THE ROYAL COMMISSION ON ACCIDENTS IN MINES.

The final report of this Commission will not be made for some time to come, but it is desirable that the public should be informed of its progress from time to time. Indeed, the immediate value of the work done by this Commission will in a measure depend on the confidence placed in it. We say the "immediate value," because sound scientific work will in the long run generally establish its own credit in the teeth of prejudice or suspicion, or even misrepresentation; but in the meantime much may be lost. Clearly in the case of the Commission on Mines, any recommendations can only be carried into effect by compulsory legislation or by voluntary adoption. In England we object to the former, and only resort to it in cases of special necessity, and the latter must be the offspring of confidence. How far the Commission in question deserves it may be best seen by noticing briefly its object, constitution, and the nature of the work it has performed. It was appointed in 1879, with the object of inquiring into the elements of danger connected with the working of mines, especially coal mines, with a view to arriving at the best possible understanding of the conditions involving danger, and introducing any practicable means furnished by the resources of science to prevent the occurrence of accidents or to limit their disastrous consequences. The members first appointed were as follows: — Mr. Warington Smyth, F.R.S., Sir George Elliot, Sir Frederick Abel, C.B., F.R.S., Dr. Tyndall, F.R.S., Mr. Thomas Burt, M.P., Professor Clifton, F.R.S., Mr. W. T. Lewis, and Mr. Lindsay Wood. To these was afterwards added the name of the Earl of Crawford, and Mr. Arthur J. Williams was appointed secretary.

These names are so well-known, that there is no occasion to dwell on the reason for the selection of any of them. To those who are sufficiently interested in the question to read this, the particular qualification of each will probably be apparent. It may, however, be well to note the fact that the whole of the Commission, including the secretary, give their services without receiving pay; and it should be observed that this has involved a much greater sacrifice than is perhaps apparent at first, because long and tedious work had to be performed in places far distant from London. Those who have the special knowledge that they feel qualifies them to weigh and criticise the work that has been done will, we think, bear this in mind in dealing with conclusions on subtle questions involving conflicting interests, where confidence is specially needed. The first step was naturally to take evidence. For this purpose a series of suggestions as to the subjects on which information was required was prepared and issued to those invited to tender evidence. Matters specially indicated were classed under the following heads:—1. Mode of working mines. 2. Ventilation. 3. Lighting. 4. Fire damp. 5. Emanation of gases other than fire-damp. 6. Influence of fine coal dust in promoting or intensifying explosions. 7. Blasting. 8. Falls of roof and mineral. 9. Engine planes, shafts and machinery. 10. Inundations. 11. Arrangements for saving life after accidents, as well as any matters on which special individual knowledge might have been obtained by each witness.

In this way were examined the twelve inspectors of coal mines and the two inspectors of metalliferous mines acting under the Home-office, together with a number of experienced colliery viewers and mining engineers, and also a number of workmen selected by the Coal and Ironstone Miners' Association in various parts of the kingdom. Next, with the object of examining the various systems practised in different districts for getting coal, the methods of ventilation now in use, and the general arrangements both on the surface and underground, as well as for the purpose of examining the effect produced in coal mines by explosions of considerable magnitude, visits of inspection were paid to the following collieries:—Boldon and Harton, Durham; Newport, Abercarne, Monmouthshire; Old Duffryn; Glamorganshire; Navigation and Deep Duffryn Glamorganshire; and Harris's Navigation, Glamorganshire; Bestwood, Nottingham; Ryhope, Durham; Harrington and Whitehaven, Cumberland; Rosebridge, Lancashire; Sandwell Park, Staffordshire; Pleasley, near Mansfield, Nottinghamshire; Garswood Hall, Lancashire; Stafford Main, near Barnsley, Yorkshire (where a sudden burst of gas occurred on January 30th, 1877); Abercarne, Monmouthshire (where 267 lives were lost by an explosion on Sept. 11, 1878); Dinas, Glamorganshire (where 63 lives were lost by an explosion on Jan. 13, 1879); Penygraig, Glamorganshire (where 101 lives were lost by an explosion on Dec. 10, 1880); Leycet, Staffordshire (where 62 lives were lost by explosion on Jan. 21, 1879); Blantyre, near Glasgow (where 209 lives were lost by an explosion on Oct. 22, 1879); The Oaks, Yorkshire (where 361 lives were lost by explosions on Dec. 13 and 14, 1866); and Seaham, Durham (where 164 lives were lost by an explosion on Sept. 8, 1880). These visits resulted in an extensive series of experiments being undertaken, some in the localities visited, and others of a strictly comparative and systematic character in the Royal Arsenal, Woolwich. A voluminous preliminary report, made by the Committee, contains a number of facts which were laid before Parliament in 1881.

The fact is noted of increased safety in working mines, the number of deaths remaining stationary, while the numbers working in mines have nearly doubled. This is attributed to the simultaneous action of legislation, and of the voluntary efforts of the mine managers themselves.

Then follows a short summary as to the present position of matters established by the evidence taken on various questions. In giving this summary the Committee confine their report to evidence received, and abstain from expressing a judgment or offering recommendations. The questions discussed are as follows:—

(1) *Method of working.*—There is much in favour of different systems being followed under different circumstances, but evidence is contradictory; for example, the "long wall" method is only considered applicable to seams under 5ft. thick in Scotland, which opinion is at variance with English and Welsh examples. On rapid working which is said by some to be dangerous and others safe, and methods of driving, the same difference of opinion is found.

(2) *Ventilation.*—Opinion is unanimous in favour of "splitting" the air and shortening the distance it has to travel, and of increasing its volume. Ventilation may be effected well either by furnaces or by fans when well worked.

(3) *Falls of roofs and sides.*—The propping of the roof is apt to be delayed too long or to be done imperfectly, unless it is made the work of specially selected men.

(4) *The emission of gas* sometimes takes place to an almost incredible extent, and no system of ventilation could cope with it at times of special outbursts. Much has been done in the way of careful inspection, and by drilling escape holes.

(5) *Atmospheric pressure* affects the above, and should be carefully recorded by barometer. In some cases the furnace or fans for ventilation are worked specially fast in a S.W. or S.E. wind with a falling barometer.

(6) *Coal dust* in suspension aggravates explosion of gas, but mere mixture of dust and air scarcely cause explosion. Experiments are needed on this subject.

(7) *Gob fires* are chiefly attributed to pressure, friction, and heating of masses of slack coal, producing spontaneous combustion.

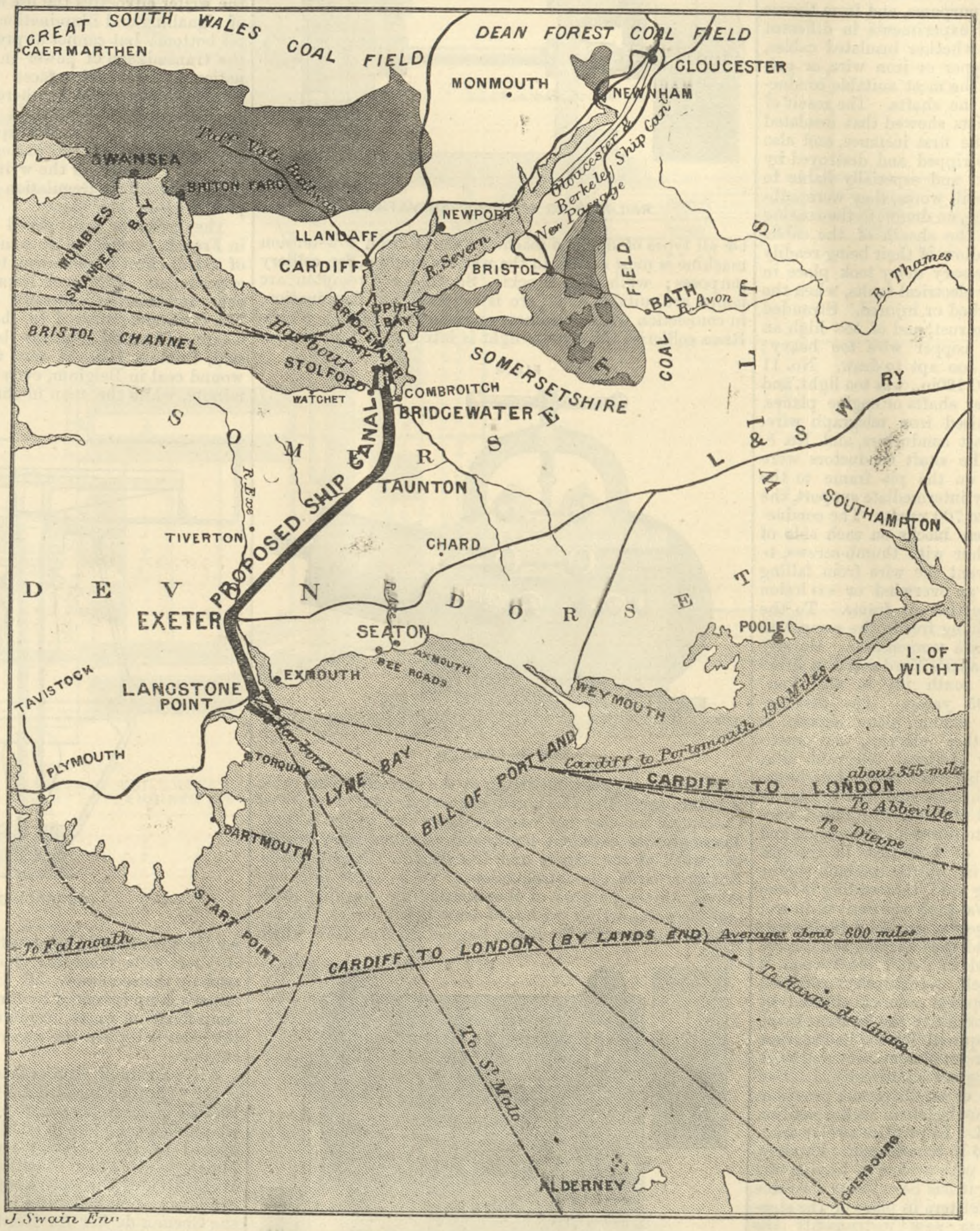
(8) *Lighting.*—Many different opinions exist as to the best course to be pursued in the matter of lighting, chiefly based on local experience. In some cases open lights can be used, and in others special kinds of lamps have won confidence owing to experience having been acquired with them. The Davy, the Clanny, the Stevenson, the Mueseler, and Teale's "protector," are the favourites; but the Commission have made a long course of experiments on this question, of which more by-and-bye.

(9) *Explosives.*—In certain mines a great number of charges are fired daily; in one case as many as 677. In many cases powder may be employed quite safely, but much depends on the nature of the mine and its liability to gas escape.

(10) *Engines, planes, shafts, &c.*—In spite of the great improvements which have been effected in all the machinery of mines accidents in connection with it continue to be nearly as frequent as formerly. Simplicity and care in use appear to be the first requirements.

(11) *Signalling* can be effectually carried out by mechanical means, although electricity has improved matters.

(12) *Arrangements for saving life.* — More than one excellent kind of apparatus has been devised to enable men to enter with lights into deadly gases or to work under a considerable depth of water. The difficulty is to secure immediate readiness on the scene of action after an accident. The actual work of the Commission, in following up this collection of evidence, has been the investigation of the conditions under which accidents occur in mines in various localities, of which a report in detail is in preparation. A long series of competitive trials as to behaviour of lamps under the action of explosive gas has been carried out, as noticed above, near Wigan, at Llynipin in South Wales, and in Woolwich Arsenal. About 180 lamps of many different kinds have been tested. Without in any way anticipating the report of the Commission, we may describe one test which is being applied, and which we could wish could be seen by all those interested in the question. Each lamp in turn is placed in a sort of flue constructed of wood, with weak places formed by lids laid on openings so as to yield readily to the force of any explosion. By means of a fan, air is drawn through this flue at any required velocity up to perhaps 1500ft. a minute. Coal gas or pit gas is allowed to enter in any desired proportion by turning on a cock communicating with meter or gasholder, and the current can be made to impinge on the lamp in any desired direction. By these means the various conditions of danger arising from mixture of air and explosive gas can be imitated, including a violent rush of gas suddenly liberated in a mine. The lamps are subjected to the same test in succession for a given time, generally first to a rush of air and then to that of mixed air and gas, the behaviour of the lamps being carefully observed through a glass window and recorded, whether, for example, like the Mueseler, it generally avoids explosion by being immediately extinguished, or whether, like some specimens of Davy lamps inside a glass case, the flame continues to burn for some time, and eventually goes out without igniting the gas. We believe that all the lamps have been tested by currents of gas and air with a velocity of 1200ft. per minute, and are now being subjected to one of 1500, which represents an exceptional condition of things in ordinary mine workings. The report of the Commission will explain the course which has been pursued. Our present object is to



PROPOSED SHIP CANAL BETWEEN THE ENGLISH CHANNEL AND THE BRISTOL CHANNEL.

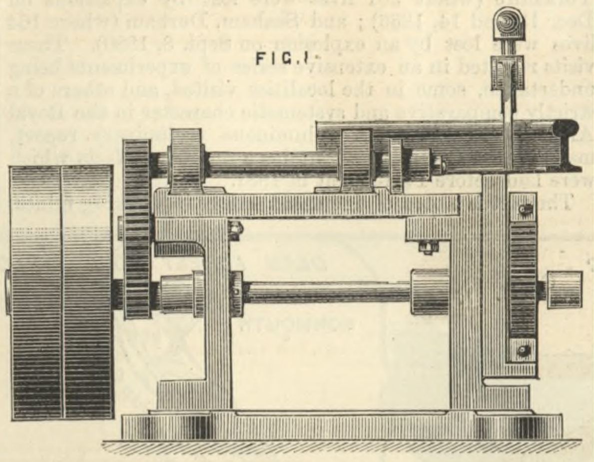
call attention to the fact that this work, which is of such great importance to our mining districts, is being pushed forward in a manner which may well invite attention to the report when it appears.

THE INSTITUTION OF MECHANICAL ENGINEERS AT LIEGE.

On Wednesday morning, the 25th ult., the members of the Institution of Mechanical Engineers met again in the hall of the Société d'Emulation at 8.30, when the secretary concluded the reading in abstract of an extremely lengthy paper on the manufacture of sugar from beetroot, by M. Melin, of Wanze. No discussion followed. A short and interesting paper on the application of electricity to the working of coal-mines, by Mr. Alan Bagot, of London, was then read, of which we give an abstract.

The author divided his subject into two heads, as follows:—(1) The application of electricity to signalling purposes; (2) the more recent application of powerful electric currents for the purpose of illumination, or of transmission, or storage of power, both on the surface and within the workings of the mine itself. He began by explaining the defects of the old system. In 1874 he determined on using electricity for signalling purposes, and from thence to 1877 he carried on a series of experiments in different shafts with a view to determine whether insulated cables, naked copper wire, stranded copper or iron wire, or galvanised iron telegraph wire was the most suitable conductor for conveying the current in the shafts. The result of trials in several different districts showed that insulated cables were too expensive in the first instance, and also were practically useless, being stripped and destroyed by falling coal from the cages, &c., and especially liable to electrical leakage. What was still worse, they were subject to a form of back charge, due, no doubt, to the coating of coal-dust which adhered to the sheath of the cable. Further, their position did not allow of their being readily tested or inspected, and unnecessary delay took place in finding disconnections and other electrical faults, when the cable was not manifestly disturbed or injured. Stranded iron wire was found too prone to rust, and of too high an electrical resistance; stranded copper wire too heavy; solid copper wire too soft and too apt to draw. No. 11 galvanised iron telegraph wire, 0·120in., was too light, and of too high a resistance for either shafts or engine planes. Finally, No. 4, 0·238in. galvanised iron telegraph wire, was found most suited for shaft conductors, and No. 8, 0·165in., for engine planes. The shaft conductors were hung vertically from shackles on the pit frame to the bottom of the shaft, without any intermediate support, the depth in some cases being 600 to 700 yards. The conductors were provided with wooden blocks on each side of the wire, screwed tightly together with thumb-screws, to act as safety clips, and to prevent the wire from falling down the shaft in the event of an overwind or explosion carrying away the shackles on the pit frame. To the lower end of each wire, which hung free in the sump, was attached a 20 lb. weight to act as a compensator. Harris's Deep Navigation Colliery at Quaker's Yard was thus fitted in 1880, the depth of the south pit to the four-feet Aberdare seam being 695 yards. The arrangement of No. 8 wire for the engine plane signals at Risca, North Dunraven, and other collieries, was practically the same as an ordinary overhead telegraph line. The batteries found most suitable were twelve-cell large-size Leclanché batteries; the outsides and the insides of the glass cells down to the level of the exciting fluid were well brushed with paraffine oil to prevent efflorescence and evaporation. The evil effect of coal-dust in the pit batteries was avoided by pouring a little common engine oil on the surface of the exciting fluid, thus sealing it from the air of the mine. Great advantage was derived in wet shafts, where the electric leakage was great, by duplicating the pit batteries for quantity, and thus keeping the tension low. The author then described in detail the system of signalling employed at Cannock and Rugeley collieries. The electrical transmission of special orders is effected by two dial circuits previously mentioned; the current being supplied from the batteries required for the bell service. The transmitters are simply circuit closers, provided with mechanical means for ensuring an electrical contact of given duration; and by means of an air piston, provision is made that the apparatus cannot be left in such a position that the circuit remains closed. In practice twelve separate orders may be transmitted in ten seconds. Latterly, however, in the present year, with a view to leaving the banksman and cager at liberty, it has been found desirable to substitute clockwork transmitters in place of the step-by-step transmitters. In these new instruments the natural operation would be for the clockwork to run itself down. This is prevented by a revolving projecting pin coming in contact with the pin of a lever corresponding to the zero point on the signal, and denoting "safety." For example, on pushing back No. 0 lever, and pulling out No. 5 lever, the clockwork revolves, makes five separate contacts, transmits five electric currents of given duration, and actuates the receiving apparatus five times; the corresponding order, namely, "men coming up," being simultaneously indicated on all the dials in the circuit. The revolving projecting pin of No. 5 lever then arrests the clockwork until the transmission of the next signal, before which No. 5 lever must be pushed back. In engine plane signals, the bell signals are made at any part of the road, by simply making connection between the line and the return wire, and thus closing the circuit; this can be done by the boy in charge of the journey, while the tubs are running. Another application of electricity in coal mines is the electric recording anemometer introduced by the writer. There is another application of electricity which has been found extremely useful by the writer. It is desirable at times to hear the action of pump valves in the pit, without having to send the sinkers down. For this purpose the writer has used with success a modified telephone, attaching it to the outside of the valve cover; but to get really exact repetitions of the beat of the valves, a stout piece of asbestos card should be interposed between the valve cover and the mouth of the telephone. A little practice enables the engine man to follow the action of the valves as accurately as when, in the human body, the heart's action is examined by means of the stethoscope. The author next considered the application of electricity in mining for illumination and for transmission or storage of power. In 1881 the writer experimented at length on the illumination of the pit bank and screens at Harris's Navigation collieries. A Gramme dynamo machine was driven off an engine that worked a Schiele fan, thus ensuring great steadiness of motion and economy in motive power. The result of the experiment showed that incandescent lamps were useless, and powerful arc lamps, fixed 40ft. above the ground, the most suited for the purpose.

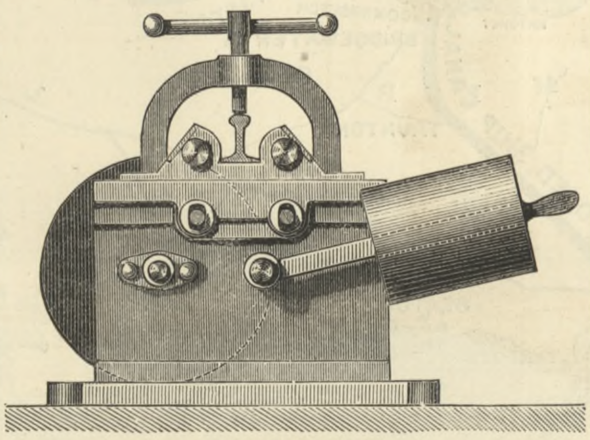
FIG. 1



RAIL-NICKING MACHINE—ELEVATION.

Of all types of dynamo machines, the Edison low-tension machine is most suited, in the writer's opinion, for colliery purposes; while the Brockie, Serrin, or Crompton arc lamps are suitable, if an arc is required for illumination, in connection with a Gramme or Siemens dynamo. At the Risca collieries the electric light is introduced into the pit

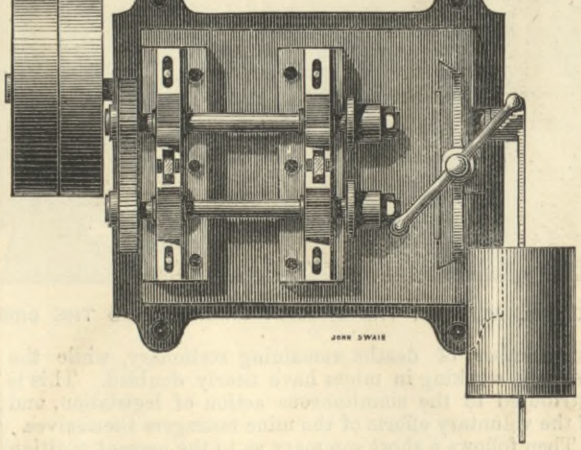
FIG. 2



END ELEVATION.

from a dynamo machine driven at the surface. The cable is taken down the shaft, and connected with a series of Crompton incandescent lamps of large size at the bottom. These give an excellent light, and facilitate very greatly the work of the cagers and the men in the gate-roads. But as regards the introduction of such lights into coal mines, for the purpose of illuminating the working stalls and faces, the writer wishes to draw attention to the 7th general rule, section 76, Mines Regulation Act, 1872, which

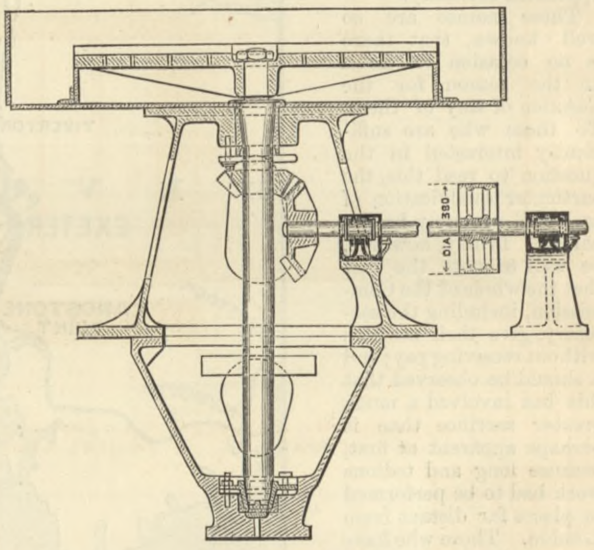
FIG. 3



PLAN.

provides that "In every working approaching any place where there is likely to be an accumulation of explosive gas, no light or lamp other than a locked safety lamp shall be allowed or used." It must be borne in mind that with safety lamps a constant watch is kept on the appearance of gas. Now a blower of gas has been known by the writer to back up against an air current of 65,000 cubic feet per minute passing down the split; and with electric lamps no notice would be given of the fact. Such accidents—or again, a fall of roof breaking a wire, or the breakage of a lamp—cannot be guarded against; and hence the writer is of opinion that no increased safety would be afforded by the electric illumination of the working faces from dynamo machines. It must be borne in mind that a miner, when holing, requires his safety lamp just above or below his work, and is constantly shifting its position and his own, as the holing progresses, to set sprags. This would be a serious difficulty; and further, before withdrawing his sprags to allow the coal to come down, he would have to move the incandescent lamp away altogether and refix it afterwards. Allowing ten minutes for the two operations, this, in a mine of sixty working stalls, would entail a loss of ten hours per day, say one man's labour, or 3s. 6d. daily. Except in long-wall work, reflected illumination by means of electricity would be impracticable. In effect, therefore, without going into details of cost at the present time, electricity can only be successfully applied to the illumination of the working faces by means of a hermetically sealed glass incandescent lamp containing a supply of electricity for nine hours' consumption. If this is charged from dynamo machines at the surface, due regard must be had to the length of time occupied in the operation. The weight of each electric lamp should not exceed that of the present lamps in use, or 3 lb. as a maximum. Such an appliance does not at present exist. The useful application of electricity for the transmission of power would be confined to underground haulage, on the electrical tramway principle of Sir William Siemens and others. But, according to the writer's information, such engines as those constructed at the Grange Ironworks, Durham, or compressed air locomotives, are capable of being used far more economically than electricity, so that the question of electric haulage need not be considered. Recapitulating the points mentioned, the writer advocates the use of electricity for the purposes of signalling and illumination, as regards the pit bank and pit bottom; but cannot at present approve its adoption for the transmission of power in the workings, or for illumination at the working faces. He is of opinion that no increased safety would be thereby derived, and that inconvenience and danger might arise through falls of roof; whilst the constant watch upon gas, kept by the present extensive use of self-extinguishing lamps, would be removed. Lastly, in the writer's opinion, the 7th general rule of the Mines Regulation Act, 1872, would not be complied with in such cases.

The discussion was opened by M. Tresca, who speaking in French, considered at some length the causes of loss of useful effect in electrical transmission, referring to the experiments of Marcel Depretz, but adding nothing to the information already possessed by electricians. Mr. Cochrane referred to the admirable lighting of the Channel Tunnel borings by incandescent lamps, and said, further, that he saw with astonishment that they wound coal in Belgium, even at the rate of 600 yards a minute, while the man in charge of the engine could not



SURFACING MACHINE.

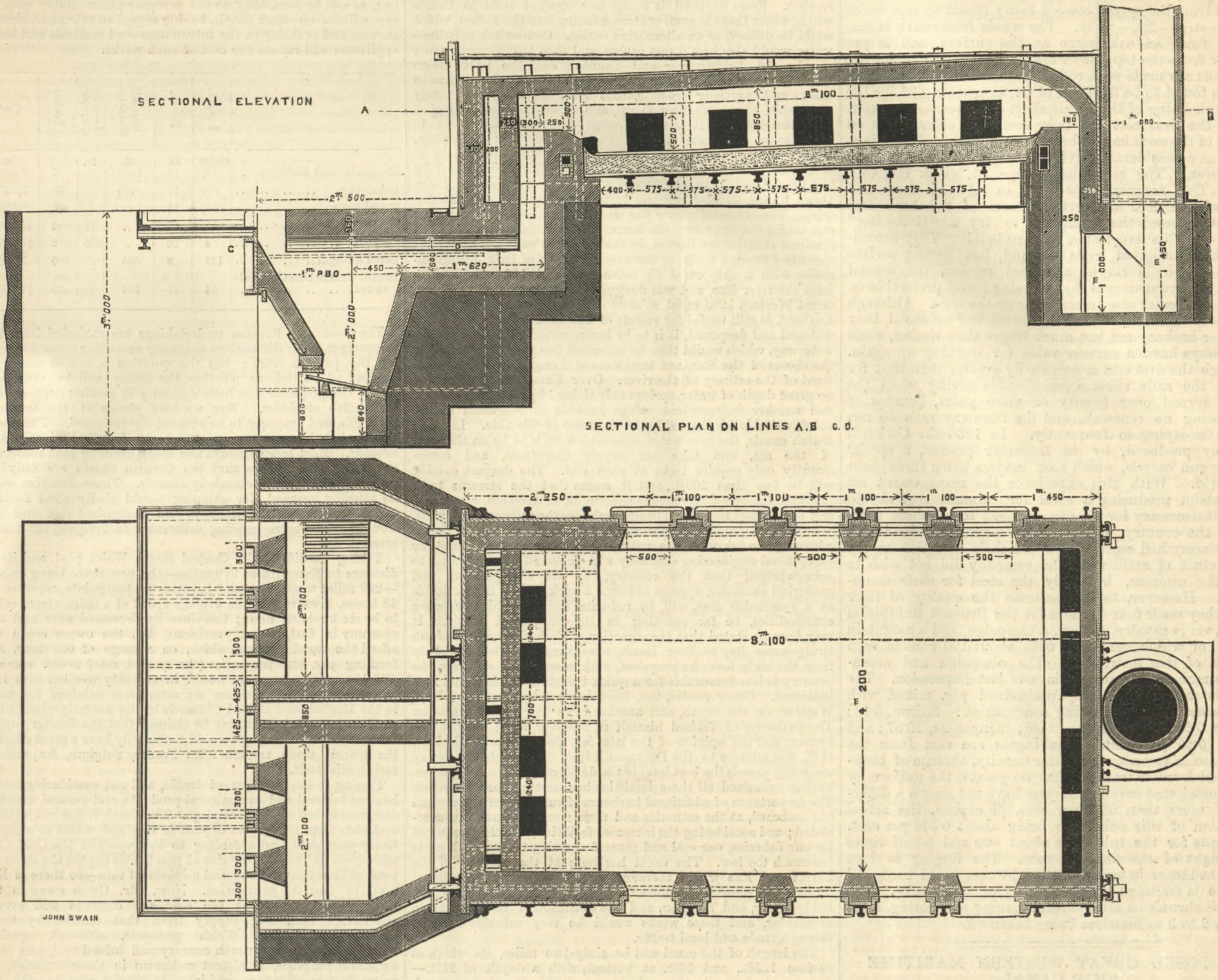
see the pit's mouth, but trusted entirely to dial indications. A short note from Mr. Killingworth Hedges was then read by the secretary. Mr. Hedges briefly described a new miner's lamp invented by him, in which the incandescent lamp floats on water, inside the glass, so that the moment the glass is broken the water runs out and the current is cut off.

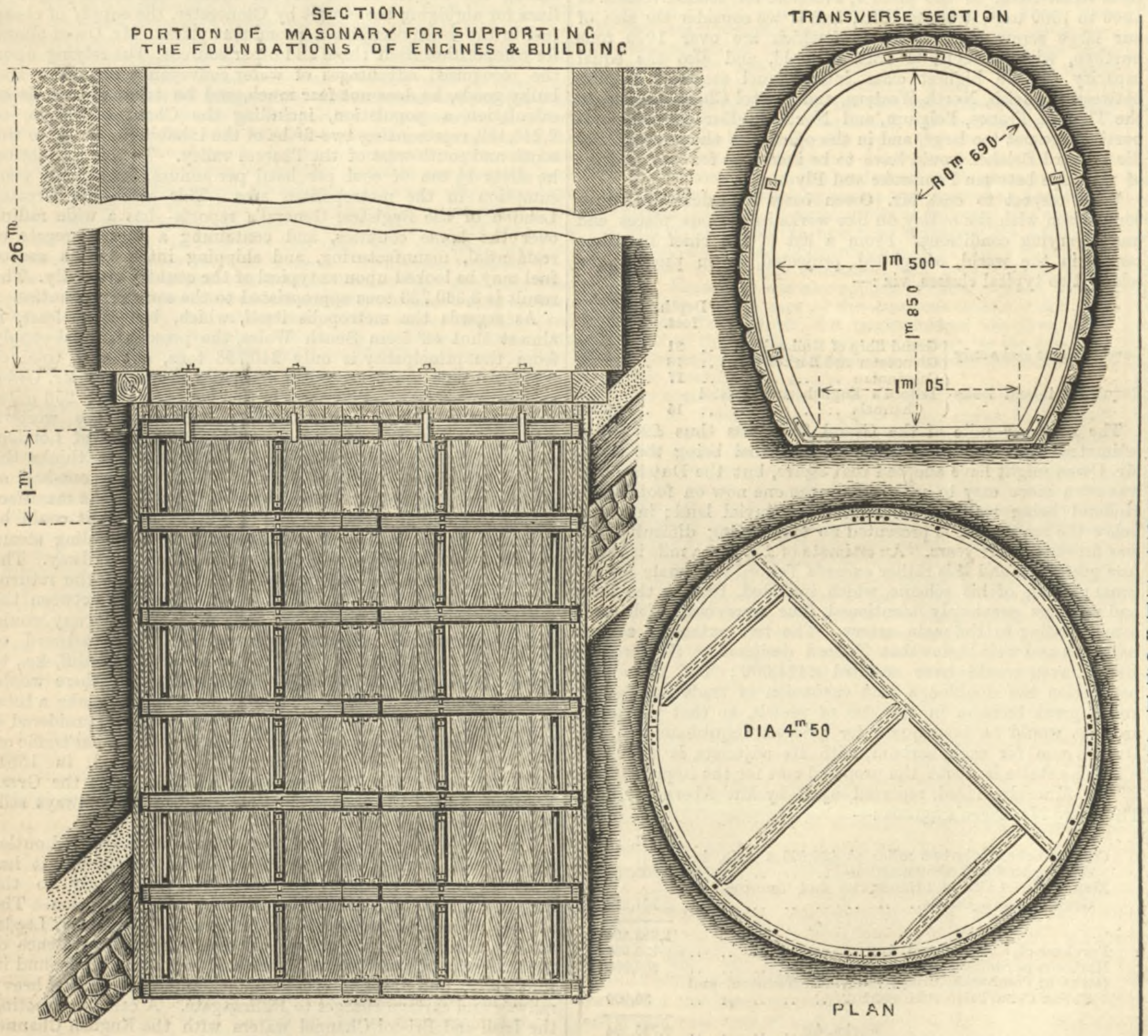
After a vote of thanks had been proposed, Mr. Webb's paper "On the Compound Engine" was read. This paper, because of its importance and the great interest it excited, we publish complete in another place. The discussion was opened by the secretary reading a short note from M. Malet, who calling attention to the way in which Mr. Webb divided the motive power, and said that the multiple cylinder system had already been tried by M. Petiot on the Chemin de Fer du Nord, with unsatisfactory results. The engine, however, was not compound, and he thought that the advantages possessed, according to Mr. Webb, by the compound locomotive, were due to other causes than compounding. As to the use of three cylinders, M. Morandier described a similar engine in 1866.

M. Rich said that he was glad to see the compound engine attracting so much attention. He believed that the time was not far distant when all non-condensing land engines would be compound; and he replied briefly to the action of the Royal Agricultural Society, and said that it was not impossible competitive trials of compound traction, ploughing, and portable engines might be made next year. As regarded the compound locomotive, if it was as economical as Mr. Webb pointed out, great advantage would be derived, apart from saving in fuel, by the fact that a given weight of water would suffice to carry the engine much farther than it now did. He would ask Mr. Webb whether or not he found the absence of a jacket, especially in the low-pressure cylinder, injurious; he advocated jackets. Herr Gottschalk, of the Sudbahn, Austria, made a few remarks, principally dwelling on the point that a more economical might also be a lighter engine, and would save the permanent way.

Mr. Crampton advocated simplicity of construction, and said that he had long since advised the late Mr. Aveling to use but one cylinder in his traction engines. He held that the economy obtained by Mr. Webb was not due to

BICHEROUX FURNACES—MESSRS. COCKERILL'S STEEL WORKS, LIEGE.





TUBBING, GUIDES, AND IRON SUPPORTS IN COLARD COLLIERY.

compounding, but to the circumstance that he had provided double the usual cylinder capacity for the performance of a given duty. Mr. English, of Russia, pointed out that it was mathematically impossible for Mr Webb to get the saving he claimed, for calculations, backed up by Hirn's experiments, showed that with non-condensing engines the utmost saving to be had by compounding was 15 to 18 per cent., while Mr. Webb claimed 25 per cent. The modern locomotive was so excellent it would be hard to beat it. He concluded by saying he hoped yet to see a condensing locomotive.

Mr. David Joy said he saw nothing to discuss, as the success of the engine was complete. As for the compound engine, he could only say that she ran "like a hare" with the utmost freedom, because of the absence of the strains set up by coupling rods. He thought it a pity that Mr. Webb did not use 200 lb. steam instead of 150 lb. After a few remarks from Mr. Halpin, Mr. M'Donnell, of the North-Eastern, said that thanks were due to Mr. Webb and his company for trying a very costly experiment. There were many interesting points about the engine besides compounding. As to Mr. Crampton, he carried his desire for simplicity to such a pitch that he supposed he would advocate that men should scrape along on one leg as best they could, rather than use two; but they could not do with single cylinder locomotives. Mr. Stroudley approved of the engine generally, but thought it ought to be a goods engine with which the experiment was first tried. On the Brighton line he only used 25 lb. of coal per mile with ordinary engines, as good a result as Mr. Webb got with the compound.

Mr. Webb replied on the whole discussion very briefly. He said that the compound engine was capable of hauling a load of nineteen coaches, that there was no cylinder condensation, and that the first run of one of his new compound engines was 528 miles before the fire was drawn, as a christening trip. He was now designing a compound for the Metropolitan Railway traffic.

A vote of thanks was passed by acclamation, one more paper was read to a very small audience, and the meeting adjourned to La Salle de la Legia, where the members were entertained by the engineers of Liége and the district in a very splendid fashion. Subsequently several excursions took place, our notice of which, and the remainder of the proceedings, we must postpone.

In our last impression we referred at some length to the visit to Messrs. Cockerill's works, and our plan of the steel works showed the position of the Bicheroux furnaces. These furnaces we now illustrate above. The rail-nicking machine shown at page 84 was also seen at these works, and serves to mill the nicks or notches in the flange of steel rails instead of punching them as usual. The surface grinding machine shown at page 84 was designed to give a bright surface to work that is not required to be absolutely true, and is especially useful and economical, with case-hardened parts and chilled castings.

On increasing the diameter of the Cécile shaft of the Colard Colliery 4½ metres, it was decided, on account of the thrust of the strata, to adopt a metal tubbing instead of brick lining. Rings of channel iron, in four segments, a metre apart, are connected by eight vertical bars, also of channel iron, the space between being closed by oak spiles 5 centimetres—2in.—thick. The whole framework is suspended from an oak frame on the surface, and is put together from the top downwards. The partitions for the cage wells are made with rolled joists. The cost per metre run was found to be 360f.—£14 8s., as against £32 for the brickwork lining of the Marie shaft of the same diameter. Nor is the first cost the only economy effected, as on account of the work having been done in two-thirds the time, there was a considerable saving in wages, superintendence, and stores. The engravings, page 85, show this tubbing. The frequent crushing in of the roof and rising of the floor at certain parts of the horizontal drivings, induced the company to try a "timbering" of iron—if this expression be permissible. They accordingly bent rejected rails — sound, but having surface defects—to the form of a tunnel section, the second of the two arrangements shown being found preferable on account of greater ease in screwing up the nuts. Although the rails are sometimes bent by thrust and upheaval, they are never broken, and last much longer than timber, while they always have a certain value for working up again. Although the first cost is necessarily greater than that for timber, the rails effect a considerable saving when the cost is spread over twenty or more years, because of there being no renewals, and the tramway rails do not require re-laying so frequently. In 1866 the Cockerill Company produced, by the Bessemer process, a special steel for gun barrels, which soon made a name throughout the world. With this experience the management set itself about producing a steel for cannons that should render it necessary for the Government to purchase them out of the country, especially as several officers in the Belgian army had especially turned their attention to the manufacture of artillery. The company did not wish to make the cannons, but only the steel for their manufacture. However, to demonstrate the quality of their metal, they made four cannons for the Brussels Exhibition of 1880, viz., a cavalry, a siege, a campaign, and a mountain gun, all of which were fired with about 100 rounds each by way of demonstration. The campaign and mountain guns were illustrated in our last impression. The metal is made from pure Cumberland pig, mixed with spiegeleisen of the following composition:—Silicon, 0·56; sulphur, 0·022; phosphorus, trace; manganese, 10·87; and carbon, 5·25 per cent. The ingots are cast from the bottom, so as to secure a greater density, absence of blowholes, and freedom from cinder. So great is the uniformity of the metal that several analyses have not shown a difference of more than 0·02 per cent. of carbon, the actual proportion of this substance being about 0·346 per cent. The ingots for the tubes are about two and a-half times the weight of the finished tube. The forging is done under the steam hammer at a bright cherry-red heat, and the tube is annealed in wood ashes or small coke. The rings are shrunk on after careful turning and boring, a cut of from 2 to 3 millimetres being taken off.

PROPOSED GREAT WESTERN MARITIME SHIP CANAL.

There is now throughout the world a great reaction in favour of water communications, as the only means of competing with the railway monopoly of which so much is heard; and the success of the Suez Canal has given a marked impulse to similar undertakings in either hemisphere. It is, therefore, a fitting opportunity to re-introduce to the public a maritime canal project previously referred to in our own columns, and which, if carried out, would probably assume far more than a local importance.

In 1869, Mr. F. A. Owen, of Hayes, Middlesex—who has supplied us with the information contained in this article—first brought into notice the proposal for joining the English and Bristol Channels by a canal for the passage of ships. Since that time Mr. Owen has worked at the details of the scheme, and has recently issued an exhaustive statement on the project, which contains sufficient to justify further investigation. Such a connection of the two channels has been long thought of. There have been attempts to cut the isthmus which forms the neck of the great Devonian peninsula, and we find the distinguished names of Brindley, Rennie, and Telford associated with the inception of the enterprise. Indeed, in some parts of the proposed route there are small canals which were originally intended to connect the tidal waters of the rivers Parret and Exe; but the through communication was never effected, and, like the Mersey and Irwell navigation, and many other canals in England, these waterways having passed into the hands of the railway companies have fallen into decay, the railways thus securing the entire traffic of the district.

This continued absorption or control of canals is thought by many persons to be opposed to public policy, and it is certainly contrary to the opinions of the Board of Trade, and the Chambers of Commerce, and to the recommendations of the Joint Select Committee of the Lords and Commons of 1872, which considered the question of railway and canal amalgamation. The subject is too wide to be discussed within our present limits, but it will doubtless be fought out before the Bill for that important project, the Manchester Ship Canal, has been passed by the Committee.

