whole difficulty. We cannot believe it to be possible that British engineers will permit themselves to be beaten, and either a furnace or a boiler, or both, will be available, we feel sure, as soon as a proper demand is made for them.

THE SEVERN TUNNEL.

Another important stage in connection with the Severn Tunnel works has been recently completed, the effect being to provide a double set of rails from Bristol through the tunnel to Wales. Very soon, it is expected, a greatly improved service between London and South Wales will be established, from which important and valuable results are anticipated. The lately finished portion of the whole scheme is thus described:—The old New Passage line below Patchway goes through the Cattybrook Tunnel at a gradient of 1 in 68, which is rather steeper than is desirable for heavily-laden trucks to ascend, and accordingly a second line and a second tunnel at the easier gradient of 1 in 100 has been made parallel with the original track. The new portion of the line is about three miles in length, and for the first three-quarters of a mile, after leaving Patchway Station, is in a deep cutting through the lias and new red marl formations. The tunnel through Almondsbury Hill, one mile in length, then begins and runs through the new red marl, dolomitic conglomerate, millstone grit, and carboniferous limestone formations, some portions of which were very hard. The tunnel is built of brindled bricks—the arch being in vertical bond—from the Cattybrook brick works. The line, after leaving the tunnel, runs through a rock cutting, past the Cattybrook Brick Company's works, where there are sidings, over an embankment averaging about 50ft. in height and three-quarters of a mile in length to Bell-lane, about half a mile from Pilning Station, where it joins the Severn Tunnel railway. The two tunnels through Almondsbury Hill are on different levels, the old tunnel, which will be used for the down trains, being on the higher level, and the new tunnel for the up trains on the lower level, there being about 20ft. difference in their levels, and they are about 50ft. apart centre to centre. The engineer of the works is Mr. Charles Richardson—engineer of the Severn Tunnel—and the resident engineer, Mr. Joel Lean, with assistant resident engineer Mr. A. J. Simpson, the works having been constructed by Mr. Thomas Oliver, contractor, of Horsham, Sussex.

THE MELBOURNE CENTENNIAL EXHIBITION, 1888.

In connection with the announcement that the Government of the Colony of Victoria will hold an International Exhibition of Arts, Manufactures, and Agriculture, in Melbourne next year, from the 1st August to 31st January, 1889, attention is called to the fact that during the year 1885 Australasia, with a population of 3,500,000, imported from Great Britain goods to the amount of £32,000,000. The United States, France, and Germany, whose combined populations number 133,000,000, imported during the same period from Great Britain to the amount of £53,000,000. Calculated at per head of the population, Australasia, therefore, imported nearly twenty-three times as much as the above-named countries combined; and this in addition to a large and increasing trade with other countries. The last International Exhibition held at Melbourne, in the year 1880, was followed by a remarkable increase in the imports of the Colony. The imports of Victoria, which in 1880, the year in which the Exhibition was held, were £14,556,894, rose in 1881 to £16,718,521, and in 1882 to £18,748,081. The capitals of the adjoining Colonies, Adelaide and Sydney, are now connected with Melbourne by railway, and before next year the line to Brisbane will be open, so that the population of the greater Colonies will be placed within easy access of the Exhibition. It may thus be hoped that a stimulus will be given to British trade with all the Australasian Colonies. The main buildings erected for that Exhibition are of a permanent character, and to these will be added annexes of iron, covering a total area of 24 acres. No charge will be made for space, and every facility will be afforded to exhibitors respecting customs, transit from wharves to Exhibition, and supply of motive power. Her Majesty's Government propose to issue a Royal Commission, of which his Royal Highness the Prince of Wales has consented to be President.

LITERATURE.

Fortunes Made in Business: A Series of Original Sketches, Biographical and Anecdotic, from the recent History of Industry and Commerce. By Various Writers. Vol. III. London: Sampson, Low, and Co. 1887.

In The Engineer of 24th October, 1884, the two first volumes of these histories were noticed. The popular reception of these has been so good that the publishers have issued a third volume. Like its predecessors it contains a great deal that is interesting in the history of men who, with great ability—and some with great business tact—have originated great industries; and who, while overcoming great difficulties in inventing and making new machines for producing new articles of commerce, and in overcoming prejudice in the minds of men and in the markets of the world, have made large fortunes for themselves, and have been the means of enriching others and providing work for many thousands. The new volume relates the business and much of the personal histories of the Horrock's, the Mintons, Sir W. G. Armstrong, the Henrys of Manchester, the Crossleys of Halifax, Kitsons of Leeds, Richardsons of Bessbrook, Platts of Oldham, and Sir Donald Currie. Most of these sketches describe the rise of businesses established by men who commenced in a very small way; nearly always by saving a little money in the first instance and then purchasing enough tools or machinery—the invention of others—to make and sell certain articles that were

growing in public favour. Most of them were shrewd men, who were able to form a clear and accurate idea of the business value of new things, and most of them had received more or less training in some trade or handicraft other than that they entered to make a fortune. It is very noticeable that a very large proportion of the men who have risen in these great industrial centres have commenced with no training in the occupation from which they have acquired riches.

Amongst those who are the subjects of the sketches in this book, Sir W. Armstrong provides an exception; not with respect to his adoption of a profession very different from that to which he was trained, for it was not until he was in his thirty-seventh year that he gave up the legal profession, but in that he invented the machines and apparatus from the construction of which he has derived his wealth. The stories of the business lives of most of these men are very well told, though in some cases with verbosity that could be easily dispensed with; but the technical details which would interest engineers are generally passed over, or given with insufficient accuracy, in favour of more popular generalities. Like the two first, this volume might, without omitting anything, but by using somewhat smaller type not so heavily leaded, and thinner paper, have been reduced to half its present awkward bulkiness.

The Storage of Electrical Energy and Researches in the Effects created by Currents combining Quantity with High Tension. By GASTON PLANTÉ. Translated from the French by Paul Bedford Elwell. London: Whitaker and Co. 1887. 268 pp.

THE book, of which this is a well-made translation, is so well known, though very scarce, that it is barely necessary to do more than announce the publication of the translation. So much has been based upon the work described in the first part of the book, namely, that comprising the study of secondary currents with a great variety of voltameters, the storage of the energy of the voltaic battery by means of secondary cells with lead plates, and the transformation of the energy of the voltaic battery by means of lead plate secondary batteries, that those interested in the subject will be glad to find it now placed before them in its present form. The latter parts of the book are of much interest, and deal with applications, the rheostatic machine, and is descriptive of numerous effects produced by high tension currents, and comparison of these with various meteoric and other phenomena. But the first part is that which will be most carefully read by the designers of batteries, and those interested in the work that did most to open the way to the modern accumulators, though the recent developments have left Planté's battery much in the rear. From a historic point of view it has special importance, though credit must always in this matter be given to D. G. FitzGerald, who, as far back as 1863, described in the old *Electrician* secondary combinations in which not only lead, but lead with peroxide of lead in dilute sulphuric acid, were employed. It is interesting to note that although nothing is said in the pages of this book concerning the use of oxides of lead applied to lead plates for secondary battery elements in the way employed by Faure and others, Planté is credited by Du Moncel with having tried this before other experimenters, though not with satisfactory results, because the coating so made would not adhere to the metallic lead.

Handbook of Brewing Calculations. By O. W. VILLIERS. Shepherd and St. John. 1887.

THE literature of brewing is exceptionally rich, so this little book has numerous predecessors. Unlike most of these it aims at brief simplicity, and furnishes forty pages of matter of direct use to many connected with brewing, but is not thorough enough to be of use to all. Numerous rules that should be familiar to every brewer are given with simple illustrations, but others that are equally necessary are omitted. The author aims at illustration by example rather than by mere verbal explanation of his rules; but a good deal of practice would be necessary to ensure thorough grasp of his methods. That which he calls the "cross-numbers" method has a formidable aspect to the non-mathematical eye, but is only a clumsy way of writing formulæ of simple character. Rules will never supersede the exercise of common sense, and those before us will require much intelligence for their effective use. The want of explanatory matter is a serious drawback to the use of the book by young brewers. It is still more difficult to be understood by engineers, and others, to whom some knowledge of brewers' calculations would prove of service in the arrangement and construction of brewers' plant and buildings. The absence of an index is but partially compensated by the table of contents. Nevertheless, the author's modest hope that his "work may supply a want frequently felt by brewers and others," and that it will to some extent replace "rule-of-thumb," will probably be realised; as, despite the defects we have noted, it really deserves to be widely used.

The Construction and Equipment of Grain Magazines. By G. LUTHER. Edited and translated by F. STALLMAIER and JOSEPH FUX. London and Manchester: John Heywood. 1886.

THIS translation of a German book deals with the construction of large and small granaries, and especially with the construction of granary silos, as practised in the principal ports and elsewhere on the Continent, including Hamburg, Antwerp, Deynze, Mannheim, and one or two in America. These are treated under the general classification of granaries. The experimental investigation into the vertical and lateral pressures of granular substances—"Proceedings" Royal Society, 1884—as carried out by Mr. Isaac Roberts, does not seem to be known to the author, but the silos he describes are of various kinds and forms. The mechanical appliances in granaries, including motive-power and the working appliances of granaries, such as elevators and conveyors of various kinds, are treated separately, and the grain magazine in operation is also separately dealt with. The machinery appliances and buildings are to a very great extent similar to those employed in England; and, in fact, some described are of English make and design. The book, 110 pages, is supplied with a good many engravings, and has besides fourteen plates and some phototypes, which have for some reason not had their titles translated into English. It has some features which are much of the order of a very well executed catalogue, but it is a book that will be found useful to those interested in its subjects.

Textbook of Gunnery, 1887. By Major G. MACKINLAY, R.A. Eyre and Spottiswoode, Harrison and Sons, London.

THIS is the second edition of a work which established its reputation in 1883. The function of a textbook of this kind is to introduce the reader to the elements of all branches of artillery, which ought to be investigated in as clear and a simple way as is consistent with sound mathematical treatment. It is very necessary to have such a work, but few men are capable of writing it. Major Mackinlay has been very successful, we think, in his treatment of the various branches he deals with. The work is a textbook at the Royal Military Academy; it therefore must sell at a certain rate, but we believe that the outside sale of the 1883 edition has been large, and it is quoted frequently in authoritative works—especially in the official Naval Gunnery Book. The present edition deals much more fully than its predecessor with the principles of gun construction, and has additional matter on steel, on which subject the author read papers at the Royal Artillery Institution and the United Service Institution. A work of this kind is, of course, not of a popular character, nor does it deal much in opinions. It is not therefore a subject for a lengthened review. Those who are likely to be interested in it are those seeking sound information on the fundamental questions of all branches of gunnery. This need, we think, this work well supplies.

COTTON MACHINERY AT THE MANCHESTER EXHIBITION.

No. II.

THE process of "opening," already described, serves not only to thoroughly loosen the matted fibres of cotton, but also to remove much impurity. As delivered from the opener the cotton assumes the form of a "lap" or roll of spongy web, well compressed, so that it may be drawn off in the next process—that of "scutching." Six makers exhibit specimens of their scutching machines, the object of which is, in each case, to still further cleanse the cotton and to equalise the substance of the web, which is again formed into a lap. What may be called the main features of construction in these exhibits are very much alike, but there are some not unimportant differences of detail. The equalisation of the substance of the web is obtained by running four laps together, and by the well-known delicately adjusted automatic feed arrangement known as the "piano key-board" and cone drum regulator. On entering the beater cylinder the cotton is struck downward by the dull blades of the horizontal beater, the seed, leaf, and other impurities falling into the enclosed space below between adjusted

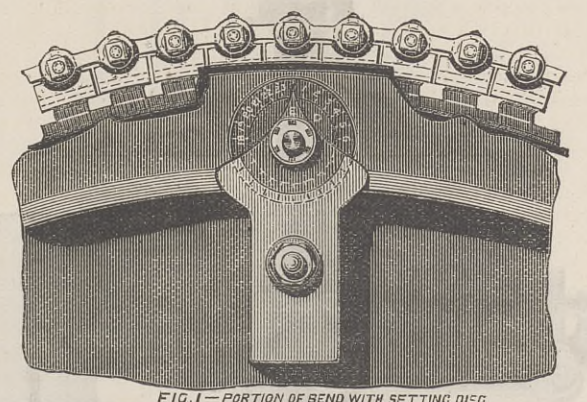
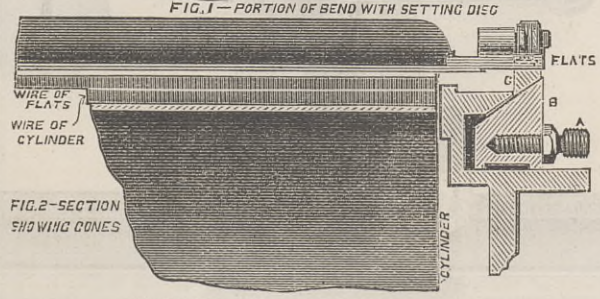


FIG. 1—PORTION OF BEND WITH SETTING DISC



HOWARD AND BULLOUGH BEND.

grate bars. The snowy fibre, confined within the air-tight cover of the machine, is now drawn by an exhaust fan between two perforated cage cylinders, where the web is re-formed, and after passing between heavy calender rollers, is again coiled into a lap. In the scutcher of Messrs. Asa Lees and Co., the cone drums of the feed regulator are not fixed vertically but horizontally, in order to avoid any slipping of the strap or its friction against one side of the strap guide. The driving of the lap part as well as the cone drum feed section is accomplished from a friction clutch on the beater shaft, and ropes are used instead of leather straps. The advantages of this method are that the beater cylinder cannot be choked, and that the cones can be run at an unusually high speed, affording great sensitiveness to the regulator, and permitting a wide variation in the thickness of the web by a simple change in the rim pulley on the feed motion.

The scutcher of Messrs. Platt Bros. and Co. is of the ordinary type, but the bars under the beater, as well as between the beater and cages, are specially constructed, with a view to extracting as much leaf as possible from the cotton. In the machine exhibited by Messrs. Howard and Bullough, the beater shaft is hollow and open at the ends, having also openings into the beater cylinder. The intention of this peculiarity is, that the air drawn through the shaft, and discharged into the cylinder, may help to carry down the dirt through the grate bars. These, too, have a special contrivance, by means of which they can be at once and simultaneously opened or closed, like the lattices of a Venetian blind, in order to allow for the passage of a larger quantity of dirt when low grade cotton is being used. Messrs. Dobson and Barlow exhibit a scutcher of which the feed, cage, and lap motions are driven by one band, the object being, as in the case of Messrs. Asa Lees and Co.'s machine, to prevent accumulation of cotton in the beater cylinder. Very efficient machines of this class are shown also by Messrs. Taylor, Lang, and Co., and Messrs. Curtis, Sons, and Co.

After being thoroughly loosened and freed from all its grosser impurities, the cotton is next subjected to the process either of carding or of combing, both operations being essentially the same. The former is applied to medium or shorter-stapled varieties, the latter to the longer-stapled ones, which cannot be treated with the carding engine. In the lap, the fibres lie in all directions, and what is now required is that they should be brought into parallel order and laid perfectly straight, or at least as straight as the naturally curly texture of the staple will permit. In this process, too, some further purification is effected. Light motes and "nep," as well as much short and weak fibre, are taken out. This operation is, as all practical spinners well know, the *crux* of good cotton spinning. The essential features of the carding engine are a large main cylinder, covered with minute wire teeth, ground sharp, and perfectly level, and working almost, but not quite, in contact with similar teeth set either on rollers or on "flats" around the upper half of the cylinder. The fibres are thus combed out, and are afterwards laid on the "doffer" cylinder, which is also covered with similar teeth, and from this it is stripped by a doffer comb, then collected in the form of a continuous sliver, and deposited in long, upright cans. Only two examples of the "roller" carding engine are exhibited, those of Messrs. Dobson and Barlow, and Mr. Samuel Walker. This type of machine is still preferred for certain purposes by some spinners, but the system of "revolving flats" has in recent years been steadily gaining ground. This arrangement is used in the single cylinder carding engines shown by Messrs. Platt, Howard and Bullough, Asa Lees and Co., Curtis and Sons, Lord Bros., and Dobson and Barlow. So great has been the demand for them that Messrs. Platt Brothers and Co. have during the past six years made upwards of 6000 of these revolving flat "cards"—to use the brief technicality known in the cotton industry. This firm has applied a patent slow driving apparatus for propelling the cylinder and doffer when the wire with which they are closed is being ground. The hardened and tempered steel wire introduced in recent years can only be properly sharpened by the emery roller when running slowly, and the arrangement in question has been devised in order to provide for this emergency. The carding engine exhibited by Messrs. Asa Lees and Co. is very similar to that of Messrs. Platt. The cylinder pedestal and the side frame are cast in one piece, the side being turned so as to fit close to the cylinder and prevent the accumulation or escape of fibre. The chain of flats surmounting the upper half of the main cylinder revolves very slowly, and as each flat comes out of operation it is stripped of fluff and short-stapled cotton by an oscillating comb, and is afterwards brushed out clean by the usual serpentine revolving brush.

The semicircular bend A forms a nicely adjusted guide on each side of the cylinder, upon which the flats slowly travel from back to front. The bend is flexible, and its adjustment, so as that the points of the cards on the flats may be brought close to those of the cylinder but without actually touching them, is obviously a matter of great delicacy. An ingenious and novel provision for securing this adjustment is presented in the engines shown by Messrs. Howard and Bullough. Here the bend B C is a segment much resembling that of a steam engine cylinder piston, and it is regulated with the utmost nicety by means of discs affixed to setting screws A, as shown in the accompanying figures.

An electrical attachment enables the person who is "setting" the flats to discover through the ringing of a bell whenever the slightest contact is set up between the wires of the cylinder and those of the flats, and, of course, by turning the disc at E D backward one or two points, he may at once obtain the requisite proximity of the wires without actual contact.