The canals proposed by the engineers named were only for small ships, and required locks, which would have rendered the passage slow and difficult. Mr. Owen is in favour of a route somewhat differing from any previously surveyed, and gives as reasons for the deviation: better engineering facilities, and the necessity of connecting large centres of trade and population with the mining districts. He also advocates a canal for ships of large tonnage, and which in capacity and general scope shall be in every way equal to the large traffic that would probably quickly develope through it. The route is clearly shown by the map, page 83.

A distinctive part of the proposal is the utilisation of local canals, and adopting the suggestions of the joint committee of 1872, compulsory powers will be sought to acquire such portions of these waterways as may be needed. The following is the direction of the new canal. Its northern outlet is to be near Stolford, at the south-east angle of Bridgewater Bay, west of the river Parret. This was the point selected by Telford in his scheme of 1825, for which an Act of Parliament was obtained, and it possesses advantages for the formation of harbour and dock works. The tide rises at Bridgewater Bar, 35ft. at springs, and 26½ft. at neaps, and a port of asylum at Stolford would remedy the well-known defects of the bay, and all that part of the coast; and vessels would avoid the shoals which lie off the mouth of the river, and the dangerous navigation of its lower reaches. From Stolford it would be a straight level to Combwitch, where there is a pill or stream falling into the Parret, which could be utilised as an alternative outlet. Combwitch to Bridgewater would also be a direct course, and then following the route of the old Bridgewater and Taunton cut, the latter town would be reached. The remaining section would be parallel with, and partially include, the site of the now nearly abandoned Great Western Canal, and after passing Wellington and Burlescombe, it would diverge into the valleys on to Collumpton and Exeter, *viâ* Kellerton Park and Stoke Cannon. Near Wellington the land gradually rises, and culminates at White Ball Hill in an elevation of 536ft. This hill, pierced by the Bristol and Exeter Railway tunnel, is a spur of the Black Down Range, which forms the principal watershed of that district. The old canal makes the circuit of the hill, and the new one taking the same line, the summit level of the route would be attained at Grinham Barton, in the adjacent valley. At Exeter there is a floating basin, of the average depth of 18ft., communicating with a ship canal 5½ miles long and 15ft. deep, which joins the river Exe, and was designed as a part of the original Great Western local canal scheme. This ship canal, the first in England, is still useful for vessels of 300 to 400 tons, and when widened and deepened, it is to be incorporated with the through waterway, which would then be extended five miles further along the shores of the Exe, and terminate at Longstone Point, westward of the estuary of the river. Over Exmouth Bar there is no great depth of water, springs only rising 12½ft. and neaps 8¼ft., and another independent refuge harbour is suggested at the point, suitable for large ships at all states of the tide. Like the Dutch canals, the new water communication is to be on the level of the sea, and take its supply therefrom, and consequently only require locks at each end. The deepest cutting will be less than 200ft., and it seems that the streams to be provided for by subterraneous aqueducts, or diverted, are small, and few swing bridges will be necessary for the railways and roads.

In the construction of the canal, the projector alleges that if advantage be taken of the natural depressions of the land, no exceptional engineering difficulty will be found; and it must be acknowledged that the country, by its configuration and geological character, appears to invite a work, which, if practicable at a reasonable cost, will, by reducing freights and cheapening commodities, be far reaching in its commercial utility. It may here be stated that the direction of Telford's canal was from Bridgewater Bay to Beer Roads, near Axmouth; but evidently from the sixty locks he proposed, with many deep cuttings, the country is less favourable for a quick transit canal than that now indicated. Other routes, too, have been mentioned; one from Watchet on the north, and another from Dartmouth Harbour. The authority of Telford himself is, however, cited against the former, and the opinion of the late Mr. George Parker Bidder, C.E., was adverse to the Dartmouth line. No doubt for heavy sea-going vessels the best level is the desideratum; and Mr. Owen having examined all these localities has selected that described. The importance of additional harbours of small dimensions round our seaboard, at the estuaries and river mouths, cannot be overstated; and considering the increased facilities and safety required for our fisheries, our coal and general coasting trades, such ports are much too few. The canal harbours at the mouths of the Parret and Exe would therefore help to supply this national want. The scheme also includes floating docks at Combwich, Bridgewater, and Taunton, and the extension of the canal basin at Exeter, and these works would be very valuable for the through trade and local traffic.

The length of the canal will be sixty-two miles, its width at surface 125ft., and 36ft. at bottom, with a depth of 21ft.—dimensions similar to those of the grand Ship Canal of Holland, from Amsterdam to the Helder, available for loaded vessels of 1000 to 1500 tons, drawing 18ft.; and if we consider the size of our large screw colliers, some of which are over 1000 tons burthen, with a depth of 18ft. in hold, and also the equal capacity of the highest class interchannel steamers trading between the Irish, North-Western, and Bristol Channel ports, to the Thames, France, Belgium, and Northern Europe, these proportions are not too large, and in the opinion of the late Admiral Sir Edward Belcher would have to be increased for the passage of warships between Pembroke and Plymouth.

With respect to cost, Mr. Owen bases his calculations on a comparison with the outlay on like works in various places and under varying conditions. From a list of the chief maritime canals in the world, completed, projected, or in progress, he selects two typical classes, viz.:—

		Depth. feet.	Cost per mile. £
Level with sea locks only	Grand Ship of Holland	21 ..	20,000
	Gloucester and Berkeley	18 ..	29,500
Requiring inland locks	Caledonian	17 ..	22,500
	Telford's English and Bristol Channels	15 ..	29,300

The cost per mile of the Grand Ship was thus £20,000—estimated—and the dimensions of his canal being the same, Mr. Owen might have adopted that figure, but the Dutch canal was even more easy to make than the one now on foot, North Holland being really a dead level of alluvial land; in places below the sea surface it presented no engineering difficulty, and was finished in six years. An estimate of £30,000 a mile is therefore preferred, and this rather exceeds Telford's estimate for the canal portion of his scheme, which included, besides the locks and cuttings previously mentioned, four reservoirs, with small canals leading to the main artery. The two extensive asylum harbours and weir basins that Telford designed at Stolford and Beer Haven would have entailed £424,000; but since then population has doubled, a vast expansion of trade has ensued, and a great increase in the size of vessels, so that the above amount would be inadequate for present requirements. Mr. Owen's sum for each harbour, with its adjuncts, is £400,000, which he states is about the proposed cost for the improvements at the Mumbles Head, reported upon by Mr. Abernethy, C.E. These are Mr. Owen's figures:—

	£.
Canal works, sixty-two miles at £30,000 a mile, including land and compensation	1,860,000
Less value of site of Bridgewater and Taunton and Great Western Canals..	104,696
	1,755,304
Purchase of Exeter Canal, &c.	150,000
Harbours at Stolford and Langstone Point	800,000
Docks at Combwich, Bridgewater, and Taunton, and Exeter Canal basin enlargement	80,000
Works, &c...	2,785,304
Obtaining Act, 5 per cent. on this cost, and engineering, surveying and law preliminary expenses at £150 a mile	148,565
	2,933,869
Contingencies, 5 per cent.	146,693
Total	3,080,562

Of course the foregoing estimates are merely approximate, liable to variation either way; for until detailed surveys are made, and cubic contents ascertained, no certain amount can be stated, but, as will be seen, they do not compare unfavourably with the expenditure on other canals, having regard to attendant circumstances, and probably in the future improved methods and steam appliances will reduce the cost of such works.

	Length.	Depth.	Summit Elevation.	Deepest Cutting	Locks.	Cost.
	miles.	ft.	ft.	ft.		£
Gloucester and Berkeley ..	16½	18	Level		2	*500,000
Caledonian	60¼	17	96½		28	1,347,780
Grand Ship	50½	21	Level		2	1,000,000
North Sea..	16½	23	,,	78	2	†2,250,000
Corinth	4	26	,,	255	2	‡1,250,000
Canal du Midi..	148	6	600		100	1,300,000
English and Bristol Channels of 1825	44	15	266		60	§1,712,844

The Suez and Panama undertakings are excluded from this comparison, their dimensions so greatly exceeding those necessary for the present work; but the question is not so much the amount of capital, as whether the outlay will be remunerative. The projector has little difficulty in getting support from instructive statistics. But we may glance at the saving of time, life, and property to be effected by the canal. The uncertain and boisterous voyage round the Land's End would be avoided. Most serious delays and losses occur by that route, and the wreck charts show that the Cornish shores are only too prominent in those melancholy records. These disasters would be sensibly lessened, for shipping would gladly avail itself of the passage across the isthmus, and diminished risk and time would lead to corresponding differences in freights, insurances, interest, &c.

Taking Cardiff as the Central South Wales port, and its sea distance to Exmouth as 370 miles—the new route being only 80—290 miles would be saved between the two points, representing 48 hours, if we reckon the average speed of a laden steam collier to be six knots an hour; therefore by decreased wear and tear, economy in fuel, wages, provisions, &c., the owner could well afford the canal charges, which, on a cargo of 600 tons, at a farthing per ton per mile (the quoted rate) would come to £38 15s. Sailing vessels would in ordinary weather save from five to six days, but coasters are sometimes detained for weeks in the English and Bristol Channels by the westerly winds which so often prevail; and it may be claimed that the shorter voyages between the two channels would necessarily have a great effect on the transit trade to and from France, Belgium, &c., and the metropolis itself.

Passing to the question of traffic, and not considering miscellaneous mineral and agricultural products, and general merchandise, we will deal with coal carriage. The South Wales and adjacent coalfields form the largest deposit in England, which is comparatively unworked, and according to the report of the Coal Commissioners of 1871, it contains at practicable depths the enormous total of thirty-seven thousand millions of tons—so there is little need to fear its exhaustion. Now, Mr. Owen assumes that the greater portion of the southern counties will eventually derive their coal supply from that district by means of the canal. The Welsh products, although equal in most respects to the north country and inland coal, and better for steam purposes, is almost unknown in those counties, and prices in consequence range high. It should also be said, that among the objects of the Severn tunnel and other projected lines for abridging the circuit by Gloucester, the supply of cheap fuel in the south occupies a prominent place. Mr. Owen allows for competition from these and other sources; but relying upon the recognised advantages of water conveyance for heavy and bulky goods, he does not fear much, and he takes as a basis of calculation a population, including the Channel Islands, of 2,240,489, representing two-fifths of the inhabitants living to the south and south-west of the Thames valley. To this population he allots 1½ ton of coal per head per annum, the average consumption in the metropolitan area. This area—the Greater London of the Registrar-General's reports—has a wide radius over the home counties, and containing a vast aggregate of residential, manufacturing, and shipping interests, its use of fuel may be looked upon as typical of the country generally. The result is 3,360,733 tons appropriated to the southern counties.

As regards the metropolis itself, which, by sea, at least, is almost shut off from South Wales, the present annual supply from the principality is only 240,758 tons, out of a total of 3,773,610 tons seaborne, which immense discrepancy Mr. Owen says is caused by the difference in the voyage—about 250 miles—comparing Shields with Cardiff; but when the western collieries are, by the new route, within 355 miles of London, and equidistant with those on the east coast, he thinks the capital will absorb 1,886,805 tons of Welsh coal, or one-half of all the coal shipments. It will be chiefly used in the manufacturing and shipping districts, and it is believed that it could be delivered in the Thames for foreign export, for coaling steam vessels, and at the river side, more cheaply than by railway. The remaining item is the export trade to France, and the returns furnish a tonnage of 3,488,521, equally divided between the northern and western collieries; but the direct waterway would greatly favour the latter as regards most places eastward of Brest; and, reckoning the present output from Cardiff, &c., to those French ports at 1,000,000 tons, it is supposed there would be an increase of 500,000. The foregoing figures make a total annual transit of 6,747,538 tons, which may be considered a tolerably fair estimate when we compare it with similar traffic on the Birmingham Canal navigations, which carried, in 1881, 4,416,337 tons; the Taff Vale line, 7,278,617 tons; the Great Western, 10,481,153 tons, and other coal-bearing railways still larger quantities.

The utility of the suggested waterway as an improved outlet for coal will predispose many minds in its favour, but it has other important aspects. An increased fish supply to the metropolis is a question which is demanding attention. The average prices in London are higher than at Manchester, Leeds, and other inland towns; and we also learn from the evidence of the chairman of the Severn Fisheries Board, that fish abound in that river, but are not caught in consequence of the heavy railway and cartage charges to Billingsgate. A canal connecting the Irish and Bristol Channel waters with the English Channel and the Thames would, it is said, possess an advantage over railway routes, and bring fish in prime condition direct from the

* Including docks.
† Including harbour and reclamation work.
‡ Including docks estimated.
§ Including harbours estimated.

fishing grounds to our waterside markets. The maximum rate for the coal traffic is a farthing per ton per mile, and Mr. Owen states that no railway can afford that. Competition has sometimes reduced the rate nearly to the farthing, but it was impossible to continue it, and on most lines carrying a mixed traffic necessarily at high speeds, from ·45d. to ·55d. is about the lowest remunerative charge. In working expenses also canals contrast favourably with railways. On the latter these are 50 to 55 per cent. taking the lines generally, and renewals form a serious item; but a canal company is, as a rule, merely the owner of the waterway, which can obviously be worked cheaply. Cost of maintenance is, however, very unequal, ranging from £100 to £1000 a mile. The Gloucester and Berkeley navigation incurs a charge of £700 to £800. The promoters of the Manchester Canal say their expenses will be some 15 per cent., and Mr. Owen estimates his at about the same percentage on the gross receipts, or £1000 a mile, which was the amount named in the prospectus of the channels' scheme of 1825. The following are Mr. Owen's conclusions:—

		£
Capital expenditure		3,030,562
Coal traffic receipts, 6,747,533 tons	£435,778	
Less expenses of maintenance	£62,000	
Leaving		373,778

or over 12 per cent. per annum on the outlay from the carriage of coal alone.

Such are the outlines of this proposed maritime canal which we place before our readers, with the facts and figures as they are presented to us. From the encouragement the projector has hitherto received from the Welsh coal and ironmasters, and landowners, merchants, and others in the west of England, he believes that if the project is taken up in earnest it will prove a certain success. It is early to pronounce judgment upon the matter, but we live in a canal-making era, and the subject of increased facilities of communication is always interesting to a commercial country. The scheme appeals to the feelings and interests of many classes and merits careful inquiry, and that is what Mr. Owen desires. When it has assumed a more definite shape we shall be happy to give it further attention.

HISTORY OF THE IRON AND COAL INDUSTRIES IN THE LIEGE DISTRICT.

By M. EDOUARD DE LAVELEYE, of Liége.

(*Concluded from page* 69.)

FOR a long time the Belgians were contented to follow the footsteps of the English in adopting geared engines, with the subsequent improvement of coupling the engines directly to two cranks at right angles on the shaft of the winding drum. This system was applied for the first time in Belgium at the Bois D'Avroy Collieries, by the firm of Charles Marcellis in 1847. The same firm erected in 1860 for the La Haye Collieries the first expansive winding engine. This machine had a fixed grade of expansion on the Meyer system, and solved the problem of disconnecting the expansion gear at the beginning and end of each run, with a simplicity which has never been attained subsequently. The gear was disconnected by simply bringing the link-block of the reversing gear to the middle of the link. Much attention has been given in Belgium to the means of varying the expansion during the run of the winding engine, so as to proportion the power to the resistance at each instant. Several solutions have been proposed, of which that of MM. Brialmont and Kraft is one of the best; but it is difficult to obtain from the engineman the attention necessary to operate the lever which regulates the expansion. The engine-men have been accustomed to proportion the power to the resistance by throttling the steam with the throttle valve. The experiments of M. Hallauer have shown that this method is not so barbarous as it appears, and does not waste fuel provided that the variation is not too great. In consequence the use of variable expansion has lost much of its interest, except in cases where the depth is very great. In this case its advantages return, but it must be rendered independent of the hand of the driver. The last progress made in this direction was by M. Beer in 1871; he made the expansion automatic by connecting it with the movement of the governor. At the Marie Collard pit at Seraing can be seen a fine example of the improvements recently developed in the winding process. These comprise a round rope of steel weighing not more than 5·7 kilogrammes per metre run—11⅓ lb. per yard—or 6660 lb. for a depth of 580 yards. It is wound upon a drum worked by an engine with variable expansion; the cages are also made of steel. The descent of the colliers into the pits was originally carried on by nothing but ladders placed in one compartment of the shaft. This system offered one advantage only—that of safety. It was thus that from 1840 to 1844, during which fifteen accidents took place in the Belgian mines, five miners only were injured on the ladders; in 1849 only two men were wounded, and in 1851 there were merely two men bruised. By degrees, however, with the increase of depth this system became too slow and fatiguing; the miners were allowed to descend by the barrels used for drawing water and coal, and subsequently in the cages, especially when the latter had been furnished with safety appliances. These were first used in Belgium in 1846, and have since been improved, without arriving, however, at any absolute security. Man engines were for a time used to a certain extent, but can nowhere be found in the district now.

As to lighting, the original method consisted simply of a candle fixed to the miner's hat by a lump of clay. A particular workman called "The Penitent" was charged with the duty of going every morning with a candle at the end of a long rod to kindle the fire-damp in recesses where it might have accumulated. In spite of the terrible and numerous accidents which had demonstrated the dangers due to fire-damp, still when M. Orban introduced the Davy safety lamp, its adoption was for a long time opposed by the force of custom; and it required two successive explosions in 1822 and 1823—in the latter of which thirty workmen were killed, and the survivors saved by an overman provided with a safety lamp—to prove to the Liége miners the advantages of the new invention. The Davy lamp is, however, far from offering absolute security, especially in rapid currents of air; and in 1840 an engineer of Liége, the late M. Mueseler, improved it by augmenting its lighting power, and especially by giving it the important quality of self-extinguishment as soon as the surrounding atmosphere is sufficiently mixed with fire-damp to be explosive. Numerous commissions have experimented on different systems of lamps in use in fiery mines, notably the Belgian Commission appointed in 1868, the French Fire-damp Commission, and different private committees appointed by engineering societies in England and France. They have unanimously reported that in rapid currents the Mueseler lamp offers a better resistance to gas than any other. The Davy lamp causes an explosion in a current of 1½ to 2 metres per second—5ft. to 6ft.—whilst the Mueseler lamp resists currents from 4 to 5 metres per second—13ft. to 16ft.—and even more. At the time of the recent disaster at L'Agrappe, which cost the lives of more than 100 miners, a sudden escape of gas issued from the shaft, and burned for several hours like an enormous gas burner. It only took fire at the surface, and no explosion took place inside the mine, the 220 Mueseler lamps, which were employed there having all of them become extinguished. These instantaneous developments of gas appear to be an unfortunate privilege peculiar to the Belgian mines. They have taken place on several occasions and in large volume without anything having previously announced their occurrence. Enormous quantities of gas suddenly escape from the beds of coal, oversetting everything in their passage and accumulating in the workings immense quantities of coal dust. Science itself has hitherto been powerless to deal with these frightful accidents. The Mueseler lamp extended rapidly in use after 1844. On the 1st January, 1860, 14,597 lamps of this type were already in use in the province of Liége. They are now employed exclusively throughout the fiery mines of Belgium, where their price is from five to six francs a-piece. The existence of fire-damp is mentioned for the first time in the fifteenth century by the historian of Liége, Bartholomew Fisen. It appears it was first found in the mines on the shores of the Meuse; and it is said to have appeared in a form resembling spiders' webs, which it was sought to disperse by agitating the air with sticks and with cloths. Efforts were soon made to get rid of the gas by renewing the air, and ventilating shafts were employed from 1696. Even when the mines were still of small depth, these were found to be necessary. A furnace was lighted at the bottom of the shaft, to augment the draught of air. The first ventilating machines were pressure pumps worked by windmills. Large bellows, similar to those of the blacksmith, were also employed. Steam came in subsequently to transform completely the principles of ventilation, by substituting the process of exhaustion for the process of pumping. The first steam ventilators were piston pumps, which still exist at the Esperance shaft and at Seraing, where they were installed in 1835. A similar machine with air vessels was installed at Mariehaye in 1842, and has been often imitated since; amongst other places in the construction of the Mont Cenis and St. Gothard tunnels. In 1845 M. Fabry invented his rotary pumps, which still remain in favour to a certain extent. A remarkable specimen can be seen at the Marihaye colliery, one of the most fiery mines in the Liége basin. Shortly afterwards M. Lemielle invented a fan founded on the same principle as the last named, viz., the formation of a vacuum within a space varying in size, into which the air from the mine passes and from which it is expelled outwards by means of an impressed rotary motion. A fan on this system, and of colossal dimensions, can be seen at the Horloz Colliery. Lastly, M. Guibal invented his centrifugal fan, provided with an exterior casing and a chimney. This last system is at present mainly in fashion, not only in Belgium but in all mining districts. It is not rare to see Guibal fans having a diameter of 12 metres—40ft.—running at eighty revolutions per minute, and discharging 50 cube metres of air per minute—1760 cubic feet—with a vacuum of 215 millimetres head of water—8½in. In England they have even been constructed with a diameter of 46ft. This system has numerous good qualities, which give it the preference over others in all cases where the volume of air to be drawn, and especially the vacuum to be produced, does not necessitate dimensions which are altogether out of the question. Ventilators present great advantages over the furnaces still employed in many places in England. Independently of the permanent danger which the latter offer in fiery mines, they have the further inconvenience of consuming a vast amount of coal, and not having the same efficiency as fans for great depth. There is still to be mentioned the Harzé ventilator, in which the Guibal chimney has been replaced by a diffuser on the Rittinger system. These ventilators can be seen at the Lonette and other collieries. At the Marie shaft in the Seraing works a turbine ventilator was put up in 1878. This ventilator had a diffuser and guide blades, and was constructed according to the theory of turbines from the designs of M. Kraft, chief engineer to the Society Cockerill. Lastly, in several collieries within the basin, the steam jet ventilators of Körting Bros. have been erected for cases of emergency. These ventilators are based on the same principle as the Giffard injector. We have still to record the progress made in the district as regards the drainage of mines. The first methods of drainage, as we have seen, were the areines or adits; but when coal had to be sought below the level at which adits could be driven, recourse was had to the raising of water in tubs and barrels. For this purpose a sump or reservoir was excavated below the level to which the mine was to be worked; into this sump all the water of the mine was run during the day, and it was emptied during the night. Soon, however, the amount of water became so great that special shafts were obliged to be reserved for its extraction. From 1630 it became necessary to employ pumps, which were worked by water or wind power. The principle of a main pump rod working several bucket and plunger lifts was already known, and it may be remembered that it was a citizen of Liége, Renkin Sualem, who constructed the famous hydraulic engine at Marly, near Marseilles, in the reign of Louis XIV. Here again we see steam introducing a complete transformation in the systems employed. In 1767 there were already four steam pumping engines in the Liége basin; these were atmospheric engines on the Newcomen system. After this came the engines of Watt, which for a long time were employed almost exclusively. In 1827 the Society Cockerill erected at the Colliery des Artistes at Flémalle Grande the first large direct-acting rotary engine; but this system was abandoned, and fashion returned to the pumping engines of the Cornish type. However, from 1837 the simplicity of the direct-acting and non-expansive engine and its economy in first cost gave it the preference in Belgium over other systems. The first direct-acting engine was erected at Ans, in the Bonne Fortune Colliery. Several collieries followed this example, and the firm of Ch. Marcellis, now the Compagnie des Ateliers de la Meuse, introduced great improvements into engines of this kind—in particular the Letoret condenser, and modifications in the tappet gear. Expansion was also applied to these engines, but was found difficult in consequence of the enormous masses which were set in motion. To diminish this inconvenience the firm of Ch. Marcellis applied the Woolf or compound system for the first time, in 1859, to the engines which they erected for the Moresnet mines of the Vieille Montagne Company.

The rotary engine of 1827 was, however, destined to regain favour, and in 1863 M. Colson erected a new rotary engine at the Many shaft at Marihaye. The Cockerill Company also erected a large rotary engine on the Woolf system at the Bleyberg mines, and in 1878 Rittinger pumps were attached to a rotary engine erected at the Gosson Collieries. Numerous engines of this class may now be seen in the Liége basin. At the same time direct-acting engines present certain advantages, which will yet give them the preference in cases where economy in first cost and facility of maintenance are of more importance than economy in fuel. In fact, in direct-acting engines the consumption of fuel does not exceed three kilogrammes per effective horse-power in water raised per hour—6·6 lb.—whilst with rotary engines the amount falls to two kilogrammes—4·4 lb.—and even one and a-half—3·3 lb. Underground pumping engines are little used in Belgium; two, however, have been recently erected in the basin, namely, at the St. Marguerite and at the Horloz Collieries. A few figures will give an idea of the progress attained in the coal trade of the province. In 1765 there were only 97 coal mines in the Liége district; in 1855 the province of Liége alone counted 115 coal mines, and the production was 1,720,053 tons. Lastly, in 1882 there were 56 coal mines at work; they employed 23,694 hands, whose average yearly wage was 975 francs, and yielded a yearly total of 3,993,482 tons. This total is made up as follows:—Non-bituminous coal, 408,096 tons; partially bituminous coal, 1,260,811 tons; bituminous coal, 2,324,575 tons; total, 3,993,482. The steam winding engines are 105 in number, and have a total power of 9456-horse power. Pumping is carried on by 64 engines, with a total of 12,281-horse power. These engines in 1882 raised from a mean depth of 263·5 metres—865ft.—a quantity of water equal to 20,698,055 cubic metres—about 730,964,000 cubic feet, or 45,539 millions of pounds. The cost per cubic metre, lifted 100 metres, was in many cases below two centimes—0·277d. per million foot-pounds. Lastly, there were 82 ventilating machines consuming 1684-horse power. In 1882, 834,212 tons of coal were converted into coke, and produced from 1602 ovens 615,281 tons, giving a mean yield of 70 per cent. This high yield is due to the employment of improved ovens. Those chiefly in use at present are the Coppée and the Appolt ovens, the latter being especially suitable to the less rich coals worked in the Seraing basin. The so-called beehive ovens have entirely disappeared in the district, on account of their restricted production and of the nature of the coal, which requires to be attacked by a powerful and sudden heat.

To conclude this description, already too long, and yet very incomplete, it only remains to ask indulgence for the numerous imperfections which it presents, and to thank those whose previous labours have facilitated the task undertaken by the writer. Amongst these he would wish to cite the papers of M. Franquoi, at present director of the La Haye Collieries, dealing with the iron trade of the Liége Basin, and also those of M. Renier Malherbe, Ingénieur au Corps des Mines, and Superintendent of Public Works for the town of Liége, dealing with the coal trade; both of these have been published by the Société d'Emulation at Liége. He would also refer to the description by M. Julien Deby, published on the occasion of the visit of the Iron and Steel Institute to Liége, in 1873; to the reports of M. Van Scherpenzeel Thim, Chief Engineer of the Liége province on the Mineral and Metallurgical Industries of the province during the year 1882; and lastly, to the reports of M. A. Habets, Professor of Mining at the University, upon the Exhibitions at Vienna in 1873, and at Paris in 1878. On casting his eyes back along the line of history which we have been tracing, a Belgian may venture to congratulate himself on a brilliant past; to rejoice at the importance of the position assigned to his country in the present; and to hope for a future of prosperity to be shared with his own by all industrial nations, and more than any other, by the chief among them all—England.

THE STRIKE AT SUNDERLAND.

DURING the past six weeks the engineering establishments of Sunderland have been laid idle, in consequence of a demand made by the Sunderland district branch of the Amalgamated Society of Engineers to restrict the number of apprentices at the trade. The following is a copy of the circular containing the demand sent to the employers in Sunderland by Matthew Patterson, secretary of the Sunderland District Committee:—

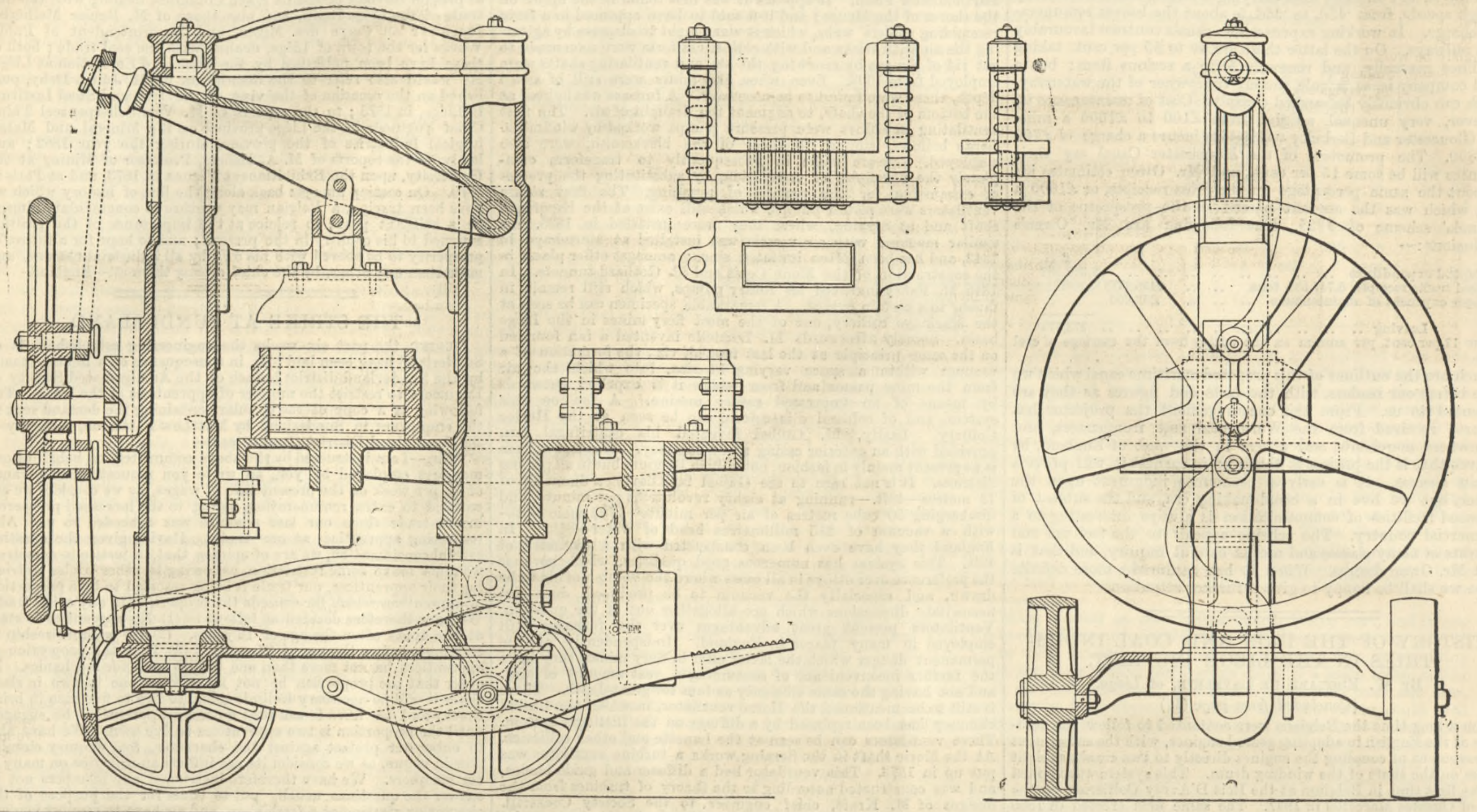
"Sir,—I am instructed by the above committee, on behalf of our members employed by you, to write you requesting an advance of 2s. per week on the present rate of wages, as we consider we are entitled to extra remuneration, owing to the increased prosperity in the trade since our last advance was conceded to us. Also respecting apprentices at our trade. Having given the question careful consideration, we are of opinion that, in justice to ourselves, we must make some restriction, as, owing to other trades restricting their apprentices, our trade is being resorted to by a proportion of apprentices which far exceeds the proportion in any other trade. We have therefore decided as follows:—(1) No apprentice to start at the trade after the age of 16 years. (2) No apprenticeship to terminate before the age of 21 years. (3) That the proportion of apprentices be not more than one to two *bonâ fide* mechanics. In order that the proportion be not more than one to two in slack times it will be necessary to limit them to two to five men in brisk times; and we have to ask that no more apprentices be engaged until the proportion is two apprentices to five men. We have also to enter our protest against the character, &c., enquiry circular now in vogue, as we consider its use inflicts an injustice on many of our members. We have therefore instructed our members not to answer the questions usually put to them for the purpose of the circular on starting at a fresh shop, and we have to request you not to carry on the system, as we fail to see that the benefit accruing to the employers can be in proportion to the injustice inflicted on our members. The above alterations to take effect on and after June 21st, 1883. We also take this opportunity of informing you that working on new work between 6 p.m. on Saturday and 6 a.m. on Monday is prohibited. Awaiting a reply at your earliest convenience."

No great difficulty was found in dealing with the questions raised by the aforesaid circular except that portion of it relating to the restriction in the number of the apprentices. Upon this point the men refused to work, and have been out on strike since the 21st June last. Of course, the refusal of the men to accept their employers' terms has restored the original position of affairs; but there can be no doubt that the apprentice restriction question is the real bone of contention between the parties. On the one hand the employers are relying upon the co-operation of employers in other districts in not giving employment to the strike hands, and on the other the men are appealing to the country for assistance in the shape of funds. They say they have 300 men out of 1000 unprovided for.

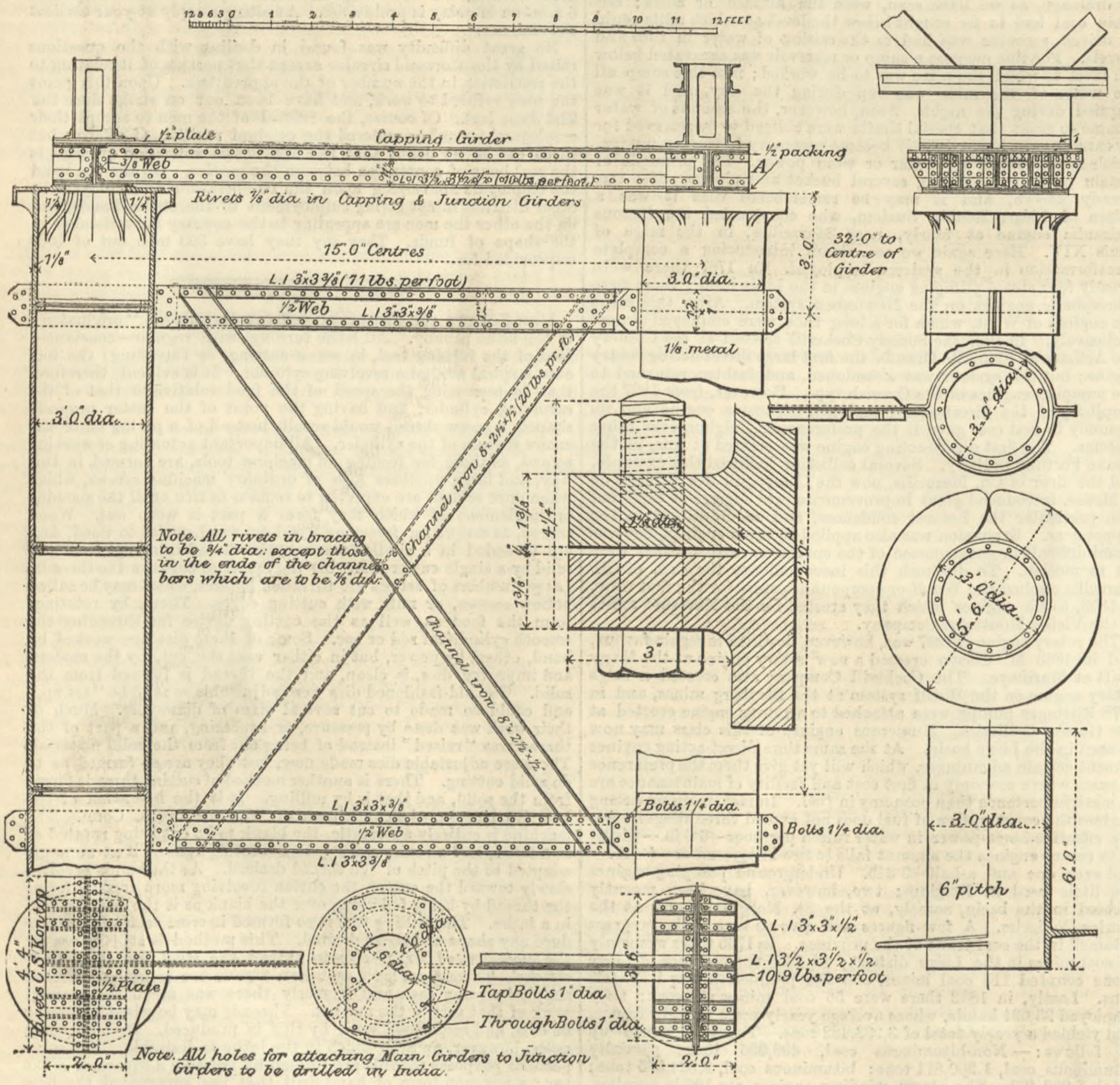
HOW SCREWS ARE THREADED.—Screw threads are "originated" in the lathe usually. All lathe turning, with regular—constant—feed of the turning tool, in screw-cutting, or threading; the tool cuts a spiral around a revolving cylinder. It is evident, therefore, that by increasing the speed of the feed relative to that of the revolving cylinder, and having the point of the cutter properly shaped, a screw-thread would result, instead of a paring off of the entire surface of the cylinder. All important actuating or working screws, as those for feeding on machine tools, are formed in this way, and large numbers also of ordinary machine screws, which when once seated, are expected to remain *in situ* until the machine or implement of which they form a part is worn out. Wood screws, as screws for fastening wood to wood, metal to wood, &c., are threaded in a similar manner, the thread being cut from the solid by a single cutter removing the material between the threads. Large numbers of screws are threaded by dies, which may be called hollow screws, or nuts with cutting edges. These, by rotating, form the feed as well as the cutting device for threading the smooth cylindrical rod or bar. Some of these dies are worked by hand, others by power, but in either case the cut, by the modern and improved dies, is clean, and the thread is formed from the solid. The old-fashioned dies were adjustable so as to be "set up," and could be made to cut several sizes of diameters. Much of their work was done by pressure, or squeezing, and a part of the thread was "raised" instead of being cut from the solid material. There are adjustable dies made now, but they are so formed as to do solid cutting. There is another method of cutting threads direct from the solid, and that is by milling. It is the invention of the late Eli Horton, the chuck man of Windsor Locks, Conn. The machine is entirely automatic, the blank to be cut being rotated as in a lathe, and a rotary milling tool rotating against it at an angle adapted to the pitch of the thread desired. As the blank revolves slowly toward the cutter, the cutter revolving more rapidly forms the thread by being fed along over the blank as is the cutting tool in a lathe. The milling tool is so formed in cross section as to produce any shape of thread desired. This method is still in use by the successors of Mr. Horton to thread the steel screws of their chucks. Threads on large cast iron screws are sometimes formed simply by being cast, and formerly there was much cheap small work of that sort in the market. Threads may be raised by forging in dies, and some good work by this is produced. In both these cases, however, an after finish in the lathe is desirable. For some peculiar purposes threads are formed by twisting a square or a flat bar; a common form of hand drill that has superseded the bow drill being a case in point. The stock of this drill is a bar, square in cross section, twisted, and which is rotated by sliding a loosely fitting nut rapidly back and forth over its length. A familiar instance of a screw-thread of this description is the ordinary auger or bit, the cross section of which is a flattened parallelogram like a flat bar. One peculiar method of forming screw threads remains to be mentioned. It is that of raising a thread by rolling between dies under pressure. There is a great deal of what is known as "bright wire goods" in the market, which are threaded. In many cases these threads are formed by simply rolling—one revolution, or a little more—the wire between two hardened steel plates that are corrugated spirally to form, when combined, a continuous thread. Sufficient pressure is applied during the rolling—which, however, is very rapid—to raise the metal from the annealed wire enough to make a thread. In this case the threaded portion is considerably larger than the stock or wire, at least half the depth of the thread on each side.—*Scientific American.*

PAGE'S HAND POWER BRICK PRESSING AND PERFORATING MACHINE.

(*For description see page 87.*)



PIERS FOR RANGOON AND IRRAWADDY VALLEY RAILWAY.



CONTRACTS OPEN.

RANGOON AND IRRAWADDY VALLEY RAILWAY.

METRE GAUGE.