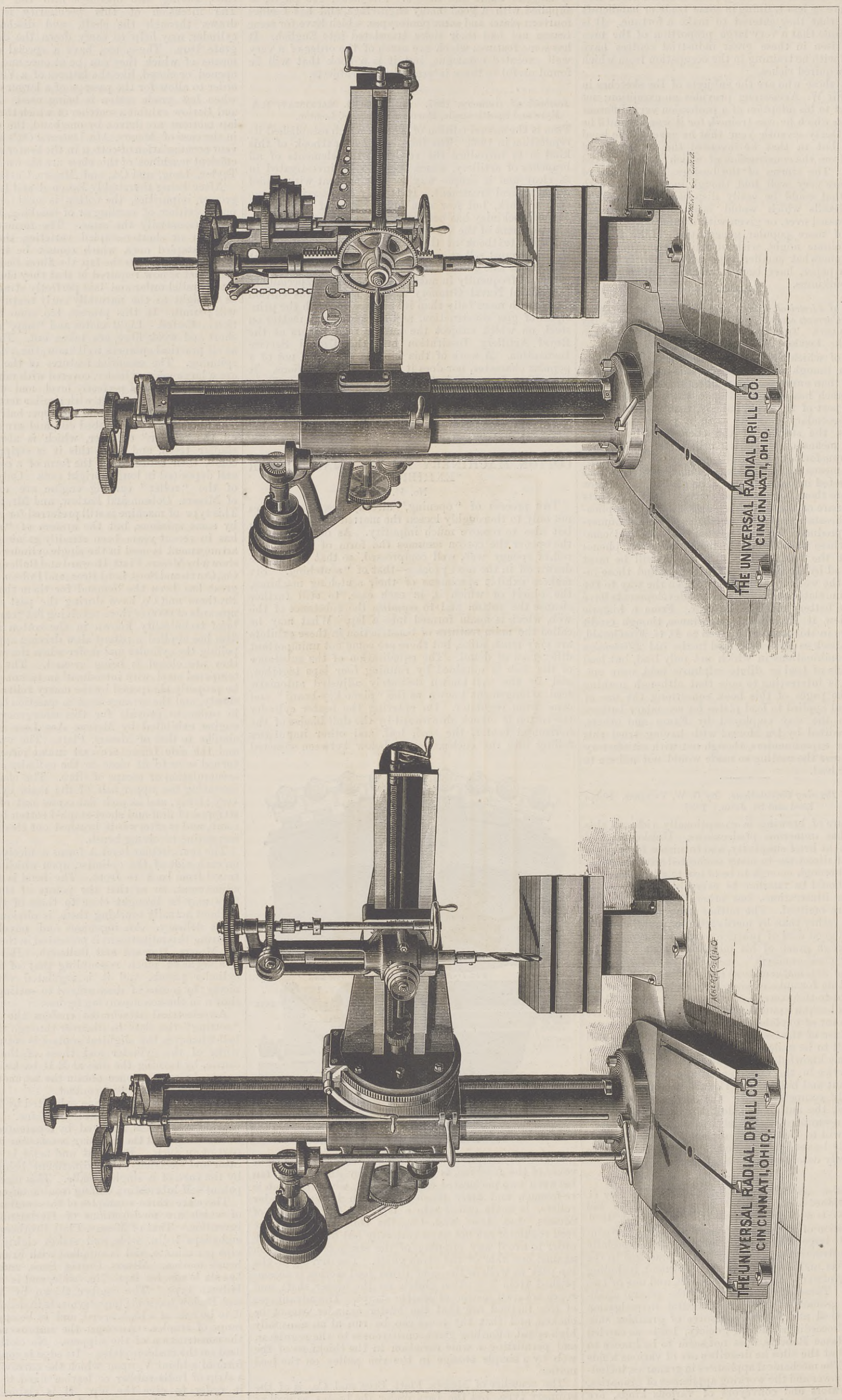
The "flat" carding engine exhibited by Messrs. Dobson and Barlow is an admirable machine. The bend is a flexible one, and is adjusted by a patented arrangement so delicately that the flats may be set to the two-thousandth part of an inch. Each flat and bend is tested by indicator and electricity, the adjustment being accomplished by the turn of a single handle. This machine has also a patent self-lubricating doffing comb motion.

There are three examples of the combing machine, all of which are modifications of Herlmann's well-known invention. That of Messrs. Platt Brothers and Co. combs eight laps 10½in. wide, and makes eighty to ninety-five nips per minute, and is supplied with Fremantle's patent brush motion. Messrs. Curtis, Sons, and Co.'s machine has six heads for laps, 7in. wide, and is of the ordinary Hilman type. The comber shown by Messrs. Dobson and Barlow has some improvements in detail which enable it to be run at a high speed, and to be applied to a wide range of staples. Amongst the improvements is one in the construction of the nippers. No cloth or leather is used on the cushion-plates. Its edge is constructed in the form of a blunt V, upon which the narrow flat surface of a strip of India-rubber or leather fixed to the knife falls in order to give the nip. It is claimed that by this arrangement minute setting is unnecessary, and considerable saving effected in the time and labour formerly required for recovering and replacing.

UNIVERSAL DRILLING MACHINE.

THE UNIVERSAL RADIAL DRILL COMPANY, CINCINNATI, U.S.A., ENGINEERS.

(For description see page 480.)



TWENTY YEARS COTTON PRESSING IN EGYPT.

By W. TURNER.

GREAT changes have been made in cotton pressing in Egypt in the last twenty years, but even yet some very antiquated apparatus is in use. In October, 1866, I visited the cotton market at Minet-el-Bassel, Alexandria, and passing a store, the door of which was open, heard a great noise, which I learned was "cotton pressing," and was invited to see the operation. With my guide I walked in, and for a while saw nothing, until, with eyes becoming accustomed to the darkness, I saw in a corner of the room the cotton press and pumps in operation. The latter were worked by a long lever, six stalwart Arabs working it up and down, with big drops of perspiration rolling down their faces, and shouting and calling in the usual Arab manner. This continued about seven minutes, when there was a repetition of the tremendous noise heard before, which turned out to be only knocking out the box door wedges. The doors now being open, and the press-box pushed away to be refilled, two more men joined the others to lend their aid for the final pinch. Three minutes more of hard labour and the ram rose as far as they could get it; then came the process of tying the bale, which was done in this case by passing pieces of iron wire through grooves made to receive them, and then twisting the ends together, the time taken being two minutes. Then opening a valve the ram slowly descended, the bale with it; before it got quite to the bottom the bale was rolled off, and ready for the ends to be sewn on. Whilst this was being accomplished, the box, now ready filled with cotton, was again pushed under the press and the same operation repeated. The bale measured 5ft. 4in. by 4ft. 6in. by 4ft., giving 96 cubic feet; weight, 7 cantars 22 rottles; time, about 11 minutes—that is 5½ bales per hour, or 55 bales per day of ten working hours. This bale was a fair sample as they were then shipped to England in 1865. Being interested in cotton pressing, I now proceeded to other pressing stores, where in a large, well-lighted room, stood a row of eight hydraulic presses, with their pumps arranged to be worked by steam power instead of Arabs. Here was a step in the right direction, less noise, more speed, and a rather heavier bale; the size being about the same. Four of the presses were at work, the driving arrangement for the others not being quite finished. These presses were all of the same type, being single ram presses, with double pumps, the plungers being 2½in. and 1¼in. diameter, 4in. stroke, driven by gearing worked from a long shaft running the length of the building. The boxes were wood, strongly bound with iron, the door forming one side, opening the whole way down to admit of the boxes being run out—a patent arrangement made by Ommanney and Tatham, of Manchester.

I thought that this was, on the whole, a more satisfactory way of working, when a noise in the immediate neighbourhood, as of some one throwing chains about, and a general shaking of the whole building, arrested my attention. The Arabs pointed to a door at the far end of the room, and in we went—a larger room than the other, but somewhat darker. In the centre was a curious-looking machine, while round it stood some Arabs, and with them an Englishman giving orders in the peculiar hasty and unmeasured tones and words that indicate that things are not as smooth as might be wished. On being asked what was wrong, he replied—"Oh, only the chain broken again and cut a man's leg open," pointing to an Arab who sat some distance off binding up his leg. "This is the fourth time to-day the chain has broken, and we have only made sixteen bales; I am getting tired of the everlasting repairs required to keep her going; yesterday the door locks gave way, the day before the sliding top got bent, and we could not move it for two hours."

In the year 1866 shippers of cotton bales first began to recognise the necessity of a better kind of press, capable of making a tighter bale, thereby saving a large amount in freight; also a press that would turn out considerably more than five or six bales an hour.

Two kinds of presses on entirely different principles were introduced in Alexandria; the compound steam and hydraulic press, with Ashcroft's patent revolving boxes, made by Routledge and Ommanney, of Salford, Manchester, the other the McCombe press, an American invention made by Fawcett and Preston, of Liverpool. The McCombe press was a complicated but powerful machine. It comprised an oblong cast iron foundation plate supporting four wrought iron columns, on the top of which two strong cast iron girders were placed longitudinally, the space between them being equal to the width of the inside of the press box. Underneath these, and attached to them, were angle irons projecting outwards, and on these a sliding false top was so arranged that one man could easily run it in or out. The upper portion of the box, for holding the cotton, was made of cast iron, the lower side pieces of teak, screwed to cast iron end frames with panels opening outwards on hinges; the whole firmly fixed to the four columns. The side doors were of cast iron, 2ft. 6in. deep, the end relieving door of wrought iron. At the bottom of the box, and 9ft. 6in. from the foundation plate, also attached to the columns, was a cast iron frame bored out in the centre to receive one end of a powerful capstan, the other end of which worked in the centre of the foundation plate. Fastened to the end of the capstan, and close to the foundation plate, was a bevel wheel 4ft. 6in. diameter, the upper part turned and grooved to receive the brake. Working into this wheel was a smaller bevel wheel, the boss of which formed a clutch; this and its shaft ran in bearings cast solid with the foundation plate. The other half of the clutch was arranged to slide on its own shaft on a feather key. On the other end of this shaft was keyed a compound grooved friction pulley 4ft. 6in. diameter, 10in. wide; and working into this, and so arranged as to be brought into contact at will, was a smaller friction wheel running at 200 revolutions per minute and driven direct from the engine by means of an 8in. double belt. On each end of the foundation plate were cast two strong brackets bored out to receive the trunnions of the side levers, 7ft. 6in. long, each of which was knuckle-jointed into the wrought iron forcing rods, 12ft. long, each attached to the loose cast iron follower plate forming the bottom of the box. On the sides of the knuckle joints, and running on the same pin, were one or two chain pulleys respectively, and reaved over these and through a hole in the bottom of the capstan, running right and left, was a ⅝in. chain, brought up by means of a right and left-handed screw link. The capstan had a double groove cast in it to receive the chain and prevent it overlapping. Buffer blocks of hard wood were built in the side walls of the foundation pit to receive the blow of the falling levers, &c., on their resuming their first position after each bale. The press was first put in motion by two levers worked from the baling floor, one in connection with the clutch and brake combined, the other with the friction gear. The box doors opened automatically, and the follower plate was kept from running back by a revolving rack, keyed on the sliding clutch-shaft, and held by two pawls in a cast-iron frame bolted to the foundation.

The press is at last finished, cotton shoots and all other incidental items ready, machinery well oiled, and the eventful hour arrives when the trial is to be made. The box being filled with cotton from the upper floor, and well tramped in through the space between the top girders, the sliding top is pushed into its place, the agent of the inventor, the principals of the firm, and their friends present, the order is given to "Stand by." Round goes the engine, and when the required speed is obtained, the lever in connection with the movable chuck and brake is pushed forward, the lever working the friction gear simultaneously pulled into position, and round goes the capstan, tightening the chain, bringing nearer together the knuckle-jointed levers, pushing up the forcing-rods, and automatically relieving the doors, which spring open with a loud noise, the levers gaining power as they come closer together. The maximum height is at last reached, and the bale finished, and the rack and the pawls take the strain while the bale is being hooped with eleven wrought iron bands, fastened with

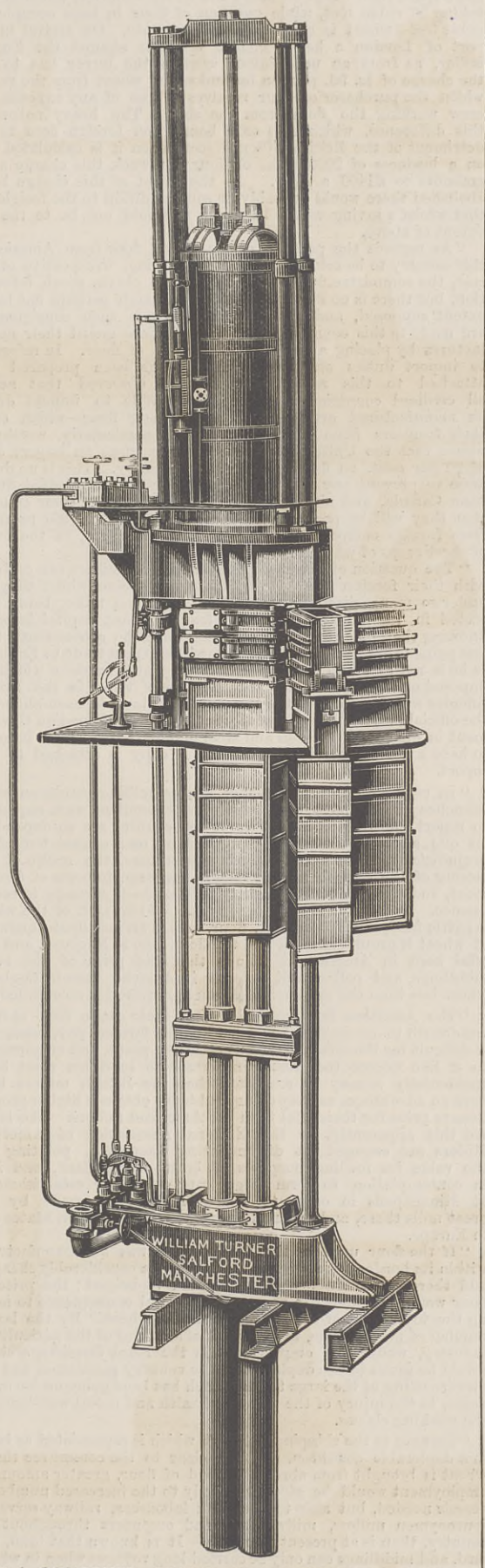


Fig. 1—COMPOUND STEAM AND HYDRAULIC PRESS.

the arrow tie. "All ready!" Now pulling the clutch free, and at the same time tightening the brake, the pressure is relieved, down comes the follower and levers, round goes the capstan, and the press resumes its original position, with its ponderous arms resting on the buffer blocks placed to receive them. The bale, being turned out, gives the following measurements—1ft. 8in. by 4ft. 3in. by 2ft. 6in., being nearly 17¾ft. cubic contents; weight about 6 cwt.

This was the best bale that up to that time had been made in Alexandria; but our troubles were to come. We had not worked long when the weak points of the press began to show themselves, resulting in breakdown after breakdown, until reparation was useless, and the press was condemned to the scrap heap, after making only sixty-seven bales, the greatest speed ever obtained being twelve bales per hour. The other press of the same type and size in Alexandria came to the same end, and their places were filled by the treble cylinder hydraulic press, fitted with the patent double revolving boxes, and worked by Armstrong's accumulator.

The vertical compound steam and hydraulic press, with Ashcroft's revolving boxes, was made by Messrs. Routledge and Ommanney, of Salford, for Messrs. Carver and Co., Alexandria. The press, as before stated made its appearance a short time before the McCombe press, but as with all new inventions, there was trouble with it at first. The speed was not up to the requirements, the bales were not as densely packed as expected, and the press showed weak points in various places. It is a curious fact that at this time no one knew the exact pressure per square inch on a bale of cotton in the press up to the finishing point; hence so many breakdowns, which increased by the different pressures required by different kinds of cotton. It was not known that the same pressure was required on the ram surface to make a bale of white cotton, and hold it, measuring 20 cubic feet, and weighing 6 cwt., as a bale of Galina or Sea Island cotton weighing 7 cwt. in the same measurement. It was not common to allow for the fact that a great deal also depends upon whether the cotton be damp or dry. The construction of this press was as follows:—Let into the cast iron foundation-plate were two 9in. hydraulic cylinders, the rams of which were increased in diameter about 6ft. above the turned or lower part which enter the hydraulic cylinders. Immediately under the collars formed by the thickened part was a cast iron crosshead bored out so as to slide up and down the turned part of the rams. At each end of this crosshead was a hole through which the two lifting rods were passed and firmly fixed; on the top of the rams was placed the follower. At one end of the bed-plate a wrought iron column was fixed, and round this the two baling boxes revolved, supported by polished chilled balls running in a strong cast iron grooved cup. At the other end of the bed-plate were two smaller wrought iron columns, and attached to these a cast iron plate, in which worked the relieving screw for the end door of the boxes and the pawl for keeping the boxes in their place during the process of filling and pressing. On the top of the columns was placed the press-head, which also formed the tank for supplying the four pumps which were fixed on the press head, and between them the steam cylinder with its piston and rod, and on the top of the steel piston-rod was a wrought iron crosshead which carried the plunger for the pumps and also the before-mentioned lifting rods. The pumps were connected by an arrangement of piping leading the water through a valve placed on the hooping platform, and from that direct to the hydraulic cylinders. There was also a knock-off valve in immediate connection with the large pumps, by opening which the water escaped from them back to the tank, throwing the whole pressure of the steam by means of the piston and crosshead, on the small pumps, and thus giving the final pressure on the bale. The stroke of the pumps being only 6ft., it took from five to six strokes of the piston up and down to finish the bale, so causing much loss of time and waste of steam. The double revolving boxes were made of cast iron with wrought iron doors; the bale was hooped with fourteen wrought iron bands, and fastened with the ordinary button, something in the shape of a shirt stud. The average number of bales per hour was 12, their weight 6½ cwt. each and 26 cubic feet measurement. After the fire at Messrs. Carver's cotton-pressing store in January, 1868, the press was re-arranged and very much improved, the boxes being lengthened and the width and breadth reduced, see Fig. 1. The bale was made by letting in the steam at the bottom of the cylinder, and so, by means of the crossheads and lifting rods, raising the hydraulic rams a distance of 6ft. on the loose cotton, then on the down-stroke the whole of the four pump-plungers forced their water direct into the hydraulic cylinders, so raising them a certain distance further; then the second stroke up was taken, the bottom crosshead sliding on the turned part of the rams. On the second downstroke the small pumps came into action—the larger ones being knocked off—and thus finished the bale.

(To be continued.)

THE INSTITUTION OF CIVIL ENGINEERS.

THE annual general meeting, to receive and deliberate upon the report of the Council on the condition of the Institution, with the annual statement of the accounts, and to elect the Council and officers for the ensuing year, was held on Tuesday, the 7th of June, Mr. Woods, the president, being in the chair.

The number of members on the roll of the Institution on the 31st of March, 1887, was 4347, of whom 20 were Honorary Members, 1568 Members, 2275 Associate Members, and 484 Associates. This was a net increase of 173, or 4·19 per cent., on the 4174 members of all classes recorded last year. The elections had included 34 Members, 234 Associate Members, and 6 Associates, while the deaths, resignations, and erasures, were 106. Many deaths had occurred among the older members of the Institution during the past twelve months, chief among whom must be placed Sir Joseph Whitworth. By his will he bequeathed to the Institution eighty shares, of £25 each, in the firm of Sir Joseph Whitworth and Company.

During the twelve months under review, 211 candidates were admitted as Students. On the other hand, 82 were elected into the Corporation as Associate Members, and 106 ceased, from various causes, to belong to the class. The total number of Students on the 31st of March last was 949, as against 926 at the same date in 1886.

To the authors of some of the papers read and discussed at the ordinary meetings medals and premiums had been awarded. For papers printed in Section II. of the Proceedings, without having been publicly discussed, awards had been made. Twelve students' meetings had been held on alternate Friday evenings, at which thirteen papers were read and discussed. A list of the medals and premiums awarded was published in our last impression.

Soon after their election, the Council endeavoured to negotiate with Sir Joseph Whitworth for the purchase of No. 24, Great George-street; but having failed in this, and No. 26, Great George-street being in the market, that house was acquired for £13,000. It was then deemed desirable to revive the option, which had lapsed, for the purchase of the freehold of No. 25, Great George-street, and this purchase was effected for £12,000. The Council had then two designs prepared—one for the rebuilding of No. 26, and incorporating it with the existing premises, and another for an entirely new building on the combined sites of Nos. 25, 26, and 27, Great George-street, it having been suggested that it might be desirable to acquire the latter house. After due consideration, the Council came to the conclusion that it was not expedient, at present, to enter into any large building operation, nor further to contemplate the purchase of No. 27. The intention then arrived at was to utilise the ground and first-floors of No. 26, by opening communications through the party-wall between Nos. 25 and 26, and to make these alterations during the coming recess. After the death of Sir Joseph Whitworth, on the 22nd of January last, his executors—acting on directions given in his will—offered the freehold of No. 24, Great George-street to the Institution for £15,000, being about the same rate per square foot of ground as had been given for No. 26 under the hammer. This offer the Council accepted.

The session was then adjourned until the second Tuesday in November, at 8 p.m.

PREPARATIONS are being made at Pola to launch the armour-plated vessel Crown Prince Rudolph, which will be one of the finest in the Austrian Imperial Navy. It is a central citadel barbette ship, with 12in. plates, and engines of 6500-horse power

DEPRESSION IN THE MILLING TRADE.

The following is the report of a special committee of the National Association of British and Irish Millers, appointed to investigate the present depression in the milling trade:—

"The subjects handed over to the committee are so important and embrace so large a number of interests, that they have felt some difficulty in dealing with them in an adequate manner, owing to the shortness of time in which to make the needful inquiries and there being no funds available for the work.

"In order to get the assistance of the trade generally, several questions were prepared and circulated throughout the country by the courtesy of the principal trade journals, and replies invited from the milling public. Very few millers have sent information in response, so that the committee had to depend very largely on other sources, and have to acknowledge the aid rendered by Mr. J. H. Chatterton, the secretary of the National Association, in whose office a good deal of valuable and authentic information has been recorded from time to time.

"There appears to be no reasonable doubt but the milling industry of the United Kingdom has for some years been declining, but no very serious alarm was felt until a comparatively recent period. For some years a steady import of fine flour was made from Austria-Hungary, where the science of milling was better understood than in England, and where the roller process was first introduced on a large scale. The principle there acted on was and is to make from the same run of wheat several qualities of flour, and as a demand sprang up for very fine white flour in England and France, whilst the inhabitants of Hungary were buyers of the darker and coarser qualities, it was a natural and legitimate method of trading. When after a time the attention of English and American millers was drawn to the subject, the millers of these countries promptly introduced roller machinery, and this has resulted in the construction in America of vast factories for the avowed purpose of supplying England and other countries, where no import duty exists with flour. It was supposed that the principal cause of English millers losing their trade was that they were not proficient in their business, and that so soon as the British and Irish mills were properly equipped with the new machines and worked by men skilled in the new methods that the flow of foreign flour would be stopped. Such has not been the case, and in some instances the large roller mills of this country have suffered as severely as the old-fashioned stone mills. It is, therefore, needful to search in other directions for the causes of the depression, and the committee in examining the subject, which has many ramifications, have to introduce some statistics in order to bring the facts of the case before the trade.

"First as to the 'depression' itself. In Ireland, in 1846, the population was 8,287,848, and from 1835 to 1844 we are informed the export of grain and meal from that island to England and Scotland was at the rate of 3,000,000 quarters per annum. In 1887 the population of Ireland has diminished to the estimated number of 4,852,914, and the production of the country has so been reduced that the export of wheat has ceased, and the people now use large quantities of imported American flour. The mills of Ireland, mainly worked by water power, have greatly diminished in number, the workmen are gone, and the water runs to waste. In Scotland grave complaints are heard from the chief ports, but especially from Glasgow, that the mills, well furnished with machinery of the most modern type, are standing idle, and that the trade is being destroyed by the introduction of the surplus products of American mills, consigned, it is stated, to be sold for what it will bring, regardless of profit, the American miller 'striking his averages,' as he calls it, with the higher prices made in his local sales. It is well known, too, that even where the practice of selling on consignment is not adopted, the American millers sell usually at a relatively higher price at home than in Europe.

"The census returns for England and Wales, together with the number of millers of corn—masters and men together—for the periods 1851 to 1881 inclusive, are as under:—

1851 ..	Population,	17,927,609	Millers of corn,		36,076
1866 ..	,,	20,066,244	,,		31,639
1871 ..	,,	22,712,266	,,		29,720
1881 ..	,,	25,974,439	,,		23,462

From 1851 to 1881 the population increased 12,046,830, and the number of master and operative millers combined became fewer by 12,614. This large and striking decrease can only be partly accounted for by the adoption of labour-saving appliances.

"Taking the whole of the United Kingdom, it appears that whilst in 1879 there were 10,450 flour mills at work, these have been reduced in 1887 to 8814, showing that 1636 have during that period ceased to exist. It must, however, be borne in mind that during these years the roller mills have sprung into existence, and most of them are of greater capacity than the stone mills they have superseded. The number of complete roller process mills erected has been 460, with a capacity of about 3800 sacks flour of 280 lb. per hour, costing in the total about £1,750,000. This is irrespective of the amount expended by millers in partially adapting millstone mills by adding rolls and purifiers, and for the improved wheat cleaning apparatus which has been added to nearly every mill in the country, whether on the old or new systems, and which has probably cost about £2,500,000. There is then to be added to these amounts the cost of new buildings and warehouses to relieve the mills proper, and if £750,000 is allowed for this purpose, the total capital expended from 1879 to 1887 in the United Kingdom in the introduction of improved methods of manufacture amounted to about £5,000,000. These figures are arrived at after a careful examination of the subject, and with the assistance of gentlemen having a special knowledge of this branch of the question. At appendix A will be found a return of the roller mills of the United Kingdom, with the number and power in each county, made up to the 1st May, 1887. The Engineer contained on April 22, 1887, an interesting article on this subject, but although this paper is usually well informed, the committee are not able to confirm the accuracy of the estimate there made, that during the past six years the expenditure in equipping the British and Irish mills with the roller or gradual reduction system has amounted to about £9,000,000.

"It is clear, however, that whether the estimate of £5,000,000 or The Engineer estimate of £9,000,000 is the correct one, there has been a very lage increase in the capacity of many mills, which must to some extent make up for the flour formerly manufactured by the 1600 mills gone out of existence, and which were probably in many cases small mills in unfavourable situations.

"There is every reason to believe that at the present time the majority of the British millers are as skilful, and their mills as efficient and as scientifically worked, as any in the world, with the possible exception of some of the chief Hungarian flour mills; there is also no doubt but that the millers of the United Kingdom are able and willing to manufacture all the flour the inhabitants of these islands can consume. Any introduction of foreign flour can therefore only result in injury to the British and Irish millers, as every bag of flour thus imported takes from the mills of this country, and deprives our workpeople of the labour by which they live.

"It is now necessary briefly to recapitulate the extent to which foreign imports of flour have reached:—

For the ten months ending April 30th, 1887..	6,781,390 sks. of 280 lb.
Corresponding period of 1886	4,473,000 ,, ,,
Increase..	2,308,390 sacks.

"The above import is at the rate of 8,000,000 sacks of flour, or 1,000,000 tons, and if in wheat would represent 6,664,000 qrs. at 480 lb., or 1,428,000 tons, so that the loss to our home industries from flour being sent, instead of wheat, is that the ships have less to carry by 428,000 tons, the mills have less to manufacture by 6,664,000 qrs., and the farmers have 400,000 tons less bran, pollard, and middlings wherewith to feed their cattle.

These figures indicate with precision what has been very generally known, that the imports of flour have been increasing, and continue to largely increase, and the committee have endeavoured to discover how it is that American millers are able to undersell those in England. So far as can be ascertained, there seems no doubt but that in America the railway companies favour the carriage of flour from the West to the eastern seaboard, and by various means, principally owing to the keen competition between the railways there, the millers of that country and also of Canada are enabled to forward flour to the seaboard upon special terms. This is done by means of what is known as 'transit rates,' which enable American millers to buy wheat in the West, have it ground anywhere on the way to the coast, and ship through to Europe, allowing the wheat to stop at the mill to be ground and shipped through in flour on the rate, paying an additional 1c. per bushel for stopping the car; the miller can send the same gross weight of flour as he received of wheat, the freight remaining the same. As regards ocean freights, the advantage is with wheat, as owing to the circumstance that flour occupies more space than wheat on board the vessels—one ton wheat in bulk taking 50 cubic feet, while one ton of flour in bags occupies 60 cubic feet—wheat is carried at a lower rate. On arrival in the port of London a heavy charge operates against the English miller, as from an unexplained custom the buyer has to pay the charge of 1s. 9d. per ton for unloading wheat from the vessel, whilst the purchaser of flour receives it free of any expense, the crew working the flour from the ship. The heavy nature of this difference, which acts as a bounty on foreign flour to the detriment of the British miller, is seen when it is calculated that on a business of 2000 sacks of flour per week this charge alone amounts to £1400 a year. In the event of this charge being abolished there would probably be some addition to the freight, so that whilst a saving would be made it would not be to the full extent of above.

"As regards the practice of consigning flour from America to this country to be sold for what it will bring, irrespective of the cost, the committee find it very difficult to obtain much information, but there is no doubt this is done, though perhaps not to the extent supposed, and probably in all cases such consignments are made to this country, as all other nations guard their manufactures by placing a duty on the import of flour. In reference to import duties on flour, a return has been prepared and attached to this report. It will be observed that nearly all civilised countries consider it desirable to impose duties on manufactured articles—always including flour—which enter their frontiers from abroad, and it is particularly worthy of notice that the United States of America place an import duty of 20 per cent. on flour entering that country. This is no doubt done to prevent any millers sending flour into the United States from Canada, and also to assure the capitalists of their country that they will be protected in their investments in mill property from foreign competition from India or elsewhere, in the event of short crops of wheat in America.

"The question of how the British and Irish millers can compete with their foreign rivals is very difficult to solve, whilst they are under so many disadvantages. The American miller being protected in his industry, does not fear to invest capital lavishly, knowing that his home trade is secure, and he consequently is at less pains to get remunerative prices on his export trade to England, as he is not called to pay any of the taxes and burdens which are imposed on the English millers. The view taken in the British colonies where import duties are placed on flour, is exemplified by the official memorandum recently issued by the Canadian Government in the case of the iron and steel manufactures, and as it seems to have a bearing on this discussion, a copy is attached to this report.

"In reference to the influence on the milling trade on other branches of commerce, as to which the committee were requested to report, the various industries of the country are so dependent on one another, that the depression of one cannot but affect prejudicially others. As regards agriculture, the result of the closing of the English mills is seen in the large imports of foreign meat, and the want of prosperity to the stock farmers in consequence. The reason is not far to seek. 30 per cent. of the wheat is cattle food, and 70 per cent. flour, and if an inordinate quantity of wheat is ground abroad, and the flour sent to England, and the offal kept in America, it follows that the price of the bran, middlings, and pollard will be lower in America than in England, where less than the proportion of wheat required is now milled.

"The American farmers are buying their cattle food at from one-fourth to one-half of the price English farmers pay, rendering it difficult for the latter to fatten cattle at a profit, and encouraging to a like degree the American farmer to send his meat here. Incidentally it may be remarked that the British millers have here an advantage, as they do undoubtediy obtain a higher proportionate price for their offal than the American millers. The latter see this apparently, as the National Association of American Millers are engaged in disseminating literature, pointing out the value for feeding purposes of bran and pollard, and it is in contemplation to form large cattle feeding establishments at Minneapolis in order to consume the offals made by the great mills there, and forward the meat to the Eastern States and to Europe.

"If the flour used in the British Isles was all manufactured within its borders, the price of offal would be considerably cheaper, and thereby the English farmer would be helped; the price of flour would be somewhat dearer as a natural consequence to make up the total value of the product from the wheat. By the larger number of persons who, in the event of a revival of the agricultural industry, would find employment in the rural districts, a check would be given to the depletion of the country population and the overcrowding of the large towns, which has been going on for many years, to the injury of the physical health and moral well-being of the working classes.

"Turning to the shipping interest, which is represented as being in a deplorable condition, it seems clear to the committee that if wheat is brought from abroad, instead of flour, greater amount of employment would be given, not only to the increased number of vessels needed, but also to the dock labourers, railway servants, journeymen millers, millwrights, and engineers throughout the country, than is at present the case. It is known that bran, pollard, and middlings can only be carried long voyages when in wheat, unmilled, and being, as above mentioned, 30 per cent. of the grain, the addition to the carrying appliances required would be very considerable. To place against this, however, must be deducted a portion of the cattle and dead meat trade, and which, if a larger number were fed in this country, would not be carried on to so great an extent. The committee have felt that the closing of large numbers of small country water mills, which is now going on, is very detrimental to the interests of the nation, besides being disastrous to an industrious and useful body of men, whose painful position claims the sympathy and concern of the trade. Looked at from an economic point of view, it must be beneficial that the water power should be utilised, and that these small mills should be at work where they can be employed so usefully. The necessity for this class of corn mills is so well understood in America, that in order to induce their establishment it is the custom for farmers and others to combine and assist, by subscriptions of money, land and materials, small millers to build and equip mills. A letter has recently been published by Messrs. Watson, Tod, and Co., of Birmingham, which deals with the carriage of flour and wheat from the coast to the interior in an exhaustive manner, and an association has been formed to further the views there advocated, and in order to give practical effect it is proposed to ask Parliament to insert clauses in the new Bill of the Government to regulate railways and canals, providing for the carriage of wheat at lower rates than the manufactured products thereof. This would probably be of great assistance to mills in the interior of the country, especially at the large centres of population, in districts where but little wheat is grown; but the committee would point out, as the subject has attracted considerable attention in the trade, that in the large wheat-growing counties of England such clauses might act very prejudicially to those country mills which are kept employed in grinding English wheat into flour, and forwarded in large quantities to London and other places for consumption, the offal remaining in the neighbourhood for farmers' use. If the flour rates were raised, and wheat rates lowered, these mills would run considerable risk of losing what trade is now left to them.

"The committee have not lost sight of the opinion of many, that the depression in trade, both in England and other countries, is to be accounted for mainly by the depreciation in the value of silver. This is a very intricate subject, and is confessedly so little understood that, beyond alluding to the matter as a possible cause, there seems but little use in going further into it, except to remark that whilst the depreciation of silver may be very detrimental in some ways, it appears to bring prosperity to the wheat growers of the Indian Empire, who, paying their expenses with a silver currency, sell their wheat in Europe for gold. They are thereby enabled to sell wheat cheaper than either the English or American farmers, and English millers have, by purchasing Indian wheat, been helped to withstand the competition to some extent.

"The general conclusions which the committee have arrived at after reviewing the subject to the best of their ability are—(1) That the milling trade of the United Kingdom is in a depressed condition, not from want of skill and enterprise, or lack of suitable machinery, but from the action of external causes, which they hope may not be permanent. The question of protective duties, specially submitted by the London Flour Millers' Association for consideration, has had careful attention; but the committee, not being unanimous, make no recommendation in this direction.

"They are of opinion that considerable advantage to the trade would result if the National Association were more generally supported by millers throughout the country, so as to provide the executive with the needed funds and authority. (1) To engage skilled assistance to deal with Bills before Parliament affecting the trade. (2) To enable the Association to watch the interests of millers, as regards the rating and taxation of mills, the charges imposed by fire insurance companies, railway, canals, docks, shipping, and warehouses. (3) To deal with the question of wheat contracts and arbitrations, now almost exclusively in the hands of corn factors and the sellers of grain, and provide for the contracts to be framed and carried out on fair and equitable terms to the millers of this country, who are ultimate purchasers of all foreign corn entering the ports. (4) To provide legal assistance to millers, and conduct cases where of interest and importance to the trade at large. (5) To obtain and disseminate information useful to the trade, and also to the public where desirable. (6) To co-operate with other branches of commerce, particularly the agricultural interest, in efforts to obtain redress of grievances from the Legislature.

"The committee have not failed to observe that all the principal trades and professions of the country have found it useful to form themselves into powerful combinations for mutual strength and support, resembling to some extent the trade guilds of the Middle Ages, and they are convinced that the time has arrived when millers, whether in large or smaller businesses, should abandon their isolated positions and co-operate with one another for the general good. The committee trust that the present state of affairs may ere long give place to a reasonable condition of prosperity, which they believe the nation will not grudge to the members of a craft of such ancient origin and primary necessity to the population."

Spanish Iron Ore.—During May no fewer than twenty-seven steamers arrived in the Clyde from Spanish ports bringing 32,188 tons of iron ore, as against nineteen steamers with 28,060 tons in May, 1886. The five months' imports are 189,746 tons, being an increase of 52,325 tons over the arrivals of the corresponding period of last year. At the moment the output of hematite pig in Scotland has been somewhat reduced by the blowing out of three furnaces, but the consumption in the steel works is still on an extensive scale.

The Royal Agricultural Society's Engine Trials.—The eleven engines entered for these competitive trials at Newcastle include seven simple engines and four compound engines. The former are by the Alnwick Foundry and Engineering Company, Mr. T. Cooper, Mr. E. Foden, Messrs. Jeffrey and Blackstone, Messrs. McLaren, Messrs. Paxman and Co., and Mr. E. Humphries. The compound engines are by Mr. E. Foden, Mr. E. Humphries, Messrs. McLaren, and Messrs. Paxman and Co. Some of the engines are not yet put together, while others have been running some months. Some of the competitors have been in such trials before, and one has achieved a very high result. It is quite impossible to say whence the winning racer is to proceed, for the conditions under which such engines are now designed differ much from those of fifteen years ago, and a genius in useful new details or departures may spring up in every place that builds an engine.