Ironwork, cast iron cylinders, &c., for piers of bridges.—The work required under this specification comprises the construction, supply, and delivery in England, at one or more of the ports named in the conditions and tender, of the cast and wrought ironwork for two piers for 60ft. spans, including four top lengths, seventeen intermediate and four screw lengths, and two sets of wrought iron bracing; and all bolts, nuts, and washers, and all rivets required for completing the work in India, together with an allowance of 50 per cent. on the net quantity of rivets, and of 10 per cent. on the net quantity of rivets, and of 10 per cent. on the net quantity of bolts, for waste. The piers are delineated on one drawing, as above, which may be seen at the office of the Director-General of Stores, India-office. The contractor will be required to make his own copy of this drawing. The contract does not include the capping and junction girders, shown on the same drawing. The cast iron to be of such quality that a bar of the same, 1in. wide, 2in. deep, and 3ft. 6in. long, placed on bearings 3ft. apart, shall not break with a less load than 30 cwt. applied in the middle. All castings must be sound and clean. The wrought iron is to be well and cleanly rolled to the full sections shown on the drawing or in the specification, and free from scales, blisters, laminations, cracked edges, and defects of every sort, and the name of the maker is to be rolled or stamped on every piece. It must be of such strength and quality as to be equal to the following tensional strains, and to indicate the following percentage of contraction of the tested area at the point of fracture:—Round and square bars, and flat bars under 6in. wide, tensional strains per square inch 24 tons, percentage of contraction 20; angle, channel, and flat bars, 6in. wide and upwards, tensional strains per square inch 22 tons, percentage of contraction 15; plates, tensional strains per square inch 21 tons, percentage of contraction 10; plates across grain, tensional strains per square inch 18 tons, percentage of contraction 5. The iron intended to be used for the rivets must, whilst cold, be capable of being bent double without showing signs of failure. The tests are to be conducted by some person to be approved by the Inspector-General of Railway Stores. The expense of the tests must be borne by the contractor. No iron is to be used which, in the opinion of the Inspector-General, falls short of the tests and other requirements of the specification, and no iron of foreign manufacture is to be used throughout the contract. It is expressly understood that the greatest accuracy is to be observed in every part of the work, a main object of the design being to facilitate as much as possible the erection of the piers in India by perfection of workmanship in this country. All corresponding parts must be made exactly similar and interchangeable. All the cylinders must be cast perfectly round, and exactly to the same diameter. The meeting ends are to be turned, and the bolt holes in the ends are to be drilled, and so accurately spaced that any one cylinder may fit any other cylinder in any position. A gauge, with studs to represent the holes, will be applied to each. The holes in the top lengths are to be drilled in India to suit. The screws must be carefully cast to the proper shape. The top lengths—caps—are to be planed or turned up flat on the top to take the junction girders, but the holes for attaching the girders will be drilled in India. All plates and bars must be rolled to the full sections, and the angle irons to the full widths and weights per foot, shown on the drawings. All plates, bars, and angle irons must be carefully levelled and straightened—the angle bars and channels by pressure, and not by hammering—before and after they are punched or drilled. All edges of plates, and the ends of all angle irons and bars, must be planed dead true to the dimensions shown on the drawings, or, where planing is impossible, they must be dressed off fair with hammer, chisel, and file. No rough edges fresh from the shears will be permitted anywhere throughout the work. All rivet holes to be filled in India are to be drilled. All other rivet holes may be either drilled or punched, at the option of the contractor, but any plate or bar in which the holes are not accurately in place will be rejected. The holes through which any one rivet passes must correspond in any number of plates or bars. The rivet holes are to be made to the sizes figured on the drawing, and in all cases the rivets must completely fill the holes when rivetted up. The rivet iron must be of such size in each case that when the rivet is inserted hot it shall be a tight fit in the hole.

SCHEDULE REFERRED TO IN THE SPECIFICATION.

Supposed quantities in a total of two piers of 60ft. spans.—Drawing No. 14. Cast iron: In No. 4 top lengths, 4 tons 3 cwt. 2 qr. 4 lb.; in No. 17 intermediate lengths, 18 tons 17 cwt. 4 lb.; in No. 4 screw lengths, 5 tons 19 cwt. 1 qr. 4 lb. Total cast iron in two piers, 28 tons 19 cwt. 3 qr. 12 lb.

Wrought iron in one set of bracing.—Plates, 4 cwt. 1 qr. 2 lb.; angle iron, 4 cwt. 3 qr. 6 lb.; Channel bars, 6 cwt. 15 lb.; rivet heads and spare rivets, say 5 per cent., 3 qr. In one set, 15 cwt. 3 qr. 23 lb.; in two sets, 1 ton 11 cwt. 3 qr. 18 lb.

Forgings in one set of bracing.—In one set of clamps for cylinders, 16 cwt. 24 lb.; in two sets, 1 ton 12 cwt. 1 qr. 20 lb.

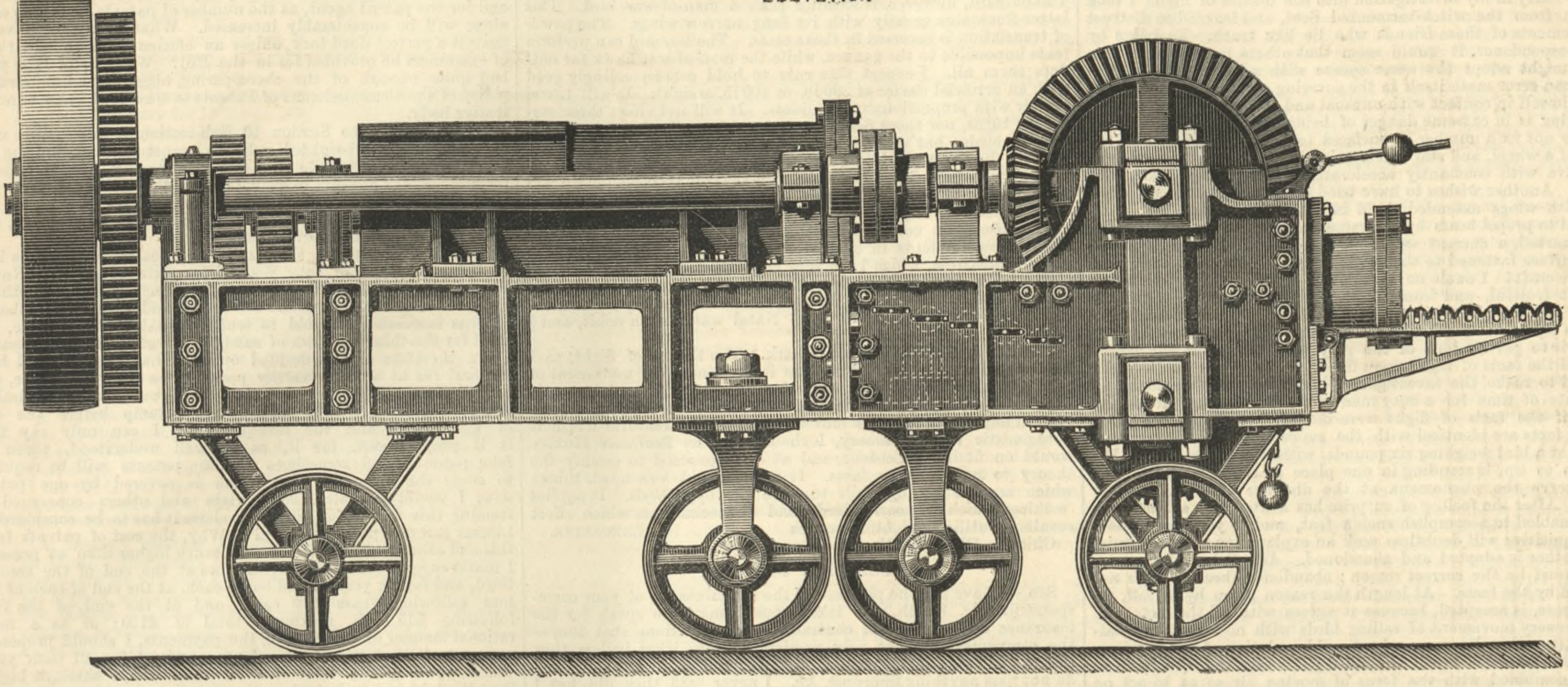
Bolts, &c.—Total in cylinder joints in two piers, 3 cwt. 3 qr. 22 lb.; total in two sets of bracing, 3 cwt. 1 qr.; total of bolts, 17 cwt 22 lb.; total cast and wrought iron in two piers, 33 tons 1 cwt. 1 qr. 16 lb.

Tenders are to be delivered at the Store Department, in the India-office, Westminster, S.W., on Wednesday, 8th August, 1883, before 2 p.m., addressed to the Secretary of State for India in Council, with the words, "Tenders for Cast Iron Cylinders for Bridge Piers" on the left-hand corner of the envelope.

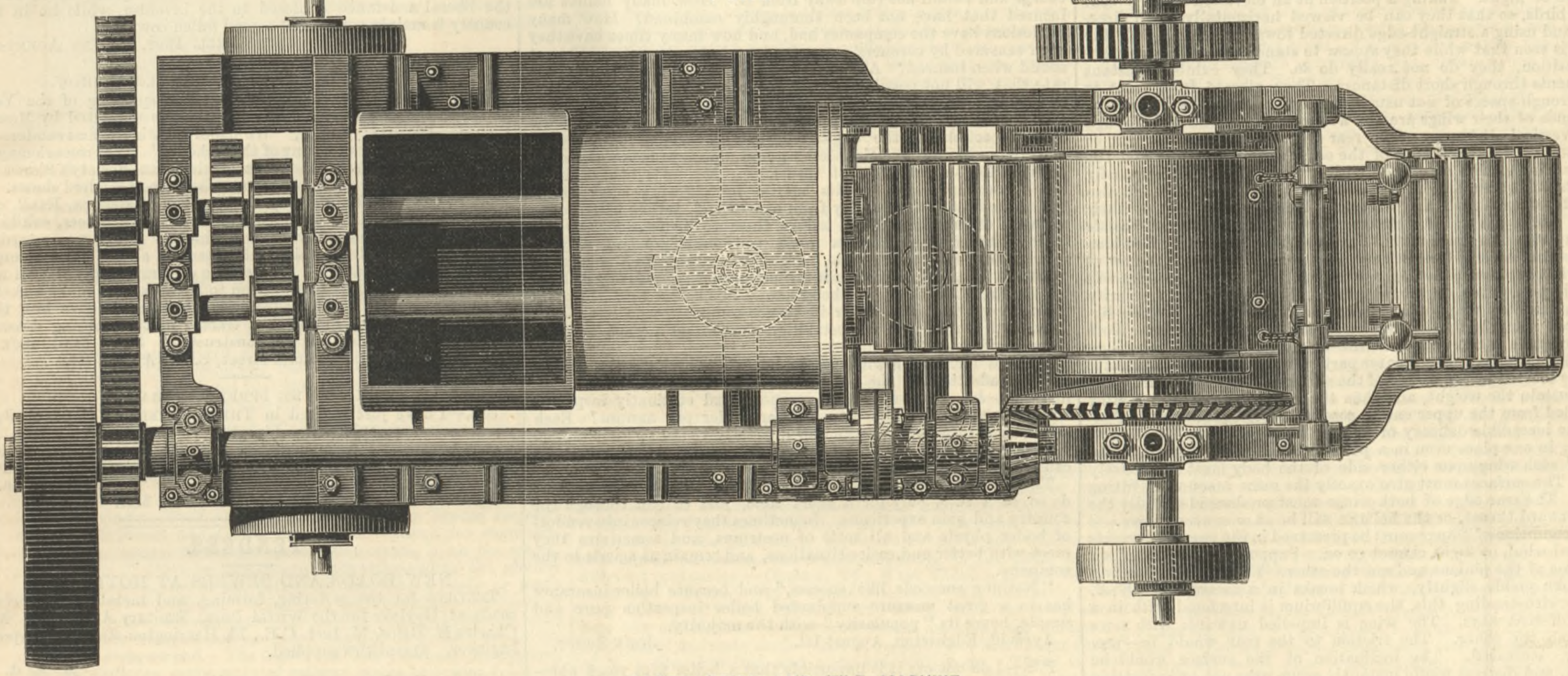
NEW LOW LEVEL BRIDGE BELOW TOWER-HILL.—Every one interested in the London Bridge question will have been glad to learn that the Metropolitan Board of Works has unanimously determined to ask the sanction of the House of Commons for the construction of a low-level bridge across the Thames immediately eastward of the Tower. Sir Joseph Bazalgette has been instructed to prepare designs for this in substitution for the plans for a high-level bridge which he submitted some months ago. It has been resolved also to seek powers to construct two great tunnels under the river, easily accessible for all kinds of traffic. The points selected for the construction of these important works are Shadwell and Blackwall, and the designs for them are already completed by Sir Joseph Bazalgette.

EXHIBITS AT THE R.A.S. SHOW AT YORK.

ELEVATION



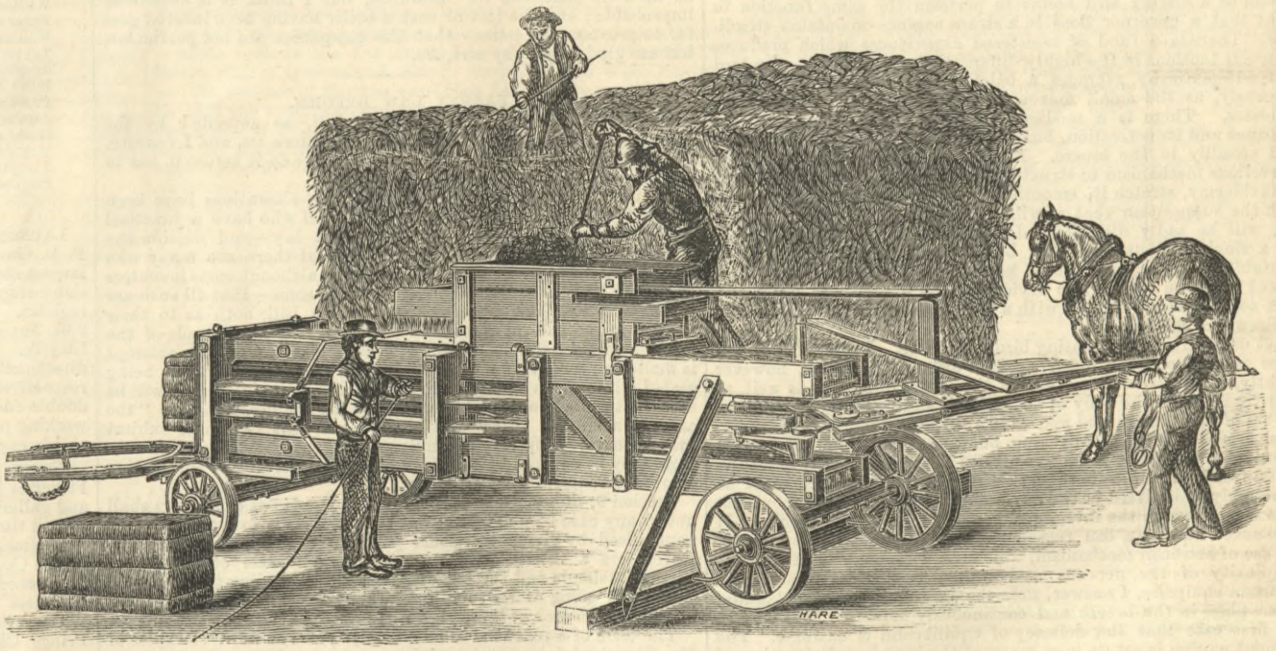
PLAN



PAGE'S BRICK AND TILE MACHINE.

THE ROYAL AGRICULTURAL SOCIETY'S SHOW AT YORK.

THERE were several machines exhibited at York to which we have not yet referred. Some of these we now illustrate. Messrs. E. Page and Co., Bedford, exhibited amongst other things the brick-making machine which is shown in plan and elevation. This machine may be used either with or without the clay rolls. As shown, the part containing the clay rolls is in use, but it will be seen that the two parts are distinct, though bolted together at the centre of the framing, and are each mounted on wheels. The horizontal pugmill, when used as shown, delivers to the rolls, but when the latter are not used the die or mouth is attached to the end of the pugmill. The latter contains two spindles, as shown, each mounted with segmental pugging screws, and the mill casing opens on a hinge. The clay roller bearings are adjustable, and the bevel-wheel which drives the rollers is fixed direct on the end of the upper roller, and a cross-head not shown is fixed at the opposite end of the roller spindle to take the thrust from and to keep the bevel-wheel in gear. Clay is prevented from getting into the roller bearings by plates, which take into grooves in the rollers. The machine illustrated is for making about 15,000 bricks per day, the quantity depending on the character and state of the clay. The same makers show the hand brick and tile press illustrated on page 88. The table of this machine rotates on a central support, so that while the brick in one mould is being pressed the other mould is being emptied and refilled. The lever-pressing arrangement is clearly illustrated by the engraving. A hand lever not shown, however, on the engraving was attached to the wheel, and extending considerably beyond its circumference to give the required power. It was shown as fitted with plain moulds, and with perforating moulds, the moulds being of steel and built up so as to be capable of adjustment to allow for wear. The perforating moulds for bricks separately shown on page 88.



LADD'S "PERPETUAL" HAY AND STRAW PRESS.

The "perpetual" hay and straw press—so called because it is continuous-acting instead of intermittent, as with all presses which have boxes to be filled and then pressed, illustrated by the engraving above—was illustrated in model by Mr. J. H. Ladd, London. It is a modification of the power perpetual press, which was awarded a silver medal at the Derby Show. The packing is performed in much the same way, but by the combined work of the man feeding and the packing piece worked by the horizontal lever attached to the vertical projection from the horse shaft. In working the press, the horse walks backwards and forwards in the path of a large curve, from which he diverges at a tangent near the end of his walk at the position shown, and then turns round and returns. This is probably much less harmful to a horse than a circular path. It is said that with two men and two boys from 4 to 6 tons of hay may be pressed in this machine per day.

LETTERS TO THE EDITOR.

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

THE PROBLEM OF FLIGHT.

Sir,—Early in my investigation into the matter of flight, I took a lessson from the witch-tormented Scot, and learned to distrust the statements of those friends who lie like truth. To judge by my correspondence, it would seem that others interested in this matter might adopt the same course with advantage. So completely can error mask itself in the covering of truth, that one who places himself in contact with unusual and hitherto unknown ways of thinking is in extreme danger of being grossly deceived. One asks why not fix a number of surfaces to horizontal arms like the spokes of a wheel, and start them going, when they would continue to revolve with constantly accelerated speed, if my theory was correct. Another wishes to have tried the experiment of a stuffed bird, with wings extended, held in the breeze. Another is determined to propel boats by the same process; for the moment the vessel started, a current would be flowing against it, and an inclined surface fastened to the bottom would utilise that current to move the craft! I made no attempt to detail experiments which were not fruitful, and from my present standpoint the wonder is not that so many did not succeed, but that any did succeed.

Let us try to comprehend this matter. The very first thing to be done is to get an idea of the play of forces about the poised bird, and the facts of flight upon fixed wings must be unreservedly admitted to make the investigation significant. It would be an idle waste of time for a busy man to trouble himself about the matter if the facts of flight were denied. However, premising that the facts are identical with the supposition, let us assume a case—that a bird weighing six pounds, with wings stretched to 7ft. from tip to tip, is standing in one place in a horizontal breeze. You observe the phenomena at the distance of 20ft. at your leisure. After the feeling of surprise has abated, you ask how the bird is enabled to accomplish such a feat, and if you are disposed to be inquisitive will doubtless seek an explanation. One surmise after another is adopted and abandoned. Adopted, because some reason must be the correct reason; abandoned, because it is not sustained by the facts. At length the reason given by myself, we will suppose, is accepted, because it agrees with all the facts, and explains every movement of sailing birds with no exception whatever. After this discovery of a tenable solution of the problem, the matter becomes much simplified; it is seen that the force of gravity combined with the force of moving air so as to act on certain inclined surfaces in a peculiar way which makes flight possible.

A starting-point is thus gained, and we go on to an examination of the entire mechanism constituting both the structure and the function of flight. Taking a position at an elevation equal to that of the birds, so that they can be viewed horizontally in all directions, and using a straight-edge directed towards them to guide the eye, it is seen that while they appear to stand in a perfectly motionless position, they do not really do so. They exhibit constant movements through short distances. They vibrate from front to rear through spaces of not usually more than an inch or two. The outer ends of their wings are also at short intervals flashed through small vertical distances. The rear edges of their pinions will be disturbed by sudden liftings of the ends of the feathers, and the angles of inclination of one or both are seen to change frequently through small arcs, and in disturbed currents of air they will also be quite often flexed and extended through one-third of their length. In rough winds a bird will sometimes be several seconds in pretty violent agitation, and finally settle into quiet by a sudden movement of several feet in any direction. At times, the flow of wind will be so nearly homogeneous that the vibratory motions will be barely perceptible, and nothing could be more devoid of regularity than this whole group of incidental tremors. What is their significance? Manifestly they are preservative of equilibrium. Note the admirable construction of the extended bird as a whole to effect this purpose. The greater part of the weight is in the body, which is located in the centre of the surfaces and below them. The wings sustain the weight, and thus the creature resembles a stick suspended from the upper end, a case of stable equilibrium. Consider the incredible delicacy of this equilibrium while the bird is standing in one place even in a perfectly steady flow of air. The slant of each wing upon either side of the body must be precisely right. The surfaces must give exactly the same amount of lifting power. The rear edge of both wings must produce identically the same forward thrust, or the balance will be at once overthrown.

This condition of things must be preserved in the varying currents of actual wind, or flight cannot go on. Suppose that a puff of air strike one of the pinions and not the other. The part that receives the stroke yields slightly, which breaks in a measure the blow. But notwithstanding this, the equilibrium is interfered with in a dozen different ways. The wing is impelled upwards with more force than the other. The friction to the rear would be—presumably—increased. The inclination of the surface would be changed, and distress would instantly occur were not compensating movements made in other parts of the mechanism. The nervous system of a soaring bird seems to perform the same function in flight that a governor does in a steam engine—maintains steadiness. There is a fund of registered experiences which produces muscular tensions in the highly differentiated mechanism of a bird that automatically averages a balance. They do not act instantaneously, as the small movements of the creature above noted indicates. There is a modicum of time lost between the disturbance and its correction, but the result is adequate to keep the bird steadily in the breeze. Now kill the creature; reduce its marvellous mechanism to structure only; stuff it with all the art of taxidermy, stretch it, smooth it, and expose it to the breeze with the supposition that it will simulate its living triumphs, and you will be sadly disappointed. It will not preserve equilibrium for a single instant. Nothing but some preternatural skill, inscrutable to me, could induce it to perform with credit. You can indeed insert an equilibrium device beneath it and get results, but none so good as can be had with a few pine sticks and cardboard, as elsewhere shown.

Let us return to the floating bird once more. Suppose that you place the tip of your finger against one of the wings, however slightly, the centre of gravity, and the centre of motion as well, at once vanish from the body of the animal, and instantly reappear at the tip of your finger, and you have a trip-hammer, or a whirligig, or a jumping Jack, or anything but a floating bird. How is it conceivable then that a captive device can be made to give results as the free bird manifests them? This matter of balance must be thoroughly assimilated in the comprehension of the experimentalist if he would pursue the investigation along lines of best results. If it be asked how man can reasonably hope to imitate the birds by the use of artificial mechanism, which can compete with the infinite complexity of the nervous and muscular changes required to maintain equipoise, I answer, note the difference between standing in one place in the breeze and continuously moving. It is only in the first case that the delicacy of equilibrium is extreme. The moment motion is set up very many of the impulses destructive of balance are lost in the general effect. A puff of wind which would raise the bird may be allowed to spend its force. The creature still goes on as well at the greater elevation. An impulse which exercises a greater forward thrust is tolerated; the only effect is to increase speed. A lop-sided movement, if not excessive, would deflect from a straight course without detriment, as the next one might urge the other way, and so average rightly. Thus, however important equilibrium must be while the mechanism is in motion, it is far from being so delicate as when at rest. Trial with an effigy shows this difference at once. I have stood for an hour with one of these in my hand trying to get it into a position of momentary equilibrium to effect a start. It would then sail with steadiness for perhaps fifty yards without getting into difficulty.

Another state of pertinent facts is at hand. In every case which I have observed, the heavier the bird to a given surface the greater the ease with which it could maintain balance. A flock of buzzards gorged with food stands with far greater immobility in the wind than when hungry. A gannet, with its short, broad pinions, will stand in a breeze from which a buzzard will retire. The inertia of its heavy body seems to compensate for strokes of inconstant force. The buzzard, however, is steadier than a man-of-war bird. This latter fluctuates greatly with its long narrow wings. The power of translation is reversed in these cases. The buzzard can perform feats impossible to the gannet, while the man-of-war hawk far outdoes them all. I expect this rule to hold correspondingly good with an artificial device of 300 lb. or 400 lb. weight. It will travel the air with proportionate steadiness. It will not effect those surprising turns, nor those headlong divings through the air common to some birds; but when one reflects that the upper air fills space of three dimensions, while we on the surface of the earth are confined to two dimensions, it will be seen that an artificial device will have plenty of room to turn in without resorting to any violent disturbance.

The discussion going on in this paper has brought me several letters from residents in countries inhabited by the large vultures and the albatross, which I am very thankful to get. The observations of the writers upon these creatures show that they are no exception to the rule of greater steadiness with the heavier weights. Your correspondent's letter from Natal was also in point, and I read it with great interest.

Permit me a single further remark. The theory of flight, as I have stated it, was adopted because it explains every movement of soaring birds which I have ever observed. So far as I know, it explains every such movement which has been observed by others. Should any one point out a movement of these creatures which is antagonistic to that theory, I should feel as Professor Huxley would on finding a Centaur, and at once proceed to modify the theory to suit the new facts. It matters not how much things which are not soaring birds traverse the hypothesis. It applies o things which are soaring birds, and to mechanisms which effect results by utilising identical causes. I. Lancaster.

Chicago, Ill., July 9th.

ELEPHANT BOILERS.

Sir,—I have not the pleasure of the acquaintance of your correspondent, Mr. Smith, who takes upon himself to speak for the insurance companies, and contradicts my assertions that they—the companies—are not very particular as to what boilers they insure. He says the inspecting engineers and engineer's staff, &c., do not pass anything improper, &c. I never said they did, but I do say they are cognisant of improper boilers being insured, and it does not rest with the inspectors or the engineers of the company to accept boilers for insurance. Is it or is it not a fact that the companies are glad to insure any kind of boilers?—for that was my charge and I shall not run away from it. How many boilers are insured that have not been thoroughly examined? How many explosions have the companies had, and how many times have they been censured by coroners' juries for insuring boilers that were not sound when insured? Again, do the companies insure boilers at a rate that will not possibly pay for effectual and thorough inspection? And is their system anything less than a giving of a "false security" to boiler users who depend upon the reports and inspection of the engineering staff? They are utterly powerless to enforce inspection, and do not make thorough examination a condition of insurance. Moreover, they hinder and oppose inspection on its merits by allowing their agents to tour and scour the country from end to end, telling boiler users all sorts of tales in order to induce them to insure. I know this to my certain loss, however much your correspondent may be interested in contradicting me. He says insurance is "popular;" of course it is, and inspection is not popular, but positively disliked by the great majority. Nobody knows this better than the great "chief engineer" of a boiler insurance company, who left £500 a year, and the highest respectability, for £1000 a year, and less respectability.

Perhaps Mr. Smith will explain how these high salaries can be paid in addition to the salaries of the inspectors, secretaries, directors, &c. &c., and boilers properly and efficiently inspected and insured for a little over £1 per boiler per annum? Each inspector is supposed to make four quarterly visits, and one annual visit for thorough examination; but I say to Mr. Smith that he cannot and does not do anything of the kind.

The class of young men who accept of these sub-inspectorships do so, as a rule, only for a short time, just to run through the country and gain experience. Sometimes they relapse into vendors of boiler physic and all sorts of nostrums, and sometimes they meet with better and easier situations, and remain as agents to the company.

"Nothing succeeds like success," and because boiler insurance has in a great measure supplanted boiler inspection pure and simple, hence its "popularity" with the majority.

Ayrfield, Edgbaston, August 1st. John Swift.

P.S.—I do not say it is impossible that a boiler fifty years old—according to a correspondent in The Engineer this week—should be in a fit condition for insurance, but I think it is extremely improbable; and the fact of such a boiler having been insured goes far to prove my assertion—that the companies are not particular, but are glad to get any sort, &c.

PATENT LAW REFORM.

Sir,—The Patents for Inventions Bill, as amended by the Standing Committee on Trade, now lies before us, and I venture, with your permission, to make a few remarks on it before it has to be considered by the House of Commons.

While admitting that some commendable alterations have been effected, I think I may safely assert that all who have a practical experience of the working of the patent law—and outside the circle of patent agents I do not believe that there are many who are competent to judge of all requirements, although some inventors and some lawyers are capable of judging of some—that all such are dissatisfied with not a few sections of the Bill, both as to their substance and the vagueness of their form. As an example of the latter I would refer to Section 7, Sub-section 5, where an attempt is made to prevent two identical pending applications from being sealed without giving notice to the last applicant. Here it will be seen that no action can be taken unless the applications bear "the same or a similar title;" but it is obvious that the same subject may be covered by very dissimilar titles, and very dissimilar subjects may be covered by the same title; the wording of this section therefore requires to be altered.

Section 9, Sub-section 5, provides that reports of examiners shall not in any case be published; but this proviso is to a great extent neutralised by giving the Court power to allow public inspection. Heretofore a British patent covered, as a matter of course, the Channel Islands and the Isle of Man; but according to Section 16 this is not going to be so in future, but a special registration will be required in each of these places. I fail to see the necessity of this.

The term of a patent is to be fourteen years as now. In spite of Mr. Chamberlain's superior wisdom on this head, there is, I believe, a general consensus of opinion that the term is too short, and that it should be at least seventeen years, as in the United States. One may, generally speaking, wonder at the studied neglect as to imitating the good points in the American Patent Law, and the confident expressions of disapproval of that law as a whole, while it is a well-known fact that that law, on the whole, gives excellent satisfaction in the United States. Of course Mr. Chamberlain and others who have ventured to express such strong opinions must be supposed to know a great deal better than the United States public.

If I understand Section 25 aright, a company to whom a patent has been assigned cannot present a petition for extending the term of a patent while the patentee is alive, but it may be that the word patentee in this place includes assignee.

In Section 26, Sub-section 3, I would suggest that the grounds on which a patent may be repealed should be clearly enumerated. Although examination as to novelty has been given up, Section 33 provides that a patent shall be granted for one invention only. If this be carried out to the extent to which it is practised in the United States, there will be plenty of work for the poor examiner and for the patent agent, as the number of patents from this cause alone will be considerably increased. What guarantee have we against a perfect dead lock unless an efficient and sufficient staff of examiners be provided for in the Bill? We have of late years had quite enough of the cheeseparing, niggardly administrative policy of the Commissioners of Patents to trust to the new administrative body.

This leads me to Section 40, Sub-section 2, where this same niggardly and short-sighted policy is perpetuated by limiting the reprint of specifications to "all complete specifications of existing patents," which appears to exclude even the reprint of their provisional specifications. But I believe the least the public can demand is that all specifications for the last forty years, or, say, since 1852, should be reprinted as required.

In the second schedule the first of the so-called further fees is to be before the end of four years from date of patent. Now I believe this to be quite wrong. The sooner we know whether a patent is to be renewed or not the better, and with the number of patents increasing fourfold to tenfold, whatever it may be, the need for the thinning down of existing patents will be the greater. I am therefore of the decided opinion that there should be a renewal fee at a much earlier period than the fourth year, and that a £5 fee before the end of the second year would be advisable. As to requiring a £50 and a £100 stamp before the end of the fourth and the seventh year, I can only say that it is preposterous, for if, as is well understood, three or four patents, and sometimes a dozen patents will be required to cover the same as that which is covered by one patent now, I would ask Mr. Chamberlain and others concerned in framing this wonderful Bill, what claim it has to be considered a Liberal Bill or a poor man's Bill? Why, the cost of patents from this and other reasons will often be much higher than at present. I would suggest that the renewal fees at the end of the second, third, and fourth year should be £5 each, at the end of each of the four following years £10 each, and at the end of the four following £15 each, making a total of £120; or as a more rational manner of distributing the payments, I should propose a payment of £4 at end of second year, and adding £1 each year, which would give a total of £114. And this, I think, is higher than it ought to be; but when the statesmen in this country have not yet been able to relinquish the false idea of making the Patent-office an important source of revenue, one has, to a certain extent, to bow to it. For all that, I believe the principle is false, and that the progress of the United States is, to a great extent, due to the liberal assistance rendered to the inventor, while he in this country is mainly considered a good milch cow.

Fell. Inst. Patent Agents.

CONDENSING ENGINE AT THE R.A.S. SHOW.

Sir,—In your paper of last week, when speaking of the York Show, on the subject of a condensing engine exhibited by Messrs. Riches and Watts, you say, "We believe this is the first condensing engine shown at work at any of these shows." That remark may be strictly correct as far as the Royal Agricultural Society's Shows are concerned, but not quite so if account is taken of kindred shows. In 1856, at the Paris Exhibition, the late firm of Barrett, Exall, and Andrewes, of Reading, of which firm I was then engineer, exhibited a condensing engine at work, for which a medal was awarded. The engine atttracted considerable attention at the time amongst French engineers, and M. Cail, of the celebrated firm of Cail and Co., of Paris. requested permission to be allowed to make a sketch of the condenser. I did not think it necessary to give him that trouble, but supplied him with a tracing of the working drawing from which the condenser was constructed. John Pinchbeck.

Victoria-chambers, Victoria-street, S.W., August 1st.

TAKING THE SPEED OF TRAINS.

Sir,—I have just noticed in The Engineer of the 20th July your answer to "Express, Lincoln," as to a handy formula for speed of trains. I have used the following:—"Number of fish-plates passed in 14½ seconds = number of miles per hour." This is right I find for 21ft. rails. J. Armer.

Dartford Ironworks, Dartford, Kent, July 31st.

TENDERS.

NEW ROADS AND SEWERS AT HOYLAKE.

Tenders for the sewering, forming, and metalling of certain roads at Hoylake for the Wirral Rural Sanitary Authority. Mr. Charles H. Beloe, M. Inst. C.E., 13, Harrington-street, Liverpool, engineer. Quantities supplied.

	£	s.	d.
William Wilkinson and Co , Liverpool	6824	10	6
Thomas Cattrall and Co., Liverpool	6300	0	0
William Hayes, Bolton	6059	9	9
Peter Smith, Rusholme	5411	19	3
William Winnard, Wigan	5285	0	0
Taylor and Duckworth, Denton	5100	0	0
Jackson and Co., Neston	5045	0	0
Isaac Auwell, Liverpool	4616	11	1
Fawkes Bros , Southport	4592	10	9
James Nuttall, Bootle	4490	0	0
R. A. Aldred, Hoylake	4478	0	0
McCabe and Co , Liverpool	4375	0	0
Joseph Price, Great Meolse—accepted	3677	5	0
Engineer's estimate	4505	14	3

Launch of a Large Steamer in Hull.—On the 23rd ult., Mr. P. D. Garbutt launched from his yard on the Humber side the largest steamer yet owned in Hull. The ship, the Wolf Rock, is a sister ship to the Bell Rock, which is a steamer of 2409 tons net register. She is 3640 gross register; length 340ft. by 42ft. by 28ft. 3in. depth of hold; constructed under special survey 100 A at Lloyd's. She is to be propelled by a pair of compound inverted direct-acting screw engines, with cylinders 44in. and 84in. diameter respectively by 54in. length of stroke; steam supplied from two double-ended steel boilers 14ft. 9in. diameter by 18ft. long at 80 lb. working pressure. Machinery is also being made by Mr. Garbutt at his engine works; all similar to the Bass Rock and Bell Rock.

Society of Arts Conversazione.—The International Fisheries Exhibition and the pleasant gardens in which its courts and galleries stand were on the evening of the 25th ult. for the second time this season turned into the scene of a brilliant *fête*. The occasion was the reception, by Sir William Siemens, chairman of the Council, and the Council of members of the Society of Arts at a *conversazione*, and the president of the Society, his Royal Highness the Prince of Wales, accompanied by the Princess of Wales, the Hereditary Grand Duchess of Saxe-Meiningen, and Prince Christian, added by their presence to the interest of a gathering which will be a memorable one among the annual *soirées* of the Society. Over 6000 visitors accepted the invitation of the hosts of the evening. July weather happily permitted a promenade in the prettily illuminated grounds without positive discomfort, and visitors were able to give the scene the credit of being one of the brightest and prettiest ever produced on this side of the Channel. The exhibition buildings were especially decorated, the grounds were profusely lighted by Chinese and other lamps amongst the trees and along the borders, and the boats on the water were lighted oriental fashion, and added much to the beauty of a scene quite foreign to our shores. For the further entertainment of the company there were excellent military bands, the Thuringian, the Hungarian, the Grenadiers, and the Royal Artillery in the galleries and grounds. It was after midnight before the large assemblage dispersed.

RAILWAY MATTERS.

THE first section of the railway from Eagle Hawk to Mitiamo, Victoria, was opened in June.

THE average cost of repairs to passenger cars, per passenger carried per 100 miles, last year on the Philadelphia and Reading Railroad, is given as 17·6c.

THE contract has been signed at Quebec for constructing the Lake St. John Railway, the cost being stated to be between 3,000,000 and 4,000,000 dols.

THE general average mileage of the cars of the Philadelphia and Reading Company for 1882 was 8647 miles, the average load per eight-wheel car being 11·8 tons.

THE half-yearly report of the Belfast and Northern Counties Railway Company gives the total cost of locomotive power as £14,577 3s. 8d.; the cost of maintenance of way and works, £15,650 18s. 8d.; and the train mileage, 442,416.

WHILE the tickets of passengers by the Edinburgh train were being collected on Saturday morning at the platform a short distance from Perth general station, the Euston mail came up, and a collision of some violence occurred between the two trains. Twenty passengers were more or less injured.

ACCORDING to the half-yearly report of the London, Chatham, and Dover Company, the total cost for locomotive power for the half-year, including repairs, renewals, workshops, salaries, &c., was £72,183 10s., and the train mileage was 1,719,749. The cost of maintenance of way, works, &c., was £44,713 5s.

A SERIOUS accident occurred on the 28th ult. a short distance west of Rochester, on the Rhone, Watertown, and Ogdensburg Railway, U.S. A passenger train from Niagara Falls ran into a goods truck which had been propelled from a siding by the force of the wind, and was thrown off the rails by the collision. Fifteen passengers and four of the railway servants were killed, and thirty other persons were injured.

A SERIOUS tram-car accident occurred on Friday evening at Bradford. The steam car from Bradford to Thornbury by some means got off the rails in Leeds-road, and in getting it righted the car slipped, and rushed down the incline at a terrific speed. Near the bottom of Leeds-road it came into contact with several vehicles, smashing them to pieces, broke a horse's leg, and nearly killed the driver, who was taken to the infirmary.

AT departure of last mail the *Colonies and India* says there was much diversity of opinion as to the route to be followed by the main line of railway in the North Island, New Zealand, there being many who contended that it should follow a central course, alleging that the present proposal to follow the line of the West Coast is unsuited to a main trunk line, as it cannot positively tap the central districts. It is alleged, however, that to alter present arrangements, with which all at one time appeared to be satisfied, will greatly delay this very desirable work.

THE Glasgow *Weekly Mail* says:—"It is understood that the Town Council have resolved to raise an action in the Court of Session to compel the North British Railway Company to remove the ruins and *débris* of the old Tay Bridge before proceeding with the erection of the new one. The Council, in taking this step, are believed to be proceeding upon the opinion of eminent parliamentary and Scotch counsel as to their rights under the last Tay Bridge Act. The clause relating to the subject definitely states that the company are bound to remove the ruins and *débris* of the old Tay Bridge, and that the Town Council may force them by legal action to do this, but no time is stated within which the work shall be done."

MR. HOLROYD SMITH, Halifax, has made an electric tramcar which has lately been tried on a track laid in the grounds of Mr. L. J. Crossley's mansion at Moorside. The car, a small one, is made to carry four. The electric conductors are placed in a channel 8in. deep, placed along the centre of the track. A small trolly runs on the conductors inside the channel. It is supplied with collectors, and plates pass through the opening in the surface of the channel, and are connected by wires to the electric engine on the tramcar. The car is driven by a large wheel, with broad surface, running on the face of the mid-channel. The system is said to overcome several serious difficulties which have hitherto attended experiments of this kind, and important results are anticipated.

IN concluding their half-yearly "Engineering Trades' Report" Messrs. Matheson and Grant say:—"The outlook for engineers, and those engaged in the commerce they create, is, on the whole, a fair one if peace be maintained, notwithstanding the gloomy views concerning the future taken by those whose trade or profit is below its maximum. Whatever the immediate condition of affairs, it must be remembered that lack of profit is caused more by excessive competition at home than by a falling off in the demands from abroad. The world has many corners yet unfilled. In the Colonies every mile of railway opens out new fields for enterprise; in China, whatever the dislike of the authorities, military and other necessities will lead to railways and telegraphs ere long, and after them to every kind of mechanical improvement; in Mexico, diplomatic relations with this country are being re-established, and so long as that country keeps clear of the tariff fetters of the United States, we must supply the bulk of her needs; in the East, the completion of the Caucasian Railway to the Caspian has made a road into Central Asia, which must either benefit us as well as Russia, or lead to our making competitive routes. There is much to be done, and engineers may fairly hope for a share in the work."

THE following is a summary of the newly-issued railway returns for the past year. The increase on the capital expenditure during the twelve months was £22,371,408, as compared with an increase of £17,211,314 in the previous twelve months; but a considerable portion of last year's growth is nominal, only being due to the consolidation of the stocks of some of the companies. The net earnings per mile show a considerable increase over those of the previous year, while the expenditure marks only a comparative slight augmentation, there being, consequently, a considerably larger balance of net earnings left. As, however, the larger net income had to be spread over a larger capital, there is but a very small increase in the percentage of net receipts to paid-up capital:—

	1882.	1881.	Increase in 1882. Amount.
Mileage	18,475	18,275	282
Double or more mileage ..	10,044	9,872	171
	£	£	£
Capital	767,899,570	745,528,162	22,571,408
Capital per mile open	41,605	41,019	586
Ordinary capital	283,574,028	275,935,904	8,638,124
Receipts—			
Passenger..	28,796,813	27,461,645	1,335,168
Goods	37,740,315	36,466,592	1,293,723
Miscellaneous..	2,839,996	2,649,205	190,791
Total receipts	69,377,124	66,557,442	2,809,682
Working expenditure	36,170,436	34,602,616	1,567,820
Net earnings	33,206,688	31,954,826	1,251,862
	d.	d.	d.
Receipts per train mile from passenger and goods traffic	64·52	61·75	2·77
Expenditure per train, exclusive of harbour, &c., expenses	32·47	32·28	0·19
Net earnings per train mile.	32·05	29·47	2·58
Percentage of net receipts to paid-up capital	4·32	4·29	0·03

NOTES AND MEMORANDA.