Effect of Tipping Slag in the Tees Bay.—At a meeting of the Tees Conservancy Commission held on the 13th inst. an animated discussion took place on the possible effect of the continued tipping of blast furnace slag in the Tees bay, diminishing the available depth at the mouth of the river. Mr. Fallows, chairman of the Works Committee, said that in some places the deposited slag appeared to be only 40ft. below low water mark, and that this knowledge might make the captains of vessels afraid to enter. After spending half a million in making a harbour second to none, the Commissioners should not allow ironmasters to make a second bar beyond the mouth of the river. In the course of the discussion which ensued it transpired that the engineer, Mr. Fowler, had taken some soundings, but not sufficient to enable him to report definitely upon the matter, which, however, he considered a serious one for the Commissioners. The difficulty was to catch those who deposited slag where they should not, the present arrangements for enforcing regulations being inadequate. The Commissioners' powers extend for three miles out to sea and fifteen fathoms in depth.

Society of Engineers.—The members of the Society of Engineers and their friends visited the steam road-roller and traction engine works of Messrs. Aveling and Porter, at Rochester, on Wednesday. The visitors, who reached Rochester at midday, were received by Mr. T. Aveling, and entertained at luncheon. They were afterwards conducted by that gentleman and Mr. Stephen Aveling over the works, where they saw steam road-rollers and traction engines in all stages of construction. The turning shop, which with the forge and boiler shop are practically under one roof and cover about four acres, was first inspected, after which the visitors went over the others in succession, and then the foundry and the erecting shop, all the departments being well occupied. They were then shown several engines at work, the first being a fine 18-horse ploughing engine, which is one of a pair being made for the South of France for breaking new land for vine cultivation, the ground being ploughed from 21in. to 2ft. deep. The plough is of steel, on the balance principle, and weighs 5 tons. A 6-horse power agricultural engine and an 8-horse traction engine, with spring wheels, were then shown in action, and they both made some splendid runs on the road, as did the ploughing engine. On leaving the works the visitors were conducted to the grounds of the old castle, which the late Mr. Thomas Aveling, the former head of the firm, was mainly instrumental in purchasing and converting from garden plots into charming public recreation grounds. It is stated that Mr. Aveling accepted the mayoralty of Rochester chiefly that he might be enabled to carry out this long-cherished scheme, to the expense of which he largely contributed. The members and their friends dined together at Rochester in the evening.

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

(*From our own Correspondent.*)

AT Wolverhampton yesterday, and in Birmingham to-day—Thursday—vendors maintained the slightly better position of last week with regard to the transaction of business. So excessive has the heat become that the puddlers will soon, it is anticipated, find it hard work to stand before the furnaces, and operations at the mills and forges may become impeded. Added to this, the partial suspension of the plants next week, the majority of which will be run only three days, on account of the Jubilee celebration, makes it necessary for buyers needing prompt supplies to be more in touch with makers' terms.

Prices are not, however, yet quotably improved. Marked bars are without alteration at £7 10s. per ton for A1 sorts, and £6 for second branded qualities; while merchant bars are £5 10s. down to £5, and hurdle bars £4 15s. A few of the best bar houses are doing pretty well at date. Messrs. Noah Hingley and Sons may be particularised as well engaged on cable iron for their own consumption, and on bars for New Zealand, Australia, and America. The New British Iron Company is rather more actively employed, orders coming to hand with more freedom from India and other distant markets. The company believe that there is a good future before their new composite steel and iron, which was introduced to the recent Iron and Steel Institute meeting.

The considerable contract for best bars and plates, which has been given out by the War Office to the New British Iron Company and the Snedshill Iron Company—the former of Birmingham and the latter of Shropshire—has occasioned satisfaction here.

The departure now made by the Government in purchasing direct, instead of through merchants, should lead to an increased appreciation of the quality of best Staffordshire iron.

Makers of hoops had to-day again to refuse export orders, owing to their inability to execute them with the required dispatch. Common hoops were quoted nominally at £5, but buyers declared that they could place orders at £4 17s. 6d.; gas tube strip was to be had at £4 15s. upwards, but most makers quoted £4 17s. 6d. to £5. Bedstead strip keeps without change at £5 to £7.

Rather more briskness is reported by the sheet makers this week, and some firms have more than they can do to get through their contracts with the needed despatch. Messrs. J. Lysaght, who are the largest makers in South Staffordshire of sheets for best galvanising purposes, are at their two works in Wolverhampton running sixteeen mills full time, which gives an output of 500 tons of finished sheets per week. If the mills were employed on merchant sheets or other iron the output would be much greater. Other sheet makers are also busy.

Superior merchant black sheets—doubles—were quoted this afternoon £6 10s. per ton, though galvanising doubles were to be had at £6. Galvanising lattens were £6 15s. to £7; and singles, £5 15s. to £5 17s. 6d.

The fall in the price of galvanised corrugated sheets, both at home and in South Australian markets, is prejudicing the position of the galvanisers considerably. For galvanised doubles, the recent minimum for which was £9 15s. per ton f.o.b. Liverpool, merchants now state they are paying only £9 10s. to £9 12s. 6d. Much of the business offered, however, makers have to refuse, and so fine have profits been cut that in the case of rejected orders the difference between buyers and sellers has this week been no more than 1s. 3d. per ton. Within the past month prices in the Australian markets have been reduced by some of the largest makers 10s. per ton.

There is a large continued increase in the exports of galvanised sheets. In April the shipments were 26 per cent. more than in the corresponding month last year, and the increase last month over a similar period was 19 per cent.

Steel sheets are being rolled in increased quantities for galvanising purposes, to be used in the flat state for working up by the hollow-ware makers, iron plate workers, and such like manufacturers. The steel does not take the galvanised coating so well as the iron, but it answers better for manufacturers' use. The price is from £1 to £1 10s. per ton above the quotation for iron sheets.

Best soft steel sheets of local make, suitable for constructive purposes, and declared to be equal to Siemens quality, are quoted at £8 15s. to £9 for heavy singles not thinner than 14 gauge. Steel stamping sheets—doubles—are quoted at £10 to £10 10s., and lattens £1 extra. Soft steel boiler plates are £7 15s. per ton. Welsh steel firms are making deliveries to local consumers at prices 10s. per ton below those of some local superior steelmasters.

Crude iron, in sympathy with northern products, has somewhat firmed, though this stronger tendency may be largely due likewise to the diminution of stocks. Deliveries from the furnaces are rather more numerous this week, and the outlook is regarded as rather better. Northamptons are quoted 35s. delivered; Derbyshires, 35s. 6d. to 35s. 9d.; and grey forge Lincolnshires, 39s., but without business. Native sorts are quoted 39s. to 40s. for part-mines, and about 50s. for all-mines. Common descriptions are 27s. 6d. to 30s. per ton.

Messrs. Alfred Hickman and Son, Spring Vale furnaces, the largest pig makers in South Staffordshire, are now turning out 1500 tons a week, the product of five furnaces, and 500 tons a week are being consumed at the adjoining steel works of the Staffordshire Steel and Iron Company, the mixture being a special one for basic steel production. Messrs. Hickman have just made an important improvement to their premises by the completion of a siding, some three-quarters of a mile in length, on to the main line of the Great Western Railway. The work has occupied some two years, since the firm have been carrying it out gradually. They are now connected with the main systems of both the London and North-Western and Great Western railways.

The business doing in cokes and ironstone is not large. Durham foundry cokes are 18s. to 22s. delivered. Welsh ground and washed cokes for foundry and best blast furnace purposes are 18s. to 20s., and Welsh washed cokes are 16s. to 18s. 6d. A little common Welsh is coming into the district at about 11s. Wigan cokes are selling very slowly at 12s., and Derbyshire and North Staffordshire furnace cokes are 10s. 6d. to 11s. 6d. delivered. Northampton ironstone is 5s. 4d. to 5s. 6d. delivered.

The North Staffordshire iron trade has been somewhat more active during the last few days. Many of the works did not resume operations until the middle of last week, and in the execution of the few orders which accumulated during the holidays sufficient work is found to keep the plants running four or five days a week. From some of the colonial markets a fair inquiry is being experienced for plates and sheets. Prices show no disposition to move upward, and at present quotations are nominal at £5 for crown bars, £5 10s. for best, £6 2s. 6d. for bridge-plates, and £6 10s. for boiler qualities, delivered Liverpool, or equal.

The death is announced of Mr. David Kendrick, ironmaster, of the Willingsworth furnaces, Bilston, at the age of sixty-four, who expired at his residence at Wolverhampton on Thursday night. He was an alderman and a borough magistrate.

Engineers are in receipt of inquiries for galvanised corrugating machinery for Spain, Germany, New Zealand, and India. Whether the work will all be booked in this district, however, depends upon the prices quoted. It is somewhat significant that distant countries should be entering upon this branch of the iron trade.

A contract is on the market on account of the Indian State Railways for a supply of steel rails—50 lb. per yard—fish plates, fish bolts, spikes, wheels, and axles.

The rivet makers in the Blackheath district have been unsuccessful in their attempt to induce the masters to return to a higher list. The men complain that the prices which they are now receiving are about half what they used to be, and that there is no trade which has got into a worse channel than theirs.

The Wolverhampton Chamber of Commerce have considered the increased Canadian import duties, and have resolved that no useful purpose would be attained by representations being made to the Canadian Government by commercial bodies interested in the iron trade of this country,

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is still an absence of any indication of improvement in the iron trade of this district. Business all through continues very slow, and the tendency of prices, although they are not quotably lower, and might perhaps be expected to receive some strength from the firmer tone reported from Glasgow and Middlesbrough, are rather in the favour of buyers than of sellers. For common pig iron the demand is very limited, and even at what may be termed comparatively low prices business is extremely difficult. Hematite qualities unquestionably hold the strongest position in the market, and this is backed up by the considerable activity which still prevails in steel rails, and in the demand for billets, which enables the producers of the raw material to maintain a firm tone at an advance upon the prices which were being taken recently. The manufactured iron trade remains in an unsatisfactory condition, and prices would almost appear to be gradually receding to something like the excessively low figures which were ruling last year. It would, in fact, seem as if this branch of trade were undergoing, if not a process of more or less gradual extinction, at any rate of gradual displacement in favour of steel in a great many directions where wrought iron has previously been used, which points to a steady lessening consumption of finished iron in the future. This is no doubt one of the most serious outlooks which makers have to face, and the question is whether it may not lead to the ultimate alternative of the absolute closing of many of the existing works, or the rearrangement for the manufacture of steel to meet the altered requirements of the times.

The Manchester iron market on Tuesday was only moderately attended, and the business doing of but a very restricted character. There was some inquiry for pig iron, but of no great weight, whilst makers even at their minimum quoted rates found themselves in most cases above what buyers were apparently disposed to give. For Lancashire pig iron makers still quote nominally about 38s. 6d. to 39s., less 2½, for forge and foundry qualities delivered equal to Manchester. Except, however, where they have special customers or very favourable rates of delivery, they are quite out of the market on the basis of these figures, and to secure business of any ordinary weight they would have to meet buyers with considerable concessions, as district brands are offered freely at 37s. to 37s. 6d., less 2½, for forge and foundry Lincolnshire delivered here, and even at these figures there is underselling, which renders business of any weight difficult. Some sales have, however, been made on the above basis for Lincolnshire iron, and makers show very little disposition to take any lower price. Outside brands offering here are steady at about late rates. Good named foundry brands of Middlesbrough are held pretty firmly at about 43s. 4d. net cash, delivered equal to Manchester, although some slight concessions would scarcely be allowed to stand in the way of actual business. In Scotch iron there has been a slight stiffening in makers' prices, but there are still sellers at quite 1s. per ton under what makers are supposed to be asking.

For hematites, although the actual business doing in this market is not more than what may be termed moderate, prices generally are firm at about 52s. 6d. to 53s. 6d., less 2½, for good No. 3 foundry qualities delivered into the Manchester district, and it is only in exceptional cases through second hands that orders could be placed at much under these figures.

For manufactured iron the demand has again been very dull with prices weak. In a few exceptional cases makers still hold to about £5 per ton for bars delivered into the Manchester district, but £4 17s. 6d. is now about the average figure, with hoops to be got at £5 4s. 9d. to £5 5s., and local made sheets at about £6 5s. per ton. In North-country plates there has been business doing at about £5 1s. 6d. per ton delivered here.

In the condition of the engineering trades there is no material change to notice; there is perhaps rather more inquiry stirring in some branches, with works here and there getting rather busier, but there is still an absence of any general improvement, and the outlook for the future continues discouraging. Engineers have still to face excessively low prices to secure new work. As the Bolton strike is still the question occupying most prominently attention in the engineering trade of this district, it will be of interest to give a few particulars as to how matters at present stand. This strike, which up to a few days past has been confined to local limits, may now be said to have entered upon an area which gives it much wider importance. On Friday last the general committee of the Iron Trades Employers' Association held a special meeting in London to hear a report from the secretary, which dealt with the history of the dispute up to the latest phase it had assumed. At this meeting there were representatives from all the great engineering centres in the United Kingdom, including Barrow, Barnsley, Bradford, Halifax, Huddersfield, Hull, Keighley, Leeds, Leicester, Liverpool and Birkenhead, London and the surrounding districts, Manchester and the surrounding districts, Newcastle-on-Tyne, Sunderland, and other places. After hearing the report, which was read by the secretary, the committee resolved that the question was one which called for the consideration and support of every district where the Association had members, and the following resolution was unanimously passed:—"That the funds of the Association be placed at the disposal of the executive committee, to be expended as they may deem fit for the assistance of the Bolton employers, and that the committee be empowered to call a special general meeting of the members of the association, if they find it desirable, with the view of taking such further united action as may be found necessary to bring the strike to an end." This shows that the Bolton employers are receiving the complete support of the engineering firms throughout the country in the determined action they have taken, and the men on their side seem to be equally determined at present to carry on the strike. Since the failure of the conference between the employers and the men on the 26th ult., the men have certainly made another proposal through the Mayor of Bolton, but not one at all calculated to find acceptance with the employers. Their further proposal has been to the effect that they would resume work immediately and accept overtime, on condition that fourteen days after date the 7½ per cent. advance of wages were conceded; and on Saturday following the meeting in London, the Mayor of Bolton called a meeting of the employers in the town to lay the men's proposal before them. He was thanked by the employers for his kindness and consideration, but was informed that they could not entertain the proposal, as the matter was now in the hands of the Iron Trades Employers' Association, which had placed at the disposal of its executive committee the funds necessary for getting workmen into the district, or otherwise bringing the strike to an end.

In the report presented to the meeting of Committee of the Iron Trades Employers' Association, held in London, a tabulated statement of machinists' wages paid in Bolton as compared with other districts was presented by Mr. Hutchings, and a few particulars extracted from this will be of interest. Testing the nominal weekly ratings of machinists in Bolton by the rates paid in Manchester and some other towns, the figures stand as follows, taking turners and fitters as a test of the entire question:—Fitters—Bolton, 26s.; Manchester, 30s.; Rochdale, 27s.; and Oldham, 30s. Turners—Bolton, 26s.; Manchester, 30s.; Rochdale, 24s.; and Oldham, 26s. But the results arrived at by weekly rates of pay are altogether illusory and misleading, as only the actual earnings of each man working piecework on his own hand can give the result. The weekly ratings and piecework earnings have therefore been taken from the pay-sheets of one of the largest machinists' shops in the Bolton district, for the planers, turners, and fitters in each case, on two consecutive pay days—viz., March 9th and March 16th, 1887, thus showing the actual earnings when the men made their demand for an advance of 7½ per cent. on their existing rates. The net result of this inquiry showed that the men added 37 per cent. to their nominal ratings, so that a workman rated at 26s. per week actually earned £1 15s. 7d. The time-sheets and wages books were also submitted to an actuary, Mr. W. E. Stark, who more than confirms the above, and states that "in the turners' department, where the nominal rating is £1 6s. per week, there are entries which show men earning over 75 per cent. above their ratings, or say, adding 19s. 6d. thereto, thus making their earning £2 5s. 6d. per week." In the planers' department there were men whose weekly earnings exceeded their weekly ratings by 50 up to 75 per cent., and in the fitters' department he found men earning over 46 per cent. in advance of their nominal ratings. This result, the actuary adds, is evidently due to more activity in the individual workman, or to a higher degree of technical skill brought to bear upon the work in hand.

The half-yearly meeting of the Manchester Association of Engineers was held on Saturday, Mr. Thos. Ashbury, C.E., the vice-president, in the chair. Prior to the consideration of any business the chairman reported that since the Association last met, death had removed four members, viz., Mr. John Burton, for upwards of thirty years one of the respected foremen of Messrs. W. and J. Galloway and Sons; Mr. John Saxon, of the engineering works, Openshaw; Mr. Wm. Heywood, of Ellesmere-street Works, Hulme; and Mr. Matthew Curtis, Mayor of Manchester—a life hon. member. Appropriate reference having been made to the memory of the deceased members, resolutions of condolence were passed, and ordered to be forwarded to the widows and families. It was further announced that the next meeting of the Association would be held on July 9th, in the building of the Royal Jubilee Exhibition. Formal business was then proceeded with, consisting of the election of two new members, the appointment of Messrs. J. Hartley, J. Horsley, and W. Lawson on the committee, and the election of Messrs. T. Corby and C. O'Brien as auditors.

In the coal trade business has now completely settled down to the usual quiet summer's demand, and pits generally are having to go on short time, with stocks accumulating. House-fire coals are, of course, only in the smallest possible request, but the common classes of round coal are also bad to sell, as not only is a considerable quantity of this description of fuel thrown upon the market by the lessened requirements for domestic purposes, but there is still only a limited quantity going into consumption for iron-making and steam purposes. Engine classes of fuel are moving off fairly well, but this is more because of the lessened quantity of slack now being produced than that there is any really increased demand. Prices are not quotably any lower, but in round coals sellers are prepared in many cases to take very low figures to effect temporary sales to clear away stocks, and this tends to give a weak tone to the market. At the pit mouth best coal averages 8s. to 8s. 6d.; seconds, 6s. 9d. to 7s. 3d.; common coal, 5s. to 5s. 6d.; burgy, 4s. 6d. to 5s.; best slack, 3s. 6d. to 4s.; and common, about 2s. 6d. per ton.

The shipping trade is rather dull, and delivered at the high-level, Liverpool, or the Garston Docks, steam coal does not average more than 6s. 9d. to 7s. per ton, with as low as 6s. 6d. taken in some cases.

Barrow.—There is a fairly steady, but certainly not active, trade in hematite pig iron in this district, but orders are not so freely offered as they were a month ago, although some of the largest makers have done a good business lately. Prices are firmly held at 45s. per ton for Bessemer iron in parcels of equal weight of Nos. 1, 2, and 3, net f.o.b. Sales of some descriptions are noted as low as 43s. 6d. per ton, but very little iron is changing hands at this low value. It is evident that makers are not pressing sales, and it is clear that they have no need to do so when it is remembered that they are practically sold forward for three or four months, and their deliveries in the meantime absorb their make. There is less business being done in hematite warrants, which in itself is a good sign, because it shows that the stocks of iron which are held are not being disposed of at prices which keep the rates down at which producers are able or are disposed to do business. It is satisfactory to note that the make of pig iron is well maintained, and that there has been no reduction in the number of furnaces in blast. The steel trade is very well employed, and it is probable that some large orders will soon be booked for forward deliveries of steel rails to American, colonial, and home buyers. Prices this week show a slight improvement, to the extent of 1s. per ton, the quotation this week being £4 2s. 6d. for ordinary heavy sections net at makers' works. There is not so much activity in other departments of the steel trade, but makers are fairly employed, and there is every reason to believe there will be a good demand for steel for shipbuilding purposes, and a fair market for blooms, billets, and bars. Blooms are not in such brisk request from America, but makers are not in a position to sell a great quantity. The shipbuilding trade has not yet been re-invigorated by the new orders which have been promised, but prospects are none the less hopeful, and there is reason to believe the activity at local yards will increase as the season proceeds. Engineering is better employed in the marine department, but the general trades are quiet. Boilermakers and iron-founders are short of work, and the general minor industries of the district are indifferently employed. Iron ore is quiet but steady, and prices are still quoted at from 8s. 6d. to 11s. per ton net at mines. The Vulcan Steel and Forge Company's Works at Salthouse, Barrow, have been very poorly employed for some time past, but I hear there is a prospect of new capital and new vigour being introduced into the undertaking, along with the development of the special business of manufacturing by Mr. Windle's patent circumferential boiler plates, for which a mill has been put down by Mr. Adamson, of Dukinfield. The new Town Hall at Barrow, which has cost from £50,000 to £60,000, will, it is expected, be opened on the 14th of July next. The shipping trade is fairly employed, and some heavy cargoes of iron and steel are being despatched to American and other ports.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The second poll of the ratepayers and owners on the question whether the water supply shall be acquired by the Corporation was ascertained last Saturday, and officially declared on Monday. It showed a largely increased majority in favour of the Corporation. In January the figures were: For the Corporation, 21,936; against, 3785; majority for the Corporation, 18,151. In June the result was as follows: For the Corporation, 25,641; against, 3604; majority for the Corporation, 22,037. In the meanwhile negotiations had been proceeding with the water company to see if terms of settlement could not be arrived at. The Water Committee of the Sheffield Corporation forwarded an offer to the directors of the water company, which on Monday they agreed to accept, and thus the Corporation, after long and bitter struggles, will obtain control over their water supply. The terms proposed are considered extremely liberal. The Corporation stock—3½ per cent.—now stands at par. The interest the Corporation have to pay under the arrangement is £74,808 per annum. Taking this at 3½ per cent., or rather over twenty-eight and a-half years' purchase, it is equivalent to £2,137,264, which may be taken as the purchase price. The sinking fund on this sum for sixty years, at 3½ per cent., would be £10,878 per annum. The net income of the water company for the last year, after payment of expenses, was £66,325, which is £8483 less than the interest the Corporation undertake to pay. Add to this the sinking fund, and the Corporation are confronted by a deficiency of £19,361 on the first year's working. This is a result which the community did not expect. They were opposed to the water company's proposal to have granted in per-

petuity 25 per cent. given to them for twenty-five years in consequence of the Sheffield flood; but it is quite clear that the Corporation will have to continue the 25 per cent., and still have a loss. The advantages from a sanitary point of view, of course, are the great argument for the Corporation obtaining control over its own water supply.

Mr. George Fisher, a well-known Sheffield manufacturer, died rather suddenly, though at a ripe old age, on Tuesday morning. Mr. Fisher was the sole partner in the well-known firm of George Fisher and Co., steel converters, file and saw manufacturers &c., Hoyle-street works, and carried on a large and lucrative business for many years. He was a native of Ranskill, near Retford, and one of our best known men of business, who kept up the sterling character of his wares. He was at one time a considerable contractor on Government account.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The Cleveland pig iron trade has certainly improved in tone. During the last few days a considerable amount of business has been done, and as consumers continue to evince a desire to purchase, prices are slowly advancing. At the beginning of last week 34s. per ton was the best price obtainable for No. 3 g.m.b.; but at the market held at Middlesbrough on Tuesday last 34s. 6d. was freely given for prompt delivery. For delivery over the next three months 35s. was offered, but sellers hold off in the belief that they will shortly be able to do better. The proprietors of some brands are able to command the same price for prompt delivery, and they will not now sell ahead except at a futher advance. There is a brisk demand for forge iron, and the price has risen to 33s. 6d. per ton.

Stevenson, Jaques, and Co.'s current quotations:—"Acklam hematite," mixed Nos., 45s. per ton; "Acklam Yorkshire," (Cleveland), No. 3, 36s. per ton; "Acklam basic," 36s. per ton; refined iron, 48s. to 63s. per ton; net cash at furnaces.

On account of the Jubilee commemoration, the Cleveland iron market will be held on the Wednesday in next week instead of the Tuesday.

The demand for warrants has somewhat improved, the lowest price accepted on Tuesday last having been 34s. 10½d. per ton as against 34s. 6d. the previous week.

In Messrs. Connal and Co.'s Middlesbrough store the stock of pig iron was on Monday last 331,632 tons, representing a decrease of 1039 tons during the week. At Glasgow they held at the same time 883,058 tons, being an increase of 2701 tons.

The shipments of pig iron from Middlesbrough have not proved so good this month as they were in May. The quantity sent away up to Monday night was 27,341 tons, or nearly 8000 tons less than before.

Finished iron makers speak a little more hopefully of their position. Orders are coming to hand more freely than for some time past, and last month's prices are fully maintained.

The steelworks are kept in regular operation, and some good orders for rails and sleepers have lately been secured. It is said that an order was booked last week for 18,000 tons of rails for an Indian railway by a Cleveland company.

Disappointment has been lately expressed by some proprietors of general engineering works in the Cleveland district that orders for work within their powers to execute, and for delivery in the immediate neighbourhood, have found their way into the hands of distant competitors. The orders which have gone past have usually been those wherein a good deal of skilled labour is required, and not so much those wherein the bulk of the value consists in heavy weights of cast and wrought iron. This is an old and a difficult question to solve, and is no doubt the reason why the lighter branches of the iron and engineering trades have never taken root in Cleveland to the same extent as the heavier trades.

At the Consett Iron and Steel Works various improvements and extensions are now in progress, and valuable orders in connection with these have been taken by Clyde engineers. Inasmuch as they have been competed for locally, and the advantage in cheaper pig iron and shorter railway carriage must have been in favour of Cleveland, it is difficult to see why the orders should have gone to Scotland. The reason may be that on the Clyde there is at present a better skilled labour market. Trade there is slack, skilled labour is plentiful, and men are exceedingly anxious for work, and willing to submit to very low wages in order to get it.

The quantity of water pumped from the Tees to supply the towns of Stockton and Middlesbrough, and the ironworks in the surrounding districts, does not seem to diminish, notwithstanding the proverbial slackness of trade. At a recent meeting of the Water Board it was reported that during the four weeks of the month of May the quantities were respectively 58, 62, 61, and 59 million gallons, and some fraction of another million. If that be so, it is clear that in the case of a return of prosperity to Cleveland the powers of the board will have to be exerted to the utmost to supply the increased demand which will then set in.

The action brought by the Skinningrove Iron Company against the North-Eastern Railway Company for prejudicial treatment has naturally excited great interest in the Cleveland district, where the circumstances of the case are well understood. Which party to the dispute is in the right, and which in the wrong, must be left for the Commissioners to decide after the long and patient hearing which they gave to the pleadings. It seems to be a fair deduction, however, that where the relations between the managers of ironworks and of the railway system upon which they are situated are lacking in cordiality, the position of neither set of officials is comparable to "a bed of roses."

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow warrant market was strong at the opening this week, and in consequence of reports as to increased inquiries from abroad, warrants, which are strongly held, advanced to 42s. 3d. A reaction afterwards took place to 41s. 10d. when it became known that the past week's shipments were only 6531 tons, as compared with 6946 in the same week of 1886. The market subsequently became strong, and prices again advanced on reports that considerable orders had been received from the United States, and that Canada was purchasing lots of iron which could not be delivered in that country until after the 30th current, when the increased import duty will be exacted.

Some ironmasters report that they have orders for pigs to be delivered in the Dominion next autumn, so that it is clear that the Canadians cannot do without our iron, and will therefore have to pay the heavy addition to the duty that has been decreed by their Government.

About 2700 tons of pig iron have, in the past week, been added to the stock in Messrs. Connal and Co.'s Glasgow stores. A furnace has been put out at Portland Ironworks by Messrs. William Baird and Co., and one at Langloan, the total in operation now being seventy-eight, against eighty-four at this date last year.

The current values of makers' pigs are firmer, as follow:—Coltness, f.o.b., at Glasgow, per ton, No. 1, 53s. 6d., No. 3, 44s.; Summerlee, 52s. 6d. and 43s.; Langloan, 50s. and 45s. 6d.; Gartsherrie, 48s. and 44s.; Calder, 49s. and 42s.; Carnbroe, 43s. and 39s. 6d.; Clyde, 46s. and 41s.; Monkland, 43s. and 38s. 6d.; Govan at Broomielaw, 43s. and 38s. 6d.; Shotts at Leith, 48s. 6d. and 45s. 6d.; Carron at Grangemouth, 47s. and 44s.; Glengarnock at Ardrossan, 46s. 6d. and 40s. 6d.; Eglinton, 43s. and 38s. 6d.; Dalmellington, 44s. and 40s.

The basic steel works are well employed, and in the past week 450 tons of Glengarnock steel billets were shipped at Ardrossan.

Manufactured iron is quiet, there being a lack of inquiries at the moment. The f.o.b. price at Glasgow, less 5 per cent., of bars, is £5 5s.; nail rods, £5 15s.; angles, £5 5s.; sheets, £6 15s.; ship-plates, £5 15s.; and boiler plates, £5 17s. 6d. Steel bars and angles, f.o.b. at Glasgow, less 5 per cent., are £6; sheets, £7 2s. 6d.; ship-plates, £7; and boiler plates, £7 5s. The above are merchant's rates, but it is well understood that contracts of importance are accepted by makers at a considerable abatement on the figures named.

The manufactured iron and steel exports from Glasgow in the past week embraced locomotive engine parts, valued at £1200; for Bombay a stern-wheel steamer, £1200; for Bangkok, a steamer worth £4150; for Egypt, machinery, £10,100; sewing machines, £8030; steel goods, £12,790; and general iron manufactures, £26,100.

The coal trade is fairly active, although the shipments are still somewhat behind those of the same time last year. During the week there was despached from Glasgow 22,940 tons; Greenock, 1002; Ayr, 10,588; Irvine, 2541; Troon, 6511; Burntisland, 10,838; Leith 4507; Grangemouth, 16,200; Bo'ness, 10,190; Granton, 990; and Dundee, 3530; total, 89,837, against 95,795 tons in the same week of 1886.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The coal trade remains in a healthy state, house coal being exceptionally firm for this time of year. I note that some of the authorities are expressing surprise at the firmness of price shown by Rhondda No. 3, which is selling freely at 8s. 6d.; but as I mentioned before, there are two special coals, the Rhondda No. 3 and 4ft. steam coal, whose area is lessening rapidly, and any change of price must be upwards.

Last week was an active one, and the shipments from Cardiff, Swansea, and Newport were good ones, Cardiff maintaining its great preponderance. During the last few days there has been an incessant stream of large cargoes to the coaling stations, Aden and Gibraltar in particular. It is evident that, whether from political movements or purely trade reasons, these are being kept well in stock. Small bituminous and small steam are in better request, the former at 5s. 9d., and best samples even are selling at 6s. Small steam continues rather low in consequence of the large output of steam, and any quantity can be had for 4s. 3d. The tendency seems to be to drop to 4s. Large coal, both steam and bituminous, is at late quotations. Patent fuel is selling more freely, both at Cardiff and Swansea the latter having good orders from France.

Railways are now fairly in for the excursion and tourist season, and little is being done except in much needed quarters, where relaying is imperative. The Barry railway is progressing well, as Mr. Walker's contracts invariably do, but the quiet course of progression was broken in upon by a slip last week, which killed four men and injured many.

In the iron trade a good deal more is being done, and most works are brisk, exports and deliveries showing a decided improvement. This week the drought is telling in several directions, and I hear that two-thirds of Dowlais works suffer more or less inaction from want of water for steam purposes. No. 8 blast engine was stopped last week from the same cause, and this week the blast furnaces have been damped down. A very awkward condition of things is certain unless the ponds get filled. A good deal of water supply is obtained from the old mine and colliery levels, and these from the surface.

I note that the "Naval Steam Coal Colliery," Rhondda, will be brought to the hammer next week at Cardiff. The machinery at the two pits is capable, I hear, of raising 1000 tons of coal each per day, and the area includes over 900 acres of the best coals of the district. In anything like good times, that is, with coal a few shillings per ton more than it is, a smart contest might be expected at the sale.

The tin-plate trade is still doubly beneficial, keeping the iron and steel works busy with the bar, and their own district as well.

In the Swansea district last week there may not have been so much briskness in buying and selling, but the make was steady, and workers are quite satisfied with the orders on hand. The only complaint is that prices do not lift up more rapidly. At present wasters are about as much in demand as anything, and terne wasters, are being sought after. Wasters command from 12s. 3d. to 12s. 6d. Coke good, 13s. 4d. to 13s. 6d., some few at 12s. 9d. Prices may be taken as firm at last week's quotations. Makers of best Siemens command their price.

Taking both districts, a good solid trade is being done. The Board of Trade returns just issued show an enormous increase in all the districts, and certainly a great share has come into this quarter. Swansea alone has a fair average rate of 35,000 boxes per week. The tonnage of this can be obtained by reckoning twenty-one boxes to the ton. I note that the increase in the trade from 1885 has been as follows:—Export in May, 1885, 633,000 boxes, value £443,873; export in May, 1887, 821,000 boxes, value £526,444.

The movement amongst the workmen in the Welsh, Monmouthshire, and Gloucestershire districts continues, and a powerful society seems to be secured. The workers must not forget that it was the formation of the Ironworkers' Society in Wales which prostrated the trade for years, and stopped Cyfarthfa works for a long time. It is remembered in the district that Robert Crawshay said he would have kept on making iron until his park was covered if his men had only remained out of the Union.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The physiognomy of the Rhenish-Westphalian iron market has not changed to a more cheerful one than it showed last week, prices have in some cases receded, while others have been maintained pretty firm; but as a rule the demand has become slower, and the chief characteristic of the whole situation is that of holding back. Buyers have little confidence in the future, and therefore a hand-to-mouth business is the outcome. As was hinted last week, and which is but natural, the reports from Silesia are beginning to be less favourable. The loss of the Russian trade is being already felt, and in some sorts of pig iron stocks have begun to accumulate, and pressing for orders is the consequence. Present prices are: Forge pig, M. 49; foundry, 50 to 59; rolled bars, 127·50; special qualities, 130 to 140; and plates 150 to 160 p.t.

In the Rhenish districts the trade in ores is stagnant, demand is much to be desired, and prices in consequence are very depressed. They range from M. 8·10 to 12 for roasted steel stone on trucks at mines. The business in pig iron also cannot be called a favourable one, and it is, so to say, somewhat demoralised. The convention till now has done its best to keep prices up nominally, but the Siegerland smelters came down in their prices a short time since, and now a report is in circulation that the convention price is all at once to be lowered about M. 4½ p.t. Rather than fly to such a course it would have been more reasonable to restrict production. Under these circumstances, it is only natural that demand should be limited and buyers reluctant to come forward. The demand for Spiegel has not revived, as was expected, and the prices have receded latterly, which, as remarked incidentally above, is the case with Siegerland forge pig, whilst till now some brands have kept up their price in Westphalia, where the demand is still pretty good. As to other sorts, there is nothing particular to mention. The last quotations were, subject now to the fall stated above, if it take place as reported, Spiegel, M. 51 to 52, and M. 2 to 3 extra for high qualities; white steel iron, 42; best Siegener forge pig, 42 to 44; Westphalia, 48; foundry, 49 to 56 for the three sorts; Bessemer, 50 to 51; basic, 41½; and Luxemburg forge, 32 to 33 p.t. on trucks at works. As regards rolled iron, till now prices have been moderately well maintained, and most of the mills have still sufficient work; but the present demand is poor, and one hears of offers being made by second-hand holders much below the prices fixed by the combination, which, in conjunction with a weak pig market, causes buyers to stand aloof in the expectation of still more advantageous prices in the future. Merchant quality bars are noted M. 110 base price, angles 111 to 115, iron hoops up to 115, and steel 110 to 122. Strip iron is likely to go out of fashion, as the "Mannesmann" system of making tubes out of round billets is coming up, and this will make a great difference to the hoop mills. Boiler plates are firm in price, and the native and foreign demand is good, much better than last month indeed, and the mills can keep on rolling them regularly. The price is still M. 145 from 5½ mm. gauge and above, with extra notations for thick plates. The demand for sheets has improved a little, especially for galvanising sorts, and it is now hoped prices will not sink any lower. Siegener sheets are noted M. 128 to 129, Rhenish Westphalia a shade higher. A better foreign demand for wire rods would be most welcome, as it is now very feeble. A convention to regulate export prices is in process of incubation. In iron they cost M. 110 to 112; in steel, 108 to 110; and iron or steel drawn wire costs 125 to 130 p.t. These quotations always mean wire nail quality, therefore a low one. Steel rails are noted M. 114 to 120; light sections, 110; and sleepers, 117 to 120 p.t. The Bochum Company has just been awarded 4500 tons of sleepers for the Palatinate Railway, which are on a new patented plan, now much in vogue on their lines, on German military ones, and in France. They are indented and thickened at the same time, whilst being rolled, as far as the description is intelligible, under that part which bears the chair. Three works have received on the 2nd inst. between them, subject to ratification, 2000 steel fish-plates and 10,000 wagon springs for the Italian Mediterranean Railway, and the Belgian Government is in treaty with Krupp for 16 million francs' worth of cannon, so it is reported, from Belgium. But such orders as these do not prevent the technical journals of this country from railing against Cockerill and Co. for coming here and occasionally carrying off a few thousand tons of steel rails. The machine shops and foundries are decidedly better off for work than for a long time past, and although the prices are a little better than heretofore, they cannot be pronounced remunerative. Just by way of giving a practical example of how the new Russian tariff must affect industry there, it may be related that when they require machinery of a better quality they must still apply to foreign countries for it, and a German firm has just received an order for salt works plant for South Russia. The invoice of it amounts to M. 70,000. By the new tariff the duty to M. 28,000, and the freight to M. 7000. Added to this will be the loss on exchange of the rouble, which is not trifling.

It is rather phenomenal to have to report in the month of June that there is a great improvement in the coal trade, but such is the case, and it would be difficult to give a good reason for it, for nothing perceptible has happened. It is not an impetus communicated to it by the strike in Belgium, for that lasted too short a time to make itself permanently felt, though some thousands of tons were ordered from there. It is, however, expected that later on a great deal of coal will be sent to Belgium, for the industrials there are so dissatisfied with the appearance of things in their own coal districts that some already have, and others intend, to contract in Germany for their near future requirements.