FOR cementing rubber or gutta-percha to metal Mr. Moritz Grossman, in his "Year Book" for 1883, gives the following recipe:—Pulverised shellac, dissolved in ten times its weight of pure ammonia. In three days the mixture will be of the required consistency. The ammonia penetrates the rubber, and enables the shellac to take a firm hold, but as it all evaporates in time, the rubber is immovably fastened to the metal, and neither gas nor water will remove it.

TAKING the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies and by the Tottenham Local Board of Health during June was:—Colne Valley, 1·1; Kent, 1·1; New River, 1·3; East London, 1·9; West Middlesex, 2·2; Tottenham, 2·3; Chelsea, 2·4; Grand Junction, 2·4; Lambeth, 2·6; Southwark, 2·7.

M. MERMET has recommended in the "Chronique Industrielle" the use of nickel crucibles instead of silver, in chemical manipulations. They are slightly attacked, it is true, by melted potash, but silver itself is not indifferent to this action. They cost at first much less than silver, and, moreover, they have the great advantage of melting at a higher temperature. It often happens, in fact, that inexperienced chemists melt their silver crucibles in heating them over a gas lamp; such an accident is not to be feared with nickel crucibles.

M. TRESCA has reported to the French Academy some experiments by Selim Lemström upon the causes of terrestrial magnetism. He used a paper tube with two concentric walls, rotating rapidly around a cylinder of soft iron, and his results confirmed the theories of Edlund and Chase, which explain magnetic effects by æthereal movements. The "Journal" of the Franklin Institute says the experiments were substantially the same as those which were performed by Chase in 1864 and 1865, and reported in the ninth and tenth volumes of the Proceedings of the American Philosophical Society.

M. AZAPIS substitutes in his battery for the acidulated water, usually used in the Bunsen form, a solution of about 15 per cent. of cyanide of potassium, caustic potash, common salt, or sal ammoniac. The liquid in the porous vase which receives the carbon is common nitric acid, the same as in the Bunsen cell. The intensity is equal to Bunsen's; the zinc does not need amalgamating; the constancy is greater; the waste of zinc is less, and there is very little smell. A battery of twenty-five elements was used for four days without disturbing the mounting, and was employed every evening to produce electric light.

THE soap-bubble colours upon glass are produced by a vapour, which is deposited on the hot glass before it goes into the annealing oven. According to the *Bulletin de la Société d'Encouragement* the vapour comes from a mixture of protochloride of tin, carbonate of baryta, and carbonate of strontia. It is said that the workmen of a Bohemian manufacturer, wishing to celebrate his arrival, kindled some Bengal lights in the annealing furnaces, and the pieces which were in the furnaces all became iridescent. The colours can be removed by hard rubbing. Messrs. Clémandot and Fremy produced a pearly lustre, like that of shells, by means of different chemical agents, chlorhydric acid among others, under pressures of four, five, or six atmospheres.

IF A designates the lowering of the point of congelation due to the presence of one part of any soluble substance in 100 parts of the solvent; M, the molecular weight of the dissolved substance; T, the lowering of the point of congelation by a dissolved molecule; F. M. Rault finds, as described in the *Comptes Rendus*, that M A = T. From his experiments he derived the following conclusions. Every body, when dissolved in a liquid which is capable of solidification, lowers the point of congelation. In all liquids, the molecular reductions of congelation which are due to different compounds approximate to two values, invariable for each liquid, of which one is double the other. The normal molecular reduction of congelation varies with the nature of the solvent. A molecule of any compound, on being dissolved in 100 molecules of any liquid, lowers the point of congelation by the nearly constant quantity 0·62 deg.—1·12 deg. F.

THE report on the organic matter in the water supplied to London by the various water companies during the month of June, 1883, as sent to the Local Government Board and Metropolitan vestries, by Professor Wanklyn and W. J. Cooper, gives the following as the quantities, expressed in parts per million, of albuminoid ammonia, the worst impurity, in the water of the different companies:—Chelsea, ·04; West Middlesex, ·06; Southwark and Vauxhall, ·06; Grand Junction, ·05; Lambeth, ·03; New River, ·02; East London, ·06; Kent, ·02. The worst contain but one-sixteen million six hundred and sixty-six thousand-six hundred and sixty-sixth—that is, $\frac{1}{16666666}$—or there is one ounce of it in four hundred and sixty-five (465) tons. There is one ounce of it in the water, which a tank 2ft. deep, 100ft. long, and 83ft. 7in. wide would hold if quite full. The Lambeth Company's water contained more organic nitrogen than any other.

IN 1871 the total population of the seven Australasian colonies—which include the five Australian colonies, viz., Victoria, New South Wales, Queensland, South Australia, and West Australia, and the colonies of Tasmania and New Zealand—was only 1,978,740. In 1881 the total population was 2,835,954, showing an increase in ten years of 857,206, or an average of 85·7 per cent. Ten years ago the combined exports of the same colonies amounted to approximately £67,000,000, and in 1881, to £105,000,000, showing an advance of more than 50 per cent. This is equal to about £38 per head of population. The public revenue of the seven colonies during the year 1881 amounted to about £21,000,000, against £18,000,000 in 1880, being an increase of £3,000,000. The colonies possess 5426 miles of railway, 49,105 miles of telegraph, 78,000,000 sheep—the wool clip of which last year realised the sum of about £21,000,000—besides 8,691,910 cattle, and several millions of horses and pigs. During the year 1881, 16,690 vessels, of an aggregate tonnage of 9,504,130, touched at the various ports of the colonies. The same colonies have 7,017,380 acres of land under profitable cultivation, and produce annually about 30,000,000 bushels of wheat, and 11,717,819 bushels of oats. Of these latter New Zealand alone produces 6,924,848 bushels.

M. TRESCA has made experiments on dynamo-electric efficiency with Deprez's machines, and has given the value of the well-known but unexplained loss of work. This loss has been attributed to different causes. Joubert thinks that the following is the most important. All machines with continuous currents are composed of a certain number of elements, such as the strands of the Gramme ring, which, when the machines act as a receiver, pass from a position in which the potential energy has a maximum value W_0, to another, diametrically opposite, of minimum value W_1. The difference $W_0—W_1$, represents the electro-magnetic work furnished by the strand in passing from the first position to the second. In order that the movement may continue, it is necessary to reverse the direction of the current in the strand, or, in other words, to destroy the electric energy which it possesses, and restore the primitive energy W_0. This operation is repeated twice in each revolution for each strand. It is known, experimentally, that in the receiving machine the change of current must be made before the strand passes the line of the poles. The position of the commutator is given analytically by the condition that the electro-magnetic work, $W_0—W_1$, must be a maximum. Like considerations may be applied to the machine when working as a generator. All the coefficients which enter into the equations can be determined directly. The "Journal" of the Franklin Institute remarks that Chase's discovery that the work of gravitation, at sun's surface, during a half rotation, gives the velocity of light, and Webber's electro-magnetic ratio, lend additional interest to this theory.

MISCELLANEA.

THE number of visitors to the Fisheries Exhibition on Saturday was 26,351, making a total for last week of 103,934.

THE managing committee of the International Electric Exhibition has now fixed the ceremony for August 16th.

THE "Journal" of the Lifeboat Institution for August contains a long article on the effect of oil in breaking waves and coast surf, or rather the effect of oil in preventing the breaking of waves, and gives some remarkable evidence of its apparent value.

THE total number of visitors to the Fisheries Exhibition reache 1,000,000 during the course of Tuesday, the last day of July, that is to say, within sixty-eight days of the opening on Whit Monday. This gives an average of about 14,700 visitors per diem. The two largest days were Whit Monday and Tuesday, with 42,941 and 29,446 visitors respectively.

AT a recent meeting in Paris of the general council of the Seine department, a proposal was agreed to for a metropolitan railway to serve the city of Paris and the neighbouring communes. According to the official memorandum on the subject, the Prefect of the Seine is invited to have completed the necessary engineering investigations relating to the proposed railway, particularly as to its suburban branches, the principle being laid down that no new development of the urban metropolitan system is to be undertaken unless the departmental suburban lines are commenced at the same time. The *Chemin de fer de l'Ouest* is to be obliged to commence the Moulineaux line for which it has a concession, or to give up its rights. The bridge over the Seine at Puteaux is to be so constructed that persons on foot and in carriages can use it.

THE Committee of the House of Commons appointed to consider the merits of the Electric Lighting Provisional Order Bills has concluded its labours. On Monday it decided to pass the Edison Order for the lighting of the parish of St. James, Westminster, on condition that the Order is extended so as to include the lighting of the whole of the parishes of St. Martin-in-the-Fields and St. Paul's, Covent-garden. The Committee also passed the Swan Order for the lighting of the Strand district, subject to the alterations made in the Edison Order, and the Victoria District Order, on condition that the Swan Company shall strike out everything relating to the district of the Westminster Board of Works. On Tuesday the Committee passed the Bill confirming an Order granted to the Swan United Electric Lighting Company, empowering them to light by electricity the district of South Kensington. The only alteration made in this Bill was the striking out of a small portion of the district which is under the control of the Westminster Board of Works.

THE twenty-fourth annual congress of the Society of German Engineers will be held at Dortmund on the 13th to the 16th prox. According to the programme the first three days of the meeting will be devoted to the business proceedings, varied by excursions and festivities in or near Dortmund itself. On the last day of the meeting there will be two separate excursions to a distance, one to Bochum and Dahlhausen, and the other to Witten and Wetter, winding up with a concluding reunion at the ruins of Hohensyburg. Amongst the papers and subjects of discussion contained in the programme are the following:—"The Development of Agricultural Machinery in England," by Herr Max Eyth; "Differences of Principle in the Arrangement of English and of German Smelting Works," by Herr F. W. Lurmann; "The Future of Electrical Transmission of Power in Mining," by Professor W. Schulz; "The Present Tendency of the Theory of the Steam Engine and its Experimental Proof," by Herr E. Brauer; "The Coal Industry in the Basin of the Ruhr," by Herr F. Peters; and "The Ironworks or Smelting Industry of Westphalia," by Herr W. Brugmann.

AN important meeting of the directors of the principal steamship insurance companies in the North of England was held last week at Newcastle, to take into consideration the report of a subcommittee which was recently appointed to investigate sundry allegations of unfair dealing by some of the shipowners in that district. These gentlemen, it appears, have been in the habit of receiving large discounts off their repairing accounts without placing them to the credit of the insurance companies, who in this manner have, in the single case under consideration, been bled to the extent of several thousand pounds. It is stated that the shipowners offered a sum of no less than £10,000 to settle the matter; this, however, has not been accepted, and at the meeting it was unanimously agreed that the steamers belonging to the firm in question should not be insured any longer in the various societies which were there represented. We understand that several other cases of a similar character are now under investigation, while strict inquiries are being made in certain quarters where dealings of the same kind are suspected.

IN his report on the London Water Supply during June Colonel F. Bolton says:—"It appears to be the rule in building a certain class of houses to place the cistern over the water-closet with an untrapped waste pipe communicating with the drains. Cisterns and water-butts are in many instances left open and regularly receive the drippings from the roofs and gutters, may be seen without lids, full of rank and decaying vegetation, which on closer examination would show more or less organic deposit, and under the microscope would be found to abound in infusorial life. They are often in close proximity to the dust-bins and other deposits of filth and garbage, while children amuse themselves by throwing all sorts of dirty rubbish into the water. The purest water in England would be poisoned by such a system of storage. A remedy for this state of affairs will be found in the establishment of the constant supply and the consequent total abolition of the intermittent system; meanwhile, and until this constant supply is completed, the owners and occupiers of houses are highly culpable in permitting such a disgraceful condition of things to exist. In the better class of houses and in many public buildings the cleansing of cisterns and tanks—often placed in positions extremely difficult of access—is frequently neglected for months, and, in some cases, years are permitted to pass without any examination or cleansing taking place. All cisterns and other receptacles should be frequently cleaned out, and every care should be taken to prevent the contamination of the domestic supply after delivery.

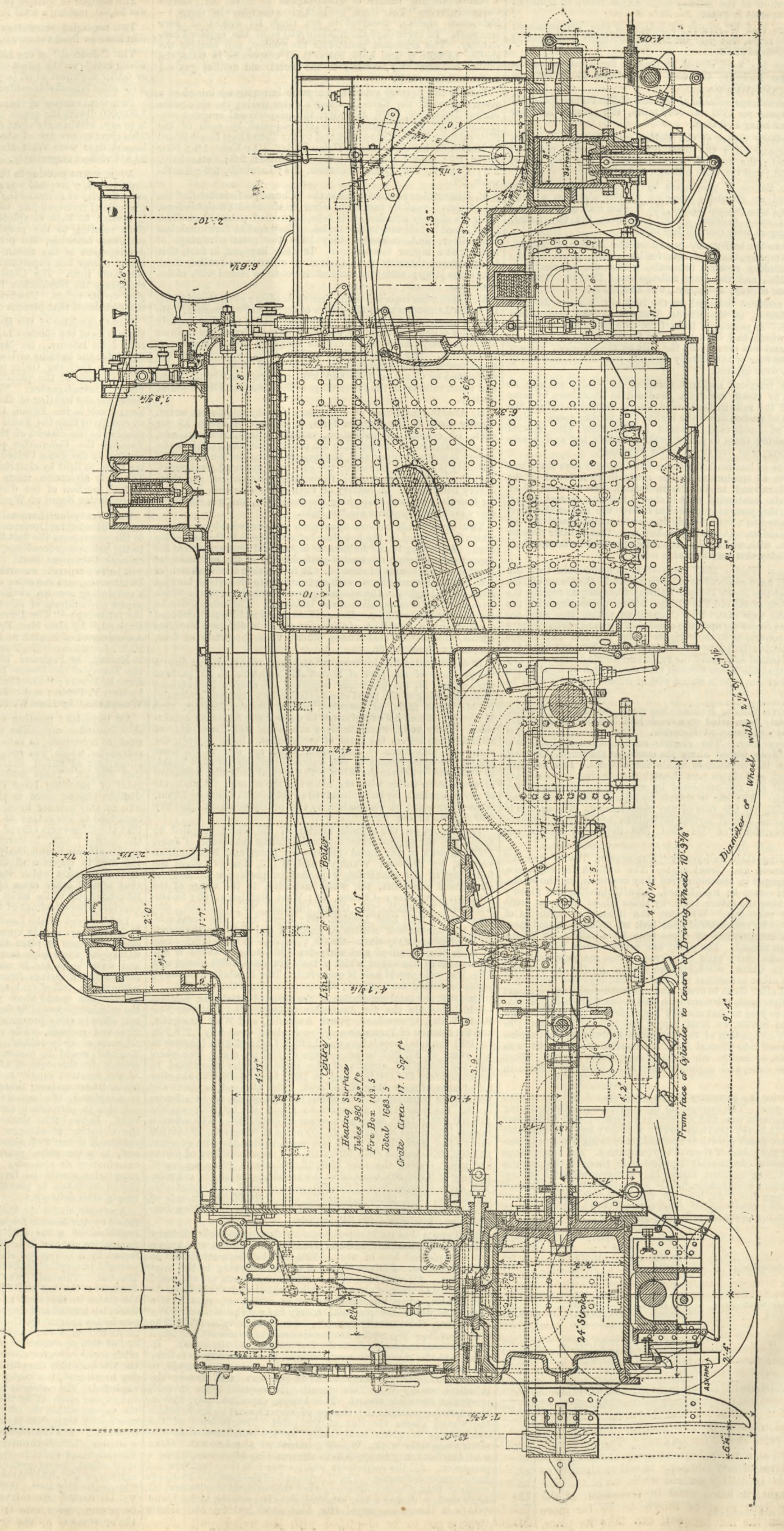
A REPORT, under the Boiler Explosions Act, 1882, has been published by the Marine Department of the Board of Trade on the explosion of a tar still at Steanor Bottom Chemical Works, Lancashire, on the 19th June. The exploded sill, shown in the report by a lithograph sheet big enough for ten such stills, was a wrought iron cylindrical vessel, set above a fire-grate 4ft. 6in. by 2ft. 6in. This still was 12ft. 3in. in height by about 8ft. in diameter; the top and the bottom were dished. The whole of the plates in the shell and the ends were originally about $\frac{7}{16}$in. thick, lap jointed and single rivetted, with $\frac{3}{4}$in. rivets, pitched about two inches apart. On the side of the sill, and within a few inches of its bottom, a 4in. emptying pipe and cock were fitted, the outer end of this pipe terminated in an old cylindrical boiler, used as a pitch cooler, situated about 10ft. in front of, and about 6ft. below, the site on which the still had been erected. In the night of the day mentioned, the works were found to be on fire, and the still exploded. The owner and the manager of the works believe that the vapour given off by the hot pitch had ignited, and set fire to the vapour within the emptying pipe, which instantaneously communicated with that remaining in the still, and thus caused the explosion. The report, by Mr. J. Ramsay, concurs with this view, and adds, "No doubt after the completion of the process of distillation there would be vapour left within the still, which, as the still cooled, would gradually condense, and thus induce an incurrent of air, either through the vapour pipe in connection with the condensing worm, or through the emptying cock, or by both. The air flowing into the still would become diffused through the remaining vapour forming a compound, which would explode on the approach of a flame to it with more or less violence."

COMPOUND LOCOMOTIVE LONDON AND NORTH WESTERN RAILWAY

SECTION THROUGH LOW PRESSURE CYLINDER.

MR. FRANCIS W. WEBB, ENGINEER.

(For description see page 97.)



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BOTTLE-MAKING MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Will any of your correspondents kindly favour us with the names of makers of bottle-making machinery? BOTTLES.

Lincoln July 31st.

THE STEAMSHIP MONA'S ISLE.

(*To the Editor of The Engineer.*)

SIR,—Would any of your readers who know anything about the above steamer, belonging to the Isle of Man Steamship Company, give me particulars about her dimensions and speed on trial; also her fastest passage?

Dublin, July 29th. J. G. B.

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THE ENGINEER.

AUGUST 3, 1883.

THE ELECTRIC LIGHTING PROVISIONAL ORDERS.

THE Parliamentary work in connection with electric lighting drags its slow length along, till but recently giving a sign as to when a definite settlement might be reached. Theoretically, every one agrees that no hindrance should be made to progress in a matter which so deeply affects the public interest; but whilst there is this agreement in the abstract, there is much disagreement as to the right or best mode of progress, and this, if not actually in opposition to progress, is at least equally obstructive to it. The *argumentum ad hominem* is really a power in the world's affairs. No one is sufficiently unselfish to accept the mere word of another in matters concerning progress, and it is this fact that introduces a preliminary difficulty in all such questions. Telegraphy and telephony never had to encounter one tithe of the opposition that has been brought to bear against the electric light. We ought to have learned from past history of progress in the practical application of science, to see that the first indication of real progress has in this case been satisfactorily made. The light is admitted even by its opponents to be better than any other artificial light. Its introduction upon a large scale is opposed on the one hand because risk against momentary failure cannot be guaranteed. This argument is unsound, for no light can be guaranteed against failure. The introduction is opposed on the other hand because of the cost. Now, in reality, cost enters to a very small extent into the question. In the case of the electric light there is opposition because of cost between competing firms. It is undoubtedly in the interest of the public that a minimum price should not be fixed. The maximum price may be fixed at a fairly high rate—in the assurance that it is the interest of any company to sell as cheaply as possible—and this is doubly assured when, as in the case of the electric light, it has a rival in possession of the field. The new light must be shown to be far more advantageous than the old before it can take its place. The supporters of electric lighting, we should imagine, look more to its indirect advantages than to its cost for its introduction. Still, in the question of cost, there ought to be a rule that prices charged should be diminished *pro rata* to dividends paid. We will not venture to prophecy, but the indications tend strongly in the direction that if the Provisional Orders can be delayed over this session, they may have to wait an indefinite period before becoming law. Although some are passed by the Committee, they have yet to be confirmed. Briefly we may summarise the present position. An Electric Lighting Act has been passed, Provisional Orders have been applied for, and, if granted, promise of trial on a large scale is guaranteed. The Orders are opposed from the standpoints of imperfection, cost, and monopoly. The two former we have noticed; the latter is a bugbear, introduced more directly by competing companies. Thus one company makes plans, and applies for Provisional Orders to light a given district; another company, new or old, determines to claim a part or the whole of this district, and then comes the rivalry. We do not think this question should for a moment be considered. If it is, the Orders may never be granted, for at the last moment a new company may spring into existence, and oppose the older companies. There are some things which must necessarily partake of the nature of monopolies, such, for example, as gas lighting in small towns, telephony in small towns, &c. We can understand two or three gas companies or electric light companies in such cities as London, but even here they restrict their work to special districts, and are practically monopolies in their districts. It is therefore the duty of all interested in the progress of the world to find arguments in support of rather than in opposition to all suggested improvements. The greatest danger is not in the support of a project that is theoretically sound, but in its opposition.

Thus far we have only looked at this question from the standpoint of those who wish to see progress made in this matter, but it will be well to briefly discuss the arguments laid before the Select Committee by the opponents to the special Orders under their consideration. The Westminster Board of Works prefer to let well alone. The lighting by means of gas is fairly satisfactory; then why interfere with it? and so far this policy has been successful, and that part of the Swan Order dealing with the district under this authority is to be left out. The question of the maximum price per unit to be charged under these Orders was well discussed, and in the case of the Edison Order was reduced from 9d. to 8d., the latter price being also the maximum of the Swan Orders. Multiplying the price per unit by ten, we get about the equivalent cost of gas per 1000 cubic feet. Thus, the maximum price to be charged is equivalent to gas at 6s. 8d. The Telegraph Construction and Maintenance Company say this is too high, and would undertake to produce at a maximum of 6d.; that is equivalent to gas at 5s. The companies argue that this maximum is obtained only as a precautionary measure, and there is no intention of charging anything like the maximum. The tendency in such cases, however, is to charge as high as one can. A good deal of evidence was given upon questions which only experience can determine. Thus, Mr. Gordon maintained on the one hand that by using his large alternate current machines a great saving would be effected in wages, while, on the other hand, it was pointed out that the use of such machines would increase the cost of the mains, a cost which forms one of the principal items of expenditure.

Now, although arguments as to cost, experience, &c., may have been put forward, they have not really constituted the groundwork to the opposition of these Orders. Let us put the matter plainly, perhaps bluntly. A happens to be a company in a position to apply early for an Order, and chooses the very best district that can be selected. B happens to be in such a position that an early Order cannot be applied for, yet before A can get the Order B is in a position to apply. Of course B wants to get into the best district, and opposes A's application. If the Order can be postponed the clauses are in B's favour, for he affirms his ability to do the work cheaper than A, yet he knows that if A obtains the Order and does the work satisfactorily the result will be practically a monopoly, and there will be no chance of B doing business in the district. The questions of cost, of improvements, of systems, will be solved by experience, but there must be a beginning. Shall we wait till every one is satisfied—if such a thing is possible—or shall an attempt be made to test the value of the new system of lighting upon a fairly practical scale? There is a good deal of truth in the arguments against the granting of Orders; but the desirability of action seems to outweigh all that can be put forward against them. One objection must, however, be borne in mind—it is that most Orders describe two areas, a comparatively small one A, and a larger encircling one B. The smaller is, of course, the choice position, and is to be lighted at once; the larger may or may not be lighted, according to the results obtained from A. Thus, if the proceeds from A are only barely satisfactory, there will be no energy thrown into the extension of the lighting, and B being the poorer district may be thrown over altogether, although the householders would like to have the light. Altogether, we think the Committee has taken the wisest course in passing the Orders, and thus giving facilities for a systematic trial of the light.

THE INVENTOR OF GAS LIGHTING.

AMONGST the public benefactors whose services have received scant recognition, we must assuredly reckon William Murdock, the introducer of gas-lighting. The erection of a statue to commemorate his valuable services was proposed by Mr. James M'Gilchrist, of the Corporation Gasworks, Dumbarton, in his address at the annual meeting of the North British Association of Gas Managers at Edinburgh in the autumn of the year 1881, but so far as we are aware no definite steps were taken to carry out the suggestion. The question has been revived during the last few days in the columns of the *Standard* by Mr. M. Macfie, who is not to be identified with the well-known opponent of patents. It appears that the house at Handsworth, near Birmingham, in which Murdock lived for so many years, and where he died, is threatened with destruction by the builders of "desirable villa residences," and Mr. Macfie proposes that the house and a portion of the grounds should be purchased for the formation of an International Gas Museum. The project does not present itself to our minds as very feasible, and the house is situated in a remote suburb, a considerable distance from the centre of the town of Birmingham. On purely antiquarian grounds it is a matter for regret that interesting landmarks should be obliterated, but we fear that it is inevitable. Soho disappeared long ago, in part, at least, though the foundry still remains.

A brisk correspondence and a leading article followed the publication of Mr. Macfie's letter, which was also reproduced by the *Birmingham Daily Post*, in the course of which the depths of public ignorance as regards Murdock's work were revealed in a remarkable way. At the very outset there arose a controversy as to the mode of spelling his name, some persons insisting upon calling him "Murdoch," the leader-writer who followed this spelling even going a step further, and calling him Robert, whereas his Christian name was William. Here he was misled by the *Encyclopædia Britannica*, a work which is generally to be relied upon where the honour of Scotchmen is in question. In spite of the fact that the name is more often spelt with a final "h" than with a "k," there is no manner of doubt that the latter is correct. The inventor wrote himself "Murdock" in all the patents which he took out, and it is so on the tablet in Handsworth Church, where he is buried. Mr. Buckle, who knew him well, calls him Murdock in the memoir which he contributed to the "Proceedings of the Institution of Mechanical Engineers" in 1850, and lastly, his name appears in the same form in the "Lives of Boulton and Watt." Judging from the tone of some of the Scotch correspondents, it would appear to be something approaching an outrage to spell the name with anything but an "h," that being the traditional form in Scotland, the "k" having been substituted in deference to the English pronunciation. One member of the "clan" or "sept," or whatever it is called, went so far as to quote a passage from Dr. Smiles's book, deliberately altering the spelling to suit his own views. But then this gentleman—a Mr. Robert H. Murdoch—thinks that Boulton and Watt's manufactory was in London—probably in the neighbourhood of "Soho" Square.

Our knowledge of Murdock's contributions to gas-lighting is almost entirely derived from his paper read before the Royal Society on the 25th of February, 1808—but probably written in the previous year—and published in the "Philosophical Transactions," vol. 98, p. 124. It was about the year 1792, when residing at Redruth as Boulton and Watt's representative, that Murdock first commenced his experiments "upon the quantities and qualities of the gases produced by distillation from different mineral and vegetable substances." They were so far successful that he was able to light his house at Redruth, and Mr. Francis Trevethick, writing in 1872, says "those still live who saw the gas pipes conveying gas from the retort in the little yard to near the ceiling of the room just over the table; a hole for the pipe was made in the window frame." His apparatus "consisted of an iron retort, with tinned copper, and iron tubes, through which the gas was conducted to a considerable distance; and there, as well as at intermediate points, was burned through apertures of varied forms and dimensions. The experiments were made upon coal of different qualities, which I procured from distant parts of the kingdom, for the purpose of ascertaining which would give the most economical results. The gas was also washed with water, and other means were employed to purify it. In the year 1798 I removed from Cornwall to Messrs. Boulton, Watt, and Co.'s works for the manufactory of steam engines at the Soho Foundry, and there I constructed an apparatus upon a larger scale, which during many successive nights was applied to the lighting of their principal building, and various new methods were practised of washing and purifying the gas. These experiments were continued with some interruptions until the Peace of 1802, when a public display of this light was made by me in the illumination of Mr. Boulton's manufactory at Soho upon that occasion. Since that period I have, under the sanction of Messrs. Boulton, Watt, and Co., extended the apparatus at Soho Foundry, so as to give light to all the principal shops, where it is in regular use, to the exclusion of other artificial lights." The paper also contains details of the lighting of Messrs. Phillips and Lee's cotton mill at Manchester, to describe which was in fact the main object of the memoir. The work was commenced in 1805 with two rooms of the mill, the counting-houses, and Mr. Lee's residence, from which it was by degrees extended through the whole manufactory. Eventually 271 argand burners and 633 "cockspurs" were fixed, "several miles" of piping being required for supplying the gas. The apparatus for making the gas is not described except in very general terms. It appears from evidence given by James Watt, jun., before a Parliamentary Committee, that Boulton and Watt had expended between four and five thousand pounds in experiments before commencing to manufacture gas-making plant.

Although we give to Murdock the sole credit for the practical introduction of gas-lighting, it may perhaps be as well to point out that the inflammable nature of the gas produced during the destructive distillation of coal had long been known. It is hardly necessary to particularise the experiments which had been made before his time, as they are to be found in nearly all the histories of the subject. We must, however, refer to those of a Mr. Diller, who about the year 1784 went about the country exhibiting what he called his "Philosophical Fireworks," which were said to be produced by the combustion of jets of coal gas, though upon whose authority this explanation rests we know not. The date just given is taken from Matthews's valuable "Historical Sketch of Gas-lighting," but as we like to be precise, we quote from an advertisement in the *Birmingham Gazette* of the 25th of May, 1789, which is given in Mr. Langford's "Century of Birmingham Life," vol. 1 p. 399. "At the New-street Theatre, on Friday next, the 29th of May inst., will be displayed the grand exhibition of the newly-invented philosophical fireworks—produced from inflammable air—being the invention of the late ingenious Mr. Diller, and performed by Mr. Pitt, and Mr. Adams—pupils of the late Mr. Diller—who experienced so much of the public's patronage during its exhibition at the Lyceum, London, which comprise the following pieces:—A fixed flower, a sun turning round, varying in figure; a star, varying; a triangle, a dragon pursuing a serpent, a star of knighthood, *a flame proper for lighthouses, to the splendour and brilliancy of which the rays of one hundred patent lamps collected in the same focus would be much inferior;* a central piece that undergoes 120 changes of figure, and produces several thousand flames, &c." We have ventured to italicise the above passage for the special benefit of the Elder Brethren of the Trinity House. In the *Gazette* of the 1st of June there is an extremely laudatory notice, stating that "the beauty and vividness of the various colours of fire could not be exceeded. The variety of forms which the works assumed and represented astonished every beholder, and raised the highest ideas of the mechanical and philosophical talents of that man who invented the complex machinery which produces such delightful effects." Making every allowance for the reporter's exaggeration, there remains enough to prove that the exhibition was of a remarkable character.

Statements have also been made in the "Encyclopædia Britannica" and other works that the Earl of Dundonald, during his experiments for producing tar by the distillation of coal, lit up Culross Abbey with gas about the year 1787. At first sight this looks like an anticipation of Murdock's work, but on investigation it appears that no pipes were used. This was made clear by a Mr. Hart, who carefully examined the Abbey when it was unroofed and in a state of ruin. By dint of questioning the old people about the place, he ascertained that the workmen were in the habit of kindling the gas as it issued from the tar-ovens for the purpose of lighting them when at work in the night. The Earl of Dundonald occasionally burned gas in the Abbey as a curiosity, especially when he had company. A vessel something like a large tea-urn was filled with gas at the ovens and carried into the house, the gas being allowed to flow out of a jet attached for the purpose. This is stated to have been about "ten or twelve years prior to Mr. Murdock's discoveries." The foregoing is taken from a discussion at the Glasgow Philosophical Society, following the reading of a paper "On Gas-lighting" by Dr. Thomas Thomson. Mr. Hart's statement is reported in the *Mechanics' Magazine* for June 15th, 1844.

It will not be necessary to allude to Winsor's labours, because they are confessedly of later date than those of Murdock. He was not an inventor in the highest sense of the word, and some of his patents show that he was either profoundly ignorant of the properties of coal gas, or he was a quack. A person who professed to render coal gas "fit for human respiration when diluted with atmospheric air" is not entitled to the least respect as a man of science. He did good service, however, by drawing attention to the advantages of the new source of light by public lectures and demonstrations, but his pretentious circulars and his extravagant promises of fabulous dividends probably retarded the formation of the company which he so ardently promoted during many years. He began his lectures at the Lyceum Theatre, about 1803, and his first patent is dated 1804. The French accuse him of having got his ideas from Lebon, whose work we shall presently allude to. There is probably some truth in this, as the retort described in his patent of 1809 is on the very same principle as Lebon's, the source of heat being in the centre of the matters to be carbonised. Indeed, Winsor himself confesses that he offered Lebon 100 louis d'or for a model of his stove, but in vain. He seems to have occupied the same position with regard to gas-lighting as certain persons at the present day do with regard to electric lighting.

It is almost needless to say that the French are not disposed to admit Murdock's claims, one well-known writer on popular science, M. Edouard Fournier, refusing in his work, *Le Vieux-Neuf*, to know anything about him until 1810. The case of Philippe Lebon, the French candidate, has been absurdly exaggerated on the one hand and unfairly depreciated on the other, mainly because neither party would take the trouble to read the specification of his patent, which bears date September 28th, 1799. The title is, "New methods of employing combustibles more usefully, either for heat, light, or for collecting the various products." It is quite evident that the production of gas for illumination was not the leading idea present in the inventor's mind. We should be the last to attempt to weaken an inventor's claim because the official index-makers failed to apprehend the real nature of his invention; but it is not a little singular that Lebon's patent nowhere appears in the indexes under the head of "gas" or "lighting," but only under "thermo-lamp." One of these indexes was published as recently as 1843. The patent is, in fact, for a retort furnace in which the usual arrangement is reversed, the fuel being burnt inside the retort, the matters to be carbonised surrounding it on all sides. The principle may be roughly illustrated by supposing a red-hot poker to be thrust into the centre of a mass of coal. A pipe is provided for carrying off the products of distillation, but there is not a single word about using the gases evolved for illuminating purposes. No particular fuel is mentioned, but a foot-note says that "wood, coal, oils, roots, grease, and other combustible matters," may be employed. A certificate of addition was granted on April 25th, 1801, when the inventor's ideas appear to have become a little more definite. The main feature of the addition consists, however, of a gas engine, which is worth attention, but not in connection with our present subject. A ventilating gas lamp, in which the products of combustion are carried off by a special pipe, is also described. Wood is throughout spoken of as the material to be used for producing the gas, which may be purified by passing it through liquids. A special arrangement for exposing a large surface to the liquid is described. The specification is exceedingly vague on the points where it ought to have been most distinct. On the whole it totally fails to support Lebon's claims to priority as regards Murdock. Lebon used gas for lighting his house and gardens in November, 1801, and perhaps a little earlier.

We would gladly have touched upon some of the details connected with gas illumination, including the early difficulties with regard to pipes, burners, and fittings. This is a branch of the subject which has never, so far as we are aware, been adequately dealt with. Our object, however, was to show that to William Murdock, and to him alone, belongs the credit of making gas lighting a practical reality. His pressing occupations at Soho compelled him to abandon his offspring while in its infancy; but it fell into good hands and grew apace. It does not come within the scope of this article to speak of its numerous foster-fathers, many of whom were exceedingly able men; we have simply endeavoured to establish its paternity.

EXPLOSION OF A COMPRESSED AIR RECEIVER.

A REPORT on a somewhat remarkable explosion has been made to the Board of Trade by Mr. T. J. Richards, one of the engineer surveyors to the Board. It relates to the explosion of an air receiver at the Ryhope Colliery, Sunderland, on the 1st March last. From the report it appears that the exploded receiver was used as a reservoir for compressed air, which was conveyed to the workings of the colliery for the purpose of working the machinery employed in hauling coal. The air was compressed and discharged into the receiver by means of two steam engines, the air-compressing cylinders being 33in. diameter, the stroke of the pistons 5ft., and the number of strokes per minute about twenty-eight. The temperature of the compressing cylinders was reduced by a stream of cold water which passed through chambers surrounding them. The air receiver—originally, it seems, an externally-fired boiler—was cylindrical, with hemispherical ends; it was 5ft. 10in. diameter, and about 29ft. long. It was made of $\frac{3}{8}$in. wrought iron plates, and all joints were single lap rivetted, the rivets, which were about $\frac{13}{16}$in. diameter, being spaced about 2in. apart. The plates are not materially reduced from their original thickness. It had two safety valves 4in. diameter, which were loaded by levers and weights to 60 lb. per square inch; and besides these safety valves, there were several others loaded to about the same pressure on smaller air receivers in the pit. The means for preventing over-pressure thus appear to have been quite sufficient. In his report, Mr. Richards says the explosion was caused by the bursting of the external shell of the air receiver, the rupture beginning at an unstrengthened manhole; but from what he says afterwards this would seem to be rather an effect than a cause. The explosion had evidently been very violent, for besides causing the destruction of the air receiver, considerable damage was done to the engine-house and other objects in the vicinity. The explosive force also extended down the 10in. wrought iron pipe which conveyed the compressed air to the underground workings. About $2\frac{1}{2}$ft. in length of one of these pipes, which was about 240 fathoms down the shaft, was blown almost entirely flat; another pipe had a large piece blown out, while one other burst at the weld, and a considerable amount of damage was done to cage guides and ventilating brattice. Mr. Richards calculates the bursting pressure of the receiver at about 200 lb. per square inch, which is certainly well within the mark. It therefore seems clear that the explosion of the receiver and pipes was not caused alone by the air compressed by the engines, which was at 60 lb. It is, therefore, necessary to look for another cause of the explosion. Mr. Routledge, the manager of the works, and several other witnesses, gave evidence that directly after the explosion they saw flames from the exploded receiver extending about 30ft. or 40ft. high. This continued for about half an hour, until they were extinguished by water. The flames brought the plates to a red heat, and were attributed to the burning of a sediment at the bottom of the receiver, which consisted of coal-dust drawn in with the air, together with portions of the lubricant carried by the air from the compressing cylinders. Until within rather more than twelve months before the explosion the air-compressing cylinders were lubricated by a mixture of animal oil, soft soap, and water, but whilst using this considerable difficulty was experienced owing to the pipes between the compressing cylinders and air receiver becoming choked. In consequence of this the use of a mixture of a mineral oil and soft soap was adopted, and water for lubricating the air-compressing cylinders. This was tried for a time, and as the difficulty previously experienced respecting the stoppage of the pipes was not found to occur, its use was continued. A new receiver was set up, and when Mr. Richards saw this at work the pressure of air was about 43 lb. per square inch, and the temperature of the receiver was about 190 deg. Fah., the increase in the air temperature of about 145 deg. being due to its compression. The discharge pipes from the compressing cylinders were at the time immersed in a tank of cold water for the purpose of experiment. This, he very reasonably thinks, caused a marked reduction of temperature in the receiver, so that with the air at a pressure of 60 lb. and without the pipes immersed in cold water tanks, the temperature of the receiver would without doubt be considerably higher than 195 deg. Now then comes the suggestion as to the curious cause of the explosion. Considering the low flashing point of many of the mineral oils, Mr. Richards thinks it most probable that the flashing point of the oil used for lubricating the compressing cylinders was less than the temperature of the air-compressing cylinders and receiver, so that the receiver would, after the lubrication of the former, be charged with vapour of the oil, and this when mixed with air in the necessary proportions only requires a flame to ignite it to cause an explosion. This seems so far to go on four wheels, but it is difficult to decide how ignition of the mixture could take place, for it appears evident that ignition of the inflammable vapour could only take place from inside the receiver. The conclusion is therefore arrived at that the ignition of the vapour was caused by flame arising from the spontaneous combustion of cotton waste or other similar substance inside, and hence the explosion. Mr. Richards, however, made some experiments with some mineral oil said to be some of that used, but found that it did not give off inflammable vapour at 208 deg., above which temperature his apparatus would not enable him to test it. It is a pity that the report was made before the flashing point of the oil was found, but it is not impossible that the ignition might take place owing to spontaneous combustion of such material as is supposed may have been in the receiver, but although such combustion has been known to take place under much less favourable circumstances, it is not clear that the oil vapour was produced at the temperature mentioned. Assuming the combustion, however, a higher temperature for the oily mass in the receiver is a necessary result, and the flashing point may conceivably have been reached, but Mr. Richards is driven to the conclusion that the temperature of the compression cylinders and receiver was at times considerably in excess of 208 deg. Assuming the compression to take place adiabatically and to be fourfold, or $\frac{P^1}{P} = 4$, then the rise in temperature, the initial temperature being 50, will be $\left((461 + 50) \times 1{\cdot}495\right) - 461 = 302$ deg., so that it is easily seen that unless a considerable quantity of cooling water was used, the rise in temperature in the receiver supplied by two cylinders as above-mentioned, might be high enough to cause the ignition of combustible material. The case is a curious one, and has several points of interest.

LONDON WATER CHARGES.