Another sad gas explosion, this time in the Hibernia coal mine, Westphalia, has occurred, by which fifty-two miners were killed and several injured. The seam caught fire, and is still burning. A dynamite shot caused the explosion—powder was forbidden in the mine—and suffocation seems to have been the main cause of the deaths.

On the 9th inst. the new enhanced coal and coke tariff, already detailed in this place, came into force in Russia, and it is not to be increased before January 1st, 1898.

The Belgian iron market is firmer than might be expected and little change of consequence has occurred. Girders are in as great demand as ever, while bars and angles are quieter. The coal mines have lost much, partly through not having been able to fulfil contracts and partly by the thin end of the wedge of foreign competition having been introduced into the coal districts, which may have a permanent character until confidence is restored by the dissatisfaction of the workpeople being appeased.

The French market, not too strong already, has been somewhat weakened again by the disquiet in Belgium.

LAUNCHES AND TRIAL TRIPS.

On the 9th inst. the steamship Emden, constructed for the Yorkshire Coal and Steamship Company, Goole, by Earle's Shipbuilding and Engineering Company, Hull, was taken on her official trial trip. She is designed to meet the requirements for the continental trade, and her dimensions are as follows:—Length, 220ft.; breadth, 32ft.; depth, 13ft. 6in. She is built to Lloyd's highest class for iron, and has topgallant forecastle bridge and poop, a considerable portion of the latter being available as shelter for deck cargo and cattle, and water ballast is provided in main and after holds. A comfortable saloon, ladies' cabin, and state room are fitted amidships under the bridge for fourteen passengers, the entrance to which accommodation, together with steering house, are in a house overhead. The captain's accommodation is on the poop, and the officers are berthed under the poop and crew forward. The vessel is schooner rigged, with two pole masts, and has a very smart appearance. The hatches, winches, &c., are carefully arranged to afford the utmost available despatch in working cargo, and she has also powerful steam steering gear of Harrison's make. The engines, which have also been made by the builders, are on the triple compound three-crank system, and have cylinders 21½in., 34in., and 52in. diameter by 36in. stroke, supplied with steam of 150 lb. pressure from a steel boiler of large size. The run on the measured mile off Withernsea proved highly satisfactory, the engines worked smoothly and well, and the mean speed attained was 13·33 knots, with a strong wind that was blowing abeam.

On the 14th inst., a new iron screw tug steamer, Mourne, built and engined by Messrs. Edward Finch and Co., went down the Bristol Channel on her official trial trip. This vessel has been built for the Carlingford Lough Commissioners, Greenore, Ireland, and her dimensions are as follows:—Length over all, 92ft.; breadth, 18ft.; depth, 8ft. 6in.; and classed 100A at Lloyd's for her particular service. Her propelling power consists of a pair of compound surface-condensing engines, of 200 indicated horse-power, embracing every recent improvement applied to engines of this class, steam being supplied by a large steel boiler working at 100 lb. per square inch pressure. The Mourne is fitted with a powerful windlass, driven by a set of three cylinder engines, arranged under deck, and capable of lifting weights of 5 tons to 6 tons, by means of suitable chain working over a large sheave fitted in head of stem, and other special arrangements for the performance of her various duties in Greenore harbour. On trial her engines worked with great smoothness, the vessel steaming 9½ knots per hour, which performance gave great satisfaction to Captain Smith, the representative of the Carlingford Lough Commissioners.

On Wednesday, June 8th, the new screw steamer Kinshin Maru, built by Messrs. Hawthorn Leslie, and Co., Hebburn, for the Japanese Navigation Company, of Yokohama, went to sea for a trial trip. The dimensions of the vessel are:—Length, 376ft.; breadth, 35ft.; depth—moulded—25ft. She has a deadweight capacity of 3050 tons, and is fitted with compound direct-acting engines, built by the North-Eastern Marine Engineering Company, Wallsend, having cylinders 32in. by 62in., and a stroke of 39in. After adjusting compasses, the vessel went for a series of runs over the measured mile, and attained a mean speed of nearly 11 knots, the engines working without any hitch and giving every satisfaction. The company was represented by Mr. Brown, the managing director, and Mr. Archibald Brown, their inspecting engineer.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, June 3rd.

THE receipts of lead at New York since January 1st foot up 7228 tons, as against 7369 tons for same time last year; and 1443 tons of spelter, against 593 tons for the same time last year. There has been a very active distribution of tin-plate, and a very active inquiry is in progress for future deliveries. Prices have advanced from 5c. to 10c., and the market is very firm at present writing. Stocks are light throughout the country. Scotch iron is dull at 19·50 dols. for Eglinton, 20 dols. for Glengarnock, and 22 dols. for Coltness. English Bessemer is quoted at 20 dols., and English spiegeleisen at 27·50 dols. There is no business done in foreign material, and American buyers are unwilling to make any offers. Steel rails have been quite active at 38 dols. to 39 dols. at mill. Tin is moving more freely; stocks, 1100 tons.

The merchant iron trade has fallen off, and quite a number of mills in New York, Pennsylvania, and Ohio have started on single turn, awaiting an improving demand which, it is thought, will set in about June 15th. The only exceptions are in structural iron, for which there is a very heavy demand at full-quoted rates, viz., 2·25 for angles and 3·30 for beams and channels. The pig iron output is about 20,000 tons per day, and as yet there are no signs of any accumulations of stocks. The Brooklyn Elevated Railroad Company has contracted for 15,000 tons of structural iron. A few Southern railway companies are in the market for early deliveries of steel rails. The winter prospects for both crude and finished iron are better than they were two weeks ago. The nail trade is active, but the capacity is far in excess of any probable requirements. The mills now built could turn out 9,000,000 kegs per year of 100 lb. each.

NEW COMPANIES.

THE following companies have just been registered:—

Anglo-Portuguese Telephone Company, Limited.

This company was registered on the 8th inst., with a capital of £50,000, in £1 shares, to carry on the business of a telephone, telegraph, and electric light, heat, and power supply company. The subscribers are:—

	Shares.
R. Rodgers, 53, New Broad-street, secretary to a company	1
T. Taunton, 72, Durham-road, Manor Park, Essex, accountant	1
C. Curtoys, 109, Farringdon-road, secretary to a company	1
R. Herring, 84, Landsmere-road, Clapham, accountant	1
W. J. Antram, 268, Shirland-road, W., clerk	1
G. P. Pike, 108, Lower Kennington-lane, parliamentary agent	1
J. S. Chisholm, 12, Pancras-lane, solicitor	1

The number of directors in London is not to be less than three, nor more than four; and in Lisbon—exclusive of the managing director—not less than three, nor more than five. The first London directors are Sir Alexander Armstrong, Frederick Clift, Esq., LL.D., and Arthur Henry Baker, Esq. The members of the Lisbon board are Conde de Gouvea, Conde de Lumiares, Senhor Barbosa Collen, Senhor E. Pinto Basoto, Senhor Jorge O'Neill O'Neill. Directors' qualification, £100 in shares or stock. Remuneration, £600 per annum to the London board, and £500 per annum to the Lisbon board; an additional sum of £100 will be allowed for the services of a secretary to the Lisbon board.

Automatic Furnace Grate Company, Limited.

This company was registered on the 2nd inst., with a capital of £2000, in £1 shares, to acquire and work the letters patent No. 15,135, dated November 22nd, 1886, for improvements in self-feeding, self-stoking, and self-cleaning furnace fire-grates. The subscribers are:—

	Shares.
L. Hopcraft, 20, Bethune-road, N., engineer	1
R. Howard, 26, Claude-road, Peckham Rye	1
H. Sprague, 17, Charles-street, Northampton-square	1
H. Wade, 13, Hadfield-terrace, Peckham, accountant	1
R. J. Howard, 26, Claude-road, Peckham, clerk	1
V. C. Doubleday, 37, Wallbrook, accountant	1
C. Wren, Luton, clerk	1

Registered without special articles.

Banwen Tin-plate Company, Limited.

This company was registered on the 8th inst., with a capital of £20,000, in £10 shares, to carry on business as iron, tin, and steel-plate manufacturers, ironfounders, steel converters, &c.; and will purchase from Mr. J. Moy Evans, of Swansea, certain property at Llandelofawr, Carmarthen. The subscribers are:—

	Shares.
W. M. G. Hole, Swansea, cattle salesman	20
M. Scapes, Swansea, cattle dealer	20
J. Thomas, Swansea, solicitor	20
J. M. Evans, Swansea, solicitor	20
B. T. Rosser, Swansea, shipbroker	1
D. Griffiths, Pontardulais, tin-plate works manager	1
R. Smith, Clydach, auctioneer	1

The number and names of the first directors will be determined by the subscribers; qualification, 20 shares. The company in general meeting will determine remuneration.

Beeston Humber Cycle Manufacturing Company, Limited.

This company was registered on the 6th inst., with a capital of £1000, in £10 shares, to take over the business of cycle manufacturers carried on by Messrs. T. Humber and T. H. Lambert, at Beeston, Nottingham. The subscribers are:—

	Shares.
W. Horton, Birmingham, solicitor	1
M. D. Rucker, 32, Holborn-viaduct, engineer	1
G. D. N. Ford, 11, Percy-square, W.C., accountant	1
T. Cokes, 7, St. Peter-street, Islington, clerk	1
T. N. Brown, 37, Vincent-square, Westminster, cashier	1
W. H. Tucker, 7, St. James-road East, machinist	1
H. J. Wallder, 28, Entick-street East, machinist	1

Registered without special articles.

Constructional Ironworks Company, Limited.

Upon terms of an agreement of the 27th ult. this company proposes to purchase the engineering and ironfoundry business lately carried on by W. Ayres, under the style of Ayres and Co., at 54, High-street, Bromley-by-Bow. It was registered on the 6th inst., with a capital of £5000, in £1 shares. The purchase consideration is £1860, in fully-paid shares. The subscribers are:—

	Shares.
*F. Brickwell, C.E., Hampden Club	300
*J. Davies, 30, Coolhurst-road, Crouch End	250
*T. Crooke, 5, Hilldrop-crescent, Camden-road	100
H. Codner, 92, London-wall, bootmaker	20
H. C. Hay, Sutton, Surrey	20
E. H. Osborn, 91, Southwark Bridge-road, traveller	10
J. C. H. Watkin, Mansion House-chambers, architect	1

The number of directors is not to be less than three, nor more than five; qualification, 50 shares. The first are Messrs. Walter Ayres, 3, South-square, Gray's-inn; W. S. Codner, Bromley-by-Bow; and the subscribers denoted by an asterisk. Remuneration, £200 per annum, or such further sum as the company in general meeting may determine, payable only after 6 per cent. per annum dividend has been paid.

Cardiff Ship Repairing Company, Limited.

Registered on the 8th inst., with a capital of £2000, in £10 shares, to take over the business of Messrs. Down and Grant, shipbuilders and repairers, carried on at the Old Canal, Cardiff. The subscribers are:—

	Shares.
G. T. Baker, Cardiff, shipowner	1
G. Stuckey, Cardiff, printer	1
A. W. Hill, Cardiff, colliery agent	1
A. G. Mugford, Swansea, shipowner	1
W. R. Hooper, Cardiff, provision merchant	1
C. Landreth, Cardiff, engineer	1
F. Haselow, Cardiff, shipbuilder	1

Registered without special articles.

Mount Shamrock Gold Company, Limited.

This company proposes to adopt an unregistered contract of the 7th inst., made with Mr. George Lloyd, relating to mines situate in Queensland, of which no particulars are given in memorandum and articles of association. It was incorporated on the 8th inst., with a capital of £280,000, in £1 shares. The subscribers, who are liable for £1 each, are:—

	Shares.
Lord Augustus Loftus, 9, Queen's-gate-place	1
Isidor Lissner, Craven Hotel, Craven-street	1
W. Smyth, 27, Norfolk-street, member for Gympie	1
A. Rumball, C.E., 1, Victoria-street, S.W.	1
J. H. Mace, Brodrick-road, Upper Tooting, director of a company	1
C. Clark, 20, Great St. Helen's, merchant	1
C. C. Rawson, 88, Bishopsgate Within, Australian agent	1

The number of directors is not to be less than three, nor more than nine; the subscribers are to appoint the first and act *ad interim;* qualification for subsequent directors, 500 shares; remuneration, £250 per annum for the chairman, and £150 per annum for each other director, and also 5 per cent. upon the amount available for yearly dividend.

Pontypool Iron and Tin-plate Company, Limited.

This company was registered on the 8th inst., with a capital of £14,500, in £5 shares, to acquire the assets and effects of the Pontypool Iron and Tin-plate Company, in the parish of Trevethin, Monmouth. The subscribers are:—

	Shares.
E. Jones, Snatchwood House, near Pontypool, colliery proprietor	1
W. Williams, Pontypool	1
D. H. Morriss, Newport, Monmouth, shipping agent	1
T. Colborne, Newport, Mon., solicitor	1
J. Richards, Blaenarvon, clerk	1
J. E. Ward, Newport, Mon., solicitor	1
G. F. Colborne, Newport, Mon., solicitor	1

The number of directors is not to be less than three, nor more than six; qualification, 50 preference shares. The first are Messrs. E. Jones, R. Beck, J. Worton, and W. J. Finch; remuneration, 5 per cent. of the net profits divided.

Utra Wood Company, Limited.

On the 4th inst. this company was registered, with a capital of £180,000, in £100 shares, to carry on business as timber growers and merchants, and as sawmill proprietors. The subscribers are:—

	Shares.
T. H. Fidgen, 3, Albion-villas, Northumberland Park, Tottenham	1
T. F. Goddard, George-lane, Wanstead	1
D. Eyre, 28, Warwick-square	1
R. Wolfenden, 129, Huddlestone-road, N.	1
W. Eacott, 56, Eleanor-road, Dalston	1
J. H. S. Caldwell, 34, Latimer-street, Stepney, E.	1
S. Jordan, 65, Limerston-street, Chelsea	1

The number of directors is not to be less than three, nor more than twelve; the subscribers are to appoint the first; qualification, £100 in shares or stock. The company in general meeting will determine remuneration.

Westinghouse Engine Company, Limited.

This company proposes to acquire several letters patent relating to the manufacture of steam engines, and to carry on business as manufacturers and dealers in Westinghouse and other steam engines, machinery, and electrical apparatus. It was registered on the 6th inst., with a capital of £100,000, in £10 shares. The subscribers are:—

	Shares.
*J. M. Stobart, Spring Vale, near Ryde	1
W. Duff Bruce, 8, Champion Park, Denmark Hill	1
*J. W. H. James, C.E., 9, Victoria-chambers, S.W.	1
*Sir J. D. Mackenzie, Bart., 62, Redcliffe-square	1
*J. A. Machellan, Glasgow, engineer	1
J. Dixon Gibbs, 18, Warwick-street, Regent-street	1
J. Edwards, 152, Holborn-viaduct, accountant	1

The number of directors is not to be less than three, nor more than seven; qualification, £250 in shares or stock; the first are the subscribers denoted by an asterisk; remuneration, £800 per annum.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

7th June, 1887.

8150. CAR BRAKE and STARTER, G. B. Siccardi, London.
8151. VAPOUR ENGINE, A. Fehlen, London.
8152. BUTTONS, H. J. Cam, Sheffield.
8153. SHARPENING RAZORS and SURGICAL INSTRUMENTS, A. R. Wonham, Southsea.
8154. MULES and TWINERS, B. Ashton and B. Wimpenny, Manchester.
8155. WIRE STRINGS for MUSICAL INSTRUMENTS, G. Hookham, Birmingham.
8156. GAS-REGULATORS and COCKS, T. Thorp, Whitefield.
8157. SPRING DRAWING-PIN, T. Cox, Edgbaston.
8158. GAS MOTOR ENGINES, H. Campbell, Halifax.
8159. ELECTRIC TELEGRAPHIC COMMUNICATION, W. Smith, London.
8160. PAPER-MAKING MACHINES, J. Wood, Glasgow.
8161. PICKERS in LOOMS for WEAVING, J. and E. Horrocks, Bradford.
8162. PIANOFORTE HAMMERS, A. H. Reed.—(*A. Dolge, United States.*)
8163. ATTACHING ROLLERS to the SHAFTS of WARPING MACHINES, T. Isherwood, Ramsbottom.
8164. ATTACHMENT for SEWING MACHINES, W. E. Hickling, Leicester.
8165. BICYCLES, A. G. Carter, London.
8166. BOTTLE FINISHING MACHINE, H. Semple, Hamilton.
8167. COMPOSITION for TREATING TEXTILE FABRICS, G. F. Wilson, London.
8168. BELLS, A. S. Bowley, London.
8169. PORTABLE APPARATUS for SOWING SEED, P. Lankester, London.
8170. SUBSTITUTE for MARBLE, J. H. Hughes and J. Holdsworth, London.
8171. MUSICAL BOXES, A. A. Lateulère, London.
8172. STEAM-BOILERS, W. Ambler and W. O. Blackburn, London.
8173. MECHANISM of CYCLOMETERS, &c., G. B. Wilkes, London.
8174. SIGNAL LAMPS, S. T. Dutton, London.
8175. LAMPS, J. Thomas, London.
8176. MOULDS, G. Eastwood, London.
8177. PREVENTING a RIDER from being DRAGGED in a STIRRUP, J. Williams, London.
8178. SCOURING WOOL, E. Tremsal and A. Dicktus, London.
8179. INJECTORS, J. Thiry and G. Chantrenne-Soiron, London.
8180. STEAM GENERATORS, PULSATORS, &c., W. H. Farris, London.
8181. TESTING SUBMARINE TELEGRAPH CABLES, H. A. Taylor, London.
8182. PROPELLING by REACTION, J. Y. Johnson.—(*A. Ciurcu, France.*)
8183. PRINTING, T. Lanston, London.
8184. SEATS on DECKS of VESSELS for use as RAFTS for SAVING LIFE at SEA, C. Henderson, Glasgow.
8185. SHOES, &c., F. J. Zwick, jun., and F. Neumann, London.
8186. GRIPS, A. J. Boult.—(*E. D. Dougherty, United States.*)
8187. GRIP CARRIAGES, A. J. Boult.—(*E. D. Dougherty, United States.*)
8188. FIXING TIRES to WHEELS, J. H. Jones, Middlesex.
8189. TENSION DEVICES, A. J. Boult.—(*E. D. Dougherty, United States.*)
8190. CONDUITS, A. J. Boult.—(*E. D. Dougherty, United States.*)
8191. IMPROVED ADDING-MACHINE, J. Richardson, London.
8192. IMPROVEMENTS in ACCORDIONS, J. F. Stratton, London.
8193. CLIP CURTAIN SUSPENDER, W. F. P. Moore, London.
8194. PREPARATION of MINERAL OILS, C. L. Baillard, London.
8195. PROPELLING CARRIAGES, &c., G. F. Lütticke, London.
8196. ABSORBENT BANDAGES, E. Jones and M. Jacks, London.
8197. STEAM PUMPS, P. A. Newton.—(*W. Craig, United States.*)
8198. IMPROVEMENT in DUST-BINS, W. J. McMullen, London.
8199. VELOCIPEDES, W. T. Shaw, and W. and A. Sydenham, London.
8200. MAKING CARDBOARD BOXES, E. Bostock, jun., London.
8201. LAMPS, H. H. Lake.—(*E. Miller and Co., Incorporated, United States.*)
8202. BINDING for GARMENTS, R. S. Green, London.
8203. TACK for GARMENTS, R. S. Green, London.
8204. PROPELLING VESSELS by means of COMPRESSED AIR or GASES, P. Haenlein, London.
8205. IMITATION LACE on TULLE MACHINES, E. Davenière, London.
8206. EFFECTING by INSERTION of a COIN the PRODUCTION of ELECTRIC LIGHT for a CERTAIN TIME, D. H. Davies and J. M. Tourtel, London.
8207. OPEN HEARTH STEEL FURNACES, H. Burrows, London.
8208. KNIFE CLEANING MACHINES, E. Wright, London.
8209. FIRE-LIGHTER, W. McCarthy, London.

8th June, 1887.

8210. PRECIOUS STONES and JEWELLERY, N. Federgreen, London.
8211. PREVENTING the BURSTING of WATER-PIPES, T. Wrigley, London.
8212. REPEATING BREECH-LOADING ALARM GUN, A. W. Burgess, Worcester.
8213. FERRIC SULPHATE or SESQUI-PERSULPHATE of IRON, S. Hallsworth and R. Bailes, London.
8214. TELEPHONE SYSTEMS, W. P. Thompson.—(*E. Mauritius, Germany.*)
8215. BALANCING of FOOT MOTIONS for SEWING and other MACHINES, L. Jones, Liverpool.
8216. SAND-MOULDING MACHINES, W. C. Whitehead and J. H. Latshaw, Liverpool.
8217. PERMANGANATE of SODA, G. H. Bolton, J. R. Wylde, and H. Auer, Liverpool.
8218. GAS from COAL, E. W. Harding, London.
8219. SELF-FLUSHING WATER-CLOSET, R. Garner, Birmingham.
8220. INCANDESCENT GAS FIRES, T. Fletcher, Manchester.
8221. BAND SAW MACHINES, J. Hamilton, Derby.
8222. COMBINED PENCIL POINT PROTECTORS and CUTTERS, C. L. Tweedale, Manchester.
8223. LETTING-OFF the WARP in LOOMS for WEAVING, B. C. Sykes and G. Blamires, Halifax.
8224. ATTACHING RAILWAY CHAIRS to METALLIC or like SLEEPERS, H. J. Harman, London.
8225. PRINTING, WAXING, or OILING TISSUE and other PAPERS, &c., W. W. Colley, London.
8226. STEAM BOILERS, R. Scott, Newcastle-on-Tyne.
8227. ELEVATORS, M. Martin, London.
8228. STEAM GENERATORS and WATER BOILERS, C. A. Knight.—(*Partly communicated by the Babcock and Wilson Company, United States.*)
8229. FORMING SERPENTINE TUBES and BARS, W. Fairweather.—(*The Babcock and Wilson Company, United States.*)
8230. SWAGING NEEDLE BLANKS, &c., A. Anderson.—(*The Singer Manufacturing Company, United States.*)
8231. SHEAVES for PULLEY BLOCKS, W. Alexander, Glasgow.
8232. COVERING of RECEPTACLES, E. Diver, Kenley.
8233. FASTENING BAGS, &c., M. Fox, Middlesex.
8234. SIMPLEX TRANSPOSING PIANO, A. G. Gigney, London.
8235. GLASS WARE, R. Stuart, London.
8236. FISH BAITS, W. Haynes, Middlesex.
8237. FILTERS, F. Brooks.—(*J. Jeffery and A. Nation, Victoria.*)
8238. VENTILATING, &c., F. Brooks.—(*J. Jeffery and A. Nation, Victoria.*)
8239. FIRE EXTINGUISHERS, F. Moore, Middlesex.
8240. BATTERY CELLS, J. R. Hard and T. Wilson, London.
8241. ORNAMENTING SURFACES, J. Budd, Surrey.
8242. STOPPING BOTTLES, F. Paling, London.
8243. CARDBOARD BOXES, W. Dickinson, sen., W. Dickinson, jun., and L. Gardner, London.
8244. SUPPORTING HAMMOCKS, J. F. C. James, Birmingham.
8245. BRACELETS, R. H. Jones and T. Lee, Birmingham.
8246. NAIL-MAKING, J. and J. Bennie, Glasgow.
8247. LOCKS, H. K. Bromhead, London.
8248. STRAW HAT SEWING APPARATUS, E. Köckritz, C. Köckritz, and F. Schüller, London.
8249. INTERNALLY-STOPPERED BOTTLES, T. P. Green, London.
8250. INDICATOR LOCKS, E. P. Rogers and E. H. Chandler, London.
8251. ADVERTISING DEVICES, A. B. Lennox and H. S. Morgan, London.
8252. CIRCULAR SAWS, W. Lee, London.
8253. PYROXYLINE COMPOUNDS, F. Crane.—(*W. D. Field, United States.*)
8254. IMPLEMENTS for GATHERING FRUIT, W. Lascelles-Scott, London.
8255. AERIAL NAVIGATION, W. Gustafson, London.
8256. CROPPING MACHINES, A. F. Craig and R. F. Craig, Glasgow.
8257. SHAVING BRUSHES, J. Meek, Glasgow.
8258. AUTOMATIC LUBRICATORS, H. Billeter, jun. London.
8259. "WIRING" COMB-FRAMES used in BEE-HIVES C. T. Abbott, London.
8260. SUPPLYING GAS to CLOSED VESSELS, M. Lachman.—(*J. J. Rauer, United States.*)
8261. CALKS for HORSESHOES, &c., S. Reiländer, London.
8262. ELECTRIC GENERATORS, W. M. Mordey, London
8263. MIRRORS, F. J. Broughan.—(*L'Heutre, Brussels.*
8264. PROJECTILES, J. Vavasseur, London.
8265. NEW NAPHTHOL-DISULPHONIC ACID, S. Pitt.—(*A. Weinberg, Germany.*)
8266. NEW BRICK, W. D. Cliff and B. E. Peto, London.
8267. ELECTRIC CURRENTS, I. A. Timmis and D. Halpin, London.
8268. SHIPS, I. A. Timmis, London.
8269. WATER METERS, H. S. Price, London.
8270. VALVES for STEAM ENGINES, C. D. Abel.—(*P. Crennicke, Germany.*)

9th June, 1887.

8271. FOUNTAIN PENHOLDERS, W. J. Thomas, Redfield.
8272. SAVING LIFE at SEA, F. P. Warren, London.
8273. CHECKING the RECEIPT of MONEY, J. M. Black, London.
8274. PADLOCKS, F. S. and S. H. Platt, Walsall.
8275. PREVENTING TRAILINGS in LOOMS, J. Aspinall and J. Rushworth, Halifax.
8276. TREATING IRON, A. L. Dowie, Glasgow.
8277. MANUFACTURE of STEEL, W. Jukes, London.
8278. CONNECTING the ENDS of DRIVING BELTS, W. H. Gilruth, Manchester.
8279. BELT FASTENERS, W. H. Gilruth, Manchester.
8280. HAYMAKING, F. A. Smith, Woodford Halse.
8281. REGISTERING the EXPOSURES of FILMS, W. Rogers, Liverpool.
8282. BICYCLE LAMPS, W. H. Freeman and J. Thomas, Aston.
8283. PUMPING MACHINERY, W. R. Renshaw, Kidsgrove.
8284. ELECTRO-DEPOSITION of the HEAVY METALS, S. P. Thompson, London.
8285. REVERSING VALVES, W., H. Neilson, and T. Williamson, Glasgow.
8286. AMUSING TOY, E. J. Adams, Sheffield.
8287. REVOLVING BRUSHES, A. S. Tanner and A. P. Godart, London.
8288. CLOSING CASKS, &c., T. Smith, London.
8289. OBTAINING CHLORINE from CHLORIDE of CALCIUM, W. Bramley, Middlesbro'-on-Tees.
8290. SAFETY MATCH BOX, G. Pullin, London.
8291. FIRE LIGHTER, I. D. E. L. Lloyd-Jones, London.
8292. RECEPTACLES, A. Wells, Pyrford.
8293. RAILWAY SIGNALLING APPARATUS, W. H. Parris, London.
8294. POURING OIL on WAVES, F. O. Larsen, London.
8295. DRESS STANDS, &c., A. Gems, Sidcup.
8296. PRODUCTION of COLOURS, L. Paul, London.
8297. EMULSIONS for EXTERNAL USE, H. V. Knaggs, London.
8298. TREATMENT of ALIMENTARY SUBSTANCES, J. H. Lock, London.
8299. CRICKET BAT, Glasspoole and Sons, London.
8300. HORSESHOES, A. J. Boult.—(*H. Jonas and C. Hirsch, Germany.*)
8301. ATMOSPHERIC GAS-BURNERS, C. L. Braithwaite, jun., and I. Braithwaite, London.
8302. SIGNALLING APPARATUS, W. H. Childes and W. L. Milne, Liverpool.
8303. MOTORS, T. Dealy, Liverpool.
8304. LIFEBOATS, G. Hughes, Liverpool.
8305. SUNSHADES, J. Fenton, Manchester.
8306. VELOCIPEDES, A. J. Boult.—(*F. Renz, Germany.*)
8307. TANDEM SAFETY BICYCLE, J. Spanton, Westminster.
8308. CHECK PERFORATING PRESS, W. A. Larlham and W. H. Heir, London.
8309. GOLF BALL, M. Gray, London.
8310. LASTS, C. H. Buchanan and J. Hewitt, Leicester.
8311. SASH FASTENERS, K. A. Reisert, London.
8312. STOP-COCKS, J. A. Hopkinson and J. Hopkinson, London.
8313. PRESERVATION of KID GLOVES, J. Wilson, Portsmouth.
8314. SECTIONAL TIPS for HEELS of BOOTS and SHOES, G. Mahaffy, London.
8315. HOLDING on the BRAKE LEVERS of VELOCIPEDES, H. Passadoro, London.
8316. FIRE-BRICKS, C. F. Laspe, London.
8317. BREECH-LOADING GUNS, T. Nordenfelt, London.
8318. COMPOUND for PAVING, A. Scrutton.—(*D. B. McLaren, New Zealand.*)
8319. DRAUGHT and DUST EXCLUDER, F. Attock, London.
8320. FIRE-LIGHTERS, B. J. Beckmann, London.
8321. CLASPING APPLIANCE for SECURING LADIES' BOAS, F. Weintraud, London.
8322. EXTINGUISHING FIRE, H. W. Hart, London.
8323. FOUNTAIN PENHOLDER, J. Gilmore and W. R. Clark, London.

10th June, 1887.

8324. LAWN TENNIS and other RACKETS, F. H. Ayres and G. E. Potts, London.
8325. STOP-MOTION applicable to TWISTING and DOUBLING YARNS, E. and D. Sykes, Huddersfield.
8326. STARTING and STOPPING MACHINERY, J. Ellison, Halifax.
8327. SECURING RAILS in CHAIRS or SLEEPERS, W. E. Partridge, Birmingham.
8328. GRABS for DREDGING and EXCAVATING, J. H. Morgan, Liverpool.
8329. COMBINATION of PARTS of TELEPHONIC and ELECTRIC BELL SIGNALLING INSTRUMENTS, &c., W. E. Langdon, Derby.
8330. YARNS, T. H. Blamires, Huddersfield.
8331. STEAM PRESSURE REDUCING VALVES, G. Spencer, Manchester.
8332. RIBS of UMBRELLAS, S. E. Coulter, Manchester.
8333. BLEACHING PAPER PULP, &c., by ELECTROLYSIS, J. Takmine, Manchester.
8334. SILVER CLEANING PASTE, J. Nicholls, Sheffield.
8335. VEHICLES for ADVERTISING PURPOSES, J. T. and W. Gregory, Sheffield.

8336. METAL CONNECTION between the HANDLE and the HEAD of a BROOM, J. Smith and R. Harris, Newcastle-on-Tyne.
8337. REGENERATIVE GAS BURNERS, T. Fletcher, Manchester.
8338. CUTTING SPACES in the DOFFERS of CARDING ENGINES, S. Roberts and W. Pitt, Halifax.
8339. ROTARY PUMPS, BLOWERS, and EXHAUSTERS, J. T. Collinge, Manchester.
8340. LIFTING and LOCKING MOTION, J. Bradbury, Manchester.
8341. DOOR and WINDOW FITTINGS, W. Griffiths, Swansea.
8342. CUTTING of SPLINTS, &c., W. Ellis, London.
8343. BREAKING-OFF COALS without BLASTING or WEDGING, W. Pegge, Stoke-on-Trent.
8344. BRAID, W. Sholton, Burton-on-Trent.
8345. CUTTING STRAIGHT ANGULAR GROOVES in TAPS and DIES, &c., J. Ruscoe, Hyde.
8346. BROOMS and BRUSHES, W. W. C. Scuse, Bristol.
8347. BENDING, &c., IRON and STEEL PLATES or BARS, A. C. Patrick and W. Hunter, Glasgow.
8348. SLIDE VALVES for ENGINES, A. Smith, Manchester.
8349. GAS and WATER-PIPE HOOKS, S. J. Ainge, Birmingham.
8350. APPARATUS for DISINFECTING CLOTHING, &c., H. H. Redfern, Hanley.
8351. LIFE and TREASURE-SAVING APPARATUS at SEA, A. Jones, Bristol.
8352. PIANOFORTES, W. Hirl, London.
8353. MINCING MEAT, &c., and FORCING the same into RECEIVERS, L. Hanks, London.
8354. SPITTOON, G. G. MacWilliam, London.
8355. DIRECT-ACTING STEAM and other PUMPS, G. G. Picking and W. Hopkins, London.
8356. LETTER-BOXES, A. Arkàj, Liverpool.
8357. PURIFYING and FILTERING WATER, &c., H. Rimmer, London.
8358. FOOT-BALL BLADDERS, T. Parry and J. Lazenby, London.
8359. CONSTRUCTION of GAS-BURNERS, W. H. Howorth, London.
8360. PIPE JOINTS, R. P. Fisher, Sheffield.
8361. PRESSING BRICKS, H. Belcher, Birmingham.
8362. ANCHORS, G. Hartshorne and G. F. Simms, Birmingham.
8363. INDESTRUCTIBLE PICTURE ALBUM, R. H. Wallbank, London.
8364. ATTACHING to LINES TEXTILE FABRICS for BLEACHING, J. A. Schofield, London.
8365. THUMB INSERTION MACHINES, W. P. Thompson. —(*S. Arnold, United States.*)
8366. COVERINGS for DEMIJOHNS, JARS, &c , E. Lyon, Liverpool.
8367. SEE-SAW for CHILDREN, W. Cunnington, London.
8368. CARRIAGE LAMPS, C. Butler, London.
8369. MEDICINE, W. G. Attree, London.
8370. TIPS for HEELS of BOOTS and SHOES, J. Branch, London.
8371. BICYCLES, &c., J. M. Starley,, London.
8372. ROLLED GLASS, G. F. Chance, London.
8373. ENEMA NOZZLE, H. J. Lange, London.
8374. HOLDING PHOTOGRAPHIC FILMS, G. V. J. Poirin, London.
8375. TUNNELLING MACHINES, R. Stanley, London
8376. SPRING MATTRESSES, &c., W. B. Hunt, London.
8377. SECURING the RAILS of RAILWAYS in their CHAIRS, J. Stevenson.—(*T. Despiau, France.*)
8378. DELIVERING GOODS in EXCHANGE for COIN, F. L. Rawson, London.
8379. AUTOMATICALLY DELIVERING PAPERS, F. L. Rawson, London.
8380. OPERATING TRAM-CARS, A. L. Lineff and W. Jones, London.
8381. SIGHT FEED LUBRICATORS, J. H. Schofield and A. V. G. Worth, London.
8382. TESTING the STRENGTH of a BLOW from the ARM, E. Parr, London.
8383. PANELS, B. Reull, London.
8384. CUT LOGWOOD, P. McAra, J. Walker, J. A. Birrell, W. Brock, jun., and J. Adam, Glasgow.
8385. SPRING CLIP and TROUSER STRETCHER, M. D. Czvetkovics, London.
8386. GUIDING BALLOONS for AERIAL NAVIGATION, J. I. Ribeiro, London.
8387. ETHEREAL OIL, I. Traube and G. Bolander, London.
8388. RACK, H. Shooling, jun., London.
8389. NEEDLE HOLDER, J. Darling, Glasgow.
8390. NEEDLE THREADERS, J. Darling, Glasgow.
8391. BOWL PAPER, &c., J. Craig.—(*C. J. Stanbold, Saxony.*)
8392. GAS BURNERS, J. A. C. Mackenzie, London.
8393. RELIEF VALVES, G. Eskholme and C. E. Chrimes, London.
8394. VENTILATING HATS, HELMETS, &c., W. H. Gilruth, London.
8395. FITTING BRAKE APPLIANCES to VEHICLES, W. M. Cochrane, London.
8396. PREVENTING CORROSION in STEAM BOILERS, A. J. Marquand, London.

11*th June*, 1887.