THE Home Secretary received an influential deputation on Tuesday, whose mission was to make representations upon the increased charges made by the water companies. Mr. W. H. Smith introduced the deputation, and Mr. Farrer spoke for it. Sir W. Harcourt said that Londoners should be ashamed of having to go to the Government and say they were powerless on a subject of the highest importance, and one which would be settled by any little town of a few thousand of inhabitants for itself. But, he said, London has no government, and until it has, Londoners cannot expect to be as free from misgovernment and oppressive demands as hundreds of smaller towns which take care of themselves, and do not go crying to the Government that they are powerless against their water companies. These are not exactly his words, but their meaning. In reply to some rather radical proposals on the part of Mr. Farrer, he said:—"Whatever may be the disputed doctrine of rights with reference to another great commercial enterprise, nobody has ever pretended that there was a monopoly for water companies, and it makes all the difference in the world for London that when dealing with the water companies Parliament can deal with them, as was pointed out in the report, in the same manner in which it dealt with the gas companies. Parliament said, 'If you do not consent to reduce your rates, and to make reasonable charges, then we will give authority to other people to supply the article.' That was the alternative pointed out in the report of the Committee of 1880, and that is really the only method of dealing with this matter. If you have to deal with companies who can make their own price, you may be certain they will always demand a price which the community will not willingly pay; but if you can go to the water companies and say, 'Unless you charge at a reasonable rate we will have a competing water supply against you,' then there may be some hope for London in the matter. How is that to be done? It can only be done by London itself. It is totally impossible that the Government can attempt the municipal administration of London, and it ought not to attempt this, for it would be putting London on a wrong footing; it would be putting it, in the scale of societies and communities, below the smallest and most insignificant town in the kingdom. You know well, gentlemen, what my views on that subject are. What I desire is to see London put in a position to help itself. If it had been put in that position years ago it would not have been in the scrape it is now in this matter, and that is the only answer I can make to Mr. Farrer and to this deputation, which I am very glad to see. Do not suppose I do not recognise fully evils under which I suffer as well as you. But I see only one remedy—in constituting London into a body able to take care of itself. When it is once so constituted, you may depend it will be the most powerful body ever constituted, and one well able to take care of its own interests, and will proceed to do so, I hope, with due respect to the rights of property, and with those arms of self-defence with which competition supplies society in other cases, just in the same way as, when you have exorbitant rates charged by a railway company, you make a rival railway which controls those rates. So in London, if London ever is able to act for itself, you will be able to defend yourselves." This is all very well for Sir W. Harcourt, who is particularly interested just now in the question of local government in London; but we may ask was it not the duty of Parliament to look after the interests of London ratepayers when the water companies were applying for their powers?

THE ST. GOTHARD TUNNEL DISPUTE.

THE last report of the directors of the St. Gothard Railway gives details with respect to the dispute which has broken out between the company and contractors concerning the balance to be paid for the construction of the great tunnel. Various attempts have been made to settle the quarrel by arbitration and without an appeal to law, but entirely without success. The company has accordingly entered an action against the contractors in the Swiss courts, in which it demands (1) that the contractors shall be required to pay or credit the company with a sum of 5,584,080f., with interest from October 15th, 1881, for advances for installation purposes, &c.; (2) that the contractors be condemned to pay 2,745,000f. as fines according to the contract on account of failure to complete various portions of the tunnel within the prescribed time, interest to be reckoned at 5 per cent.; (3) that they repay 500,000f. which they have had in instalments as loans, interest to be reckoned at 5 per cent. from the dates of the various instalments. This makes the total sum demanded by the company 8,829,080f., in addition to interest, which will bring the amount up to nearly 10,000,000f. The contractors, however, on their part, demand no less than 14,700,000f. from the company. Of this sum, 2,184,000f. are set down for extra work in the tunnel, unprovided for in the contract; 600,000f. for installation works, and 438,000f. under various minor heads, while no less than 11,500,000f. are demanded on the ground of delay in furnishing the contractors with certain necessary instructions as to the details of the construction, and further on account of the hostile *animus* of the chief engineer, Herr Hellwag, and his assistants. The loss on these two heads is reckoned by the contractors at 10 per cent. of the entire cost; they further reckon 2 per cent. for loss during the financial crisis of the company, and 8 per cent. for unforeseen difficulties, such as extra pressure, excessive heat, &c., which they had to encounter in constructing the tunnel. Much interest is felt in engineering circles on the Continent as to the issue of this lawsuit. Curiosity is particularly excited as to how the Swiss courts will deal with some of the contractors' demands for compensation, especially those under the heads of the hostile *animus* of the engineers, and the unforeseen difficulties in the construction of the tunnel.

LITERATURE.

James Nasmyth, Engineer. An Autobiography. Edited by SAMUEL SMILES, LL.D., Author of "Lives of the Engineers." London: John Murray. 1883.

[CONCLUDING NOTICE.]

THE main interest of the book centres in the account of the invention of the steam hammer, which we may now hope is given correctly. In the memoir of Mr. Nasmyth, contained in "Industrial Biography," Dr. Smiles made several mistakes as to date, although he enjoyed the advantage of Mr. Nasmyth's assistance. In the whole range of history there is not a more striking instance of rapidity of invention than that furnished by the genesis of the steam hammer. To borrow a simile suggested by the subject, it was forged at a single heat. On the 24th of November, 1839, Mr. Nasmyth received a letter from Mr. Humphreys, engineer to the Great Britain Steamship Company, informing him that not a single firm in the kingdom would undertake the forging of the paddle shaft of that vessel, and asking whether cast iron might be used with safety. The letter set Mr. Nasmyth thinking, and after meditating on the defects of the old tilt hammer, saw that "the obvious remedy was to contrive some method by which a ponderous block of iron should be lifted to a sufficient height above the object on which it was desired to strike a blow, and then to let the block fall down upon the forging, guiding it in its descent by such simple means as should give the required precision in the percussive action of the falling mass. Following out this idea, I got out my 'Scheme Book' on the pages of which I generally thought out, with the aid of pen and pencil, such mechanical adaptations as I had conceived in my mind, and was thereby enabled to render them visible. I then rapidly sketched out my steam hammer, having it all clearly before me in my mind's eye. In little more than half an hour after receiving Mr. Humphreys' letter, narrating his unlooked for difficulty, I had the whole contrivance, in all its executant details, before me in a page of my scheme book, a reduced photograph copy of which I append to this description. The date of this first drawing was the 24th of November, 1839."

The *fac-simile* sketch fully bears out Mr. Nasmyth's assertion that it "will be found to comprise all the essential elements of the invention." He is fully entitled to say, "It is no small gratification to me now, when I look over my rude and hasty first sketch, to find that I hit the mark so exactly, not only in the general structure, but in the details; and that the invention as I then conceived it and put it into shape still retains its form and arrangements intact in the thousands of steam hammers that are now doing good service in the mechanical arts throughout the civilised world." Sketches were sent to all the great firms, but no one would take the matter up, trade being very much depressed at the time. Mr. Nasmyth did not patent the steam hammer at first, as the cost of a patent was then little short of £500, and his partner was unwilling to agree to the withdrawal of so large a sum from the business. Now comes a very curious episode. Amongst the visitors to Patricroft was M. Schneider, of Creusot, who called at the works, accompanied by his manager, M. Bourdon. Mr. Nasmyth happened to be absent, but they were shown over the works by Mr. Gaskell, his partner. They were also permitted to turn over the leaves of the scheme book, as presenting the "latest novelties." They were greatly impressed with the steam hammer; and M. Bourdon took careful sketches of the design. The visitors left and the matter was forgotten; but in April, 1842, Mr. Nasmyth happened to pay a visit to Creusot, and one of the first things he saw was a large forged crank. He immediately inquired how it had been made, and the reply was, "It was forged by your steam hammer." The enterprising manager and his chief had made a steam hammer from the sketches which they had copied at Patricroft, and Mr. Nasmyth had the pleasure or mortification of seeing his "own child" brought up and nursed by foreigners. Mr. Nasmyth must be credited with a remarkable amount of good nature, for, instead of being annoyed, as most inventors would, he proceeded to explain to M. Bourdon that certain details were faulty, he having failed to copy correctly the sketches in the scheme book at Patricroft. All must admire, but few can hope to imitate such unselfishness. The effect upon M. Schneider seems to have been to harden his heart against the too-confiding inventor, and when he was under examination before a committee of the House of Commons on the patent law in 1867 he had the amazing audacity to say that the steam hammer was invented at Creusot. Mr. Nasmyth was fairly roused, and if ever he was angry in his life he was then. He requested permission to come before the committee for the purpose of giving a flat denial to M. Schneider's "evidence." But he was never a self-assertive man, and he does not notice in his book the incident we have just related. We are proud of Mr. Nasmyth and his steam hammer, and we would not allow his originality to be called in question. As a matter of simple history, however, and as a tribute to the memory of a very great man, we would suggest that in the next edition of the "Autobiography" there be added a footnote saying that the idea of a direct-acting steam hammer had occurred to James Watt many years previously, and that it is mentioned in his patent of 1784. An ingenious West country millwright, one William Deverell—of whom we would fain know more—had also worked upon the idea, and in 1806 a patent was granted to him "for giving motion to hammers, stampers, knives, shears, and other things, without wheel, pinion, or rotative motion." If the American examiners had followed their own precedents as to what constituted an "anticipation," Mr. Nasmyth would never have obtained a patent in the United States. We should add that immediately on his return to England steps were taken to secure a patent in this country. It bears date June, 1842. As might have been expected the British Government were amongst the last to adopt it, so great is the density of the official mind.

The Appendix contains a chronological list of Mr. Nasmyth's mechanical inventions and technical contrivances, which might with advantage be a little fuller, and include exact references to his various contributions to scientific periodicals and the transactions of the learned societies. There is no mention of an article on cutting tools which he contributed to Weale's edition of "Buchanan on Millwork," and he has on several occasions given valuable evidence before Parliamentary Committees, which was duly printed in the reports. We were unaware until now that he was the first to suggest the use of a submerged chain for propelling ferry boats, which has come into use during the last fifteen years or so, on some of the German rivers for driving tug boats. The mode of transmitting rotary motion by a flexible shaft, formed of a coiled spiral wire or rod of steel, is also due to him. It has been re-invented over and over again since he devised it in 1829. He is also entitled to the credit of having suggested the use of chilled iron shot, and the Mont Cenis boring machinery was in part due to him. When at Maudslay's he invented the nut-cutting machine now in everyday use.

The editor's share of the work has been performed in a very imperfect and unsatisfactory manner. The book abounds with blunders, one of which, repeated over and over again, being particularly annoying. We allude to the mis-spelling of the name "Maudslay," which is persistently written "Maudsley." Mr. Smiles knows better, as the name is correctly printed in "Industrial Biography." Another provoking error is that by which the well-known artist Reinagle is spoken of as "Renegal" (p. 26), a species of phonetic spelling for which the world is not yet ready. Again, anybody who has been in a fitting shop ought to know that Stubs, the Warrington file-maker, spells his name with one "b," and not two (p. 214). The name of Hawks is better known in Newcastle than "Hawkes" (pp. 244, 250). Mr. Francis Humphreys, the engineer of the Great Britain steamship, did not call himself "Humphries" (pp. 238, 239); Baron Brünnow—not Brunow (p. 293)—was the name of the Russian Ambassador here about thirty years ago, and Sidney Herbert (once called "Sydney") did not subsequently become "Earl of Pembroke" (p. 270), but Lord Herbert, of Lea. At p. 306, the editor makes the author say that he "took ship for England by the Batavian steamer," but he probably wrote "the Batavier steamer." The great trade society is not "the Amalgamated Society of Mechanical Engineers" (p. 310), but "Amalgamated Society of Engineers." The Mr. Joseph "Lese" mentioned at p. 316, should be "Lees"; Clarkson Stanfield, the celebrated artist is not Stansfield (p. 42); Dickens's "Brothers Cheeryble" did not call themselves "Cherryble" (p. 185); Mr. Applegath, who did so much for the printing machine, was not "Applegarth" (p. 196); the Battle of Hastings was fought in "1066," not "1060"; the well known patent barrister is "T." not "J." Aston (p. 438); and James Rendel, C.E., did not spell his name with two "ll's" (p. 402). At p. 126 the sun is described as coming "dancing up the East," but Milton has it "dancing from the East." Nor is Byron improved when his line—"She walked the waters like a thing of life," is converted into—"She trod the waters, &c." (p. 29). It is twice stated within a few pages (pp. 277, 282) that the steam pile-driver was used for driving the piles in the barrage of the Nile at Cairo, and in one place it is called an "embarrage," a word which is unfamiliar to us. There is no "Norman" work about the Church of St. Bartholomew the Less, Smithfield, though Mr. Nasmyth professes to have admired it (p. 154); and we greatly doubt the existence of architecture of that period at Kenilworth Castle (p. 169). The engine of Miller's steamboat is not in the Patent-office Museum, but in the South Kensington Museum proper. Mr. Nasmyth is hasty in blaming the late Mr. Woodcroft for having suppressed the fact that the picture of the boat in his "Origin of Steam Navigation" was taken from a drawing by Mr. Nasmyth's father. The name of the artist is stated on p. 39 of Mr. Woodcroft's book.

This list of errors might have easily been extended, but enough has been said to make good our charge of carelessness against Mr. Smiles. We have been particular in giving exact references, so that the mistakes may be corrected in the next edition. The editor may possibly disclaim responsibility for some of them, and may charge them upon the author. It is, of course, difficult to fix the responsibility, and it must be evident to all who read the book carefully that Mr. Nasmyth is rather given to enlarge upon topics with which he is unfamiliar. We are led, therefore, to express an opinion that the book would be materially improved by a somewhat extensive pruning. For instance, it is quite incorrect to say that the works of Andrea del Sarto are little known out of Pisa or Florence (p. 260), or that the name of Adam Krafft "is little known out of Nuremberg" (p. 287). Again, when speaking of the remains of the amphitheatre at Nîmes, he says (p. 256):—"This wonderfully durable stone is of the same material as that employed by lithographers. Though magnesian, it is of a different quality from that employed in building our Houses of Parliament. As this was carefully selected, the latter was carelessly *un*selected. Most probably it was the result of a job. It was quarried at random," &c. &c. As to the first sentence, we can assure the author that he is quite wrong as to the identity of the two sorts of stone. Further, the noise that was made about the selection of stone for the Houses of Parliament ought to have reached even to Patricroft. The selection was unfortunate, as everyone knows; but it is unfair to say that no attempts were made to find a proper stone. The parliamentary papers of the day are evidence to the contrary.

Though not in the least inclined to deny the mechanical ability of Manchester and the neighbourhood, we cannot admit the correctness of Mr. Nasmyth's explanation of its origin. He says—p. 214—"From an early period the finest sort of mechanical work has been turned out in that part of England. Much of the talent is inherited. It descends from father to son, and developes itself from generation to generation. I may mention one curious circumstance connected with the pedigree of Manchester—that much of the mechanical excellence of its workmen descends from the Norman smiths and armourers introduced into the neighbourhood at the Norman Conquest by Hugh de Lupus, the chief armourer of William the Conqueror. . . . . He occupied Halton Castle, and his workmen resided in the adjacent villages of Appleton, Widnes, Prescot, and Cuerdley. There they produced coats of steel mail, armour, and steel and iron weapons, under the direct superintendence of their chief. The manufacture thus founded continued for many centuries. Although the use of armour was discontinued, these workers in steel and iron still continued famous. The skill that had formerly been employed in forging chain armour and war instruments was devoted to more peaceful purposes. The cottage workmen made the best of files and steel tools of other kinds. Their talents became hereditary, and the manufacture of wire in all its forms is almost peculiar to Warrington and the neighbourhood. Mr. Stubbs also informed me that most of the workmen's peculiar names for tools and implements were traceable to old Norman-French words. He also stated that at Prescot a peculiar class of workmen has long been established, celebrated for their great skill in clock and watch making; and that in his opinion they were the direct descendants of a swarm of workmen from Hugo de Lupus's original Norman hive of refined metal workers, dating from the time of the Conquest." We believe this to be pure fiction. We will admit for argument's sake that Hugh de Lupus did settle down as stated, and it is certain that Warrington has a reputation for wire and certain steel tools, and further, Prescot and the neighbourhood have long been noted for watch movements and watchmakers' tools. But all these trades are of comparatively modern origin, and there is no evidence, so far as we are aware, that the artisans engaged in them are the lineal representatives of the Norman armourers. The intermediate links in the chain are altogether wanting, and there is no unbroken tradition of skill in metal working in South Lancashire. The drawbench undoubtedly came from Germany, and the manufacture of wire was first commenced in the neighbourhood of London. Whatever name Warrington may have for wire of a particular kind, it must be remembered that Birmingham has also achieved a considerable reputation for that article, and the "Birmingham wire gauge" is known all over the world. As to the alleged prevalence of Norman-French words, we would point out that the Norman smiths must have had very few tools, and those of a very rude description. Supposing that such words are in use—and we should much like to have instances—they are probably due to the French refugees, who are known to have settled in some parts of Lancashire.

Amongst other curious slips is that by which the expression "The Heart of Midlothian" is applied to the condemned cell in the old Tolbooth, instead of to the Tolbooth itself. Although we had a tolerably vivid recollection of Scott's novel, we took the pains to refer to it, before contradicting an Edinburgh man born and bred, on a point of local nomenclature. A paragraph is devoted to a worthy Birmingham lathe-maker, one John Drain, but his name was "Drane." Some of his lathes are still to be found in use in Birmingham workshops.

These defects may be easily remedied in future editions, and in no way detract from the abiding interest and value of the "Autobiography." We have read it from end to end with great pleasure, and can cordially recommend others to do the same. It possesses few charms of style, but abounds with touches of dry humour. For instance, when at Upsala, Mr. Nasmyth visited the three great mounds of earth erected in commemoration of the Scandinavian deities, Odin, Thor, and Freia. Having finished his survey, he says:—"I went down into a cottage near the tumuli and drank a bumper of mead to the memory of Thor from a very antique wooden vessel. I made an especial reverential obeisance to Thor, because I had a great respect for him as being the great hammerman, and one of our craft—the Scandinavian Vulcan." He goes to see the crater of Vesuvius and "on leaving this horrible pit edge I tied the card of the Bridgewater Foundry to a bit of lava and threw it in as a token of respectful civility to Vulcan." He possesses also a striking way of putting things. Speaking of the absolute necessity of manual dexterity and experience, he says:—"The nature and properties of the materials must come in through the finger ends. Hence I have no faith in young engineers who are addicted to wearing gloves. Gloves, especially kid gloves, are perfect non-conductors of technical knowledge. This has really more to do with the efficiency of young aspirants for engineering fame than most people are aware of; yet kid gloves are now considered the genteel thing." The advantages of machine tools over hand labour are thus expressed:—"The machines never got drunk, their hands never shook from excess, they were never absent from their work, they did not strike for wages, they were unfailing in their accuracy and regularity, while producing the most delicate or ponderous portions of mechanical structures." The functions of the imagination in invention are stated in these words:—"It is one of the most delightful results of the possession of the constructive faculty that one can build up in the mind mechanical structures and set them to work in imagination, and observe beforehand the various details performing their respective functions, as if they were in absolute material form and action. Unless this happy faculty exists *ab initio* in the brain of the mechanical engineer he will have a hard and disappointing time before him. It is the early cultivation of the imagination which gives the right flexibility to the thinking faculties. Thus business, commerce, and mechanics are all the better for a little *healthy* imagination." We had marked many amusing passages and anecdotes for quotation, but must leave readers to discover them for themselves. We part company with Mr. Nasmyth's "Autobiography" with regret.

NEW ORNAMENTAL COLOUR PRINTING PROCESS.—A curious process for printing in any number of colours is being introduced into this country by Mr. G. D. Davis, for whom Messrs. Borland, King, and Shaw, of Glasgow, are acting. It consists in the use of dry colour powders, which are sprinkled upon the surfaces of the material to be ornamented by automatic machinery, the surface being previously varnished on the parts to be treated. Any number of colours or tints may be used, and a mottled pattern, which is never quite the same on any two pieces, though all bear a resemblance, just as do several pieces of ornamental marble, is produced, the excess powder being brushed off, and that required pressed on. Fabrics, paper, glass, and wood may be equally well treated, and a very attractive ornamentation, variable indefinitely, is the result.

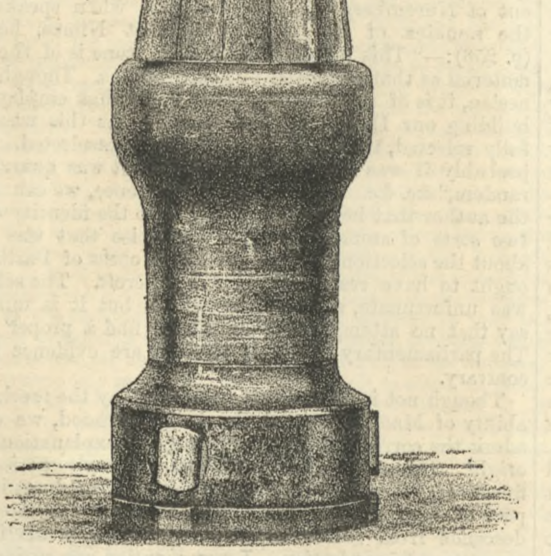
TRIALS OF PALLISER'S STEEL SHOT.

FIG. 1

The test of the 80-pounder converted Palliser gun as an armour-piercing gun has led to some interesting results. There were two contests, one between the gun and the plates, and another between rival shot. Special shot were prepared by Captain Edward Palliser and by the Royal Laboratory. The first round fired was one of Captain Palliser's steel shot with a steel jacket. This penetrated a 6in. compound plate completely, 2ft. of timber in rear, and entered 3in. into an iron plate behind. Captain Palliser is of opinion that the shot struck obliquely, of which he considers that there is evidence in—(1) the size of the hole in the plate and its character; (2) the point of the shot being bent in a peculiar manner; (3) the shot breaking up; (4) the evidence of the jacket, one side of which was arrested by the plate, while the other side dashed forward, shearing itself over the restraining step, as if done by a powerful slotting machine. Captain Palliser appears to have been unfortunate in this shot, as he maintains that a direct hit would have shown very satisfactory results, and that the shot would not have broken up. The next round was a chilled jacketted shot, and here again Captain Palliser was undoubtedly unfortunate. The shot turned out not to have been chilled to more than ½in. deep, such projectiles being known to be useless against compound plates. We are glad to hear that Sir William Armstrong and Co. have consented to cast the supply of jacketted shot ordered by the War-office for the next trial. A similar jacketted Palliser shot, chilled only ½in. deep, penetrated 9in. of wrought iron a few days previously without breaking, and had still considerable energy after passing through the plate. The charge of powder was only 20 lb. pebble powder, and velocity 1400ft. In this round the ribs appear to have opened the plate and let the shot through. It is to be regretted that a better chilled shot was not fired at the compound 6in. plate, because thus far no light has been thrown on the sudden application of these chisel-shaped ribs on steel armour. Captain Palliser's impression is that in certain proportions of shot to plate the former will star and rip up the latter. The shot from the 80-pounder and the 6in. compound plate is, he thinks, a proportion to produce the effect he anticipates, and it is to be regretted that the opportunity is gone for proving it. Two long pointed Palliser shot, that is with the same form of head as the ribbed ones, made of excellent stuff at the Royal Laboratory, both penetrated the 6in. compound plates; so that it may be said the 80-pounder converted gun has proved itself too powerful for such armour in direct fire. The committee have ordered some service pattern shot to be prepared, and when these are ready some more experiments will be made with them. They have further ordered some ribbed and jacketted Palliser shot for the Woolwich 6in. 100-pounder breech-loading gun. Some of these will be of chilled iron and some of steel; but Captain Palliser will make them all with ribs, the resistance of the basis of the ribs being absolutely necessary, he says, to prevent the jackets dashing forward on impact. He also insists on the power of the ribs to open the metal that is ripping the distended metal round the shot as it penetrates, and in this way easing the pressure sufficiently to prevent the shot from fracturing in the manner commonly seen in experiments with chilled shot at Shoeburyness.

The Palliser's improved steel-jacketted shot above referred to were fired at Shoeburyness on April 5th last against a wrought iron plate 8·73in. thick, termed the Rupert plate No. 75. It had been employed for some Admiralty proof firing. Five 9in. pro-

FIG. 2



jectiles had perforated it, one with a 50 lb. and two with 40 lb. charges. Two fired with 30 lb. charges had also in a sense perforated, but the shot had remained in the plate, not getting clean through. The portion of the plate fired at by the Palliser shot was sound and untouched for a considerable area—*vide* Fig. 1. The projectile is shown in Fig. 2. The chief peculiar features are the sharp pointed ribbed head, the reduced diameter, and the steel jacket over body. The striking velocity was 1400ft. If this projectile were one of new type, whose sectional density was considerable, its possible penetration would be about the thickness of the plate. The calibre of the gun is 6·3in., and with new type guns, where $\frac{W}{D^3} = 0·41$, we may take the limit to perforation as a calibre for each thousand feet velocity, and so $1·4 \times 6·3 = 8·82$in. We have applied this rule of thumb here merely because we know it is likely to be applied, and is fairly correct with shot of great sectional density. This shot, however, weighed only 85 lb. and its $\frac{W}{D^3} = 0·34$ only, and the above rule of thumb therefore gives much too large a result. If we calculate it out systematically we get 7·7in. as the preparation. The shot, however, not only perforated the plate, but passed on, striking an old plate which stood obliquely in rear so hard as to leave an impression of its rib and part of body, the shot being picked up having eventually broken in two, probably on the second blow, which fell transversely, and could hardly fail to effect such a result. Both shot and plate showed evidence of a violent blow, but it is impossible to estimate how much. Clearly the shot had behaved admirably because it had completely perforated more than an inch over what is due to calculation, and had still a good deal of work left in it. The cut, which is taken from a photograph, is interesting as showing the grooves cut by the ribs. This we gave in a sketch on a previous occasion—*vide* Engineer, June 9th, 1882—but a photograph carefully reproduced may be preferred to a sketch. Of course the question arises, what the success of the shot is due to. The peculiar features are, as we have said, the sharp point, the ribs, the reduced diameter, and the jacket. At Shoeburyness, we believe, it is questioned whether a plain point equally sharp, on a shot without jacket, does not give equally good results. Our own opinion, however, is, that other things being equal, it would not do so. Other conditions have not been equal hitherto, for it cannot be expected that Captain Palliser can get shot as well chilled and of as good metal as those cast in the Royal Laboratory. The miserably badly chilled shot he has now and then fired on important occasions are evidence enough of this fact, and we believe that Captain Palliser has not given himself the full benefit of his jacket hitherto. The action of ribs we regard as a doubtful question. They have cut more cleanly and well than we might have expected through iron, but the chief point is their behaviour against steel. The steel jacket ought, we think, to give a clear advantage when well applied. In the figure herewith A shows the hole perforated by the shot with grooves cut by its ribs, B the shot recovered after impact, D the jacket over shoulder set up by impact against plate, C is the base jacket.

DARTMOOR FIELD GUN TRIALS.

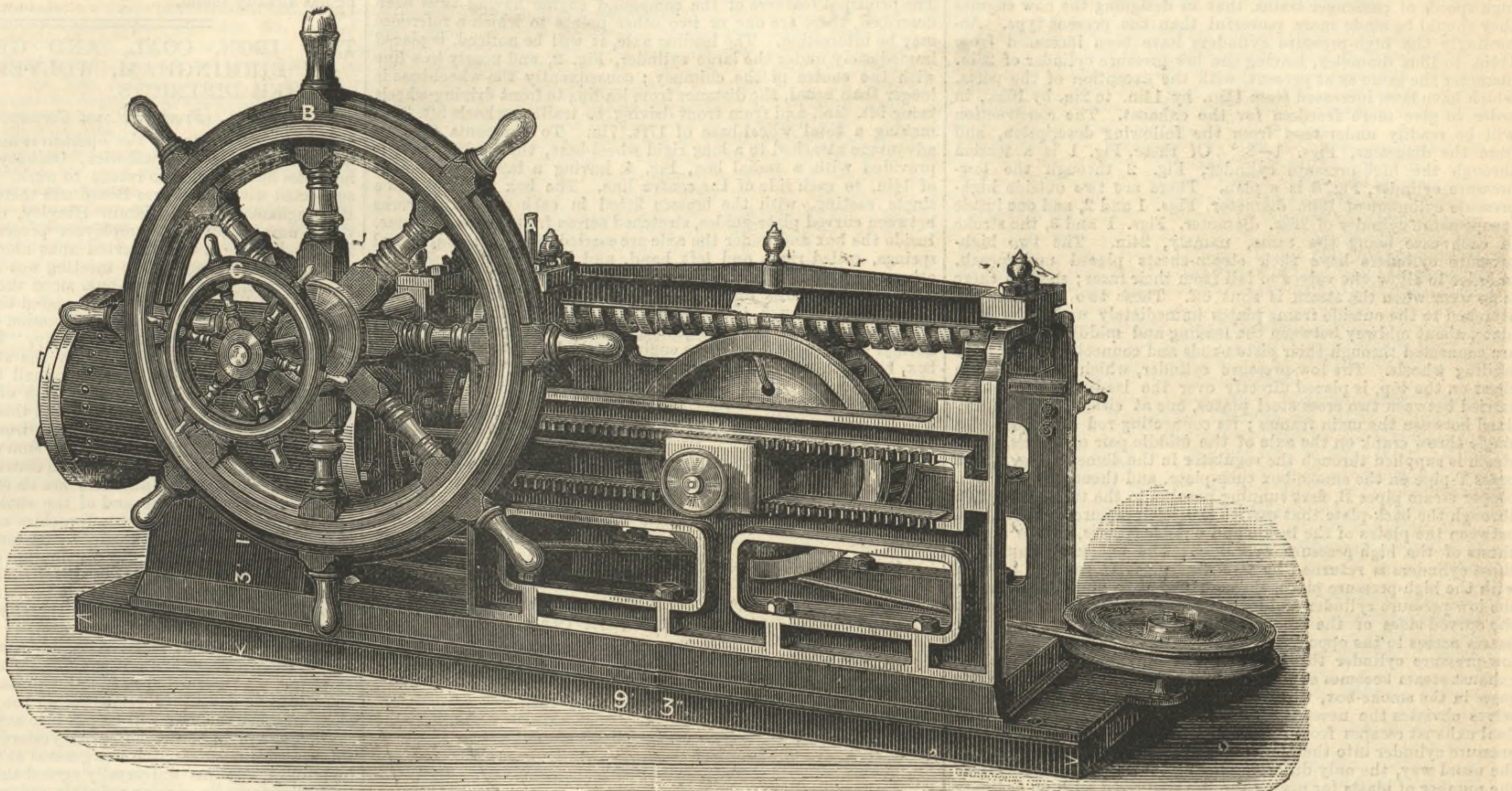
The trial of the light and heavy field guns of 7 and 12 tons weight respectively has been satisfactorily carried out during the last few weeks at Dartmoor. The guns have performed well, and there is every probability that they are in all essentials the field guns of the future. We mentioned some particulars about them in The Engineer, May 18th. The light gun has a 3in. bore, 27½ calibres long, rifled with ten grooves. Its projectile weighs 12 lb., and it discharges it with an initial velocity of 1725ft. per second. The heavy gun has a 3·5in. bore, 28 calibres long. Its projectile weighs 22 lb., and its initial velocity is 1750ft. The total weights of guns and carriages behind team do not differ greatly from those of the former light and heavy field guns. It may be hoped that a considerable proportion of the heavier guns may be issued to the field batteries. The advantage of a heavy field gun throwing a large shell was apparent in Egypt, even when represented by the 16-pounder gun, which, theoretically, is a very bad gun indeed. As to carriages, both the Carriage Department and the Elswick patterns did well. The Elswick, as it is in use, is the lighter of the two, its wheels being very light. The axis of the gun is brought lower, and the track of the wheels is considerably wider than the service pattern—namely, about 5ft. 8in. instead of 5ft. 2in. The trail is rather heavier, we believe. The application of hydraulic buffers enabling the gun to recoil on a jointed frame against springs, so as to lessen the shock on the carriage, is found only in the Carriage Department design, and there is embodied in this carriage a very neat self-acting differential brake, clutching the nave of the wheel admirably when put in action.

The carriages cannot be considered to be in fair competition, because for this conditions should be specified. Unquestionably it is an advantage to a carriage to have the axis of the gun low and the track of the wheels widened; but on both these points data have been laid down in the service so absolutely that without special sanction no Government department could have ventured to depart from them. Such carriages as have had wider tracks have been condemned from time to time until everything was brought to 5ft. 2in. The Elswick carriage, then, may be regarded as a valuable illustration of the advantages which may be obtained by departing from the service conditions; but it is only in this sense competitive. The carriage certainly benefits by it—the recoil is much more manageable, the jump being less. The wheels have stood fairly well, but we do not think that they will be considered strong enough for service; the tires are of steel. They have broken, but have not separated from the wheel, being held by their bolts. It appears that tires of wheels are some of the things in which it is most difficult to substitute steel for iron. The reason alleged has generally been that steel which is soft enough to bear the jarring is too soft to wear well. It is, of course, quite conceivable that all attempts to substitute steel in smaller bulk than iron may fail, and that the only steel that will stand is very nearly identical with wrought iron, and so must be used in an equally thick ring. Range-finders have given bad results at Dartmoor. This is due to the absence of definition in the objects to be observed, a difficulty which would often, but by no means always, exist on service, and one which may be borne in mind in selecting ground for a position.

We hope that in this, as in many other matters, distinct improvements in pattern may be adopted for service. Of late a dread of adopting anything which may be superseded in a few years has prevented the introduction of good designs into service equipments, because no promise of finality could be given. Authorities do not seem to realise the large sums of money that are annually spent in furnishing stores for supply. It is a sad waste of money to be making stores of antiquated pattern because we cannot replace them by a pattern which will be final. This can seldom, if ever, be done. It is often better to make a store which we know is very superior to our old service one, though we know it may be superseded eventually. The objection to change and complication no doubt holds good in a special manner in the case of England, with stations all over the world; but latterly this objection has, we think, been pushed too far. It is a melancholy thing to manufacture obsolete stores on a large scale, and this takes place when the gap between service and experimental equipments is allowed to grow very wide.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—William Cook, engineer, to the Victoria and Albert, vice Allen; Edward L. Carte, engineer, to the Dwarf, vice Cook; Samuel J. Follett, engineer, to the Waterwitch, vice Couper.

EXHIBITS AT THE ENGINEERING AND METAL TRADES EXHIBITION.



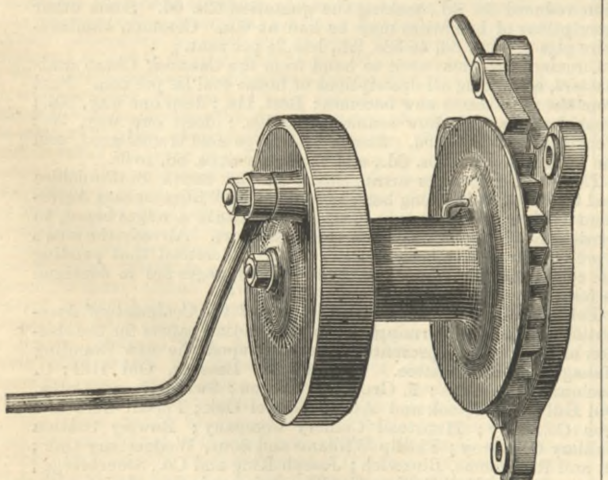
HOLLIDAY'S STEAM AND HAND STEERING GEAR.

THE ENGINEERING AND METAL TRADES EXHIBITION.

No. V.

Our notices of the machinery shown at this Exhibition leave little to be said. On this page we illustrate a vertical boiler, which was exhibited by Mr. James Blake, Manchester, the engraving having been prepared from a photograph, taken with the view of showing the accessibility of every part for repairs. This boiler has been designed to obtain as large an amount of fire-box surface as possible without diminishing the heating surface of the tubes, and it is so arranged that the front tube plate is entirely relieved from the bursting pressure by means of cross stays. The shell crown and all the tube plates are pressed into shape by hydraulic machinery, several of these being exhibited by themselves, to show the character of the work. Blake's patent locomotive boiler, which was fully described and illustrated in The Engineer of September 5th, 1879, is also shown.

Some very fine machine tools made by Messrs. Loewe and Co., Berlin, were shown by Mr. J. K. Kilbourn, Worship-street, E.C., as well as various specimens of the work produced by them. We may specially mention a very fine and well-finished universal milling machine,

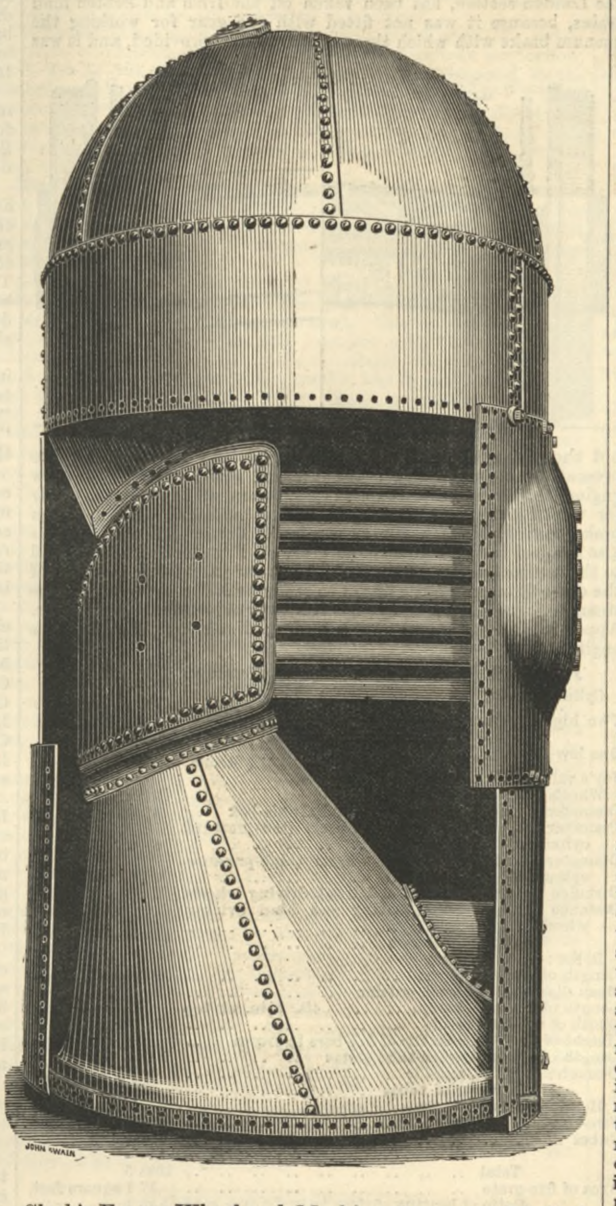


LOUDON'S BULKHEAD WINCH.

which has been designed for turning out very accurate work, so as to avoid subsequent fitting by hand, and among the specimens an army revolver, complete in all its parts, put together direct from the machine, is well worth notice.

Captain C. Douglas, Sunderland, showed a new steering gear, Holliday's patent, which is illustrated above. It is claimed that the gear is perfectly noiseless, and has fewer working parts than any other steam steering apparatus. It consists of a direct-acting cylinder, with piston and rod, actuating a crosshead carrying two large sheaves, on which the chain or wire rope is wound, racks cast on the side frames causing the sheaves to revolve as soon as motion is given to the crosshead. The steam is controlled by a retaining valve, by which an equal pressure is continually maintained on either side of the piston, so as to give an elastic cushion for taking any shock from heavy seas striking the rudder. The change from steam to hand steering can be effected at any part of the stroke at a moment's notice, by merely throwing into gear a worm wheel, previously running loose on the crosshead spindle, which is caused to revolve by a screw in connection with the hand wheel. The crosshead sheaves are made of crucible cast steel.

A very neat and useful bulkhead winch, illustrated above, was exhibited by Messrs. Loudon Brothers, Glasgow. These winches are entirely self-contained and portable, so that they can be readily moved about from one position to another, and fixed by inserting three bolts. On steam vessels they are available in many cases where it would be inconvenient to use the ordinary winch, such as for raising the ash bucket and small loads from the engine-room, while on sailing vessels they are specially suited for trimming sails, hoisting boats, and a variety of other purposes. Messrs. Loudon Brothers also show the Clyde steam winch, which we referred to in our notice of the Naval Exhibition in 1881, the Clyde steam pump, and a number of machine tools and general engineers' fittings.



Slack's Emery Wheel and Machine Company, Limited, Manchester, exhibited a large assortment of their specialities, most of the machinery being in operation. These are too well known to require a detailed description, but we may specially draw attention to an improved double tool grinder for engineers' tools, with two wheels, each 36in. diameter and 3in. thick. The body of the machine forms a tank in the usual manner, and a centrifugal pump gives a steady supply of water to the wheels, back and front. Smith and Coventry's twist drill grinding gear can be attached to this machine, also a patent holder for grinding special tools.

An improved boiler for ships' launches, and stationary engines—Cates and Howard's patent—was shown by Messrs. Bush and de Soyres, Bristol. This boiler is an improvement upon the ordinary return tubular type, the furnace only extending to the back tube plates, so that the lower part of the combustion chamber and the space at the back is dispensed with. The makers claim that the durability of this boiler is very much greater than that of the ordinary marine type, while the weight and first cost are considerably less.

Messrs. Edward Brooke and Sons, Oughtibridge, near Sheffield, showed samples of their "special" silica bricks, employed where the most intense heats have to be withstood. They also showed samples of the stone from which they are manufactured. We are informed that the analysis of this gives, silica, 98·58 per cent.; alumina and loss making up the 100. The bricks are being largely used in Siemens' steel furnaces.

Messrs. Hunter and English, Bow, exhibited several of their specialities, among which we may mention Williams' patent hydraulic capstan. In this apparatus there are four cylinders, acting directly on the capstan spindle in pairs by means of dog links, so avoiding all trunnion joints. The cylinders are not placed opposite each other, but are removed from the centre line of the shaft a distance equal to half the length of the crank, the object of this being to make the path of the crank-pin more nearly coincide with the centre of effort of each ram as it is operating. Each pair of cylinders has one double-ported slide valve, worked by means of a lever and links from the rams of the other pair of cylinders, the stopping and starting the capstan being controlled in the usual manner by a valve worked by a treadle. All the parts are bolted up to a single circular casting forming the bed-plate, which is secured to the ground by four bolts, a recess being provided for the machinery. No brick or masonry pit is required.

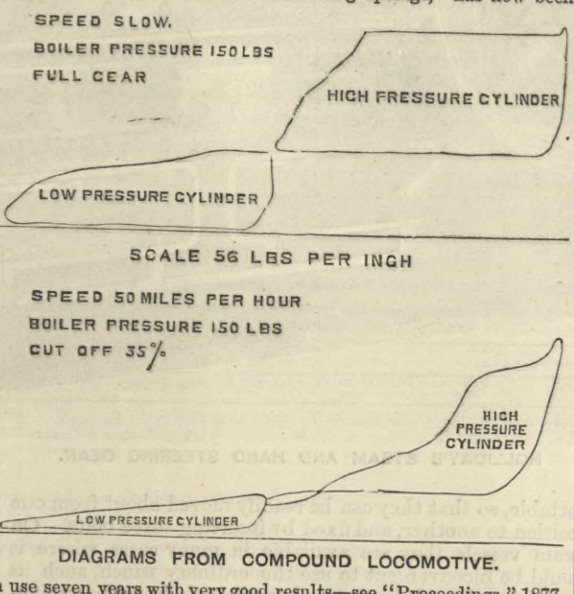
ON COMPOUND LOCOMOTIVE ENGINES.

By Mr. Francis W. Webb, of Crewe.*

The object of the present paper is to show what advantages may be obtained by compounding the locomotive engine, and how this may be practically carried out without materially adding to the weight or complicating the working parts. The subject is not a new one, as it has been dealt with in this Institution—"Proceedings" 1879, page 328—by M. Mallet, with regard to the Bayonne and Biaritz Railway. He succeeded in obtaining an economical engine, but in a form not likely to be a steady one at high speeds; great credit, however, is due to him for the attention he has given to the subject. About five years ago the author converted an old outside-cylinder engine with 15in. cylinders into a compound, on the plan adopted by M. Mallet, by lining up one of the cylinders, and reducing it to 9in. diameter. This engine has until the last three months been working light passenger trains on the Ashby and Nuneaton branch of the London and North-Western Railway; and the elements of success seen in its working led to the construction of the compound locomotive Experiment, which was what its name implies. The two main objects the author had in view when designing the Experiment were—firstly, to attain to greater economy in consumption of fuel; and secondly, to do away with coupling rods, while at the same time obtaining a greater weight for adhesion than would be possible on only one pair of driving wheels without rapid destruction of the road. The driving wheels being no longer coupled, there is less grinding action in passing round curves, and it is not even necessary that one pair should be of the same diameter as the other. The engine Experiment was constructed at the Crew locomotive works in the latter part of 1881, and has now been at work over twelve months, and run nearly 100,000 miles, chiefly with the Scotch and Irish limited mails. While on this work it made a daily run of 319 miles, and this being a longer mileage than the engines are accustomed to run in the time, two drivers and firemen were appointed to work the engine, one from Crewe to London and back one day, and the other the day following, in order thoroughly to test the engine in every way before building any more of a similar class. The engine has throughout proved itself to be very steady when running, which is no doubt

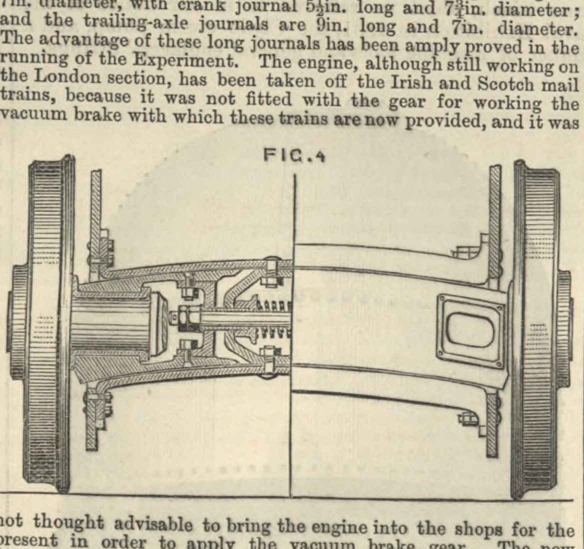
* Institution of Mechanical Engineers.

due to the arrangement of the cylinders; the engine being practically balanced, and having no coupling rods, is enabled to run at very high speeds. The principle having been proved correct, it was thought advisable, owing to the increasing weight and the high speeds of passenger trains, that in designing the new engines they should be made more powerful than the present type. Accordingly the high-pressure cylinders have been increased from $11\frac{1}{2}$in. to 13in. diameter, leaving the low-pressure cylinder of 26in. diameter the same as at present, with the exception of the ports, which have been increased from $1\frac{1}{2}$in. by 14in. to 2in. by 16in., in order to give more freedom for the exhaust. The construction will be readily understood from the following description, and from the diagrams, Figs. 1—3.* Of these, Fig. 1 is a section through the high-pressure cylinder, Fig. 2 through the low-pressure cylinder, Fig. 3 is a plan. There are two outside high-pressure cylinders of 13in. diameter, Figs. 1 and 2, and one inside low-pressure cylinder of 26in. diameter, Figs. 1 and 3, the stroke in each case being the same, namely, 24in. The two high-pressure cylinders have their steam-chests placed underneath, in order to allow the valves to fall from their faces; so that there is no wear when the steam is shut off. These two cylinders are attached to the outside frame plates immediately under the foot-plate, about midway between the leading and middle wheels, and are connected through their piston-rods and connecting-rods to the trailing wheels. The low-pressure cylinder, which has its steam chest on the top, is placed directly over the leading axle, and is carried between two cross steel plates, one at either end, securely fixed between the main frames; its connecting-rod lays hold of a single throw crank on the axle of the middle pair of wheels. The steam is supplied through the regulator in the dome A, Fig. 2, to a brass T-pipe on the smoke-box tube-plate, and thence by two 3in. copper steam pipes B, first running parallel to the tube-plate, then through the back-plate that carries the low-pressure cylinder, and between the plates of the inside and outside frames, to the steam-chests of the high-pressure cylinders. The exhaust steam from these cylinders is returned by two 4in. pipes C, running parallel with the high-pressure pipes, through the back plate that carries the low-pressure cylinder and into the smoke-box; following round the curved sides of the smoke-box nearly to the top, each pipe passes across to the opposite side, and enters the steam-chest of the low-pressure cylinder through passages in the cover. Thus the exhaust steam becomes superheated in these pipes by the waste gases in the smoke-box, while the large capacity of the pipes themselves obviates the necessity for a separate steam receiver. The final exhaust escapes from each side of the steam-chest of the low-pressure cylinder into the blast-pipe, and thence to the chimney in the usual way, the only difference being that there are only half the number of blasts for urging the fire compared with an ordinary engine; yet the compound engine steams very freely, and has a blast pipe of $4\frac{7}{8}$in. diameter for the final exhaust, compared with $4\frac{1}{2}$in. in engines of the ordinary type. The steam-chest cover of the large cylinder is provided with a relief valve D, so adjusted that the pressure admitted may never exceed 75 lb. per square inch; and a small pipe which is connected to the low-pressure steam pipe, and carried back to a gauge fixed inside the cab, shows at a glance the actual pressure of steam being used in the large cylinder. Arrangement is also made whereby steam direct from the boiler can be admitted to the low-pressure cylinder, which is useful for warming up before starting. The valve motion adopted for this engine is that designed by Mr. David Joy, and described at a former meeting—see "Proceedings" 1880, page 418—which does away with all excentric rods, and considerably reduces the number of working parts per cylinder, as well as the weight of the valve gear. The arrangement, however, for the new engines differs slightly from that on Experiment, in order to do away with the trunnion bearings on the foot plate. The total number of working or moving parts for the three sets of valve motion in the compound engine is twenty-nine, and their total weight 284 lb.; while the number of working parts in the two sets of valve motion in the ordinary standard engine is twenty-four, and their weight 793 lb.; the reversing shafts in each case not being taken into consideration. The valve chests being on the underside of the high-pressure cylinders, the motion discs E carrying the quadrant bars have to be placed in a corresponding position; and this is done by securing them to the underside of the slide bars. The quadrant bars, which are made of soft steel case hardened, are each grooved to a radius equal to the length of the valve rod link; and working in their grooves are brass side blocks F, carried by the lifting links G, to the lower end of which is attached the valve rod link H, and to the upper end the compensating link J on the connecting rod; the upper end of the compensating link is controlled by a rod K attached to a return crank on the trailing crank pin. The quadrant bars are lengthened out below the discs, so as to allow attachment to be made, by the link L, with the reversing shaft placed behind the trailing wheels. The reversing is effected by means of a screw-and-lever arrangement connected to the reversing shaft. The high-pressure slide valves are of the Trick or Allen type, which give double the lead shown at the edge of the port when the piston is at the end of its stroke; they have a travel of $3\frac{1}{8}$in. in full forward and backward gear. The lap is $\frac{3}{4}$in. and the lead $1\frac{1}{8}$in.; the port opens $\frac{3}{4}$in. for admission, and closes at 70 per cent. of the stroke. The sizes of the ports in the cylinders are, steam, $1\frac{1}{8}$in. by 9in.; exhaust, $2\frac{1}{2}$in. by 9in. The valve motion of the low-pressure cylinder differs slightly from that of the high-pressure. Instead of discs there is a cast iron shaft M, Figs. 2 and 3, carried in brackets, which are fixed to the inside frames, and the quadrant guides are bolted to it in the middle of its length. The other parts of the motion are similar to those of the high-pressure cylinders, the only difference being that the end of the compensating link in the low-pressure motion is attached to a radius rod N, centred on the back plate of the cylinder. At one end of the reversing shaft is fixed a lever, which is coupled direct by a long rod to a reversing handle on the foot-plate. The travel of the valve in full gear is $4\frac{1}{2}$in.; lap of valve, 1in.; lead, $\frac{3}{16}$in.; the port opens 1in. for admission, and is closed at 75 per cent. of the stroke, and the exhaust closes at 93 per cent. of the stroke. The sizes of the ports are, for steam, 2in. by 16in.; exhaust, $3\frac{1}{4}$in. by 16in. The reversing gears of the high and low-pressure cylinders are designed to work independently of each other, and no inconvenience has been experienced by this arrangement; they could if desired be connected, but this would mean complicating the parts, while no material advantage would be gained. With regard to the degree of expansion at which the engine is worked, in practice the low-pressure cylinder is kept nearly in full gear, while all the expansion is done in the small high-pressure cylinders, so that no more steam is used than is absolutely necessary to do the work. The commercial results with the engine Experiment have been very satisfactory. During the time the engine was working the Irish mail from Crewe to London, and the limited Scotch mail from London to Crewe, the average consumption per train mile was 26·6 lb. of coal, compared with 34·6 lb. the average consumption of the standard four-coupled passenger engines with 17in. cylinders and 24in. stroke, the boilers being precisely the same in each case. One of the principal features in the new engines has been the adoption of a boiler with the water space of the fire-box carried under the grate, Fig. 2, the space between it and the fire-bars forming the ashpan, just as was done in the case of the 18in. goods engine which was fully described at the meeting of the Institution at Barrow—"Proceedings" 1880, p. 432. The object is to do away with the rigid foundation ring, which is always a source of trouble; to obtain better circulation for the water; and to prevent the lodgment of dirt on the sides of the fire-box where subject to the most intense heat. A flanged mouthpiece, similar to that of the fire-box, is formed in the centre of the water-space, and covered with sliding doors worked from the foot-plate, so that the ashes can be easily removed or dropped; while any sediment that may collect in the water-space can readily be removed through the wash-out plugs in the sides of the fire-box, there being a clear passage from side to side when the covers are taken off. The mouth of the ashpan is made of such a width that the tube plate can be taken out and replaced by a new one, without disturbing the other parts of the fire-box. The principal features of the compound engine having thus been described, there are one or two other points to which a reference may be interesting. The leading axle, it will be noticed, is placed immediately under the large cylinder, Fig. 2, and nearly in a line with the centre of the chimney; consequently the wheel-base is longer than usual, the distance from leading to front driving-wheels being 9ft. 4in., and from front driving to trailing-wheels 8ft. 3in., making a total wheel-base of 17ft. 7in. To overcome the disadvantage attached to a long rigid wheel-base, the leading axle is provided with a radial box, Fig. 4, having a lateral movement of $1\frac{1}{4}$in. to each side of the centre line. The box is formed in a single casting, with the brasses fitted in each end, and works between curved plate-guides, stretched across from frame to frame. Inside the box and under the axle are carried two horizontal helical springs, coiled right and left hand, and working one inside the other; so that when the engine enters a curve, the springs are compressed towards one side, and take any shock that may be transmitted through the wheels from the rails; and when the engine gets on to the straight again, the springs resume their normal position, and keep the engine central. This class of axle-box, but with two sets of side controlling springs,* has now been in use seven years with very good results—see "Proceedings," 1877, p. 307—and 155 engines are fitted with it, 40 of them having one at each end. The journals of the axles, it will be seen, are long in each case. Those of the leading axle are 10in. long and 6in. diameter; while those of the front driving-axle are $13\frac{1}{2}$in. long and 7in. diameter, with crank journal $5\frac{1}{2}$in. long and $7\frac{3}{4}$in. diameter; and the trailing-axle journals are 9in. long and 7in. diameter. The advantage of these long journals has been amply proved in the running of the Experiment. The engine, although still working on the London section, has been taken off the Irish and Scotch mail trains, because it was not fitted with the gear for working the vacuum brake with which these trains are now provided, and it was not thought advisable to bring the engine into the shops for the present in order to apply the vacuum brake gear. The new engines, however, are fitted with ejectors and all the necessary gear for working the vacuum brake; and in addition with a steam brake, acting between the two pairs of driving-wheels. This is also coupled to the tender brake gear, so that the brake is applied to the engine and tender at the same time. A single movement of the driver's brake-handle serves to apply both the vacuum and the steam brake simultaneously; and similarly to release them together. Appended is a statement of the leading dimensions, &c., of these engines.



DIAGRAMS FROM COMPOUND LOCOMOTIVE.

FIG. 4



Three-cylinder Compound Express Passenger Locomotive.

Cylinders:—		
Two high-pressure outside cylinders	Diameter	13in.
	Stroke	24in.
One low-pressure inside cylinder	Diameter	26in.
	Stroke	24in.
Joy's valve motion.		
Wheels:—		ft. in.
Diameter of leading wheels, with radial axle-box		3 6
Diameter of front driving wheels (low-pressure cylinder)		6 6
Diameter of hind driving wheels (high-pressure cylinders)		6 6
Distance between leading and front driving wheels		9 4
Distance between front driving and hind driving wheels		8 3
Total wheel base		17 7
Boiler:—		
Length of barrel		9 10
Mean diameter of barrel, outside		4 $1\frac{3}{16}$
Length of fire-box, inside	4ft. $9\frac{1}{8}$in. at top	4 $10\frac{1}{2}$ at bottom.
Width of fire-box, inside		3 $5\frac{1}{4}$
Height of fire-box from top of fire-bars to crown		5 $5\frac{1}{2}$
Length of tubes between tube plates		10 1
Diameter of tubes, outside		0 $1\frac{7}{8}$
Number of tubes		198
Heating surface:—		
Fire-box		103·5 square feet.
Tubes		980 "
Total		1083·5
Area of fire-grate		17·1 square feet.
Ratio of heating surface to grate area = 63·35 to 1.		
Weight:—		
Weight of engine when empty		34·75 tons.
Weight of engine when in working order—		
Leading wheels	10·40 tons	
Front driving wheels	14·20 tons	
Hind driving wheels	13·15 tons	
Total		37·75 tons

In closing this paper the writer wishes to add that his motive in laying before the members of the Institution the particulars of his system of compounding locomotives is to draw attention to the subject, and encourage its full investigation, as he feels assured that better economical results are to be obtained than those which he has already found.

* Of these Figs. 1 and 3 will appear in our next impression.

* The single set of springs is a great improvement, as there is otherwise a possibility of side action, in case one set of springs breaks or is weaker than the other.

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

(*From our own Correspondent.*)

WITH the exception of the operatives at two or three works, the ironworkers in the Smethwick, Oldbury, and West Bromwich localities have refused to return to work. A meeting of masters connected with the Wages Board was therefore held on Tuesday in Birmingham. Mr. Benjamin Hingley, chairman, presided, and there were about fifty employers present, representing all the leading firms. It was reported that about 3500 men are still on strike. The feeling of the meeting was against resorting to the extreme remedy of a lock-out, since the area of the strike was lessening daily. It was further stated that fourteen days' notice would have to be given before such action could legally take place. Ultimately it was resolved—Firstly, "That those ironmasters whose works are still stopped by the strike shall be subsidised and protected from loss, and they shall be allowed a sum of £5 per furnace per week from the 30th of this month—July—for every furnace they have standing, and this shall continue until the strike ends;" secondly, "That those ironmasters whose furnaces are in operation shall contribute the sum of £1 per week for each puddling furnace in operation, to be distributed *pro rata* amongst those employers whose puddlers are on strike, and that this contribution continue to the end of the strike;" and thirdly, "That the ironmasters of South Staffordshire call upon the ironmasters in every other district to afford assistance." A committee was appointed to superintend the distribution of the funds.

The men on strike are badly off for funds. Last week the committee stated that they expected to be able to distribute about 10s. to each man; but the amount actually forthcoming was only 1s. 3d. to each puddler and 8d. each to the other hands. This week the fore hands received 2s. 4d. each and the under hands 1s. 2d. each. There are not wanting indications that the men are wavering. At a meeting at Smethwick on Wednesday a large vote was given in favour of resuming at the drop; but it is not yet clear whether the vote will be put into action.

On 'Change in Wolverhampton yesterday, and in Birmingham this afternoon, satisfaction was general at the course which masters had taken. It was universally agreed that a lockout would have been disastrous by causing valuable orders to be placed elsewhere, and the opinion was equally wide that the policy adopted would be successful in bringing the strike to an end. The market had an improved aspect upon a week ago, since the uncertainties which then existed as to future supplies are now removed.

Sheets again led the market alike as to demand and price. Consumers were pressing makers for deliveries, and these were firm in asking their 5s. advance noted last week. A few of those whose order books are especially well placed asked 7s. 6d. rise. In other than exceptional cases buyers refused to give this latter advance. Singles were quoted £7 15s., and doubles £8 10s. to £8 15s., with latens at £1 additional.

The galvanisers reported themselves busy, and were asking better prices. They quoted £3 10s. for 24 w.g., packed in bundles, delivered Liverpool; £15 10s. for 26 w.g., and £17s. 10s. for 30 w.g.

The first bar houses in the trade gave their quotations this afternoon as: Marked bars, £7 10s.; best ditto, £9; best best, £10; best scrap bars, £9; best ditto, £10; best chain bars, £9; best best ditto, £10; best turning bars, £11 easy; and double best charcoal bars, £16 easy. From bar firms of less repute, but who, nevertheless, occupy a good position, supplies might have been obtained at 10s. per ton less than these prices.

Common bars were £6 10s. to £6 as a minimum. One or two makers of gas strip spoke of sales at 5s. per ton advance upon former rates, but this advance did not leave prices at more than £6 5s. Hoops were generally £6 10s.; wire rods were £7 easy, delivered Liverpool

In the pig iron trade the demand remains quiet. Stocks have accumulated in consumers' hands, and until these are worked off they will not consent to accept deliveries with much vigour. Prices are weak. Native all-mines are nominal at 62s. 6d. to 65s., and the "Willingsworth" brand of native pigs is quoted 45s. to 47s. 6d. The Tredegar—South Wales—brand of hematites has this week been reduced 2s. 6d., making the quotation 62s. 6d. Some other descriptions of hematites may be had at 60s. Common Staffordshire pigs are 42s. 6d. to 38s. 9d., less $2\frac{1}{2}$ per cent.

Circulars are this week to hand from the Cannock Chase coalmasters, advancing all descriptions of house coal 1s. per ton. Fuel from the deep seams now becomes: Best, 11s.; deep one way, 10s.; "cobbles," 9s. Shallow seams, best, 10s.; deep one way, 9s.; "cobbles," 8s. to 7s. 6d. Steam and forge coal is unaltered, and the former stands at 5s. 6d., and the latter at 5s. 6d. to 6s.

This week the wages arrangement in the South Staffordshire coal trade which has long been known as the "Birmingham Agreement" terminates. It is proposed to substitute a wages board, to consist of twelve workmen and twelve masters. Already the men's representatives have been chosen. It is understood that pending the completion of arrangements the present wages are to continue in force.

This—Thursday—afternoon a meeting of the Coalmasters' Association was held in Birmingham to open voting papers for the election of the twelve representative masters upon the new Standing Management Committee. Elected, W. Bassans, Old Hill; C. Cochrane, Woodside; F. Groucutt, Bilston; Swindell and Collis, Old Hill; Crazebrook and Aston, Gospel Oak; Pelsall Coal and Iron Company; Himstead Colliery Company; Rowley Station Colliery Company; Phillip Williams and Sons, Wednesbury Oak; D. and R. Thomas, Bloxwich; Joseph King and Co., Stourbridge; and the Rowley Hall Colliery Co. The chairman is elected next week.

The bridge, roofing, and girder yards are active. A firm in the Dudley district is engaged on an extensive iron bridge to cross the river Georges, in New South Wales. Is is to consist of six openings, each to be spanned by two main girders, each 160ft. long, making in the aggregate twelve main girders, with the usual cross girders, bracings, &c. Colonial orders from other sources consist of bridges for different parts of Australia and the Cape of Good Hope, iron railway roofing for Ceylon, and pier work for Cyprus.

The steam tramcars in Birmingham, the introduction of which caused considerable diversity of opinion, have so far proved a great success. At the first annual meeting on Wednesday, a dividend of 6 per cent. was declared, and the chairman stated that, taking into consideration what was placed to the reserve fund, and what had been written off for the preliminary costs, the dividend was equal to 10 per cent.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—In the iron trade of this district the market continues quiet, but the continued absence of any weight of business coming forward generally has so far had no very appreciable effect upon prices. Makers are still kept well employed on work in hand, and offer no concessions to stimulate business. Buyers hold back as long as possible any orders they may have to place in the hope of getting more favourable terms, but they are unable to move makers, and as it is found that concessions are not obtainable, business slowly results at the full rates. Buyers, however, are not disposed to accept present prices as a permanent basis of values, and transactions as a rule are limited to pressing requirements. In the finished iron trade, the local sheet makers are kept very busy with orders that have come into this district as the result of the Staffordshire strike, and this is enabling them to realise better prices, At the Manchester market on Tuesday business was flat. Inquiries for pig iron were very small, but prices were firm at last week's rates. Moderate orders for Lancashire pig iron have been given out during the last few days on the basis of 45s. for forge and 45s. 6d. for foundry less 2½ delivered equal to Manchester, and in district brands a few occasional sales are made at about 44s. 10d. to 45s. 10d. for forge and foundry Lincolnshire and 48s. 6d. for foundry Derbyshire less 2½ delivered here. Moderate inquiries for hematite from the Sheffield district were reported, but the demand locally continues very dull, with 60s. per ton less 2½ for good foundry qualities delivered equal to Manchester representing the sticking point below which makers are not disposed to go, and which buyers at present are not disposed to give.

A fairly good demand for iron ore is reported in this market, and moderate sales have been placed on the basis of 7s. 6d. to 7s. 2d. per ton for good purple ore delivered at Widnes.

In the finished iron trade there is not, with the exception of sheets, any great weight of business offering, but makers are mostly fully employed, and are firm in their prices. For local-made sheets delivered into the Manchester district prices now average £8 to £8 5s. per ton, with very few Staffordshire qualities to be bought under £8 7s. 6d.; hoops average £6 12s. 6d., and bars £6 2s. 6d. to £6 5s. per ton. Bar iron, however, meets with only a slow sale, and if there is any weakness in the market, it is here, makers in some cases showing a disposition to give way slightly to secure orders.

Founders generally throughout the district are only poorly supplied with orders. Here and there special work is keeping them busy, but of the ordinary class of work there is comparatively little giving out, and orders are competed for at very low prices. Cast iron columns for building purposes can be got at about 6s. per cwt. delivered equal to Manchester, and ordinary pipe castings at as low as £4 10s. to £4 12s. per ton.

The engineering trades, so far as tool-makers, locomotive builders, and marine work are concerned, are kept generally well employed, but small stationary engine builders are only very moderately supplied with work, and cotton machinists, as a rule, are far from busy.

A fine art and industrial exhibition was opened at Oldham on Wednesday. The industrial section is devoted mainly to cotton manufacturing machinery, and is probably one of the best of its kind that has ever been brought together. I must, however, hold over for the present any attempt at detailed description.

Messrs. De Bergue and Co., of the Strangeways Ironworks, Manchester, have in hand several special machine tools of which a brief notice will be of interest. An exceptionally powerful plate shearing machine has just been completed for France. In this machine the shear blades are 10ft. 7in. long and the gap or distance from the blades to the face of the main standard is 3ft. Each half of the bottom shear blade block is cast to its corresponding side standard, and the halves are firmly united with turned bolts at front as well as through vertical flanges behind the cutter, which act as struts from the base plates also cast with each standard. This plan not only gives great rigidity to the cutter block, but renders the machine independent of all masonry foundation. The steam cylinder, which is of exceptionally large capacity, has a diameter of 18in., with a stroke of 20in., thus insuring ample power, with only a moderate pressure of steam, for shearing with ease a 1¼in. plate, the longest and heaviest cut within the compass of the machine at one stroke; and this is the test-capacity of the machine. The main excentric shaft is of steel, the bearings are all bushed with gun-metal, and the total weight with steam engine is about 33 tons. The firm have also just completed a powerful double-acting puddled bar shearing machine for the North of England, and they have two other similar machines in hand for the Butterley Iron Company. These machines have an exceptional capacity for work, as they are constructed to cut puddled bars up to 18in. by 1½in. continuously, at a speed of sixteen to eighteen cuts per minute at each side of the machine. They have steam cylinders of 17in. diameter, with 12in. stroke, and the machines each weigh about 20 tons. Another tool of a special character in hand at Messrs. De Bergue's works is a multiple punching machine for boiler plates. The machine is being constructed to punch all the holes both in the ends and sides of a boiler plate automatically, without stopping, and can be regulated for any pitch of holes. It will enable a plate having 200 holes to be punched throughout in 3½ minutes, whilst accuracy of pitch will be secured. Amongst other work in hand, the firm are very busy on orders for girders, both iron and steel, as well as roofing.

During a recent visit to the works of Messrs. Hetherington and Co., of Manchester, I had an opportunity of inspecting several specialties they have in hand. In machine tools for marine work it is almost needless to say that constant improvements are rendered almost imperative to meet the varying requirements of marine engineering, and in this direction Messrs. Hetherington had in hand a 24in. stroke slotting machine for a firm in the North of England, in which a special feature has been introduced in the shape of an adjustable slide carrying the ram, by means of which the ram can be supported when cutting close to the table. The slide is raised and lowered by being fastened to the ram by means of a special screw, and the bolts holding the slide to the frame being slacked, the machine is set in motion, bringing the slide to the position required. The machine is then stopped, the slide locked in its given position, and the special screw slacked off. The ram which is balanced can be raised or lowered by a screw at either end, and the machine, which is of massive character throughout, weighs about 20 tons. Other work of a special kind was an improved patent safety hoist for workshops and mills, which is so constructed that if the rope or ropes break the cage cannot fall a greater distance than 9in. This is effected by means of lever bolts which are fixed to two cross shafts in the same bearings, each shaft being worked by a quadrant and rack in connection with powerful springs. The breakage of either of the ropes would at once cause the bolts to shoot out into cast iron racks fixed in the well hole at right angles to each other, thereby stopping the further descent of the cage. For the purpose of testing at any time the working condition of the safety apparatus the attendant can by means of a lever liberate the bolts, and thus ascertain that the springs are right, the bolts can then by means of another lever, whilst the cage is ascending, be returned to their original position. This principle has already been adopted for the hoists at Messrs. Hetherington's establishment, and another feature I noticed in connection with the works was the introduction of rope driving instead of the ordinary shafts and gearing. The main rope pulley was 25ft. in diameter, had twenty separate grooves, and weighed about 32 tons, and from this pulley power is distributed throughout the works.

The Building Trades Exhibition, which was recently opened in the St. James's Hall by the Mayor of Manchester, is naturally, to some extent, a repetition of the similar exhibition held previously in London. A very excellent collection of exhibits has, however, been got together; but one section is not so well represented as it might be. Considering how largely iron is now being introduced for building and general constructive work, especially where space and strength have to be considered, it might have been expected that the ironworks in the district would have put in a good appearance. This section of building work is, however, practically represented by only one important firm, Messrs. Wm. Barningham and Co., of Pendleton, whose exhibits comprise wrought iron rolled joists and beams, ranging from 3in. in depth and 4 lb. per foot up to 18in. deep and 80 lb. per foot, together with combination beams of great strength and completeness, made with rolled girders and plates rivetted on the top and bottom flanges. There are also sections of angle and tee iron, samples of mild tough steel bars bent double whilst cold without fracture, and this material I understand can also be worked and welded in the same manner as malleable iron. As one of the oldest manufacturing firms of railway material in the country, Messrs. Barningham have added to their exhibits sections of iron and steel rails from 10 lb. to 85 lb. per yard, chairs, fish plates, rail benders, and turntables for contractors, which can be fixed without any special foundations, and are easily removed from place to place.

In the coal trade a steady business continues to be done. The pits, on an average, are being kept working four or five days a week, and although the whole of the output is not going away, the accumulation of stocks is not at all heavy generally for the time of year. Both the best and common classes of round coal are moving off moderately well; but slack is still plentiful in the market, and common qualities can be bought at very low prices. There has been no material alteration in prices with the commencement of the month; but prices are steady at late rates, with a decided stiffening tendency for anything like forward sales. At the pit mouth the average prices are as under:—Best coal, 9s.; seconds, 7s.; common round coal, 5s. 6d. to 6s.; burgy, 4s. 6d. to 5s.; best slack, 4s. to 4s. 3d.; and common, 3s. to 3s. 3d. per ton.

The shipping trade has been fairly brisk, but no appreciably better prices are being obtained, steam coal delivered at the high level, Liverpool, or the Garston Docks, still averaging 7s. 3d. to 7s. 6d.; and seconds—house coal—8s. 6d. per ton.

For coke there is a tolerably good demand at late rates.

Barrow.—The attitude of the hematite iron trade remains very quiet, and the business which has lately come to hand is inconsiderable. The works in some instances are fairly well employed, but this is only the case where either steel works exist or where large supplies of iron are produced for steel conversion. Makers as a rule are holding large stocks in the hopes of a better market. Prices remain at 50s. per ton for mixed parcels of Bessemer, and 49s. for No. 3 forge. Orders have been offered at prices a little lower than this, but have not been accepted. The business on foreign and colonial behalf is a little firmer than last week, and it is expected that during the coming week it will see a further improvement. Steel makers are fairly employed, and the output remains steady. Prices are unchanged at from £5 per ton. Iron ore is in fair request at 9s. to 11s. 6d. per ton at the mines. Coal and coke remain steady, except for manufacturing qualities, which are in a little better demand. Shipping is fairly employed.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

COMPLAINTS are common on every side with regard to the steel trade, both in crucible and Bessemer. Business is undoubtedly very quiet, both for the continental and colonial markets, while there is no change for the better in the home districts. Among the few firms who are doing fairly well on Australian account may be mentioned Messrs. W. Turner and Sons, of the Caledonia Works, and Messrs. Christopher Johnson and Co.

The sheep shear season is now over. Though several good orders have been received, it can scarcely be regarded as equal to previous seasons. This falling off is mainly owing to overstocking in South America, and the utter failure of the Cape markets. Most deplorable accounts are given of the latter region. A large house in Sheffield, which usually has very important sheep-shear dealings with the Cape, has not at this moment a single order on its books from any merchant there. All the transactions reported—and these are of a limited character—are from London dealers. Messrs. Ward and Payne are completing extensive premises at "Limerick Wheel," in the Hillsborough district, to which they intend transferring the whole of their sheep-shear manufacture. They will retain at West-street, for the present, at all events, the production of edge tools and carving tools, in both of which departments the firm are actively engaged for the Continent as well as for the colonies. America is an important customer for carving tools. Messrs. Ward and Payne have this season had several gratifying lines for sheep-shears from California, a market of which too little is heard in Sheffield.

Razors continue to be in lighter demand, but Messrs. W. and S. Butcher, of Arundel-street, who have a large American connection, have not as yet severely felt the increased duty imposed by the States upon this class of goods. They report that their "Wade" razors are still freely called for; and there is no doubt the Americans will not be deterred, by an extra 15 per cent., from indulging in the luxury of shaving with a reliable razor to which they are accustomed.

Messrs. Samuel Laycock and Sons, of Portobello-place, Sheffield, who sent an interesting exhibit to the Chicago Exhibition for foreign railway appliances, have had awarded to them the first prize, for Mr. W. S. Laycock's patent railway passenger carriage blind.

At Chesterfield a conference of East Derbyshire miners was held on Saturday afternoon. The question of the increasing use of lamps in Derbyshire was considered. The men greatly dislike lamps on the ground that they interfere with their work and affect their sight. Several colliers declared they would rather work for 6d. per day less with a candle, and it was decided to try and get extra remuneration where lamps are used. Complaint was made that the men were being widely pressed to join the Fatal Accident Relief Society. And all this discussion took place within a mile or two of Clay Cross, where less than a year ago near half-a-hundred lives were lost by a colliery explosion!

The Magpie Lead Mine, situate at Sheldon, near Bakewell, in the High Peak of Derbyshire, is on the point of being closed. At a general meeting of shareholders, held at Sheffield on Tuesday, this resolution was adopted, and it was decided to pay off the liabilities by a call of £3 per share. As there are 892 shares in the concern, with £32 per share paid-up, the loss to the shareholders—excluding loss of interest on capital—will be about £34,000. The mine has been worked for between three and four hundred years, with the exception of a short interval from 1843 to 1869. In the latter year it was opened out by Mr. Rawson Barker, Alderman Fairburn, and other Sheffield gentlemen, who were induced to enter upon the enterprise from the large returns of ore which the books showed had been made from time to time. The Magpie being a heavily watered mine, it was thought desirable to put down powerful pumping machinery, with which 1800 gallons of water per minute were brought up at an expenditure of 80 to 100 tons of coal per week. This was done for two years, during which £19,000 worth of ore was raised. Then it was resolved to get rid of the water by driving a level to the river Wye. This was done at a cost of £14,000. All this time, from 1869 to the present, the owners have been working without dividends. In cutting the level a vein of zinc ore was discovered, which was regarded as of immense value, and the hopes of the proprietors were further raised by the opinion of competent experts who examined samples. The company at once commenced to lay down a four-feet track to the deposit, but they had no sooner commenced to win the zinc ore than they found it was all on the face of the rock, and behind it was a huge cavern, in which all their hopes of profit vanished. The chairman of the company, Alderman Fairburn, formerly Mayor of Sheffield, has filed his petition, with liabilities estimated at £20,000. His failure is owing to the long-continued depression in the lead trade, the value of ore having fallen from £24 to £12 10s. per ton, and chiefly to the collapse of the Magpie enterprise, in which he and his friends were heavily concerned. Very great sympathy is expressed for Mr. Fairburn, who is highly respected.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland pig iron trade has been in a dull, inanimate condition during the last few days. Makers will not accept the low prices current, and consequently merchants monopolise whatever business is being transacted. Only small quantities are, however, obtainable at the low rates which ruled last week. The market value of No. 3 g.m.b. is 39s. per ton; but some merchants will not take less than 39s. 3d., and makers, as a rule, continue to quote 39s. 6d. to 40s. per ton.

Warrants are seldom asked for. The price is nominally 39s. per ton delivered f.o.b.

The stock of Cleveland pig iron in Messrs. Connals' Middlesbrough store on Monday night was 73,667 tons, being a decrease of 74 tons for the week. In their Glasgow store they hold 584,558 tons of iron.

The shipments from the Tees for July are considered satisfactory. There were 84,392 tons of pig iron shipped, against 94,043 tons for June, and 74,311 tons for July last year. The following are the principal items:—Scotland took 22,060 tons; Germany, 15,305 tons; France, 9370 tons; Wales, 5682 tons; Newcastle, 4835 tons; Belgium, 4290 tons; and Russia, 4240 tons.

The shipments of manufactured iron and steel amounted to 34,540 tons. Last month the quantity was only 19,815 tons.

There is no new feature to report with respect to the manufactured iron trade. Fresh orders are somewhat scarce, but prices are maintained, as the leading makers have work which will keep them going for some time yet. Last week's rates are still quoted, and are as follows:—Ship plates, £6 to £6 5s.; shipbuilding angles, £5 12s. 6d. to £5 15s.; engineering angles, £5 17s. 6d.; and common bars, £5 15s. to £6 per ton, free on trucks at makers' works, cash 10th, less 2½ per cent.

The accountants' certificate under the sliding scale in connection with the Durham coal trade gives the net average selling price of coal for the quarter ending June 30th as 4s. 10·71d. per ton. The present rate of wages will remain unaltered.

The accountants' report to the North of England Board of Arbitration was issued on Wednesday, the 25th ult. It shows that the average net selling price of manufactured iron for the three months ending June 30th, was £6 4s. 2·98d. per ton. In the quarter ending March the price was £6 6s. 0·20d. The sales of five firms, not previously included in the returns, are now given, and consequently the total quantity upon which the average is taken is now much larger. The deliveries of finished iron of all kinds for the three months amounted to 173,910 tons. There will be no alteration in the rate of wages paid, as the award given by Sir J. W. Pease covers the present year.

The half-yearly meeting of the Board of Arbitration was held at Darlington on Monday last. The standing committee's report showed the number of firms in membership to be sixteen, or four less than at the beginning of the year, and the number of operative subscribing members to be 9037. The income for the half-year was £984 9s., and the expenditure £815 17s. 2d., leaving a balance in hand of £168 11s. 10d.

At a meeting of creditors and shareholders of the South Bank Iron Company, Limited, held at Middlesbrough on the 26th ult., resolutions were passed accepting an offer by Mr. Coulthard, of London, the first mortgagee, to pay 10s. in the pound to the other creditors, he retaining possession of the works. This composition, added to the mortgages on the property, makes the purchase price about £32,000. A syndicate of capitalists will be formed to acquire the property, but it is not likely that they will commence active operations until trade improves.

A preliminary programme of the ensuing meeting of the Iron and Steel Institute, to be held at Middlesbrough from the 18th to the 21st of September, has been issued. There will be general meetings for the reading and discussion of papers on the mornings of the first three days. Excursions are arranged to the steelworks and blast furnaces of Messrs. Bolckow, Vaughan, and Co., the blast furnaces and salt works of Messrs. Bell Bros., the North-Eastern Steelworks, and the other ironworks at Middlesbrough, the ironworks and shipyards at Stockton, and the Cleveland ironstone mines. A special train will be run to Crook, where the new coke ovens on the Simon Carvès system are to be seen at work at Messrs. Pearce and Partners' collieries.

At the general meeting of the Consett Iron Company, Limited, to be held on the 18th inst., the directors will recommend the payment of a dividend of 15s. per share. The Consett Spanish Ore Company, Limited, will hold a meeting on the same day, and a dividend of 2s. per share will be recommended.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow warrant market has been considerably more active this week. A larger quantity of iron found purchasers than usual, speculators having been influenced to buy on account of the advance in the price of coals. Prices advanced during the first two days of the week, and then the market quietened a little, there being a disposition to wait and see if the value of coals would rise all over the country, and if there was any likelihood of wages also being affected. The shipments of pig iron were very good in the past week, exceeding 14,000 tons, and the stocks in the warrant stores show a decline of about 500 tons for the week.

Business was done in the warrant market on Friday forenoon at 47s. 3½d. to 47s. 5d. cash, and 47s. 6d. to 47s. 7d. one month, the afternoon quotations being 47s. 4½d. to 47s. 5d. cash, and 47s. 6½d. to 47s. 7d. one month. On Monday morning transactions took place at 47s. 5½d. to 47s. 7d. cash, and 47s. 7½d. to 47s. 9d. one month; while the afternoon business was at 47s. 8d. to 47s. 5½d. cash, and 47s. 10d. to 47s. 9½d. one month. On Tuesday forenoon business took place at from 47s. 7d. to 47s. 8½d. cash, and 47s. 10d. to 47s. 10½d. one month, there being a slight reaction to 47s. 6d. in the afternoon. Business was done on Wednesday at 47s. 6d. to 47s. 5d. cash, and 47s. 8d. to 47s. 7d. one month. To-day—Thursday—business was done at 47s. 5d. to 47s. 7d. cash, and 47s. 8d. to 47s. 9d. one month.