8397. BALLS for LAWN-TENNIS, F. H. Ayres, London.
8398. EXPANDING APPARATUS for LADDERS, G. Edwards, London.
8399. IVORY CARDBOARD-MAKING MACHINE, W. Bowery, Hemel Hempstead.
8400. GRIST MILLS, R. Burns, Rugeley.
8401. LOG, S. S. Bromhead.—(*C. Sonnet and A. Leredde, France.*)
8402. BLOTTING PAPER, C. Jackson, Nottingham.
8403. COKE GRIPES, J. Atkinson and J. M. Wright, Newcastle-upon-Tyne.
8404. SAFETY ENVELOPE, J. J. Nicholson, Penang, Africa.
8405. ROLLED IRON, W. C. Readhead and W. Rockliffe, Sunderland.
8406. CLOSET SEAT COVER, F. A. Binney.—(*J. G. Bodemer, Germany.*)
8407. CARRIAGE IRONWORK, J. G. Harrison, Birmingham.
8408. ELASTIC TIRED WHEELS, J. Shelton, London.
8409. LUMINOUS SIGNAL, C. V. Boys, London.
8410. EGG BOILER, J. Wangler, Birmingham.
8411. TORPEDO CONDUCTOR, J. C. Tanner and J. Mansbridge, London.
8412. SCULLS, OARS, &c., H. P. Golton, Forest Gate.
8413. STEAM BOILER FEEDING, &c., G. H. Stechmann, Manchester.
8414. DRYING SMALL COAL, J. A. Yeadon and R. Middleton, Leeds.
8415. DISTRIBUTING INSECTICIDE MOIST or DRY, J. L. Wood, London.
8416. TYPE-WRITER, H. P. Babbage, Cheltenham.
8417. CONNECTING the PICKERS with the PICKING STICKS of LOOMS for WEAVING, H., L., and F. C. Lister and G. Thewlis, Bradford.
8418. PILLAR PUMPS, &c., T. Fisk, Ipswich.
8419. ACTUATING, &c., SHEDDING TAPPETS, J. Knowles and J. Mercer, Blackburn.
8420. DELIVERING BOTTLES from FILLING MACHINES, W. H. Dance and W. Smith, Landport.
8421. EQUALISING the MOTION of CRANKS, G. H. Harris, London.
8422. REMOVING DIRT from CARDING MACHINES, C. de Hemptinne and F. de Hemptinne, London.
8423. SUPPORTING MUSIC and other BOOKS, H. C. Pretty, London.
8424. HOSIERY, J. Hearth, W. Hearth, J. Raven, and W. H. Willis, London.
8425. DOUGH-CUTTING MACHINE, J. Baker, J. A. Baker, W. K. Baker, and G. S. Baker.—(*H. Bertram, Deutschland.*)
8426. SODIUM and POTASSIUM, J. B. Thompson and W. White, London.
8427. ALUMINIUM, J. B. Thompson and W. White, London.
8428. WARP BEAMS, J. Goff, London.
8429. CARPET-BEATING MACHINERY, A. Orr, Glasgow.
8430. FARE and TIME APPARATUS, C. A. Anderson, London.
8431. ANTHRAQUINONE, J. Imray.—(*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, and D. A. Rosenstiehl, France.*)
8432. INDICATING the ATTENDANCE of WAITERS at TABLES, A. Rettich, London.
8433. TELEPHONE APPARATUS, F. W. Neale, London.
8434. EMBROIDERY FRAMES, E. O. Eaton.—(*J. Lancaster, United States.*)
8435. SUPPORTING BANNERS, &c., E. O. Eaton.—(*J. H. Lancaster, United States.*)
8436. MECHANISM for LAMP EXTINGUISHING, A. Rettich, London.
8437. MONO and DIAMIDOAZOBENZIDINES, &c., L. Paul, London.
8438. MILLS for GRINDING COFFEE, &c., H. Kill, London.
8439. STREET and other PAVING, C. F. W. Doehring, London.
8440. FIRING TORPEDO, A. P. McMullen.—(*J. A. McMullen, Formosa.*)
8441. DISINFECTION, &c., of FOUL MATTERS, J. Hanson, London.
8442. COCKS or VALVES, W. Young, London.
8443. ELECTROLYTES for ELECTRIC BATTERIES, R. McKenzie.—(*H. Weymersch, France.*)
8444. SEWING MACHINES, J. S. Edwards, London.
8445. MILKING COWS, G. Steimann, London.
8446. RECEIVING the THRUST of the SCREW SHAFT of MARINE ENGINES with LESS FRICTION, H. E. Daniell, London.
8447. SHIPPING and TRANSFERRING COAL, P. G. B. Westmacott, London.
8448. SEWING MACHINES, H. H. Lake.—(*N. Wheeler, United States.*)
8449. MAGAZINE FIRE-ARMS, A. R. J. von Wehrstedt, London.
8450. DOVETAILING MACHINES, R. Low, London.
8451. COUPLING BUFFERS, G. Turton, London.
8452. SHEARING ANIMALS, W. Bell, J. W. Broomhead, W. A. Jones, and J. L. Suckling, London.

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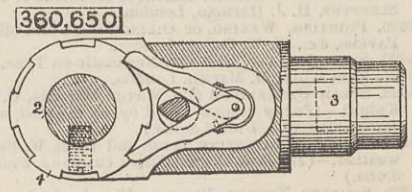
8453. ELECTRIC MOTOR, Messrs. Thompson, Dowsing, and Rew, London.
8454. HYDRAULIC MACHINES, J. P. O'Donnell.—(*N. Trébault, France.*)
8455. RAILWAY COUPLINGS, R. C. Sayer, Bristol.
8456. FIXING PARTS of VELOCIPEDES, &c., J. Beesley, Coventry.
8457. COUPLING, &c., ROLLING STOCK, E. McKay, Glasgow.
8458. BUTTONS, C. Seel, Barmen.
8459. HOISTS and CRABS, F. Hindle and J. E. Norton, Manchester.
8460. JACQUARD MACHINES, J. McMurdo, Manchester.
8461. SHIELDS of HAY-MAKERS, E. N. Ruck, Swindon.
8462. KNITTING MACHINES and NEEDLES, C. de Negri, London.
8463. VERTICAL HINGES, J. Rowland, Sunderland.
8464. DECORATING TOY TOPS, S. Strange, Liverpool.
8465. ATTACHING PICKING STRAPS, J. Barker and A. Barker, Bradford.
8466. ATMOSPHERIC VACUUM MOTORS, E. G. Wastfield, Manchester.
8467. WEIGHING MACHINE, F. Foster, London.
8468. USING ZINC for LITHO PRINTING, W. Selous, London.
8469. BEER ENGINE CASE TOPS, C. Facer, Birmingham.
8470. TESTING BUTTER, W. Devoll, Erdington, near Manchester.
8471. LUGGAGE CARRIER, J. B. Brooks, Birmingham.
8472. PHOTOGRAPHIC DARK SLIDES, W. Middlemiss, Bradford.
8473. COMBINED DOOR SPRING and CHECK, G. F. Newman, Birmingham.
8474. COOKING ASPARAGUS, &c., E. Thomson, Lower Bentham.
8475. LOCK NUTS, W. P. Thompson —(*W. A. Pungs, United States.*)
8476. HOOKS and EYES for MACHINE BANDS, &c., D. F. Campbell, London.
8477. CLOSING or FOLDING SEAT, J. Tourtel, Westminster.
8478. PICKERS for LOOMS, S. Fielden and Y. J. Fielden, Manchester.
8479. FINGER PROTECTORS, W. P. Thompson.—(*P. Bouveron, Germany.*)
8480. CLEANSING SHIPS' BOTTOMS, T. Drewry, London.
8481. CARRIAGE LAMPS, W. Howes, London.
8482. ADVERTISING and AUTOMATIC DELIVERY of GOODS, A. J. Maffuniades, London.
8483. WARMING BUILDINGS, &c., T. Wright, Sheffield.
8484. AUDIBLE SIGNALS, J. Spiers, London.
8485. PRINTING MACHINES, A. H. Marinoni and J. Michaud, London.
8486. INTERLOCKING LEVERS in RAILWAY POINT and SIGNAL APPARATUS, J. P. O'Donnell, New Malden.
8487. LOWERING BOATS from SHIPS' SIDES, G. H. Hayler, London.
8488. SHUTTERS for CAMERAS, W. J. Lancaster, Birmingham.
8489. FIREPROOF METALLIC PLASTERING, W. C. Milton, London.
8490. DETECTOR APPARATUS, J. Burch, London.
8491. NEEDLE for SEWING MACHINES, T. Smith, London.
8492. GRINDING ANIMAL and other SUBSTANCES, F. Quénéhen and A. Vansteenkiste, London.
8493. PROTECTORS, &c., for CARDS, &c., G. A. Hearn, London.
8494. REGULATORS, W. H. Metcalf, London.
8495. ELECTRIC LAMPS, A. M. Clark. —(*C. Bertou, France.*)
8496. TRICYCLES, W. Phillips, London.
8497. SHARPENING SAWS, C. F. Hax, London.
8498. LAMPS, L. W. Adamson and W. F. Hall, Newcastle-on-Tyne,
8499. MOWERS, W. Timms and R. B. Thompson, Glasgow.
8500. ELECTRIC WIRES, R. S. Waring, London.
8501. RIFLES, H. W. Holland, London.
8502. BARBED WIRE, L. Hen, London.
8503. TRUSSES, C. B. Harness, London.
8504. COLOURING, C. A. Bennert, London.

SELECTED AMERICAN PATENTS.

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

360,650. RATCHET BIT-BRACE, *L. C. Bolen, Springfield, Mass.—Filed August 4th*, 1886.

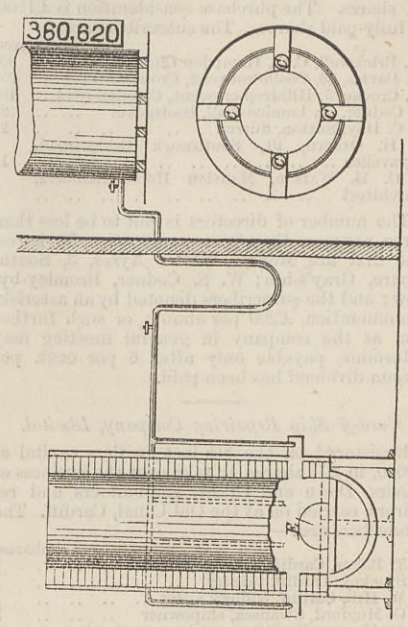
Claim.—(1) In combination, the stock 2, having the ratchet wheel 4 secured thereon, the brace 3, rotably attached to said stock, two pawls pivotally attached to said brace to one side of said ratchet wheel, capable of a vibratory motion toward and from the latter, and a rotating stud 9, located between said pawls, having a cam-shaped neck for engagement therewith, whereby they are vibrated, and a head engaging under said pawls, substantially as set forth. (2) In combination, the stock 2, having the ratchet wheel 4 secured thereon,



the brace 3 rotably attached to said stock, two pawls pivotally attached to said brace to one side of said ratchet wheel, capable of a vibratory motion toward and from the latter, united by a spring, and a rotating stud 9 located between said pawls, having a cam-shaped neck for engagement therewith, whereby they are vibrated, and a head engaging under said pawls, substantially as set forth.

360,620. PROCESS OF TREATING IRON, *J. Rigby, Minneapolis, Minn.—Filed March 15th*, 1886.

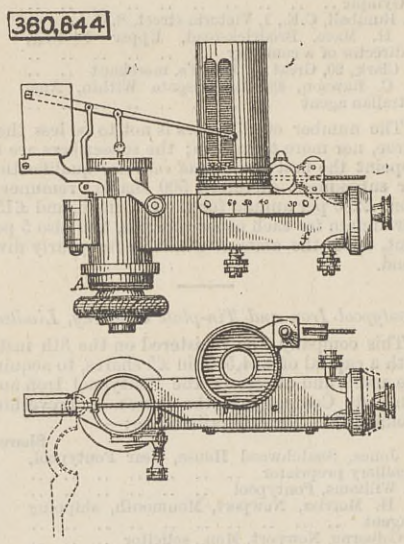
Claim.—The herein-described process of melting and treating wrought iron scraps or wrought iron of any description, which consists in placing the scrap iron



and suitable solid fuel in the cupola and then injecting naphtha into the air space with the blast, substantially as described.

360,644. STEAM ENGINE ATTACHMENT, *J. H. C. Bachelder, Meriden, Conn.—Filed November 23rd*, 1886.

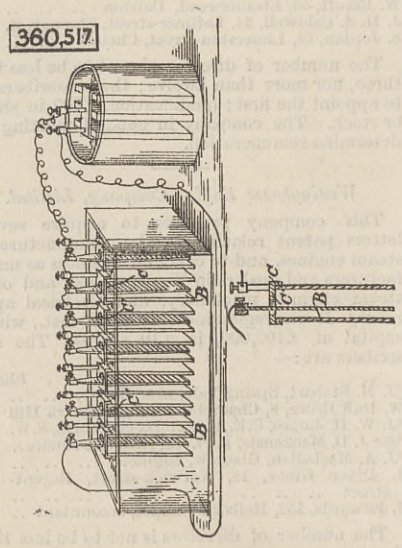
Claim.—(1) The combination of the steam cylinder A, piston B therein, the spring M, in a plane substantially at right angles to the axis of the piston, fixed at one end, the other end hung to the piston as a resistance to the movement of the piston, and an oscillating cylinder, with a system of levers between said cylinder and said piston, the end of the lever next the cylinder carrying a marker, and by which levers the movement of the piston against the action of the said spring will be imparted to said marker, substantially as described. (2) The combination of a steam cylinder, a piston movable therein, a spring



arranged in a plane at substantially right angles to the axis of the piston, fixed at one end, the other end hung to the piston, and an adjustable fulcrum between the fixed and opposite ends of the spring, with connections, substantially such as described, from said piston to the card-carrying device, substantially as and for the purpose described. (3) The combination of the steam cylinder A, piston B therein, divided case *e f*, surrounding said cylinder, the two parts of the case hinged together upon one side of the cylinder, each of the parts having an extension opposite the hinge, one of said parts forming a spring case and the other the cover, and a spring in said case, fixed at one end and by the opposite end hung to the piston, with a card-carrying device, and mechanism between said piston and said card-carrying device, whereby the movement of the piston may be communicated to said mechanism, substantially as described.

360,517. APPARATUS FOR RECUTTING FILES, *J. E. Emley, Weatherford, Tex.—Filed July 28th*, 1886.

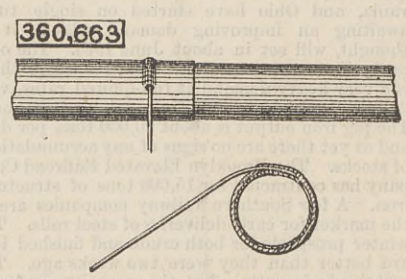
Claim.—(1) In an apparatus for recutting files by electro-chemical action, the dielectric plates C and the



carbon plates B, having their upper ends attached to the said non-conducting plates, whereby the files to be recut are disposed between the carbon plates when in the solution, substantially as described. (2) In an apparatus for recutting files by electro-chemical action, the combination of the tank to contain the solution, the series of pairs of carbon plates B, located in the tank, the non-conducting plates C, connecting the upper ends of the pairs of carbon plates above the level of the solution in the tank, said plates C having the openings C^1, the files arranged between the pairs of plates B and projecting through the openings C^1, and the conducting wires attached to the poles of a battery and connecting one carbon plate of each pair to the file between the adjacent pair of carbon plates in series, substantially as described. (3) In an apparatus for recutting files, the carbon or other suitable plates connecting together in pairs, substantially as described. (4) The combination of the tank containing the acid or alkaline solution, the carbon plates immersed therein, the files immersed in the solution between the plates, and the battery or other source of electricity connected in circuit with the plates and the files, and adapted to pass electrical current through the said plates and files and through the solution in which they are immersed, for the purpose set forth, substantially as described.

360,663. METHOD OF FORMING JOINTS IN SHEET-METAL TUBES, *E. O. Daniels, Springfield, Ohio.—Filed September 28th*, 1882.

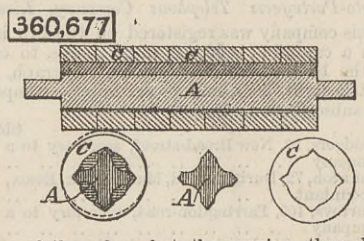
Claim.—The herein-described method of forming a joint in sheet-metal tubes, the same consisting in



fitting the end of one such tube into the end of another such tube, in attaching a wire to the inner tube, and in revolving both tubes in opposite directions, whereby the wire is drawn between the two tubes and the thin metal bulged so as to form a groove therefor.

360,677. FEED-ROLL, *L. Garrigues, Waterville, Conn. —Filed January 6th*, 1887.

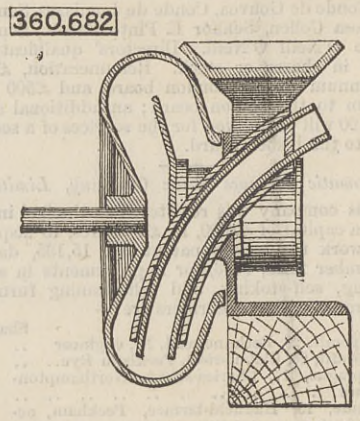
Claim.—The herein described feed-roll, consisting of the arbor A, of polygonal or non-cylindrical shape, combined with two or more concentric sections, C, the interior of said sections corresponding in shape to the



shape of the arbor, but the opening through the sections of greater transverse area than the transverse area of the arbor, with elastic material between the inner surfaces of the sections and the corresponding surfaces of the arbor substantially as described.

360,682. ORE PULVERISER, *E. C. Griffin, Brooklyn N.Y.—Filed October 31st*, 1885.

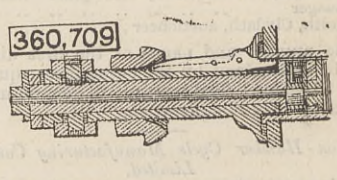
Claim.—(1) In an ore pulveriser, a vertical spheroidal rotating shell, in combination with an interior stationary diaphragm for directing the current of air upon the line or surface of attrition, so that the said current may carry off the pulverised material as fast as ground, substantially as described. (2) In an ore pulveriser, a



vertical spheroidal rotating shell, in combination with an interior stationary diaphragm for directing the current of air upon the line of attrition, and passages for introducing said air current thereto and for carrying the air and powdered substance therefrom, substantially as described. (3) In an ore pulveriser, a vertical spheroidal rotating shell, interior stationary diaphragm, air passages to and from the same, and feed passage, substantially as described.

360,709. TUBE CUTTER, *O. F. Martin, Somerville.— Filed March 3rd*, 1887.

Claim.—(1) In a tool for cutting tubes, the combination of a sleeve having a diameter at one end not greater than the interior diameter of the tube to be cut, a plurality of clamping levers pivotted to said sleeve, a nut fitted to said sleeve and constructed and arranged to act upon said levers to vibrate them and cause them to clamp the tube to be cut, a revoluble cutter-head constructed and arranged to enter the tube to be cut and mounted by its shank in a bearing in said sleeve, a cutter-stock carring a rotatable cutter



and fitted to a bearing in and movable transversely to the axis of said cutter-head, a revoluble shaft extending through the shank of said head, an excentric formed upon or secured to said shaft and fitted to work in a slot formed in the cutter-stock for the purpose of feeding said stock and its cutter outward, a ratchet mechanism for rotating the cutter-head, and means, substantially as set forth, for rotating said excentric. (2) The combination of the revoluble head A, the cutter-stock G, provided with the slot e^1, the revoluble cutter *e*, the excentric *f*, the shaft f^1, the collar H, mounted upon the shaft f^1 and provided with holes *g g*, the pawl *k*, and the collar F^1, mounted upon the shank A^1 of the head A, and having a series of ratchet teeth formed in and extending around one-half its periphery, the other half of said periphery being smooth and concentric with the axis.