The values of makers' iron have been firm, and an advance has been noted in Carnbroe and Glengarnock. The quotations are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 57s.; No. 3, 53s.; Coltness, 61s. and 53s. 6d.; Langloan, 60s. and 53s. 6d.; Summerlee, 57s. 6d. and 51s. 3d.; Chapelhall, 57s. and 54s.; Calder, 57s. 6d. and 50s. 6d.; Carnbroe, 55s. and 49s. 3d.; Clyde, 50s. 9d. and 48s. 9d.; Monkland, 48s. 6d. and 46s. 6d.; Quarter, 47s. 6d. and 45s. 6d.; Govan, at Broomielaw, 48s. 9d. and 46s. 9d.; Shotts, at Leith, 59s. 6d. and 54s. 6d.; Carron, at Grangemouth, 48s. 6d. (specially selected, 54s. 6d.) and 47s.; Kinneil, at Bo'ness, 49s. 6d. and 48s.; Glengarnock, at Ardrossan, 55s. 3d. and 48s.; Eglinton, 48s. 9d. and 46s.; Dalmellington, 49s. 6d. and 48s. 6d.

The state of business in the manufactured iron trade is quite satisfactory, and the prospects appear as good as they have been any time during the present year. Prices of malleable iron are firm, and merchants are awaiting certain eventualities in the hope of some advance being obtained. In the past week the shipments of iron manufactures from Glasgow were not quite so large as usual, but they may be expected to improve in succeeding weeks. Exclusive of pig iron, which was valued at £7800, they consisted of £19,100 worth of machinery, £2100 steel goods, and £15,100 general iron manufactures.

The coal trade is quite brisk. The shipping qualities have been advanced about 4d. per ton at Glasgow, and it is the intention of a number of coalmasters to obtain an advance of about 1s. per ton on inland sales if at all possible. The experiment is being made in Lanarkshire this week, and it lies in the hands of the coalmasters themselves to procure the increase. If they are faithful to each other it will become general; if not, it may end in failure. There is a general belief that a slight advance in prices would be beneficial far beyond the coal trade, and that at present it could not possibly have any ill effects. The week's coal shipments from Glasgow included 4050 tons for Canada, 3100 for Genoa and Mediterranean ports, 1600 for San Francisco, 800 tons for the West Indies, 800 for France, and 700 for Gibraltar. On the east coast trade has been fairly good, although in some localities interruptions have been experienced from workpeople taking holidays. The coal shipped at Bo'ness is about 4500 tons, there being rather less dispatched from Leith, and close upon 9000 tons at Grangemouth. In Fife trade is very good, and the average quotations for coals f.o.b. at Burntisland is given at 7s. 9d., while superior qualities are quoted at from

8s. 3d. to 8s. 8d. per ton. Stocks have become very small, and the outlook altogether is better than of late.

Mr. William Fraser, late manager of the Uphall Oil Company, has obtained on lease from Mr. M'Lagan, M.P., an extensive and valuable mineral field on the estate of Pumpherston.

The directors of the Cambuslang Coal Company, Limited, have issued a favourable report on the operations of the company for the past twelve months. They are distributing 5 per cent. dividend among the shareholders, at the same time that they set aside a considerable sum to meet previous losses, and continue to develope the output.

The miners of Fife and Clackmannan do not appear satisfied with the advance of 4½d. per day, given them by the employers. At a meeting, held at Kelty, in the West of Fife, on Saturday, it was asserted that the increase ought to have been twice as much. It was resolved to ask for an additional 6d. per day.

The coalmasters of Mid and East Lothian have resolved to return to their men the amount of the last reduction of wages.

The new vessels launched on the Clyde during July numbered twenty-five, with an aggregate tonnage of 28,715, as compared with twenty-four vessels of 28,380 tons in the corresponding month last year.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

Newport presents a very satisfactory aspect at present. The lines to the Alexandra Dock this week were thronged, and the whole district showed a great amount of vitality. I visited the port this week and was much struck with the condition of things. The rivalry to Cardiff is a keen one. In the close vicinity, in a railway sense, we have also the Severn Tunnel, which is prosecuted with vigour. Mr. Walker has still an enormous amount of work to achieve, but he is doing it satisfactorily.

The Chepstow shipbuilding industry is satisfactory. The iron and coal industries of Wales are in a satisfactory condition, the latter especially, and a large amount of business has been done in Cardiff, Newport, and Swansea during the week. Cardiff in particular has been very busy, and the railway occupied to the greatest extent of capacity.

I note that the new branch of the Taff, near Aberdare Junction, is still unused, waiting the colliery developments in the neighbourhood. The new line to Newport, *viâ* Caerphilly, is progressing. Probably October will witness the opening. The new line from Quaker's-yard into Cyfarthfa works and collieries is also in good hands. At one point the work will be a costly one—the viaduct spanning the river—in which the Taff Vale Railway will be jointly interested.

The colliery districts are quiet with one exception—that of Mountain Ash—where the doctor's dispute continues to attract attention. Probably—thanks to the offices of Mr. W. T. Lewis—an agreement will be brought about this week. I should like to see the generous offer of Mr. Nixon taken to establish an accident fund out of the surplus left after paying "the doctor." The proposed arrangement is between Mr. Abraham and others on the part of the men, and Mr. W. T. Lewis on the part of the owners of the collieries, first, that a fund shall be formed to be called the Nixon's Navigation Medical Fund; secondly, that such fund shall be governed by a committee of the workmen not exceeding one to every 100 men employed; thirdly, that the committee shall be nominated by the workmen. Further, the agreement stipulates that the workmen shall pay 2d. in the £; that the aid of the colliery clerks shall be given in the management of the accounts. Some degree of peace may now be expected after the turmoil, for I fully expect that the workmen will ratify the agreement, and Mr. Lewis will have accomplished another great work, and that may be taken as a copy for the whole of the colliery districts. The question of medical and surgical arrangements as connected with collieries has always been a vexed one; now light begins to be seen ahead.

There is nothing new with regard to the iron and steel trade. Local railways are buying more freely, and Canadian business is tolerably good. Tin-plate is unchanged.

The Powell Duffryn Company have won the 4ft. seam at their new sinking of Lower Duffryn. This adds several hundred acres of this valuable seam to their mineral stores. There is a prospect of a new sinking near Pontllanpraith by the Newport Abercarn Steam Coal Company.

Bridges and Structural Ironwork.—Manufacturers in these branches continue busy, and early delivery cannot easily be obtained at current prices. Some very large orders for India have been given out during the past half-year, and these, added to foreign, colonial, and home orders, will afford employment for the factories till the end of the year, and bridges have been ordered on the Continent that would in ordinary course have been made in this country. The results, if quality and price be considered together, are not such as to cause any uneasiness concerning foreign competition. The introduction of steel continues to make progress, but the advantages it affords are not yet fully understood. A saving in weight and a consequent reduction in the total cost to that of an iron structure is not the only gain. It is rather in the facilities that its superior ductility allows, in the new shapes that can be given to parts when made of mild steel, and in the superior strength which steel affords to small as well as large structures, that must ultimately lead to its universal adoption, and, if judged on these bases, steel is really cheaper than iron. The construction of big bridges is much encouraged by recent success. The New York Brooklyn Bridge has been opened for traffic with much *éclat;* the Forth Bridge, which in stability and dimensions will much exceed it, is now fairly commenced. The Attock Bridge in India, one of the largest in the world, is completed. The manufacture of the Benares Bridge of steel is nearly finished, and the caisson piers are well advanced *in situ.* Over the Thames at London new bridges are to be constructed at Blackfriars, Battersea, Hammersmith, and Putney, and one at the Tower for East-end traffic cannot much longer be delayed.—*Matheson and Grant's Trade Report.*

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office officials, by giving the number of the page of* The Engineer *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* The Engineer *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the numbers of the Specification.*

Applications for Letters Patent.

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

24th July, 1883.

3619. Glass Ware, A. G. Brookes.—(*W. L. Libbey, U.S.*)
3620. Anti-friction Roller Devices, J. H. Johnson.—(*H. G. Yates, A. Shotwell, and L. W. Boyer, U.S.*)
3621. Telegraphic Apparatus, H. H. Lake.—(*F. van Rysselberghe, Belgium*)
3622. Smoking Pipes, J. H. M. Locke, Chesterfield.
3623. Sheep Shears, T. Birkhead, Sheffield.
3624. Extracting Sulphur Compounds from Alkali Waste, J. Simpson, Liverpool.
3625. Printing, &c., Tickets for Tram-cars, T. King, East Dulwich, and R. Wilson, Wandsworth.
3626. Hair Pins, W. A. Anderton, Bradford.
3627. Treating Phosphates, H. J. Haddan.—(*A. H. Koefoed and T. B. Stillman, New York.*)
3628. Velocipedes, M. D. Rucker and J. Winterschladen, London.
3629. Advertising, A. M. Clark.—(*C. Herbelot, Paris.*)
3630. Ornamental Fabrics, &c., W. Clark.—(*E. Barou, Paris.*)
3631. Steam Cultivation, A. Greig, Leeds.
3632. Preparing Insulated Wires, H. E. Newton.—(*A. A. Cowles, New York.*)
3633. Machines for Obtaining Electric Currents, E. Jones, Leeds.
3634. Hygienic Joint for Doors, B. J. B. Mills.—(*J. Couturier, Lyons.*)
3635. Machines for Indicating Weights, T. H. Ward, Tipton.
3636. Watches, W. R. Lake.—(*F. Fitt, Switzerland.*)
3637. Railway Rail Joints, T. H. Gibbon, New York.
3638. Cloth made from India-rubber, W. R. Lake.—(*F. E. Aldrich, Boston, U.S.*)
3639. Watches, W. R. Lake.—(*F. Fitt, Switzerland.*)
3640. Brake Mechanism for Looms, J. Wetter.—(*C. Sylànder, jun., Bolkenhayn.*)
3641. Finishing Textile Fabrics, J. H. Johnson.—(*E. A. Ruizand, Villeurbanne.*)
3642. Purifying Coal Gas, M. Williams, Wigan.

25th July, 1883.

3643. Pickers for Looms, J. K. Tullis, Glasgow.
3644. Valves, &c., J. K. Tullis, Glasgow.
3645. Hansom Cabs, L. Engel, London.
3646. Floating Pontoon Bridges, &c., S. Lampard, Portsea.
3647. Ventilator Cowls, A. Mechan, Glasgow.
3648. Fire-resisting Doors, F. W. E. Braid, London.
3649. Facilitating the Gearing of Healds in Looms, S. H. Storry and S. D. Rhodes, Huddersfield.
3650. Attaching Door Knobs to Spindles, H. C. Webb, Worcester.
3651. Receptacles for Conveying Fluids, F. Marsden, Sheffield.
3652. Separating Metals from their Ores, &c., W. P. Thompson.—(*G. T. Lewis, Philadelphia.*)
3653. Devonshire Cream, W. Horner, Addington.
3654. Apparatus for Curling the Hair, H. Roman, Haverstock Hill.
3655. Weaving Looms, R. H. Brandon.—(*G. Crompton, Worcester, U.S.*)
3656. Flushing Apparatus, W. B. Bennett, Cranleigh.
3657. Treating Spent Lime, &c., W. R. Lake.—(*A. T. Schuessler, V. Zeis, and M. D. Hanover, U.S.*)

26th July, 1883.

3658. Treating Fats for Soap, J. Imray.—(*I. A. F. Bang and J. de Castro, Paris.*)
3659. Fallers for Preparing Flax, J. W. Bradley, Bradford.
3660. Motors for Tram-cars, J. T. Dann.—(*C. Brown, Winterthur.*)
3661. Street Gratings, E. Jordan, Cardiff.
3662. Belt Fasteners, H. Greene, London.
3663. Distributing Blast to Blast Furnaces, P. P. de la Sala, London.
3664. Grinding Mills, C. Duckering, Lincoln.
3665. Metallic Packing Cases, C. H. W. S. Brodersen.—(*Braun and Bloem, Düsseldorf.*)
3666. Ships, W. P. Thompson.—(*H. le Roux, Paris.*)
3667. Tool for Manufacturing Boots, A. J. Boult.—(*S. Fejes, Kula.*)
3668. Removing Stones from the Bladder, W. P. Thompson.—(*N. Verguiro, Brazil.*)
3669. Propelling Ships, G. W. von Nawrocki.—(*A. F. Barth, Grossenhain.*)
3670. Traction Engines, J. H. Johnson.—(*J. E. E. Pécourt, Paris.*)
3671. Railway Lamps, J. Harbottle, Newcastle-upon-Tyne.

27th July, 1883.

3672. Millinery Trimmings, W. Askham, Nottingham.
3673. Bundle Carriers for Harvesters, W. M. Cranston.—(*W. A. Wood, New York.*)
3674. Shears for Clipping Horses, J. Sabartier.—(*J. Bariquand and Son, Paris.*)
3675. Mats, R. Martinez, New York.
3676. Apparatus for Enabling Persons to Remain in Rooms Filled with Smoke, L. A. Groth.—(*B. Loeb, jun., Berlin.*)
3677. Making Casks, S. Wright, Egremont.
3678. Refining Oils, J. Imray.—(*I. A. F. Baug and C. A. Sanguinetti, Paris.*)
3679. Smelting Furnaces, N. Frère, Belgium.
3680. Preservieg Food, D. Chapman, Manchester.
3681. Sliding Chandeliers, J. Nadal, London.
3682. Emptying the Contents of Centrifugal Machines, G. H. Bolton, Widnes.
3683. Life Rafts, A. H. Williams, London.
3684. Iron Ships' Compasses, B. Biggs, Cardiff.
3685. Fastenings for Folding Book Case Doors, W. A. Bonella, London.

28th July, 1883.

3686. Cutting Sugar-cane into Lengths, J. Thornton, Cleckheaton.
3687. Chairs, F. C. Glaser.—(*F. W. Erdmann, Wismar.*)
3688. Guiding Chains for Winches, R. Rudd, Croydon.
3689. Spinning Machinery, T. E. Smith, Keighley.
3690. Alcohols, H. A. Bonneville.—(*A. Ralu, jun., Ermont.*)
3691. Preserving Pastry, H. J. Haddan.—(*A. Kluche, Berlin.*)
3692. Electrical Distribution, &c., St. G. Lane-Fox, London.
3693. Bottle Stoppers, M. Gill, Huddersfield.
3694. Preparing Yarns, W. Lancaster, Accrington.
3695. Checking the Receipt of Money from Persons Riding in Vehicles, D. Dessett, Leyton.
3696. Recording Speed of Vessels, F. H. F. Engel.—(*O. Pezoldt, Hamburg.*)
3697. Pantographs, C. Pieper, Altona.
3698. Station Indicators, S. Ballin, Hamburg.
3699. Treating Waste Products, W. J. Brewer and A. Binns, London.
3700. Core Supports for Moulds for Casting, &c., T. Samson, Greenock.
3701. Increasing Ventilation in Chimnies, J. Davies, Llanfyllin.
3702. Dynamo-electric Machines, S. Z. di Ferranti and A. Thompson, London.
3703. Gas Engines, J. Pickering, Stockton-on-Tees.
3704. Feed for Rollers, R. S. Piercy, Blackburn.
3705. Racks for Storing Whisky, E. Smith.—(*C. M. Johnson, Kentucky.*)
3706. Steam Steering Apparatus, J. Downton and E. Wimshurst, London.
3707. Moulds for Obtaining Fac-similes, R. Lanham, London.

30th July, 1883.

3708. Illuminating Gases, A. G. Henderson and J. A. Kelman, London.
3709. Photographic Back-grounds, F. Marra, London.
3710. Cutting Double-woven Fabrics, H. Springmann.—(*E. Cohnitz, Elberfeld.*)
3711. Reducing Grain, H. Springmann.—(*A. C. Nagel, R. H. Kaemp, and A. Linnenbrügge, Hamburg.*)
3712. Wick Holders for Railway Carriage Lamps, W. P. Thompson.—(*J. Scrafton, Lahore.*)
3713. Radiating Axles for Railway Carriages, L. S. Zachariasen, Christiania.
3714. Facilitating the Tapping of Beer Casks, W. S. and W. A. Dackus, Birmingham.
3715. Fastener for Gloves, H. Pataky.—(*C. Distel, Nuremberg.*)
3716. Roof Covering, H. Pataky.—(*C. Wildhagen, Nuremburg.*)
3717. Refining Paraffine, C. Crellin, Leytonstone.
3718. Asphalte Apparatus, B. D. Healey, Brighouse.
3719. Screw Hooks, &c., S. W. and J. A. Richards, Birmingham.
3720. Treating Soap Suds, A. Crossley, Adwalton.
3721. Checking Receipts of Money, H. Lyon, London.
3722. Stop Motions for Looms, A. W. L. Reddie.—(*P. Bouy et Compagnie, Paris*)
3723. Doors of Gas Retorts, J. Bartle, London.
3724. Transmitting Telephonic Messages, G. F. Redfern.—(*C. Mildé, fils, et Cie., and C. T. d'Argy, Paris.*)
3725. Treating Bituminous Shales, C. M. Irvine, Blackwood, and R. Slater, Blackheath.
3726. Organs, T. C. Lewis, Brixton.

Inventions Protected for Six Months on Deposit of Complete Specifications.

3598. Corsets, H. H. Lake, Southampton-buildings, London.—A communication from C. N. Chadwick, Brooklyn.—*21st July*, 1883.
3603. Fire-escapes, G. S. Prindle, Washington.—A communication from G. H. Thompson, Plattsmouth, and S. O. Ryder, New York.—*23rd July*, 1883.
3655. Looms for Weaving, R. H. Brandon, Paris.—A communication from G. Crompton, Worcester, U.S.—*25th July*, 1883.

Patents on which the Stamp Duty of £50 has been paid.

3058. Permanent Way of Railways, J. Cleminson, London.—*24th July*, 1880.
3049. Clarifying Vegetable Infusions, S. C. Davidson, Belfast.—*24th July*, 1880.
3070. Differential Valve Gear, H. Davey, Leeds.—*26th July*, 1880.
3038. Making Ice, W. A. Gorman, London.—*24th July*, 1880.
3143. Pianofortes, H. W. Pohlmann, Halifax.—*30th July*, 1880.
3080. Cultivating Land, W. Barford and T. Perkins, Peterborough.—*26th July*, 1880.
3086. Air Engines, L. Sterne, London.—*27th July*, 1880.
3111. Supporting, &c., Ships' Boats, J. Donovan, West Hartlepool.—*29th July*, 1880.
3139. Kilns, W. Holcroft, Stourbridge.—*30th July*, 1880.
3330. Cinnamic Acid, J. H. Johnson, London.—*17th August*, 1880.
3084. Locomotive Tram-cars, T. Turton, Liverpool.—*27th July*, 1880.
3129. Joints in Lead Pipes, S. Bennett, Manchester.—*29th July*, 1880.
3374. Gas Producers, C. W. Siemens, London.—*19th August*, 1880.
3088. Match-boxes, W. J. Webster, London.—*27th July*, 1880.
3176. Producing Motive Power, W. H. Northcott, London.—*3rd August*, 1880.

Patents on which the Stamp Duty of £100 has been paid.

3029. Articulating the Axles of Railway Carriages, J. Cleminson, London.—*27th July*, 1876.
2849. Tobacco-cutting Machines, R. Legg, London.—*12th July*, 1876.
3019. Machinery for Folding Paper, W. Conquest, London.—*26th July*, 1876.
3032. Cleaning Cotton, &c., W. R. Lake, London.—*27th July*, 1876.
3062. Weaving Looms, G. Hodgson, J. Broadley, and J. Lister, Bradford.—*31st July*, 1876.
3048. Shaping Sugar, A. Lyle, sen., Greenock.—*29th July*, 1880.
3041. Weft Grates, S. Cook, Bury.—*27th July*, 1880.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition*, 17*th August*, 1883.)

1034. Manual Steering Apparatus, J. L. Cathcart, Alexandria, U.S.—*26th February*, 1883.
1078. Elastic Wire Bands, F. Wirth, Frankfort-on-the-Main.—A communication from G. Pickhardt.—*27th February*, 1883.
1221. Torpedoes, A. J. Boult, London.—A communication from A. Weeks.—*7th March*, 1883.
1315. Lawn Tennis Balls, F. O. Heinrich, Wimbledon.—*12th March*, 1883.
1487. Rolling Angular Wire, J. W. Hirst, J. Hirst, and J. Bottomley, Brighouse.—*21st March*, 1883.
1508. Stereotype Plates, A. Sauvée, London.—Com. from H. Marinoni & J. Michaud.—*22nd March*, 1883.
1516. Coffee Roasters, G. H. Pfeifer, Freiberg.—*22nd March*, 1883.
1525. Cartridge Boxes and Carriers, G. Pitt, Sutton.—Com. from G. V. Fosbery.—*22nd March*, 1883.
1526. Checking Fares, &c., T. A. Silverwood, Brighton.—*24th March*, 1883.
1528. Flexible Wheel Bases, T. Slater and S. Owen, London.—Com. from E. Kiebitz.—*24th March*, 1883.
1532. Automatic Flushing Apparatus, A. C. Boothby, Kirkcaldy.—*24th March*, 1883.
1534. Looms, J. Hodgson and S. Greenwood, Brearley.—*24th March*, 1883.
1538. Electrical Conductors, H. H. Lake, London.—Com. from C. de Cazenave.—*24th March*, 1883.
1578. Furnaces, P. M. Justice, London.—A communication from C. Dietzsch.—*28th March*, 1883.
1589. Blue Colour, W. H. Spence, London.—A communication from A. Chesnais.—*29th March*, 1883.
1609. Fire Alarms, &c., I. Thomas, Aberdare.—*30th March*, 1883.
1614. Effecting Interchange of Temperature between Liquids and Gases, &c., J. H. Johnson, London.—A communication from J. A. Saladin.—*30th March*, 1883.
1742. Dividing Double-piled Fabrics, J. H. Johnson, London.—Com. from T. Diéderichs.—*6th April*, 1883.
1786. Wheels, J. McLaren and H. McLaren, Leeds.—*9th April*, 1883.
1999. Preparing Machinery for Flax, &c., J. Reynolds, Belfast.—*19th April*, 1883.
2032. Refrigerating, A. S. Haslam, Derby.—*21st April*, 1883.
2669. Obtaining Ammonia from Coal Gas, W. J. Cooper, London.—*29th May*, 1883.
2765. Fireplaces, P. Jensen, London.—Com. from F. von Callenberg and E. Fischer.—*4th June*, 1883.
2947. Spirit Cooking Stoves or Lamps, D. Pozainski, London.—*13th June*, 1883.
3069. Converting Reciprocating into Rotary Motion, H. G. Willams, East Greenwich.—*20th June*, 1883.
3083. Baling Presses, J. Watson, London.—*21st June*, 1883.
3086. Railway Chairs, J. Hopkinson, Rowsley.—*21st June*, 1883.
3127. Compound suitable for Electro Non-conductors, E. C. T. Blake, London.—*23rd June*, 1883.
3158. Valve Apparatus, C. D. Abel, London.—A com. from G. Westinghouse, jun.—*26th June*, 1883.
3180. Lace, W. Birks, jun., Nottingham.—*26th June*, 1883.
3200. Inducing Air from Chimneys, H. Burgin, Walthamstow.—*27th June*, 1883.
3242. Tulle or Lace Machines, C. D. Abel, London.—A communication from E. Davenière.—*30th June*, 1883.
3603. Fire-escapes, G. S. Prindle, Washington, U.S.—A communication from G. H. Thompson and S. O. Ryder.—*23rd July*, 1883.

(*Last day for filing opposition*, 21*st August*, 1883.)

1547. Making Paper Bags, T. Bibby, J. Bibby, J. Baron, and J. Duerden, Burnley, and W. Baron, Rochdale.—*27th March*, 1883.
1552. Aerial Navigation, B. W. Maughan and S. D. Waddy, London.—*27th March*, 1883.
1582. Cards for the Reception of Sewing Silk, &c., J. H. Johnson, London.—A communication from F. E. Vaguez-Fessart.—*29th March*, 1883.
1593. Steam Traps, J. Gillies, Glasgow.—*29th March*, 1883.
1605. Globes for Gas Burners, A. E. Edwards, London.—*30th March*, 1883.
1611. Manufacturing Tissues, H. J. Haddan, London.—A com. from H. Kahls.—*30th March*, 1883.
1678. Steel Bands, J. Sheldon, Stocksbridge.—*3rd April*, 1883.
1694. Window Sashes, J. B. Adams and J. Telford, Liverpool.—*4th April*, 1883.
1711. Carding Machines, H. J. Haddan, London.—A communication from J. B. Bolette.—*5th April*, 1883.
1724. Locks and Lock-gates, W. R. Lake, London.—A communication from L. Coiseau.—*5th April*, 1883.
1729. Remedying Physical Defects of the Mouth and Palate, R. H. Brandon, Paris.—A communication from B. J. Bing.—*6th April*, 1883.
1733. Rotary Knotters, H. J. Haddan, London.—A com. from Reinicke and Jasper.—*6th April*, 1883.
1750. Removing Sand from Rivers, &c., W. R. Lake, London.—Com. from L. Coiseau.—*6th April*, 1883.
1788. Colouring Matters, P. J. Meyer, Berlin.—*9th April*, 1883.
1790. Gas Regulator, H. J. Haddan, London.—A communication from J. Fleischer.—*9th April*, 1883.
1879. Electric Signalling, &c., J. H. Johnson, London.—A communication from A. Jeanjean and L. J. Eon.—*13th April*, 1883.
1883. Explosive Compounds, F. W. Gillies, Germany.—*13th April*, 1883.
1905. Winding Yarn and Thread, J. Liddell, J. S. Brierley, S. H. Brierley, F. W. Hirst, and D. Hamer, Huddersfield.—*14th April*, 1883.
1918. Harmonising Melodies, B. S. Maitland, London.—*16th April*, 1883.
1968. Stopping Holes in Ships, J. B. Wilkie, North Shields.—*18th April*, 1883.
2042. Magneto-electric Machines, &c., G. Hookham, Birmingham.—*21st April*, 1883.
2111. Cartridges and Wads, R. Morris, Blackheath.—*26th April*, 1883.
2131. Capsules for Bottles, E. P. Alexander, London.—Com. from C. Cheswright.—*27th April*, 1883.
2186. Preventing Fraudulent Interference with the Contents of Bottles, &c., E. P. Alexander, London.—A communication from C. Cheswright.—*30th April*, 1883.
2291. Reversing the Motion of Engines, E. Boutard, Leiston.—*5th May*, 1883.
2368. Measuring Lengths of Embroidery, &c., H. H. Lake, London.—A communication from M. Guggenheim's Sons.—*9th May*, 1883.
2380. Crushing Stone, &c., S. Mason, Leicester.—*10th May*, 1883.
2861. Looms for Weaving, M. Sowden, Bradford.—*8th June*, 1883.
3135. Gas Engines, P. Niel, London.—*25th June*, 1883.
3169. Matting, W. R. Lake, London.—A communication from J. Bray.—*26th June*, 1883.
3173. Boring Holes in Rock, W. L. Wise, London.—Com. from C. W. Burton.—*26th June*, 1883.
3175. Steam Engines, W. P. Thomson, Liverpool.—A communication from E. A. Corbin and G. W. Hunter.—*26th June*, 1883.
3224. Pianoforte Actions, J. J. Robinson, London.—*29th June*, 1883.
3300. Springs, W. R. Lake, London.—A communication from C. Mace.—*3rd July*, 1883.
3361. Cooling the Lining Tubes for Artillery, S. Pitt, Sutton.—Communication from H. Harmet.—*6th July*, 1883.
3598. Corsets, H. H. Lake, London.—A communication from C. N. Chadwick.—*21st July*, 1883.
3655. Looms for Weaving, R. H. Brandon, Paris.—A communication from G. Crompton.—*25th July*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 24th July*, 1883.)

481. Grappling and Hoisting Stone, R. Stone, New York.—*29th January*, 1883.
494. Skates, E. K. Dutton, Manchester.—*30th January*, 1883.
496. Gradual Reduction of Grain, W. P. Thompson, Liverpool.—*30th January*, 1883.
499. Air and Gas Motors, G. W. Weatherhogg, London.—*30th January*, 1883.
508. Primary Voltaic Batteries, G. G. André, Dorking.—*30th January*, 1883.
511. Radiators, L. W. Leeds, London.—*30th January*, 1883.
515. Digging or Cultivating Land, E. Cobham, Stevenage.—*30th January*, 1883.
520. Electric Arc Lamps, A. Kryszat, Moscow.—*31st January*, 1883.
525. Exhibiting Goods, F. McIlvenna, Manchester.—*31st January*, 1883.
534. Stands for Holding Vessels, F. A. Colley and J. Wingfield, Sheffield.—*31st January*, 1883.
539. Tram-cars, &c., M. R. Ward, London.—*31st January*, 1883.
541. Coaling Steamships, S. Plimsoll, London.—*1st February*, 1883.
550. Spring Hasp or Clip, C. Mohr, Birmingham.—*1st February*, 1883.
555. Electrical Conductors, J. Imray, London.—*1st February*, 1883.
559. Dynamo-electric Machines, W. P. Thompson, Liverpool.—*1st February*, 1883.
576. Window Sashes, D. F. W. Quayle, Isle of Man.—*2nd February*, 1883.
577. Pure Spirits of Wine, M. Bauer, London.—*2nd February*, 1883.
579. Floats of Paddle-wheels, J. Stewart, Blackwall.—*2nd February*, 1883.
582. Chain Coupling, J. H. Vidal, Sunderland.—*2nd February*, 1883.
601. Indicators, A. Budenberg, Manchester.—*3rd February*, 1883.
606. Letting-off Apparatus, J. Schofield and J. E. Bentley, Littleborough.—*5th February*, 1883.
614. Electric Generators, J. A. Fleming, London.—*5th February*, 1883.
623. Regulating Currents of Electricity, P. Cardew, Chatham.—*5th February*, 1883.
653. Spinning Wool, &c., J. T. Nelson, Leeds.—*6th February*, 1883.
679. Safety Lamps, L. T. Wright, Beckton.—*7th February*, 1883.
699. Moulds for Shaping Bulbs, &c., A. Swan, Gateshead.—*8th February*, 1883.
708. Steering Gear, G. D. Davis, London.—*9th February*, 1883.
713. Hose Reels, J. T. Foot, Hammersmith.—*9th February*, 1883.
723. Roundabouts, W. Meeds, W. Meeds, jun., and T. Blinkhorn, Boston.—*9th February*, 1883.

731. PREPARING MALT, J. H. Johnson, London.—*9th February*, 1883.
732. TREATING MINERAL PHOSPHATES, W. G. Strype, Wicklow.—*9th February*, 1883.
739. TREATING ALKALI WASTE, J. Simpson, Liverpool.—*10th February*, 1883.
775. CONSUMING SMOKE, J. H. Johnson, London.—*12th February*, 1883.
783. PICKERS for LOOMS, R. Fielden and T. Fielden, Walsden.—*13th February*, 1883.
799. FINISHING BLACKENED LEATHER, F. J. Drewry, Burton-on-Trent.—*14th February*, 1883.
800. PLANING MACHINES, F. J. Drewry, Burton-on-Trent.—*14th February*, 1883.
802. BUTTER WORKERS, T. Bradford, Manchester.—*14th February*, 1883.
889. COOKING STOVES, T. Fletcher, Warrington.—*17th February*, 1883.
910. CONCENTRATING and TREATING WINES, S. Pitt, Sutton.—*19th February*, 1883.
961. MINERS' SAFETY LAMPS, G. H. Timmis, Stourbridge.—*21st February*, 1883.
1024. CRIBS for CHILDREN, A. M. Clark, London.—*24th February*, 1883.
1067. HOLDER for RIBBON, &c., A. M. Clark, London.—*27th February*, 1883.
1093. GAS ENGINES, E. G. Wastfield, Liverpool.—*1st March*, 1883.
1133. SPOOLS or BOBBINS, F. Wirth, Frankfort-on-the-Main.—*2nd March*, 1883.
1334. SLIDE VALVES, &c., A. J. Boult, London.—*13th March*, 1883.
1380. PREPARING PICTURES, &c., R. Brown, R. W. Barnes, and J. Bell, Liverpool.—*15th March*, 1883.
1602. UTILISING SLAG, C. Pieper, Berlin.—*30th March*, 1883.
1604. HEATING and COOLING FLUIDS, W. Schönheyder, London.—*30th March*, 1883.
1944. DETECTING LEAKS in PIPES, J. J. Tylor, London.—*17th April*, 1883.
2052. METALLIC ROOFING, &c., R. Hudson, Gildersome.—*23rd April*, 1883.
2197. TENNIS BALLS, A. W. Phillips, Atherstone.—*1st May*, 1883.
2209. FLUES for STEAM BOILERS, J. A. Hopkinson, London.—*1st May*, 1883.
2222. EXTINGUISHING FIRE, W. R. Lake, London.—*1st May*, 1883.
2273. GOVERNORS, J. Musgrave and R. Gregory, jun., Bolton.—*4th May*, 1883.
2337. ELECTRIC LAMPS, A. Shedlock, New York.—*8th May*, 1883.
2339. DYNAMO-ELECTRIC MACHINES, H. H. Lake, London.—*8th May*, 1883.
2340. SHIPS' SLEEPING BERTHS, H. H. Lake, London.—*8th May*, 1883.
2347. REMOVABLE PROTECTING COVER for BOOKS, H. J. Fitch, London.—*8th May*, 1883.
2361. GRAVING DOCKS, &c., J. Walsh, Cardiff.—*9th May*, 1883.
2384. TREATING ORES, J. Cross and G. Wells, Widnes.—*10th May*, 1883.
2386. EXTRACTING SILVER from BLUESTONE, &c., J. Cross and G. Wells, Widnes.—*10th May*, 1883.
2390. OBTAINING METALS from ORES, C. D. Abel, London.—*10th May*, 1883.
2400. LOOMS for WEAVING WIRE, E. Lucas, Balsall Heath.—*11th May*, 1883.
2411. COLOURING MATTERS, J. Erskine, Glasgow.—*12th May*, 1883.
2416. EXTRACTING SUGAR, C. Steffen, Vienna.—*12th May*, 1883.
2494. MULTIPLE CYLINDER ENGINES, P. Brotherhood, London.—*18th May*, 1883.
2504. MANUFACTURE of IRON and STEEL, T. Griffiths, Abergavenny.—*19th May*, 1883.

(List of Letters Patent which passed the Great Seal on the 30th July, 1883.)

4440. REMOVING IRON and MANGANESE from certain SOLUTIONS, C. Semper, Philadelphia, U.S.—*19th September*, 1882.
543. METAL PRINTING, &c., PLATES, D. Appleton, Manchester.—*1st February*, 1883.
551. ARTIFICIAL INDIA-RUBBER, W. H. Harrison, London.—*1st February*, 1883.
585. STAMPING, &c., CIGARETTE PAPER, W. H. Beck, London.—*2nd February*, 1883.
589. COMBUSTIBLE GAS, W. Crossley, Glasgow.—*3rd February*, 1883.
595. BLEACHING, J. B. Thompson, London.—*3rd February*, 1883.
599. WATER-CLOSETS, S. S. Hellyer, London.—*3rd February*, 1883.
602. HOLDING NECKTIES in POSITION, E. C. Wise, Belvedere.—*3rd February*, 1883.
609. COVERS for UMBRELLAS, M. Hyam, London.—*5th February*, 1883.
610. LIGHTING by GAS, F. A. L. de Gruyter, Amsterdam.—*5th February*, 1883.
626. FOUNTAIN PENS, J. J. Ridge, Enfield.—*5th February*, 1883.
645. MOTIVE POWER ENGINES, J. Robson, Birmingham.—*6th February*, 1883.
647. PLATE PRINTING PRESS, H. Luetke, Berlin.—*6th February*, 1883.
666. FACILITATING HEARING and SPEAKING SIMULTANEOUSLY, H. Marlow, Shepherd's Bush.—*6th February*, 1883.
695. WINDOW SASHES, J. Hay and G. Robertson, Glasgow.—*8th February*, 1883.
698. ELECTRIC LAMPS, &c., J. T. Todman, Dorking.—*8th February*, 1883.
725. LAMPS, T. E. Bladon, Birmingham.—*9th February*, 1883.
729. FASTENINGS for GLOVES, &c., J. Pitt and J. Wormington, Birmingham.—*9th February*, 1883.
754. OPEN-HEADED CARRIAGES, W. H. Bailey, London.—*10th February*, 1883.
794. SHEARING SHEEP, W. R. Lake, London.—*13th February*, 1883.
952. HORSESHOES, J. Ferris, Athlone.—*21st February*, 1883.
984. CHIMNEY POTS, &c., F. Hamond, London.—*23rd February*, 1883.
999. GAS ENGINES, &c., A. M. Clark, London.—*23rd February*, 1883.
1115. TELEPHONIC APPARATUS, A. R. Bennett, Glasgow.—*1st March*, 1883.
2139. EXPLOSIVE COMPOUNDS, E. Turpin, Paris.—*27th April*, 1883.
2231. STEREOTYPE MATRICES, L. Possett and H. Schimansky, Berlin.—*2nd May*, 1883.
2261. BOXES or BARRELS, G. D. Terry, London.—*3rd May*, 1883.
2270. ACTION for PIANOFORTES, J. Herrburger, Paris.—*4th May*, 1883.
2471. EVER-POINTED PENCIL-CASES, W. Wiley, Birmingham.—*17th May*, 1883.
2510. SPINNING SPINDLES and BEARINGS, A. M. Clark, London.—*19th May*, 1883.
2523. EXTINGUISHING FIRES, T. V. Trotha, Germany.—*21st May*, 1883.
2781. CARBURETTING AIR, J. S. Muir, London.—*5th June*, 1883.
2789. DISINTEGRATING FIBROUS PLANTS, W. L. Wise, London.—*5th June*, 1883.

List of Specifications published during the week ending July 28th, 1883.

4604, 2d.; 4616, 2d.; 4738, 2d.; 4942, 2d.; 4950, 2d.; 5072, 2d.; 5389, 6d.; 5394, 2d.; 5418, 6d.; 5434, 2d.; 5500, 2d.; 5524, 2d.; 5551, 4d.; 5558, 6d.; 5610, 6d.; 5611, 6d.; 5617, 6d.; 5619, 10d.; 5625, 2d.; 5686, 6d.; 5704, 2d.; 5716, 6d.; 5721, 2d.; 5722, 2d.; 5736, 2d.; 5737, 2d.; 5741, 2d.; 5742, 4d.; 5744, 8d.; 5746, 2d.; 5747, 4d.; 5748, 2d.; 5750, 2d.; 5751, 2d.; 5752, 2d.; 5753, 10d.; 5756, 6d.; 5757, 4d.; 5758, 6d.; 5759, 6d.; 5760, 6d.; 5761, 6d.; 5762, 2d.; 5763, 6d.; 5764, 6d.; 2767, 6d.; 5770, 6d.; 5772, 6d.; 5773, 2d.; 5774, 2d.; 5775, 6d.; 5776, 2d.; 5777, 6d.; 5778, 6d.; 5780, 6d.; 5781, 6d.; 5782, 6d.; 5783, 2d.; 5784, 2d.; 5786, 2d.; 5787, 4d.; 5788, 4d.; 5789, 6d.; 5790, 6d.; 5791, 6d.; 5792, 6d.; 5796, 6d.; 5797, 2d.; 5800, 2d.; 5801, 2d.; 5802, 2d.; 5803, 6d.; 5804, 6d.; 5806, 6d.; 5807, 6d.; 5808, 2d.; 5809, 6d.; 5810, 4d.; 5813, 6d.; 5814, 2d.; 5816, 6d.; 5818, 2d.; 5819, 6d.; 5820, 6d.; 5821, 2d.; 5822, 6d.; 5823, 6d.; 5824, 6d.; 5825, 2d.; 5826, 6d.; 5827, 2d.; 5828, 2d.; 5829, 2d.; 5830, 2d.; 5832, 6d.; 5833, 2d.; 5834, 6d.; 5836, 2d.; 5837, 6d.; 5838, 4d.; 5839, 2d.; 5840, 6d.; 5841, 6d.; 5842, 2d.; 5844, 6d.; 5845, 8d.; 5846, 6d.; 5847, 6d.; 5848, 2d.; 5849, 6d.; 5854, 4d.; 5855, 2d.; 5856, 2d.; 5859, 2d.; 5860, 4d.; 5861, 2d.; 5862, 6d.; 5864, 2d.; 5865, 4d.; 5866, 4d.; 5869, 4d.; 5873, 2d.; 5880, 6d.; 5885, 8d.; 5893, 2d.; 5908, 6d.; 5912, 1s.; 5913, 4d.; 5916, 6d.; 5926, 8d.; 5940, 6d.; 5941, 6d.; 5942, 6d.; 5948, 6d.; 5965, 6d.; 5989, 4d.; 5991, 6d.; 6027, 6d.; 6047, 4d.; 6072, 6d.; 6120, 6d.; 564, 6d.; 785, 4d.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for THE ENGINEER *at the office of Her Majesty's Commissioners of Patents.*

4604. BALLS FOR LAWN TENNIS, CRICKET, &c., *J. Neville, Hackney.—28th September*, 1882.—*(Provisional protection not allowed.)* 2*d*.
The ball is composed of india-rubber, cork dust, or other wood dust, and a fibre of cotton, wool, flax, hemp, or any other similar material.

4616. SYSTEM AND MEANS OF ADVERTISING, *S. Puente, Kensington.—28th September*, 1882.—*(Provisional protection not allowed.)* 2*d*.
Advertisements are exhibited on smooth walls which are covered with Portland or Roman cement or asphalte.

4942. STAYS, *W. G. W. Reynolds, Leicester.—17th October*, 1882.—*(Provisional protection not allowed.)* 2*d*.
In the body of the stay is inserted a piece of elastic web.

4950. POSTAL WRAPPERS, *A. Savage, New Kent-road.—18th October*, 1882.—*(Provisional protection not allowed.)* 2*d*.
Relates to formation of the wrapper so that the contents may be withdrawn and replaced without breaking the wrapper.

5072. PLAYING CARDS, *W. R. Lake, London.—24th October*, 1882.—*(A communication from B. Dreyfuss, New York.)—(Provisional protection not allowed.)* 2*d*.
Each characteristic mark or design on the face of the card is formed of letters and words, so arranged and proportioned as to make not only the several distinctive characters, each possessing its well-known conventional colour, but also to convey to the player an advertising announcement.

5389. APPARATUS FOR SUSPENDING, HOISTING, LOWERING, AND DISCONNECTING HEAVY WEIGHTS, SUCH AS BOATS, AND IN SHACKLES FOR SAME, &c., *S. S. Sugden, Woodford.—11th November*, 1882. 6*d*.
This relates to the construction, arrangement, and operation of shackles, wherein there is a bolt, revolving disc, and slot, in which the end of the bolt rests, and lever or spanner for opening the same. Modifications are described.

5394. MANUFACTURE OF BRUSHES, *J. J. Danks, London.—13th November*, 1882.—*(Provisional protection not allowed.)* 2*d*.
This relates to the employment of woven hair and fibre.

5418. APPARATUS FOR FASTENING BUTTONS WITH EYES TO BOOTS SHOES, &c., *F. J. Drewry, Burton-on-Trent, executor of W. Morgan-Brown, London.—14th November*, 1882.—*(A communication from J. Davis, Lynn, Mass., U.S.)* 6*d*.
The object is to secure upon shoes or garments, by means of a single-pronged rack or fastener, usual buttons having shanks provided with eyes.

5434. CONSTRUCTION OF LACE EDGING, &c., *R. J. S. Joyce, London.—14th November*, 1882.—*(Provisional protection not allowed.)* 2*d*.
The object is to construct lace edging or borders with a fringe or trimming, plain or fancy, and with or without beads or other ornamentation from its band or top.

5500. LADIES' DRESS BODICE FORMS, *S. Stott, Manchester.—18th November*, 1882.—*(Partly a communication from C. I. Haley, New York.)—(Provisional protection not allowed.)* 2*d*.
The object is the manufacture of an article to be used by a lady over the corset for improving the form or shape of the bodice of her dress, and also the appearance of her figure.

5524. LAWN POOL, *A. J. Adams, London.—21st November*, 1882.—*(Provisional protection not allowed.)* 2*d*.
This relates to a method of playing the game of pool on a lawn as usually played on a billiard table, and the apparatus for playing it consists of rods or cues and balls.

5551. APPARATUS FOR SHAMPOOING AND WASHING THE HUMAN HEAD, *A. G. Klugh, St. John's Wood.—22nd November*, 1882. 4*d*.
This relates to the combination of elastic tubes provided with a ball or balls, and arranged in connection with a rose or other similar contrivance.

5558. FOUNTAIN OR RESERVOIR PENHOLDERS, *A. Osborn, Birmingham.—22nd November*, 1882. 6*d*.
The inventor claims improvements in fountain or reservoir penholders, in which the spring actions are enclosed in dry chambers, so that the springs never coming into contact with the ink, cannot get clogged or corroded together, with the simultaneous action of the valves produced by the arrangement of such valves and springs.

5611. APPARATUS FOR REGULATING THE FLOW OF LIQUIDS, *P. J. Catterall and E. Birch, Manchester.—25th November*, 1882. 6*d*.
To regulate the supply of water the inventors make use of a tube, on which are fixed two diaphragms of leather or other material, the upper diaphragm being larger than the lower. The periphery of each diaphragm is secured between the flanges of a shell or case formed in three parts. The lower end of the tube is fixed in or formed with a chamber, in which is a ball resting on a seating to form a valve. In the lowest part of the shell is fixed a waste pipe that may enter the chamber and be closed by the ball. To the top of the shell is connected a water supply pipe provided with an improved tap, and to the space between the diaphragms water is admitted, the pressure of which lifts the diaphragms and tube when the supply to the top of the shell is shut off.

5617. MACHINES FOR SHARPENING AND SETTING SAWS, *W. R. Lake, London.—25th November*, 1882.—*(A communication from L. Martinier, Cognin, France.)* 6*d*.
The machines effect the sharpening by means of an ordinary file, and not by a grindstone or emery wheel.

5619. APPARATUS FOR FILLING AND CLOSING BOTTLES, *J. Phillips, Walworth.—27th November*, 1882. 10*d*.
This relates to the general construction of the apparatus for filling and closing externally-stoppered bottles, or bottles to which the stoppers are permanently attached.

5686. GLASS FURNACES, *J. H. Johnson, London.—29th November*, 1882.—*(A communication from A. Duchet, Paris.)* 6*d*.
This relates to the employment of a dam or barrier submerged below the surface of the glass, and provided with internal passages for cooling the same, in combination with floats or rings resting against it.

5704. COMPOSITION OF MATTER OR ARTIFICIAL STONE FOR VENEERS, &c., *H. J. Allison, London.—30th November*, 1882.—*(A communication from W. Matt and M. Mehrbach, New York.)—(Not proceeded with.)* 2*d*.
This is composed of a solution of glue, oil, and resin, to which is added glycerine and paper pulp, and then passed through a sieve, and afterwards stiffened by French chalk, China clay, or other equivalent material.

5716. WAGONS, TRUCKS, BARROWS, &c., *W. P. Wilson, Brockley.—30th November*, 1882. 6*d*.
The body is constructed of sheet iron buckled to obtain strength with lightness. Another part of the invention relates to the tipping of the vehicles.

5721. APPARATUS FOR STRAINING PULP, *R. Brodie, Leith.—1st December*, 1882.—*(Not proceeded with.)* 2*d*.
This relates to several improvements in the general construction of the apparatus.

5722. VELOCIPEDES, *M. D. Rucker, jun., and H. S. Jackson, London.—1st December*, 1882.—*(Not proceeded with.)* 2*d*.
This consists of a driving arrangement for "three-wheeled" velocipedes, the driving wheels of which are mounted on stud axles.

5736. INDICATORS FOR EXHIBITING CONSECUTIVE NUMERALS, *J. H. R. Dinsmore, Liverpool.—1st December*, 1882.—*(Not proceeded with.)* 2*d*.
This consists in a certain arrangement of endless bands, or endless band chains, which are mounted in a frame and worked by a rack and pinion motion, an alarum bell being provided to call attention to the changes.

5737. CONSTRUCTION OF STOVES FOR BURNING PARAFFIN AND PETROLEUM OILS, *J. F. Farwig, London.—1st December*, 1882.—*(Not proceeded with.)* 2*d*.
This relates to improvements in the burner and the arrangement of pipes.

5741. OIL CANS, &c., *J. Robinson, Bradford, and G. Robinson, Sheffield.—1st December*, 1882.—*(Not proceeded with.)* 2*d*.
This relates partly to improvements on patent No. 1998, dated 27th April, 1882, and consists in forming screw threads in the opening and on the plug, so that the latter may be tightly screwed therein and effectually prevent evaporation.

5746. PROCESSES AND APPARATUS FOR OBTAINING USEFUL PRODUCTS IN THE TREATMENT OF GALVANISERS' FLUX, &c., *H. Kenyon, Altrincham.—2nd December*, 1882.—*(Not proceeded with.)* 2*d*.
The principal object is to utilise galvanisers' flux, and thereby to obtain zinc paint and other useful products.

5748. CLOCKS DRIVEN BY WEIGHTS, *E. Wulff and J. Moser, Oxford-street.—2nd December*, 1882.—*(Provisional protection not allowed.)* 2*d*.
This relates to the movements of the clocks driven by weights which are inclosed in air-tight cases and are not required to be opened, and consequently no dust can get into the movement, and change of temperature has no effect upon the time keeping.

5750. APPARATUS FOR REGULATING THE "CUT-OFF" IN CONNECTION WITH STEAM ENGINE CYLINDERS, *L. Gooder, Wakefield.—2nd December*, 1882.—*(Not proceeded with.)* 2*d*.
This relates to employment of automatic apparatus by which the engine can be worked without the usual slide valve, because the steam is admitted at boiler pressure direct into the cylinder.

5751. APPARATUS FOR MAKING COFFEE, TEA, &c., *C. D. Abel, London.—2nd December*, 1882.—*(A communication from B. Harrass, Bohlen, Germany.)—(Not proceeded with.)* 2*d*.
This relates to apparatus wherein the parts containing the water to be heated and the tea or coffee grains to be acted upon thereby are contained in separate vessels, made principally of glass, so that the action of the apparatus can be readily observed, the proper cleansing thereof be insured, while the tea or coffee grains are also contained in a receptacle separate from that containing the beverage.

5752. SELF-ACTING HORSE RAKES FOR HARVESTING PURPOSES, *G. W. Brown, Reading.—2nd December*, 1882.—*(Not proceeded with.)* 2*d*.
The teeth of the horse rake are lifted by means of a friction clutch or clutches.

5753. MECHANISM FOR THE PREPARATION OF WARPS OF JUTE, HEMP, FLAX, &c., *D. R. and G. Malcolm, Dundee.—2nd December*, 1882. 10*d*.
The object is to obtain equal warps, that is to say, warps in which all the threads are of the same length, and to obtain warps which are more suitable for weaving than those prepared by the ordinary warping mill, and warps of more "cuts" than can be obtained by the ordinary mill.

5756. BRICKS, BLOCKS, AND SLABS FOR BUILDIN AND PAVING PURPOSES, &c., *W. Foot, Wellington.—2nd December*, 1882. 6*d*.
This relates to the construction of bricks so that they may be interlocked.

5758. FOUNTAIN OR RESERVOIR PENHOLDERS, *J. E. Cousté, Soho.—2nd December*, 1882. 6*d*.
This relates to the general construction of the penholder.

5759. SMALL FIRE-ARMS, *T. Gilbert, London.—2nd December*, 1882. 6*d*.
This relates to improvements in small fire-arms whereby the unlocking and locking of the arm are automatically effected immediately before and after firing or attempting to fire by the act of pressing the gun to the shoulder and removing it therefrom, and without it being necessary to employ the hands or fingers for that purpose.

5760. BRICKS OR BLOCKS FOR BUILDING PURPOSES, *J. H. Johnson, London.—2nd December*, 1882.—*(A communication from J. Darrigan, Vagnotte, France.)* 6*d*.
This relates to bricks furnished with double interlocking or compound dovetails.

5761. REFRIGERATING APPARATUS, *W. R. Lake, London.—2nd December*, 1882.—*(A communication from R. A. Messervey, Medford, U.S.)* 6*d*.
This consists in certain improvements in construction, whereby, First, the refrigerant is prevented from escaping into the preserving chamber in case of a leak in the refrigerating pipes; Secondly, access can be had to the said pipes for repairs without allowing outside air or gas from the pipes to enter the preserving chamber; Thirdly, direct contact between the surfaces of the refrigerating pipes and the air in the preserving chamber is prevented, and the said pipes are kept to a great extent free from frost; and Fourthly, air passages are provided of improved form and greater cooling capacity than those heretofore used.

5762. BRUSHES, *W. Thomson, Glasgow.—2nd December*, 1882.—*(Not proceeded with.)* 2*d*.
This relates to screwing the handle to the head or hook.

5763. APPLIANCES FOR PROTECTING CHIMNEYS OR FUNNELS OF SHIPS OF WAR AGAINST SHOT, *P. Jensen, London.—2nd December*, 1882.—*(A communication from H. von Stockhausen, Dresden.)* 6*d*.
This relates to the construction of a funnel shield or means of protection for the funnel of war ships, for the purpose of shielding the boiler against the shot.

5764. FURNACES AND MECHANICAL STOKERS, &c., *J. C. Brentnall, Timperley.—4th December*, 1882. 6*d*.
This relates to and consists of a combination and arrangement of parts or mechanism for the feeding and combustion of coal and other fuel for generating steam and other heating purposes.

5770. MANUFACTURE OF SHRAPNEL SHELLS, *M. Delmard, Plumstead-common.—4th December*, 1882. 6*d*.
This relates to the making of the body of a wrought iron or steel tube, to which a wrought iron or steel base piece provided with a chamber for containing the bursting charge is fitted and welded, so that the said body (without the conoidal head) consists of one single piece.

5772. CONSTRUCTION OF FIRE AND SOUNDPROOF CEILINGS AND FLOORS, *R. W. Hitchins, Stoke Newington.—4th December*, 1882. 6*d*.
This relates to a ceiling composed of plaster of Paris or cement, coke, and a small quantity of vegetable fibre or hair, in combination with open-meshed wire netting embedded therein.

5773. PIPES FOR SMOKING TOBACCO, *W. H. Sharman, Highbury.—4th December*, 1882.—*(Not proceeded with.)* 2*d*.
This relates to the mode of connecting the mouth-piece to the stem.

5774. VESSELS FOR CONTAINING COMPRESSED OR LIQUEFIED GASES, *S. J. Coxeter, London.—4th December*, 1882.—*(Not proceeded with.)* 2*d*.
This relates to the employment of a safety valve.

5775. APPLIANCES FOR RAISING, LOWERING, AND SECURING SHIPS' BOATS, *E. J. Harland, G. W. Wolff, W. H. Wilson, and W. J. Pirrie, Queen's Island, Ireland.—4th December*, 1882. 6*d*.
The inventors claim the application, in combination with davits, tackles, or lifting and lowering mechanism operating above the boat, of lifting mechanism below the boat, the same lifting the boat off the chocks, so that the outer chock may be struck down and the boat left free for swinging out.

5776. DRIVING GEAR OF, AND BENCHES OR FRAMES FOR, CARRYING SEWING MACHINES, *T. Murphie, Glasgow.—5th December*, 1882.—*(Not proceeded with.)* 2*d*.
The object is, First, to dispense with the necessity of employing packing between the floor and the brackets which carry the clutch shafts, in order to raise or adjust the clutch operation or lever to the proper height; Secondly, to provide a very much larger receptacle than is usual for the holding or receiving of the work from two lines of sewing machines arranged at opposite sides of a bench or table.

5777. PERAMBULATORS, *A. Lloyd, London.—5th December*, 1882. 6*d*.
This consists in constructing perambulators of the kind usually known as "single," with an additional or second seat, which may be turned down and stowed away when not wanted, such seat being attached to the perambulator by links or jointed bars.

5778. WINDOW SASH FASTENINGS, *J. D. Sprague, Upper Norwood.—5th December*, 1882. 6*d*.
The object is the construction of window sash fastenings, which, on the window being closed, will lock the same automatically and prevent it from being opened except from the inside.

5780. MACHINERY FOR CORRUGATING OR SHAPING METAL SHEETS, *G. M. Edwards, London.—5th December*, 1882. 6*d*.
The corrugations or channels to be formed can be made in the shape of three sides of a square or parallelogram, or of a dovetail, the open end of which shall be less in extent than the base, thus forming channels which, in the case of the dovetailed formation, shall be capable of retaining in their grip materials which may be inserted in a plastic condition but which will afterwards harden or set, or such corrugated metal may be in other forms and be used for other purposes.

5781. JOINTS FOR SUSPENDING SWING LOOKING GLASSES, FAN-LIGHTS, &c., *G. Crofts and G. F. Assinder, Birmingham.—5th December*, 1882. 6*d*.
The construction of the joints or movements upon which the articles turn are much simplified in their construction, and the production of a stiff or tight joint. The swing looking glass or other article suspended is fixed on rests in any position to which it has been brought.

5782. GAS ENGINES, *W. Watson, Leeds.—5th December*, 1882. 6*d*.
This relates to several improvements in the details of construction.

5784. WALKING-STICK UMBRELLAS AND STRETCHER SLIDE TO OPEN AND SHUT THE SAME, *J. T. Ford, Portsmouth.—5th December*, 1882.—*(Not proceeded with.)* 2*d*.
This relates to improvements in the general construction of walking stick umbrellas.

5786. PROCESS FOR PREPARING FLUID GLUE FROM FISH, &c., *L. A. Groth, London.—5th December*, 1882.—*(A communication from C. A. Sahlström, Jönköping, Sweden.)* 2*d*.
The inventor claims producing glue from fish, whales, and other sea animals or parts of the same, by soaking such materials in warm water mixed with acid of vinegar after they have been liberated from all the albumen, salts, and other extractive matter.

5787. PROCESS FOR EXTRACTING AND PRESERVING THE OIL FROM FISH, WHALE, &c., *L. A. Groth, London.—5th December*, 1882.—*(A communication from C. A. Sahlström, Jönköping, Sweden.)* 4*d*.
This consists in producing a tasteless and colourless oil from fish, whales, and other sea animals, by cutting up the raw material and treating it with cold water, to which has been added ammonia or other suitable alkaline matter and a disinfectant such as hypermanganic alkali.

5788. PROCESS FOR PREPARING EXTRACT FROM FISH, WHALE, &c., FOR FOOD, &c., *L. A. Groth, London.—5th December*, 1882.—*(A communication from C. A. Sahlström, Jönköping, Sweden.)* 4*d*.
This consists in extracting the nutritive parts, namely, the albumen and salts, from the flesh of the shark, whale, seal, and other sea animals and fish by cutting the raw material into pieces; then soaking it in cold water with which has been mixed ammonia and some disinfectant, such as hypermanganic alkali; then mixing the extract with common salt and sugar, and evaporating the same to the required consistency.

5789. PNEUMATIC RAILWAYS, *A. W. L. Reddie, London.—5th December*, 1882.—*(A communication from E. P. Needham, New York.)* 6*d*.
This relates to pneumatic railways in which the carriages or trains are contained wholly within the air tube, and are propelled either by compressing the air in the tube behind them, by exhausting the air from the tube in advance of them, or by both so compressing and exhausting the air, the carriages being provided with any suitable packing which approximately fits the interior of the air tube, and so prevents the leakage of air past them to any injurious extent.

5790. APPARATUS FOR CONDENSING STEAM AND HEATING WATER, &c., *A. W. L. Reddie, London.—5th December*, 1882.—*(A communication from E. Theisen, near Leipsic.)* 6*d*.
This relates to an apparatus in which the cooling water employed is converted into a product of condensation of distillation by means of the caloric of the steam to be condensed, and by means of a system of counter currents.

5791. STOPPERS FOR BOTTLES, *P. P. Deslandes, Jersey.—5th December*, 1882. 6*d*.
The inventor claims forming a stopper for bottles with a space or opening in the head thereof, to allow of a wire fastener moving freely therein to lock and unlock the stopper.

5792. DIGGING MACHINES, *J. Parker, Stevenage.—5th December*, 1882. 6*d*.
This refers to arranging the forks across the end of a traction or other engine, but quite distinct from it, such forks or digging tools being connected by means of rods, plates, &c., that have a concentric movement or are free to rise and fall concentrically with the driving shaft.

5800. APPARATUS FOR SIGNALLING ON RAILWAY TRAINS, *R. W. Vining, Liverpool.—5th December*, 1882.—*(Not proceeded with.)* 2*d*.
The object is the communication between engine-

driver and guard, and between the passengers and either or both.

5801. Treating and Dyeing Loose Wool, &c., *T. Fox, jun., Wellington.—5th December, 1882.—(Not proceeded with.)* 2d.

This relates to a process by means of which loose wool and other similar materials, such as cotton, rags, &c., can be mordanted, washed, and dyed in one vessel, the present laborious method of stirring with poles dispensed with, so that manual labour is much reduced and a considerable quantity of dye stuff is saved.

5802. Coupling Apparatus for Railway Vehicles, *E. Lumley, New York.—5th December, 1882.—(Not proceeded with.)* 2d.

This relates to that class of couplings which are automatic or self-coupling.

5803. Draw-off Apparatus for Receptacles Containing Beer, &c., *T. Collingwood, Lambeth.—5th December, 1882.* 6d.

This relates to a simple and effective arrangement whereby beer or other liquids containing more or less sedimentary matter can be drawn off clear and bright to the last without necessitating the tilting or tipping of the barrel or other receptacle.

5804. Cruet Frames, &c., *J. F. Homer, Birmingham.—5th December, 1882.* 6d.

This consists in the construction of the body or ban of cruet or other frames or stands for holding sauces, liquors, scents, or other like purposes, of a solid piece of wood, papier maché, or other suitable materials, with the holes or recesses for receiving the receptacles bored, moulded, or otherwise formed in the aforesaid solid body.

5806. Apparatus for Tightening the Felloes of Wheels, *A. M. Clark, London.—5th December, 1882.—(A communication from A. Galbraith, Amadore, Mich., U.S.)* 6d.

This relates to a felloe-tightener, consisting of a right-and-left threaded screw, two internally threaded bars, two pairs of serrated clamping jaws, and two pairs of fastening or clamping bars, attached to the said bars by bolts and nuts.

5807. Metallic Inlaid Work, &c., *A. M. Clark, London.—5th December, 1882.—(A communication from W. C. Edge, Newark, U.S.)* 6d.

The invention consists in producing the same effect as Damascene work, or any other suitable effect that may be desired, by superposing the metals of which the work is to be composed in slices one upon the other, then embossing them, so as to raise the lower slice of metal where it is embossed into the plane of the upper slice, and then filing or cutting away such portions of the embossed projections as are desired to produce the design.

5808. Gas Burners, *A. H. Robinson, Dublin.—5th December, 1882.—(Not proceeded with.)* 2d.

This relates to the employment of a cap or cover having within it a chamber for heating the gas.

5809. Treating Hydrochloric Acid, &c., *J. Hargreaves and T. Robinson, Widnes.—6th December, 1882.* 6d.

The invention consists in improvements in treating hydrochloric acid; in methods, means, and appliances for cooling, condensing, refrigerating, purifying, moving, conveying, storing, heating and evaporating hydrochloric acid; in apparatus employed therein, and in the manufacture of such apparatus.

5810. Treatment of Spoil Heaps of Collieries, &c., *L. H. Armour, Gateshead-on-Tyne.—6th December, 1882.* 4d.

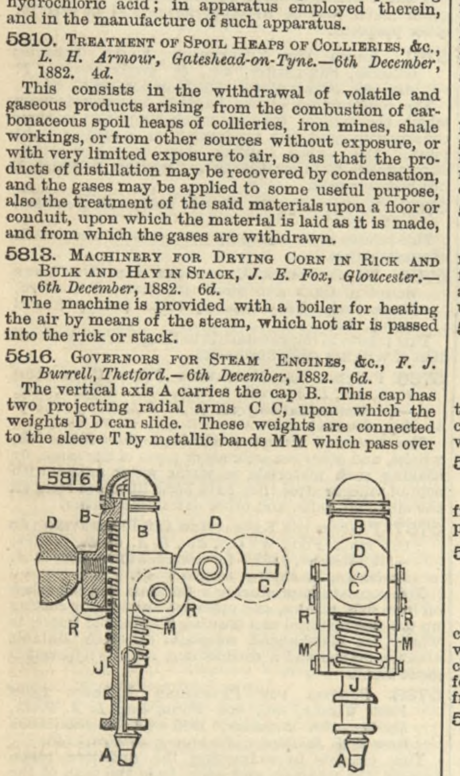
This consists in the withdrawal of volatile and gaseous products arising from the combustion of carbonaceous spoil heaps of collieries, iron mines, shale workings, or from other sources without exposure, or with very limited exposure to air, so as that the products of distillation may be recovered by condensation, and the gases may be applied to some useful purpose, also the treatment of the said materials upon a floor or conduit, upon which the material is laid as it is made, and from which the gases are withdrawn.

5813. Machinery for Drying Corn in Rick and Bulk and Hay in Stack, *J. E. Fox, Gloucester.—6th December, 1882.* 6d.

The machine is provided with a boiler for heating the air by means of the steam, which hot air is passed into the rick or stack.

5816. Governors for Steam Engines, &c., *F. J. Burrell, Thetford.—6th December, 1882.* 6d.

The vertical axis A carries the cap B. This cap has two projecting radial arms C C, upon which the weights D D can slide. These weights are connected to the sleeve T by metallic bands M M which pass over



the rollers R R attached to the cap B by studs or bolts on which they turn freely. A spring K is compressed between the cap and the sleeve T which tends to draw the weights D D inwards along the arms C C. The movement of the sleeve is transmitted in the usual way to the valve.

5818. Combing Machines, *F. Ambler, Bradford.—6th December, 1882.—(Not proceeded with.)* 2d.

The object is to run the dabbing brush at a higher speed than hitherto.

5819. Gas Motor Engines, *G. Whittaker, Manchester.—6th December, 1882.* 6d.

The inventor claims improvements in a revolving ignition valve entirely separate and distinct from the air, gas, and exhaust valves.

5820. Mechanism Applicable to and for Playing Pianofortes, *A. Capra, Clerkenwell.—6th December, 1882.* 6d.

The inventor claims the improved arrangement and application of mechanism or apparatus to pianofortes for playing the same, in which a series of levers are actuated by a pin barrel to give motion to a series of striking rods or fingers.

5821. Corsets, &c., *J. R. Ajax, Paddington.—6th December, 1882.—(Not proceeded with.)* 2d.

This relates to the application to corsets of an abdominal belt or support.

5822. Manufacture of Bottles, &c., *J. T. Creasy, London.—6th December, 1882.* 6d.

This relates to the means of effectually securing stoppers in bottles and similar vessels.

5823. Holders or Galleries for Holding and Fixing the Globes or Shades of Gas Lamps, &c., *T. Carpenter, Birmingham.—6th December, 1882.* 6d.

This consists in constructing and combining the parts of the holders or galleries in such manner that the holders or galleries are made to support the whole of the lower edges of the globes or shades.

5824. Tramway Cars, *E. C. Wickes and F. E. B. Beaumont, Westminster.—6th December, 1882.* 6d.

This consists in constructing a tramway car in two parts, having their under and their upper framings jointed together.

5825. Gas Motor Engines, *F. J. Odling, Derby.—6th December, 1882.—(Not proceeded with.)* 2d.

This relates to the construction and mode of working of a gas motor engine in such a manner as to avoid the explosive shock resulting from too rapid combustion of the charge by retarding the combustion within the cylinder.

5826. Apparatus for Heating Water and other Liquids, *A. G. V. Harcourt, Oxford.—6th December, 1882.* 6d.

This relates to the general construction of the apparatus for heating water or other liquids where quick action is required.

5827. Cleaning Iron, *C. A. T. Rollason, Birmingham, and C. A. Rollason, Aston.—6th December, 1882.—(Not proceeded with.)* 2d.

This consists in immersing the iron in a strong solution of hot salt and water, having previously heated the iron almost to a red heat.

5828. Mules for Spinning, *T. Knowles, Blackburn.—6th December, 1882.—(Not proceeded with.)* 2d.

This consists in an arrangement of parts whereby the tension on the yarn, during winding-on, may be continued in a uniform degree up to the end or nose of the cop.

5829. Manufacture of Mild Steel, *W. Prosser, Newcastle-upon-Tyne.—6th December, 1882.—(Not proceeded with.)* 2d.

The steel or iron is cast from the converting vessel or ladle into comparatively broad and thin sheets or slabs, say of 1in. or any other thickness, the steel or iron having already been tested, to insure its being sufficiently free from carbon and other foreign ingredients as to make it of a weldable quality. These sheets or slabs are, when cooled sufficiently to remove, taken to suitable shears or other machinery, and cut into convenient strips both in width and length for piling, and are then treated as bar iron or steel produced by the puddling process.

5830. Brakes for Carriages, *E. T. Robinson, Cheshunt.—6th December, 1882.—(Not proceeded with.)* 2d.

The brake connections are arranged so as to be out of sight.

5832. Steam Generators, *W. R. Lake, London.—6th December, 1882.—(A communication from J. C. Stead, Brooklyn, U.S.)* 6d.

This relates to the combination with a drum or chamber, which is kept partly filled with water, of a header; circulating pipes leading therefrom and communicating with the drum or chamber to said header; and a pipe for feeding water into the generator below the said drum or chamber.

5834. Pipe Couplings for Air or Vacuum Brake Apparatus, *D. Drummond, Lenzie, N.B.—7th December, 1882.* 6d.

This consists in the constructing of pipe couplings for connecting air or vacuum brake apparatus between railway carriages and for analogous purposes, with metallic pieces united by a sufficient number of swivel joints.

5836. Manufacture of Leather, *J. Imray, London.—7th December, 1882.—(A communication from J. Shaw, near Adelaide, South Australia.)* 2d.

This consists in the manufacture of leather by treating hides or skins with carbolic acid, or sulphocarbolic or salicylic acid, or compounds containing these, instead of tan or its equivalent, along with suitable penetrating media.

5837. Machinery for Bending Metallic Plates, *C. Scriven, Leeds.—7th December, 1882.* 6d.

This consists in a machine for bending metallic plates; of the use, in conjunction with two main and gripping rolls, of two bending rolls so arranged in relation to the said main or gripping rolls that a plate may be bent throughout its length or breadth at one operation.

5838. Panels, Plates, and Name Plates, &c., *C. L. H. Lammers, Gosforth.—7th December, 1882.* 4d.

This relates to means of producing in all kinds of metal plates letters, figures, and designs, and the filling up of such letters, figures, and designs with a more durable and harder substance than hitherto used.

5839. Treatment of Silk for Loading it previous to Dyeing, *G. W. von Nawrocki, Berlin.—7th December, 1882.—(A communication from W. Meister, New York.)* 2d.

This relates to the process for loading silk previous to dyeing it, consisting in dipping it into baths of chloride of tin and of soda several times, and afterwards into one of boiled soap lye.

5840. Arrangement of Sewing Machine, *T. J. Denne, Red Hill.—7th December, 1882.* 6d.

This relates to a special combination of details to a frame of special construction forming a new or improved sewing machine.

5841. Reducing the Friction between Water and Submerged Bodies, &c., *F. H. F. Engel, Hamburg.—7th December, 1882.—(A communication from G. de Laval, Stockholm.)* 6d.

This relates to the application of upright pneumatic chambers or channels to the inner or outer wall, or within the wall of a vessel, out of which chambers or channels, through openings or slits, air or other gas is forced out against the water for purpose of reducing friction between vessel and water.

5842. Construction of Horseshoes and the Manufacture thereof, *W. Sykes, Boxmoor, and H. J. Sykes, Lincoln.—7th December, 1882.—(Not proceeded with.)* 2d.

On the surface of the shoe proper are provided a convenient number of projections or teeth, which may cross the shoe transversely or diagonally, and the said projections may be parallel with each other or not, and there may be two rows of teeth arranged alternately, and they may intercept each other.

5844. Suspended Lights from Existing Fittings, &c., *S. J. J. Royle, Manchester.—7th December, 1882.* 6d.

This relates to improvements on patent No. 5446, A.D. 1881, and has for its object to produce a steadier and stronger light and to render the apparatus applicable to positions where the pressure of gas is low and insufficient to produce a steady light, and also to render the same capable of folding up or occupying less room for the purpose of packing or carriage from place to place.

5845. Apparatus for Heeling Boots and Shoes, &c., *J. Keats, Bagnal.—7th December, 1882.—(Partly a communication from V. R. W. Keats, Mons, Belgium.)* 8d.

The chief object is so to construct the apparatus employed for applying the attaching nails to the heels of boots and shoes that a large variety of forms and sizes of heels may be built up and secured by the use of one set of dies.

5846. Rowlocks for Boats, *C. W. Morris, Lowestoft.—7th December, 1882.* 6d.

The inventor claims the use of rowlocks for boats, and providing them with means for fastening and releasing them, so that they can be raised and fastened in position for use, or lowered out of the position for use.

5847. Apparatus for Indicating and Recording Time, &c., *C. H. and C. W. Thompson, London.—7th December, 1882.* 6d.

The principal part of the invention relates to the combination of a clock or indicator of time with a press in such a manner as to enable impressions to be taken from the said press, recording accurately and instantaneously the time of the day, as well as the date at which any impression of the stamp is taken, together with any other particulars.

5848. Indurating Artificial Stone, &c., *J. W. Butler, Blackheath.—7th December, 1882.* 2d.

The material is subjected to the action of the fumes of carbonic acid gas, and vapours of sulphur, together with steam or watery vapour.

5849. Apparatus for Connecting and Disconnecting Draught Animals to and from Vehicles, &c., *J. Rexford, Edmonton.—7th December, 1882.* 6d.

The principal object is to provide simple means of securely connecting draught animals to wheeled vehicles, and such as will allow of the sure and instant disconnection or freeing of the animals from the vehicles upon the animals taking fright or falling down, or upon any other such emergency, for insuring the safety of the occupants of the vehicle.

5854. Manufacture of Metallic Alloys, *W. Keep, New Quay, Cornwall.—8th December, 1882.* 4d.

The object is the production of a non-corrosive metallic alloy of increased whiteness and uniformity in colour throughout.

5855. Open Fire Grates, Stoves, &c., *T. E. Parker, London.—8th December, 1882.—(Not proceeded with.)* 2d.

This relates to an improvement on patent 3156, A.D. 1881, and consists in the application of the conical principle to all of the perforations and apertures which are employed to perform the operation of combustion.

5856. Diaphragms for Gas Governors, &c., *G. Porter, London.—8th December, 1882.—(Not proceeded with.)* 2d.

The diaphragms are made of very thin metal.

5859. Displaying Notices, Advertisements, &c., *A. Bruckner, London.—8th December, 1882.—(Not proceeded with.)* 2d.

This relates to the construction of a frame and to the employment of strips of cardboard with letters on.

5860. Manufacture of Stays or Corsets, *W. H. Symington, Market Harborough.—8th December, 1882.* 4d.

This relates to the construction of busks for stays or corsets with outwardly curved upper parts.

5862. Bucket Dredgers, *G. Klug, Hamburg.—8th December, 1882.* 6d.

This consists, First, in providing the tumblers of the bucket dredgers with lining or sheathing upon their wearing surfaces; Secondly, in forming the bearing or working surfaces of chain links and tumblers with an extension portion beyond the tumbler.

5864. Manufacture or Treatment of Caoutchouc, &c., *W. C. Horne, Old Charlton.—8th December, 1882.* 2d.

The object is to render caoutchouc, gutta-percha, and similar gums luminous by incorporation therewith of luminous or phosphorescent sulphide of calcium.

5865. Gas Motor Engines, *J. J. Butcher, Newcastle-upon-Tyne.—8th December, 1882.—(Not proceeded with.)* 4d.

This relates to the arrangement of the valves.

5869. Manufacture of Beer and other Beverages, &c., *J. Armstrong, Clapham.—8th December, 1882.* 4d.

This relates to the manufacture of beer from various seeds.

5873. Applying Zinc for Preventing Corrosion in Steam Boilers, *J. B. Hannay, Glasgow.—9th December, 1882.* 2d.

This relates to the forming of blocks or masses of zinc alloyed with 10 per cent. or less of lead, tin, or copper, and subjected to compression after having been cast.

5880. Consuming Smoke and Economising Fuel in Steam Boiler and other Furnaces, *H. C. Paterson, Glasgow.* 9th December, 1882. 6d.

This consists in special means or arrangements for providing for the supply of heated air either below the fire-bars or at or through the bridge of furnaces or fire-places, and it also consists in the utilisation of the waste heat in the flues or ash-pits of such furnaces for the purpose of heating the air.

5885. Apparatus for Controlling or Regulating the Discharge of Water and other Liquids, *W. A. G. Schonheyder, Shepherd's Bush.—9th December, 1882.* 8d.

This relates to apparatus for controlling the supply of water to closets.

5893. Manufacture of Billiard Cloths, *J. and G. E. Stead, Leeds.—9th Becember, 1882.* 2d.

This consists in the manufacture of billiard cloths from worsted or long fibred carded yarns "six-folded."

5908. Tobacco-pipes and Clearers, *A. Barr, Glasgow.—11th December, 1882.* 6d.

This consists in the application for cleaning pipes of a strip or blade of thin steel or other suitable metal, which is twisted throughout its length or at one or more parts of its length.

5912. Breech-loading Fire-arms, &c., *J. S. Jarmann, Christiania.—11th December, 1882.* 1s.

This relates partly to a main single-loading breech mechanism, arranged to be used in three constructions of fire-arms, as also of special arrangements added to it, in order to adapt it to two constructions of repeating fire-arms.

5913. Production of Magnesia Salts from Sulpho-acids, *F. Wirth, Frankfort.—11th December, 1882.—(A communication from the "Farbfabrik vormals Bronner," Frankfort.)* 4d.

The inventor claims the method of producing magnesia salts from sulpho-acids by the action of the halogen and sulphate combinations of magnesium thereon.

5916. Looms for Weaving Chenille or Fur Pile Fabrics, *W. Adam, Kidderminster.—11th December, 1882.* 6d.

This relates to the employment of an automatic brush or comb bar.

5940. Tricycles, &c., *W. H. Thacker and J. T. Green, Nottingham.—13th December, 1882.* 6d.

This relates to the employment of a telescopic axle.

5941. Machine for Surfacing the Inside of Reversing Links, *C. Pieper, Berlin.—13th December, 1882.—(A communication from H. Friederichs, Hanover.)* 6d.

This consists of a machine for finishing and readjusting the inside surfaces of reversing links of steam engines in hardened state, the operation being carried out by a rotating grinding disc, combined with suitable means for presenting the surfaces of the link to be acted upon.

5942. Mouthpieces of Cigars and Cigarettes, *O. W. T. Barnsdale, Nottingham.—13th December, 1882.* 6d.

This relates to a pipeclay tube covered with paper.

5948. Machinery for Manufacturing Wedges, &c., *G. Guthrie, Sunderland.—13th December, 1882.* 6d.

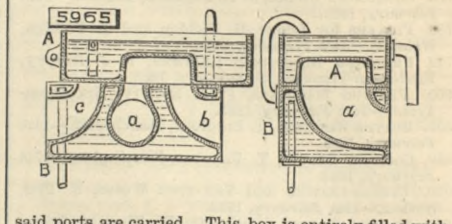
This consists in the production of tapered wedges and other articles of smith's work by passing the metal between two or more grooved rolls, or both of the said rolls being provided with notches, cutters, or dies, the form of the said notches, cutters, or dies being varied according to the article desired to be produced, and the rolls, cutters, and dies being arranged so as to form the articles consecutively by rolling their points first.

5989. Manufacture of Bichromate of Soda, *C. D. Abel, London.—15th December, 1882.—(A communication from F. C. Glaser, Berlin.)* 4d.

This consists in the manufacture of anhydrous bichromate of soda by heating the bichromate, after its separation by means of acid, to such a degree that it becomes melted, the solidified product being then brought into commerce.

5965. Slide Valves, &c., *C. Pieper, Berlin.—14th December, 1882.—(A communication from E. Blass, near Osnabruck, Prussia.)* 6d.

The drawings show in two different sections a slide valve A adapted to be shifted in a straight line, and a plate provided with the ports *a b c*, of which *a* is to be put alternately in communication with *b* and *c*, while at the same time the non-communicating channel is closed. The valve is provided with a rim or walls, forming with a valve box adapted to contain water. The port plate forms the top or side of another box B, through which the channel ends terminating in the



said ports are carried. This box is entirely filled with water. Both parts A and B are provided with suitable pipes for conveying water into and out of the same, and they are so arranged that the water flowing through them will cover or lie in contact with all the surfaces exposed to the heat.

1494. Skiving and Trimming Machines for the Manufacture of Leather, *W. R. Lake, London.—21st March, 1883.—(A communication from F. F. Raymond, Massachusetts.)—(Complete.)* 6d.

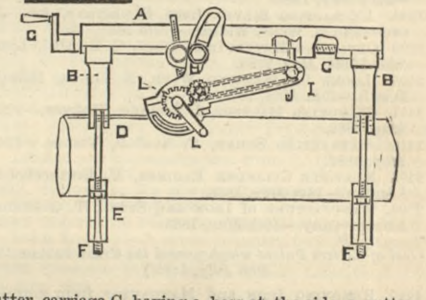
The machine has a revolving cutter arranged transversely to the line of feed. The feed is effected by a revolving roll and disc, which is positively rotated, and is so mounted as to permit a certain vertical movement to allow for variation of thickness. Suitable guiding and pressing mechanism is provided. The cutting disc is supported so that its inclination to the feed roll can be varied.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

280,582. Machine for Cutting Key Seats, *Lawrence Cosgrove, Baltimore, Md.—Filed February 19th, 1883.*

Claim.—(1) In a machine for cutting key seats, the combination, with the immovable carriage way having a fixed screw G, extending lengthwise of the carriage C, having a box F and a worm shaft I, a rotatable cutter L[1], mounted on the carriage, an internally threaded nut, fitting the box and carrying a spiral pinion, which engages with the worm shaft, and mechanism, substantially as described, to connect the rotatable cutter and the worm shaft, as set forth. (2) In a machine for cutting key seats, the combination of the



cutter carriage C, having a boss at the side, a cutter, arms J, loosely mounted by one end to the carriage, and provided in the movable end which carries the cutter with a segment slot, and a set screw, through the slot into the boss, as set forth. (3) In a machine for cutting key seats, the combination of the cutter-carriage having a boss, provided with a slot, and a hub, tapped in the direction at right angles to its axis, threaded, loosely mounted in the boss, and adapted to rock, a cutter carried on a movable arm, and a screw, passed through the slot and hub, and having its end bearing on the movable arm, as set forth.

CONTENTS.

The Engineer, August 3rd, 1883.

South Kensington Museum.—Visitors during the week ending July 28th, 1883:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 11,051; mercantile marine, Indian section, and other collections, 5650. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 2062; mercantile marine, Indian section, and other collections, 1454. Total, 20,217. Average of corresponding week in former years, 18,266. Total from the opening of the Museum, 22,225,157.